MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF ENVIRONMENTAL SAFETY,
ENGINEERING AND TECHNOLOGIES
DEPARTMENT OF ENVIRONMENTAL SCIENCE

APPROVED TO DEFENCE
Head of the Graduate Department
_____________ T. V. Dudar
«_____» ____________ 2023

BACHELOR THESIS
(EXPLANATORY NOTE)

SPECIALTY 101 “ECOLOGY”,
EDUCATIONAL AND PROFESSIONAL PROGRAM:
“ECOLOGY AND ENVIRONMENT PROTECTION”

Theme: «Analysis of the operation ofsewage treatment plants in the city of Myropil,Zhytomyr oblast, and their impact on the environment»

Done by: student of EK-402 group, Klymenko Oleksandr A.
(student, group, surname, name, patronymic)

Supervisor: cand. of Phys. and Math., associate professor Dudar T.V.
(academic degree, academic rank, surname, name, patronymic)

Standards Inspector: ______________ ___________
(signature) (S.N.P)

KYIV 2023

NATIONAL AVIATION UNIVERSITY

Faculty of Environmental Safety, Engineering and Technologies

Department of Environmental Science

Specialty, Educational and Professional Program: specialty 101 “Ecology”,

Educational and Professional Program: “Ecology and Environment Protection”

(code, name)

APPROVED

Head of the Department

___________ Dudar T.V.

«____» __________ 2023

BACHELOR THESIS ASSIGNMENT

Klymenko Oleksandr A.

1. Theme: «**Analysis of the operation ofsewage treatment plants in the city of Myropil,Zhytomyr oblast, and their impact on the environment**» approved by the Rector on April 19, 2023, № 529/ст.

2. Duration of work: 29.05.2023 – 20.06.2023.

3. Output work (project): __________

5. The list of mandatory graphic (illustrated materials): tables, figures, graphs.

6.Schedule of thesis fulfillment

№ з/п	Task	Term	Advisor’s signature
1	Justification of the goal, object and subject of research	29.05.2023 – 04.06.2023	

2	Review of literary sources	01.06.2023 – 08.06.2023	
3	Collection and analysis of materials	01.06.2023 – 10.06.2023	
4	Writing chapters I of the thesis	02.06.2023 – 05.06.2023	
5	Writing chapters II of the thesis	05.06.2023 – 12.06.2023	
6	Writing chapters III of the thesis	09.06.2023 – 12.06.2023	
7	Issuance of an explanatory note	13.04.2023 – 19.06.2023	
8	Defense of the thesis	20.06.2023	

7. Date of task issue: «_19_» April 2023

Diploma (project) advisor: ________________ Dudar T.V.

(advisor's signature) (S.N.P.)

Task is taken to perform: ________________ Klymenko Oleksandr A.

(graduate's signature) (S.N.P.

ABSTRACT

The qualification work titled **" Analysis of the operation of sewage treatment plants in the city of Myropil, Zhytomyr oblast, and their impact on the environment"** consists of 60 pages, 3 chapters, 13 subchapters, 2 tables, 4 figures, and references to 20 sources.

RESEARCH OBJECT: Wastewater treatment facilities. Research Subject: The activities of wastewater treatment facilities in the town of Myropil and their impact on the environment. Objective of the qualification work: Environmental assessment of the impact of wastewater treatment facilities' activities in the town of Myropil. Research.

METHODS: Information gathering on the state and activities of wastewater treatment facilities in the town of Myropil, analysis of literature sources, online resources, and documents from the Unified Register of Environmental Impact Assessment.

As of May 2022, the wastewater treatment facilities in the town of Myropil are not operational. Currently, a project has been developed, and the construction of wastewater treatment facilities has commenced. The qualification work analyzes the activities of the wastewater treatment facilities in the town of Myropil and their environmental impact, starting from the construction phase to subsequent operation.

CONCLUSIONS: The qualification work analyzes the activities of wastewater treatment facilities, specifically the technology of treating domestic wastewater, which includes mechanical processes (screening, sedimentation), biological processes (aerobic oxidation), and their impact on the natural environment.

KEYWORDS: Wastewater treatment facilities, wastewater treatment methods, environmental impact assessment, objectives of planned activities, characteristics of

planned activities, technological scheme of wastewater treatment facilities' operation, technical alternatives for construction, environmental factors' impacts.

Content

INTRODUCTION

The relevance of the topic: Wastewater treatment facilities are essential for any enterprise and settlement to prevent untreated wastewater from entering the environment in its original form. Given the complex situation with wastewater treatment and the residents of the town of Myropil expressing concerns about the water quality of the Sluch River downstream from the discharge of private wastewater treatment facilities, it would be interesting to investigate the current state of the wastewater treatment facilities in this settlement and their environmental impact during operation.

Research Object: Wastewater treatment facilities. Research Subject: The activities of wastewater treatment facilities in the town of Myropil and their impact on the environment. Research Objective: Environmental assessment of the impact of wastewater treatment facilities' activities in the town of Myropil.

Tasks:

1. Analyze technical documentation, treatment schemes, literature sources, and other documentation related to the activities of wastewater treatment facilities.
2. Study the types of wastewater treatment facilities and methods of wastewater treatment.
3. Investigate the current state of wastewater treatment facilities in the town of Myropil.
4. Conduct an assessment of the environmental impact of wastewater treatment facilities in the town of Myropil.
5. Analyze the current state of the operation of wastewater treatment facilities and prospects for their improvement.

Research Methods: Information gathering on the state and activities of wastewater treatment facilities in the town of Myropil, analysis of literature sources, online resources, and documents from the Unified Register of Environmental Impact Assessment.

Chapter 1

THEORETICAL BACKGROUND OF THE PROBLEM

1.1. Concept of wastewater treatment facilities. Methods of wastewater treatment.

Wastewater treatment facilities are engineering structures designed for the purification, disposal, and disinfection of wastewater. These facilities include aerated tanks, aerofilters, biofilters, septic tanks, settling tanks, methane tanks, screens, crushers, sand, oil, grease, and fat separators, and more [14].

Wastewater refers to water that is generated during domestic, industrial, and commercial activities (excluding mining, quarrying, and drainage water), as well as water discharged from developed areas where it has accumulated due to atmospheric precipitation.

Water resources encompass the volumes of surface, underground, and marine waters within a specific territory [1].

Wastewater treatment facilities are essential for any enterprise and community to prevent untreated wastewater from entering the surrounding environment in its original state.

Based on their scale and location, wastewater treatment facilities can be classified as follows:

• Municipal treatment plants: These facilities receive waste from large cities, towns, and industrial establishments after local preliminary treatment. They are characterized by high capacity and large footprint.

• Local treatment facilities: These are installed in smaller towns and on industrial premises. They typically perform preliminary treatment before discharging the wastewater into municipal networks.

• Biological treatment plants: These are compact individual systems designed for private households.

Timely wastewater treatment is crucial, primarily for the water bodies to which they are discharged. It prevents irreversible pollution of reservoirs, soil, and groundwater. Polluted water disrupts the entire ecosystem for kilometers around, affecting flora, fauna, human health, and domestic animals.

The presence of wastewater treatment facilities in an enterprise makes its operational process more economical since treated wastewater can sometimes be reused for other purposes.

New technologies and methods are constantly emerging, and their development and implementation at the legislative level are necessary steps for preserving the environment, the world around us, and human well-being. Modern automated systems are equipped with emergency mechanisms, reducing the risk of discharging untreated hazardous or toxic waste to almost zero [14].

Water treatment is carried out using mechanical, physico-chemical, and biological methods.

Mechanical methods involve the removal of coarse pollutants through screens, sedimentation, and filtration. These methods are applied in the mining industry, as industrial wastewater is typically contaminated with ore disintegration products and mineral-bearing rocks, or in the oil extraction industry, where oil products are present.

Physico-chemical methods involve the aggregation of finely dispersed impurities in water using reagents, such as coagulants and flocculants. Physico-chemical methods are most commonly used. The choice of specific water treatment methods depends on the composition of dissolved substances and the applied technology for mineral processing. In the mining industry, reagent-based, sorption, electrochemical, and other physico-chemical methods are used.

Reagent methods include neutralization of acids and alkalis, conversion of ions into a poorly soluble state, and more.

Copption methods involve the removal of organic and inorganic pollutants by natural or synthetic sorbents, as well as the use of ion-selective materials. Electrochemical methods include electrodialysis, electrochemical oxidation, and hydrolysis, which involve the application of electric current to aqueous solutions. Generally, electrochemical treatment of wastewater, similar to the oxidation of impurities (ozonation, chlorination), falls under destructive methods of treatment, where the impurities are destroyed. These methods are applied when it is not possible or economically feasible to remove impurities from wastewater.

This method is economically beneficial not only due to the recovery of valuable metals but also because its implementation can reduce the cyanide compound content by 50% compared to fisheries protection standards.

The use of other regenerative water treatment methods allows not only the neutralization of wastewater but also the extraction of valuable impurities from it. The return of extracted impurities to production reduces losses of valuable components of mineral raw materials, reagents, and auxiliary materials, often making the water treatment process cost-effective. The prospect of creating low-waste production at mining enterprises increases the importance of using regenerative treatment methods. Some of the mentioned methods include various physico-chemical methods such as extraction cleaning based on the removal of pollutants by a special solvent, distillation, rectification, adsorption on solid sorbents, foam flotation, and others, in addition to mechanical cleaning methods.

Biological treatment methods are applied for the treatment of domestic wastewater in populated areas as well as industrial facilities. They are based on the ability of microorganisms, such as bacteria and fungi, to utilize various organic and inorganic compounds during their life processes and remove them from wastewater. Microorganisms' properties are utilized in treatment facilities involving the presence of oxygen (aerobic processes) - aerobic tanks (activated sludge), biofilters; and in the absence of oxygen (anaerobic processes) - methane tanks (for anaerobic digestion of wastewater sludge). In particular, the biological method is used to treat wastewater from flotation plants to remove surfactants. During the biological treatment process, toxic substances are transformed into harmless oxidation products such as water, carbon dioxide, and others. Typically, biological purification is the final stage of wastewater treatment, often preceded by a combination of other water purification methods. Treated wastewater can be used for irrigation of agricultural lands, in industrial water supply systems, and other applications.Перед скиданням у водні об'єкти очищені стічні води знезаражують (як правило, хлоруванням) [10].

1.2. Environmental Issues of the Sluch River in Mirovil Town. Objectives of Planned Construction and Operation of Treatment Facilities.

The town of Mirovil is located on the banks of the Sluch, Ruda, and Krykukha rivers. To the north of the town lies the Mirovil Forest Reserve. The distance to the city of Zhytomyr, the district and regional center, is 85 km.

The climate in the region is moderately continental.

The design project for the construction and operation of treatment facilities has been developed according to the I architectural and construction climatic region, which is characterized by the following natural and climatic data:

- Snow load: 1390 Pa
- Wind load: 520 Pa
- Design temperature: -22ºC,
- Seismicity of the construction area: 6 points.

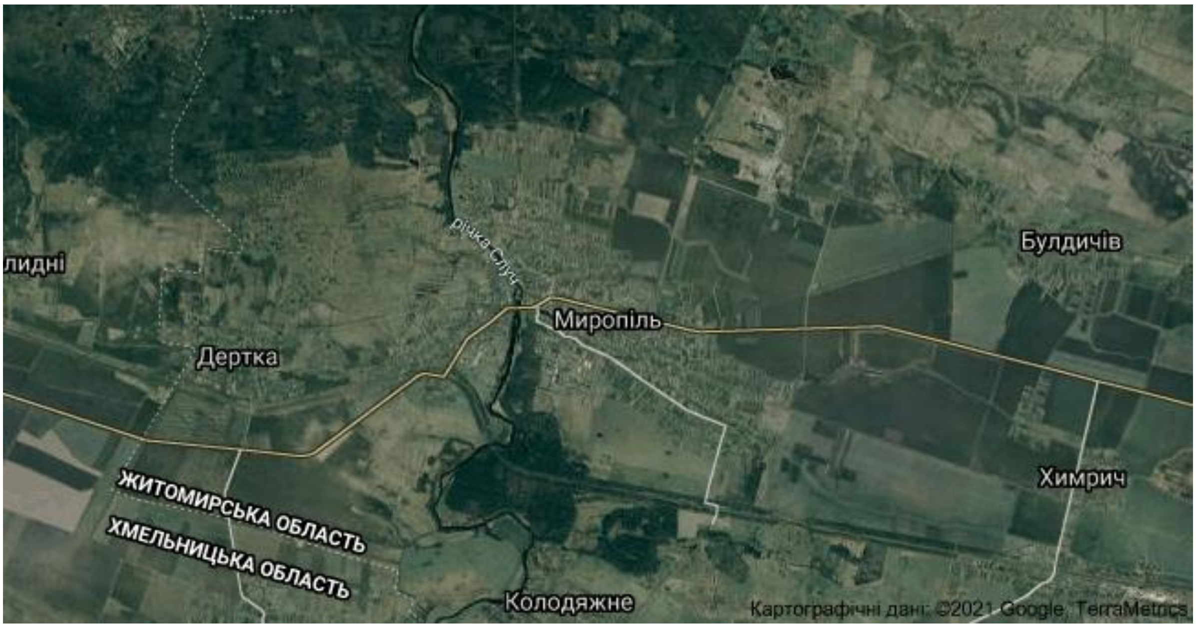

Fig. 1.1. Satellite map of Myropil town

The purpose of planned construction and operation of wastewater treatment facilities is to ensure environmental protection from wastewater pollution, improve the ecological situation, reduce the risk of emergencies during the operation of treatment facilities, and provide for the discharge of wastewater into water bodies within permissible concentration limits, thereby creating safe living conditions for the population.

The scope of work includes the implementation of a new construction project for wastewater treatment facilities based on the "KUBO" (Compact Biological Treatment Plant) system, which, according to the conclusion of the state sanitary and epidemiological expertise of the Ministry of Health of Ukraine, is safe for human health.

The designed capacity of the proposed treatment facilities will be 340 m3/day, with two construction phases of 170 m3/day each.

The designed technology is optimal for this facility, as its application will allow for:

- Wastewater treatment to meet regulatory standards.
- Stabilization of the treated water.
- Obtaining 2-3 times less waste compared to traditional schemes.
- Compact placement of the treatment equipment, reducing the length of communication lines, the number of devices, pumps, and auxiliary equipment.

The efficiency of treating domestic wastewater using the designed technology is 87-99%, which ensures the conditions for discharging treated water into the water body.

The construction and subsequent operation of the treatment facilities involve a technology for treating domestic wastewater based on mechanical (screening, sedimentation) and biological (aerobic oxidation) methods.

Mechanical treatment methods (sedimentation) facilitate the removal of coarse mechanical impurities, floating and emulsified substances from the water. These processes occur in channel screens and grit chambers.

Biological treatment of organic pollutants (aerobic oxidation) takes place in aerobic bioreactors. Optimal conditions are created in aerobic bioreactors for the formation of suspensions of microorganisms, resulting in high-efficiency wastewater treatment.

In aerobic bioreactors, proteins, fats, carbohydrates, surfactants, ammonia, amino and amide compounds are decomposed by bacteria and simpler microorganisms present in both immobilized and free-floating states.

The separation of activated sludge from the treated water is carried out in a settling tank.

To destroy remaining pathogenic bacteria in the treated wastewater and reduce the risk of water contamination in water bodies, disinfection with sodium hypochlorite is performed in a contact reservoir [7].

The wastewater treatment facilities operate year-round.

The discharge of treated water is carried out into the Sluch River outside the settlement.

Fig. 1.2. Sluch River in the town of Myropil. Photo of the discharge location

The Sluch River is 451 km long with a basin area of 13,900 km². The river has a gradient of 0.4 m/km. The width of the valley ranges from 0.8 km in the upper reaches to 5 km in the lower reaches. The riverbed width varies up to 50 m, with the widest point being 110 m. The river is mainly fed by snowmelt and rainfall. It freezes in December and thaws in March. The Sluch River floodplain is home to a valuable complex consisting of ponds, marsh areas, meadows, thickets, and water sources. It serves as a habitat and breeding ground for waterfowl, aquatic birds, fish, amphibians, and mammals, including rare species listed in the Red Book of Ukraine [5].

Fig. 1.3. Sluch River

1.3. Description of the activities performed during the preparation and construction works.

The main construction works are allowed to commence after the completion of internal site preparation works. The technological sequence of preparatory works includes:

Installation of temporary power supply networks, site lighting, and water supply.

Establishment of necessary temporary residential facilities.

Preparation of temporary areas for material and construction storage, as well as access roads to them.

The client may carry out preparatory works after submitting a notification to the State Architectural and Construction Inspection about the commencement of preparatory works.

The main construction works are allowed to start after obtaining permission from the State Architectural and Construction Inspection to begin construction.

The following types of works are envisaged:

- Excavation works.
- Compaction of soil with gravel.
- Installation of concrete foundation.
- Waterproofing.
- Formwork installation.
- Reinforcement works.
- Concrete works.
- Installation of internal waterproofing.
- Installation of external waterproofing.
- Construction of purification structures.
- Installation of interior finishing and flooring.
- Installation of heating and ventilation systems.
- Equipment installation.
- Installation of exterior finishes.
- Installation of electrical lighting.
- Backfilling of soil.
- Excavation works for technological pipelines.
- Installation of technological pipelines.
- Installation and assembly of process equipment.
- Commissioning works.

Excavation of pits and trenches is carried out using excavators with manual leveling of the soil and adjustment to the design marks. Backfilling is performed by bulldozers and partially manually, while soil transportation is done using dump trucks.

Construction and installation works are carried out in accordance with applicable regulatory documents and safety regulations.

During the installation of engineering networks, it is necessary to comply with the requirements of DBN V.2.5-74:2013 "Water Supply. External Networks and Facilities" and DBN V.2.5-75 "Sewage. External Networks and Facilities."

Excavation works should be carried out after the layout of pipeline routes and structure axes.

Open trenches should be protected from the ingress of surface and underground water.

Pipe laying works should be carried out shortly after trench excavation. Before installation, it is necessary to verify the compliance of the project regarding the bottom levels, trench widths, slope placement, and ensure that the necessary fittings, reinforcement, and other materials are available for pipe laying. If needed, they should be cleaned from impurities.

During the installation of engineering communications, the project's requirements regarding the strength and tightness of joints, as well as the stability of pipelines at turns and dead ends, should be taken into account.

Pipe laying on frozen ground during the winter period is not permitted.

When laying engineering communications, strict compliance with the requirements of DBN A.3.2-2-2009 "Labor Protection and Industrial Safety in Construction" is necessary.

Before starting the works, it is necessary to develop a Work Execution Project (WEP).

The construction period is set at 7 months. To ensure the completion of all the mentioned construction works, construction machinery with diesel engines will be used within the wastewater treatment plant construction site [3].

Table 1.1

The need for main machines and mechanisms.

№ з/п	Names of machines, mechanisms, equipment.	Purpose.	Quantity.
1	Flatbed trucks,	Cargo transportation.	4
2	Forklifts,	Loading of materials.	1
3	Portable gasoline-powered welding units with a nominal welding current of 250-400 A.	Welding works.	1
4	Portable manual arc welding unit [with direct current].	Welding works.	1
5	Road rollers (self-propelled).	Compaction of asphalt, soil.	6
6	Bulldozers.	Earthmoving works.	1
7	Wheel loaders (single-bucket).	Excavation and loading of bulk materials.	1
8	Truck-mounted cranes used for installation of industrial equipment.	Lifting of loads.	6

1.4 The planned activity, technological scheme, and methods of cleaning the treatment facilities:

The construction and subsequent operation of the following objects are planned:

1. Local wastewater treatment plants for domestic sewage "KUBO-170" with a capacity of 170 m3/day - 1st phase of construction.

2. Local wastewater treatment plants for domestic sewage "KUBO-170" with a capacity of 170 m3/day - 2nd phase of construction.

The designed wastewater treatment technology, according to the project "New Construction of Treatment Facilities in Myropil, Zhytomyr District, Zhytomyr Oblast" (developed by LLC "Komfort-Eko," Rivne), is based on the use of mechanical methods (screening, sedimentation) and biological methods (aerobic oxidation).

The total capacity of the treatment facilities is 340 m3/day. The sanitary protection zone around the treatment facilities is 20 m, according to the conclusion of the state sanitary and epidemiological expertise of the Ministry of Health of Ukraine dated 23.01.2020, No. 12.-18-1/101.6, and Technical Specification TU U 37.0-31830396-007:2015.

The wastewater treatment plants operate year-round. The treated wastewater is discharged into the Sluch River outside the settlement.

Note: The provided information is based on the details mentioned in the question and does not reflect the most up-to-date or accurate information. Please refer to the relevant official documents and expert opinions for precise and current information regarding the project. The construction of wastewater treatment facilities will improve the ecological condition in the town of Myropil and consequently create safe living conditions for the population.

The dimensions of the structures and installed tanks have been determined based on the requirements for the normal accumulation of the necessary volume of liquid, as well as the optimal placement within the land plot.

In the project, the selection of pump equipment necessary to maintain the normal hydraulic regime of the wastewater treatment facilities was carried out in accordance with the technological requirements for pumps specified in the design specification [7].

Technological scheme of the wastewater treatment facilities:

The sewage from the sewerage system of the town of Myropil flows into the designed bar screen (1), which is then conveyed to the equalization chamber (2) through a pressure collector. From there, it passes to the drum sieve combined with a sand trap (3), where sand particles are retained.

After the sand trap, the wastewater enters the equalization tank (4), where the flow and concentration of the effluents are averaged.

Next, the effluents are evenly supplied to the aerotank (5) using a submersible pump. The first corridor in the direction of the liquid flow in the aerotank serves as a denitrification zone, while the last two corridors are equipped with aeration systems. In each denitrification zone, pumps are installed to mix the sludge mixture. Recirculated activated sludge from the secondary clarifiers is introduced into the beginning of the denitrification zones, and the sludge mixture containing nitrites and nitrates is transferred from the end of the last corridor of the aeration zone. In the absence of aeration in the denitrification zones, anoxic conditions occur, during which denitrification takes place, resulting in the reduction of nitrites and nitrates with the release of molecular nitrogen. In the subsequent aerated corridors of the aerotank, oxidation of organic pollutants in the wastewater and nitrification of ammonium nitrogen occur. The supply of air to the aerated zone of the aerotanks is carried out by a pneumatic aeration system, which includes air blowers, air pipelines, and fine bubble plate diffusers.

After biological treatment, the treated effluents enter the secondary clarifiers (6), where excess activated sludge is separated from the treated water. Sodium hypochlorite is used in the disinfection unit (7) to disinfect the treated water.

After disinfection, the treated water is discharged into a water body.

During the oxidation process, the amount of sludge continuously increases due to the growth of microorganisms and the presence of organic pollutants. This excess sludge is removed from the clarifier and directed to the sludge stabilizer. The stabilized sludge is pumped to the dewatering unit. To improve the dewatering process of the sludge, a flocculant is dosed into the sludge using a dosing pump from a solution tank.

The dewatered sludge is transported to designated locations approved by the local authorities, in coordination with the sanitary-epidemiological station and the environmental and natural resources department.

A portion of the sludge (recirculated activated sludge) is returned from the clarifier to the aerobic bioreactor to maintain the necessary quantity of microorganisms in the activated sludge [7].

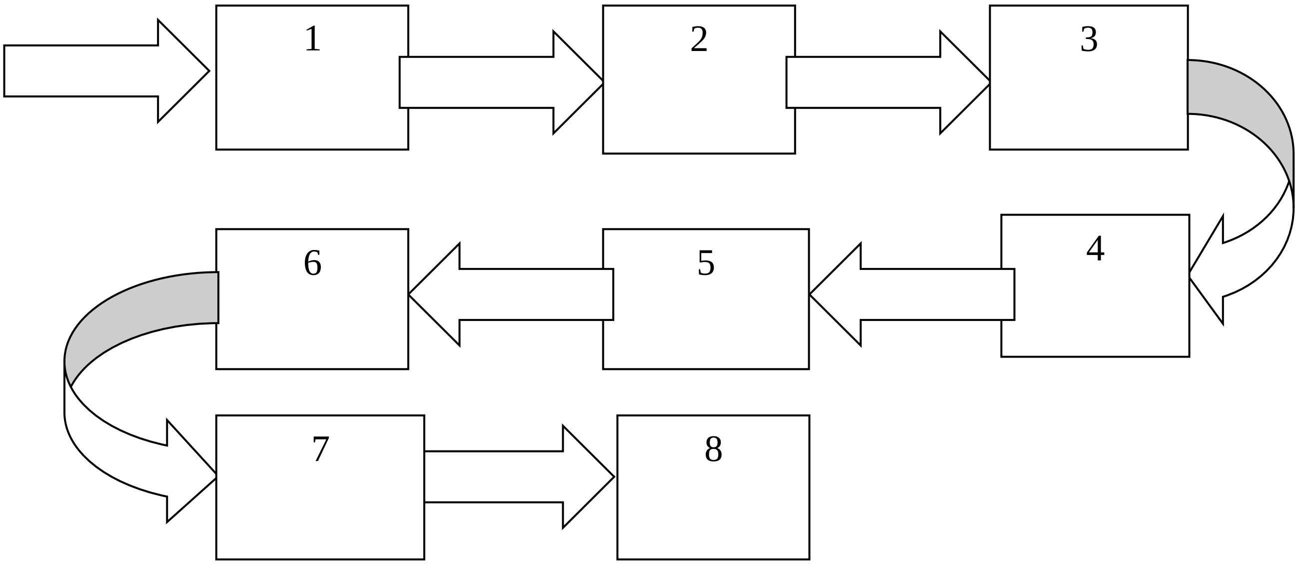

Fig. 1.4. Technological scheme

1. Dissipation chamber, 2. Bar screen, 3. Horizontal sand trap, 4. Equalization tank, 5. Aerotank, 6. Secondary clarifiers, 7. Disinfection unit, 8. Water body

The designed technology for the treatment of domestic wastewater is based on the use of mechanical (screening, sedimentation) and biological (aerobic oxidation) methods.

Mechanical methods of treatment (screens) ensure the removal of coarse mechanical impurities, floating materials, and emulsified substances from the water.

Biological treatment of organic pollutants (aerobic oxidation) takes place in aerobic bioreactors. Optimal conditions are created in the aerobic bioreactors for the formation of microbial suspensions, which results in a high level of wastewater purification.

In the aerobic bioreactors, proteins, fats, carbohydrates, surfactants, ammonia, and amino- and amido-compounds are degraded by bacteria and simpler microorganisms, both in immobilized and free-floating states.

The separation of activated sludge from the treated water is carried out in the secondary clarifier.

To eliminate pathogenic bacteria remaining in the treated wastewater and reduce the risk of water contamination in water bodies, disinfection with sodium hypochlorite is performed in a contact reservoir [7].

Table 1.2.

Quality indicators of purification

№ п/п	Name	Indicators of water at the inlet of the water treatment system	Indicators of treated water after treatment facilities
1	Suspended substances	350 mg/l	15 mg/l
2	Mineralization	1100 mg/l	1000 mg/l
3	BOD_5	300 mg/l	15 mg/l
4	COD	530 mg/l	80 mg/l
5	SPAR	4,0 mg/l	0,1 mg/l
6	Ammonia nitrogen	20 mg/l	1,0 mg/l
7	Nitrites	0,7 mg/l	0,08 mg/l
8	Nitrates	10 mg/l	40,0 mg/l
9	Sulfates	200 mg/l	100,0 mg/l
10	Phosphates	10 mg/l	2,15 mg/l
11	Chlorides	300 mg/l	300 mg/l
12	pH	6,5-8,5	6,5-8,5
13	Petroleum products	0,6 mg/l	0,05 mg/l
14	Kolbe index	>100000	<1000

Charter 2
DESCRIPTION OF THE NATURAL ENVIRONMENT AND RESEARCH OBJECT

2.1 Description of the Current Environmental State (Baseline Scenario) in Myropil Town

Myropil is an urban-type settlement located in Zhytomyr District, Zhytomyr Oblast, Ukraine. The population is 4,834 people, and it is situated 85 km away from Zhytomyr. The total area of the town is 9 km².

The background concentration values are adopted based on Section 4.8 of the "Procedure for determining the values of background concentrations of pollutants in the atmospheric air" (No. 286 dated July 30, 2001), which states that for populated areas with a population of up to 50,000 people where regular air pollution monitoring is not conducted and significant industrial emission sources are absent, the background concentration values for major common pollutants are taken from Table 4.1 (nitrogen dioxide - 0.09 MPC, sulfur dioxide - 0.04 MPC, carbon monoxide - 0.08 MPC, inorganic dust - 0.1 MPC). For other substances, the value is 0.4 MPC [16].

The climate of the region is moderately continental, characterized by mild winters with frequent thaws and warm summers with sufficient rainfall. Winter starts from November 15-17, with the average daily temperatures crossing 0°C, and it solidifies by the end of the month. The stable winter period begins in the second decade of January when the average daily temperatures drop below -5°C. This is the time when the lowest air temperatures are observed, and the number of days with thaws decreases. The winter decline begins in mid-February, and the snowmelt period lasts for 15-20 days. Spring begins in the last days of February or early March when the snow cover melts, and the average daily temperatures exceed 5°C, marking the beginning of a warmer season

April marks the beginning of true spring. By the end of April, almost all trees are covered in leaves, insects emerge, and the air temperature rises above 10°C. However, frosts in the air are still frequently observed until mid-May.

Summer starts from late May and lasts until September. During summer, anticyclonic weather predominates, but frequent cyclones from the west bring significant amounts of precipitation, reaching around 80-110 mm in July. Rainfall often occurs in the form of heavy showers. The average air temperature in July is 18.8°C.

Autumn in Zhytomyr District is characterized by prolonged rains and frequent fog. The last period of autumn is characterized by the highest cloudiness of the year, cold and humid weather, and frequent changes in precipitation patterns, including rain, snow, and mixed precipitation [7].

According to the technical assignment from the General Designer (GIP) for the justification of the working project, the scientific-research, design-exploration, and geological exploration cooperative "GEOLOG" conducted a complex of engineering-geological surveys for the construction of sewage treatment facilities in Myropil town, Zhytomyr District, Zhytomyr Oblast, in March 2021.

The engineering-geological investigations were carried out to study the geological structure and hydrogeological conditions of the site, as well as to determine the physical and mechanical properties of the soils underlying the foundations of the planned buildings and structures.

In terms of geomorphology, the research site is located within the outcrop area of crystalline rocks of the Ukrainian Shield on the river's floodplain surface, representing the first overbank terrace of the Sluch River's headwaters, a left tributary stream. The absolute surface elevations range from 235.9 to 236.1 meters. The soil category is Class II according to criterion 5.1. The seismicity of the construction site is rated at 5 (five) points.The geological structure of the site, explored to a certain depth, includes modern eluvial (e IV) and upper Quaternary alluvial (a III) deposits

Imposed on the weathered rock mass (granites) is the dispersal, fragmentary, deep-cracked Mesozoic-Cenozoic (e Mz-Kz) zone of the crust.

Based on the results of exploration drilling and according to DST U B V.2.1-2-96, the soil massif is divided into 5 (five) engineering-geological elements (EGEs):

EGE-1: Soil-vegetation layer, sandy, dark gray, with a thickness of 0.4-0.7m; EGE-2: Plastic silt, iron-containing, yellow, yellowish-brown, with a thickness of 0.4-0.6m; EGE-3: Medium-coarse sand, medium density, from slightly moist to water-saturated, with up to 2% gravel of crystalline rocks, yellow, brownish-yellow, with a thickness of 0.7-1.3m; EGE-4: Silty sand, dense, water-saturated, yellowish-gray with layers of bluish-gray silt, with a thickness of 0.6-1.4m; EGE-5: Fragmentary zone of weathered crust of crystalline rocks (granite): sandy loam, dense, with up to 5% inclusion of gravel from crystalline rocks and sapropel fragments, from slightly moist to water-saturated, gray, greenish-gray.

Hydrogeological conditions are characterized by a single aquifer in Quaternary alluvial deposits and the dispersed-fragmentary zone of weathered crust of crystalline rocks. The groundwater regime is influenced by atmospheric and groundwater factors. As of March 24, 2021, the groundwater was encountered at a depth of 2.7-2.9m from the ground surface (absolute elevation 233.2m). The fluctuation amplitude of groundwater levels is 1.0m. The groundwater is hydrocarbonate-sulfate-calcium-sodium and non-aggressive (based on previous years' data).

Based on the geological structure and hydrogeological conditions, and according to DBN V.2.1-10-2009 (DBN V.1.1-25-2009), the site is classified as a flood-prone area.

Based on the completed scope of work and according to DSTU B V.2.1-4-96, within the studied area, 5 (five) engineering-geological elements (EGEs) are identified.

According to the "Engineering-Geological Map of the Territory Affected by Exogenous Geological Processes," the surveyed area is not classified as being affected by karst phenomena.

No landslides or karst-related phenomena and processes were identified during the survey of the work area.

2.2. Description of the Plant and Animal World, Objects of the Nature Reserve Fund

The geographical location, topographic, and climatic characteristics of the Zhytomyr region have contributed to the formation of diverse vegetation, which varies from north to south. The plant life of Zhytomyr region is characterized by a great variety of native components and serves as a source of valuable plant-based resources, including medicinal, technical, and vitamin resources. The region is home to around three thousand animal species, 131 of which are listed in the Red Book of Ukraine.

The flora of the Zhytomyr region combines typical Western European and Eastern European elements. Over a long historical period, various types of vegetation have formed in the region, including forests, meadows, marshes, riverbanks, and aquatic plants. The flora is predominantly composed of diverse families of flowering plants. Among them, there are composite, grass, sedge, rose, carnation, legume, lily, buttercup, labiate, umbelliferous, and cruciferous families. In modern conditions, the flora of Zhytomyr region is experiencing increasing and diverse anthropogenic influences, which necessitates continuous monitoring to timely identify rare species and provide them with conservation status to prevent their disappearance in the region. Therefore, the regular updating of the list of rare species growing in the region is an important task for botanical research.Абсолютно корінна рослинність, Therefore, the areas that have not been influenced by human activities are rare in the region. They occur as isolated groups on exposed mountain rock formations and some marshy areas. Much more common are the practically indigenous and relatively indigenous plant communities, which have been restored to their natural or near-natural state after human intervention. These include oak, pine, and black alder forests, numerous swamp phytocoenoses, and wet meadows. Currently, forests cover one-third of the area in Volyn Oblast. Due to significant marshiness, wetland habitats are widely represented here. The meadow vegetation type is more typical of the northern regions: meadows have been preserved in forest glades and elevations amidst swamps. The most common species in these areas are fescue, sedge, reed, various grasses. Lowland meadows have formed in the depressions of river valleys. They are dominated by formations of sedges, sedge grass, reed, ferns, molinia, Carex, mint, etc.

The aquatic vegetation of the Sluch River is extremely diverse. Like any plant community, the vegetation of water bodies exhibits stratification.

At the very shore, there is a belt of riparian plants. The contact zone of the riparian area is well heated, which contributes to a great variety of submerged plants, including arrowhead, common waterwort, marsh horsetail, floating and common water chestnut, narrow-leaved waterweed, and lesser duckweed.

The second zone of the water body is occupied by shallow water plants, including reeds, water horsetail, and common reed. These plants are submerged at the lower parts and emerge above the water, forming large thickets. Waterfowl, fish fry, and other aquatic organisms find refuge in these plant thickets. The river is also home to plants that spend their entire life underwater, some of which are rooted in the soil (such as waterweed and pondweed), while others are not rooted (such as bladderwort and water milfoil). Among the most common free-floating plants in the river are water lily and common frogbit.Крім водно-болотної рослинності у прибережній In the parts and valleys of the Sluch River, perennial rhizomatous grasses are found, such as timothy grass, cocksfoot, quackgrass, sedge, meadow fescue, and brome grass. Common grasses include sorrel, tansy, common nettle, white and red clover, among others. Medicinal plants are also present, such as heartsease, valerian, common comfrey, St. John's wort, motherwort, plantain, chamomile, and others [5].

The animal life in Zhytomyr Oblast is rich and diverse, with approximately 400 species, including 67 mammals, 270 birds, and 30 fish. Particularly valuable are game animals such as red deer, roe deer, and wild boar. Beavers, otters, European mink, badgers, pine martens, and wolves are widespread in the river floodplains. In the northern regions of the oblast, valuable bird species such as capercaillie, black grouse, and hazel grouse reproduce. Rare birds found here include black stork, white-tailed eagle, and osprey.

The most typical zoocenoses in Zhytomyr Oblast are the zoocenoses of water bodies and river-lake floodplains, coniferous, predominantly pine forests, mixed forests, shrubs, as well as synanthropic (agrocenoses, settlements).

All water bodies (numerous lakes, rivers, and ponds) and their floodplains are inhabited by aquatic-bog and amphibiotic species. The aquatic-shore zoocenosis forms a highly diverse complex, especially during the vegetative period when all amphibians, reptiles, migratory birds nest, and mollusks and insects are active.

The rich bird population is closely related to the vegetation of the Sluch River. Mass species include white stork, coot, gray crow, wagtail, gull, gray heron, bittern, and mute swan. Among mammals, river otters and beavers are recorded, among amphibians, lake frog and crested newt, and among reptiles, water snake and marsh turtle. Various species of mollusks, both bivalves (pearl mussel, pond mussel or toothless mussel) and gastropods (pond snail, ramshorn snail, viviparous snail, etc.), are widespread. They play an important role in the life of freshwater bodies as consumers of plant and animal food, organic residues (sanitary functions), and as food for fish and birds.

The ichthyofauna of the Sluch River is not very diverse, and species such as roach, carp, perch, and trout are common here. Zooplankton plays a significant role in the formation of fish productivity since planktonic invertebrates form the basis of food for young fish. Additionally, they are essential in water self-purification processes. Among the zooplankton species, rotifers and cladocerans, including representatives of the genus Daphnia, are prevalent.

The population of freshwater crayfish in the Sluch River is small but plays an important role as aquatic "sanitizers." In recent years, there has been an increase in the population of European beaver, evidenced by characteristic colonies and signs of their activity [5].

The nature reserve fund includes areas of land and water, natural complexes, and objects that have special value for nature conservation, scientific research, aesthetics, recreation, and other purposes. Its main goal is to preserve the natural diversity of landscapes, the gene pool of animal and plant species, and maintain the overall ecological balance. The development of the nature reserve fund is one of the main priorities of the country's environmental policy. The protection of the natural environment, including the nature reserve fund, is considered a priority for Ukraine's European and Euro-Atlantic integration. The requirements for EU accession include the implementation of a strategy for sustainable (ecologically balanced) development, not only at the level of documents but also in practice. The Association Agreement between Ukraine and the EU specifies several obligations regarding environmental protection, including those related to protected areas.

One of the main and most effective methods of biodiversity conservation in the Zhytomyr region is the establishment of protected areas. They provide the necessary conditions to reduce harmful anthropogenic impacts on biological objects and contribute to the preservation of the integrity of ecological systems, where natural mechanisms can be maintained.

As of January 1, 2020, the nature reserve fund of the Zhytomyr region includes 235 objects with a total area of 137,601.3734 hectares. Among them, there are 20 objects of national significance covering a total area of 57,940.04 hectares, and 215 objects of local significance covering a total area of 79,661.3354 hectares. The percentage of protected areas is 4.6%. The nature reserve fund of the region has the following structure:

Nature reserves: 2 reserves covering an area of 50,976.84 hectares.

National nature monuments: 10 monuments covering an area of 6,757 hectares.

Local nature monuments: 159 monuments covering an area of 79,324.0686 hectares.

National natural landmarks: 2 landmarks covering an area of 51 hectares.

Local natural landmarks: 35 landmarks covering an area of 93.69 hectares.

Botanical gardens of national significance: 1 garden covering an area of 35.4 hectares.

Local dendrological parks: 3 parks covering an area of 14.9 hectares.

National parks and park monuments of garden and park art: 5 parks covering an area of 119.8 hectares.

Local parks and park monuments of garden and park art: 18 parks covering an area of 228.6748 hectares.

Most of the nature reserve fund in the Zhytomyr region consists of territories and objects located on the lands of forestry enterprises of the Zhytomyr Regional Forestry and Hunting Management Administration, accounting for 151 objects [20, 6].

2.3. Description of water and land resources of the region and an outline of the potential change in the current environmental state without the implementation of planned activities.

According to the data from the Main Department of State Geocadastre in the Zhytomyr region as of January 1, 2020, the total area of water resources land in the region is 205.68 thousand hectares (6.9% of the region's territory - 2,990 thousand hectares). This includes land under reservoirs and ponds - 20,886 hectares, under rivers and streams - 7.21 hectares, under lakes and other natural closed water bodies - 0.691 hectares, under artificial watercourses (canals, collectors, ditches) - 19.834 hectares, under coastal protective strips - 55.865 hectares, and under swamps - 101.194 hectares. There are 2,822 rivers flowing through the region with a total length of 13.7 thousand kilometers. The hydrographic network of the region consists of 8 medium-sized rivers: Teteriv, Sluch, Uzh, Irsha, Ubort, Stvyha, Irpin, and Slovechna, with a total length within the region of 999.6 kilometers. There are 329 small rivers longer than 10 kilometers, with a total length of 6,692 kilometers, and 2,493 small rivers shorter than 10 kilometers, with a total length of 7,062 kilometers [2, 4].

Surface water resources in the region are primarily formed from local runoff in the river network, mainly within its own territory, due to atmospheric precipitation, as well as transit runoff from neighboring regions. Only Huyva, Hnilopyat, and Rostavytsia originate in the Vinnytsia region, Sluch in the Khmelnytskyi region, and Zdvyzh in the Kyiv region, bringing insignificant transit resources. The average river flow amounts to 3,300 million cubic meters, of which 2,800 million cubic meters of water are formed within the region. The projected reserves of groundwater amount to 242.498 million cubic meters, and the approved exploitable reserves are 86.845 million cubic meters. The longest rivers are in the sub-basin of the middle Dnieper: Teteriv - with a length of 276 kilometers within the region and a water catchment area of 10,981 square kilometers, and its tributary, the Hnilopyat River, with a length of 95 kilometers and a water catchment area of 1,312 square kilometers; the Irsha River - 126 kilometers, with a water catchment area of 3,064 square kilometers, and the Irpin River - 43 kilometers, with a water catchment area of 897 square kilometers. The region has 54 reservoirs with a total area of 7.7 thousand hectares and a combined volume of over 1 million cubic meters. The presence of reservoirs and ponds allows for seasonal redistribution of runoff to some extent, creating necessary water reserves, and meeting the needs of the population and economic sectors in water resources. The Rostavytsia River and its tributaries, Irpin, Unava, Huyva, Hnylop'yat, and Teteryv (above the city of Zhytomyr), as well as the Irsha River, have significant regulation of water flow, so it is no longer practical to build new reservoirs on them. However, there is a lack of reservoirs with sufficient capacity on the rivers Sluch, Ubor, Slovechna, Noryn, Uzh, and Teteryv (below the city of Zhytomyr). In the region, 1,827 ponds have been built with a total volume of 176.98 million cubic meters. Most ponds in Zhytomyr Oblast are constructed on small rivers and streams, resulting in their water flow being regulated by 30-60%. The total number of lakes in the region is 10, with a surface area of

323.8 hectares. The current priorities include ensuring comprehensive water conservation, restoration and maintenance of water resources in proper condition, and ensuring integrated water resource management based on a basin principle [4].

The region is characterized by undulating plains with a general decline towards the north and northeast (from 280-220 meters to 150 meters and lower). In terms of relief, the region is divided into the southwestern elevated part within the boundaries of the Prydniprovska and Volyno-Podilska Uplands, and the northeastern lowland part, weakly divided within the boundaries of the Polisska Lowland. The surface of the region within the Polisska Lowland is flat, poorly dissected, while within the Prydniprovska Upland, it is densely cut by gullies, river valleys, reaching depths of 50-70 meters in some places. In areas with high occurrence of crystalline rocks, denudational relief forms are developed, including hills, cliffs with steep slopes, stretching for tens of kilometers. These include the Slovechansko-Ovruchsky, Bilokorovytsky-Popelniansky, Ozernyansky, and other ridges. The highest point of the Slovechansko-Ovruchsky ridge reaches 316 meters above sea level. The structure of the soil cover in the region is determined by the geological structure of the Ukrainian crystalline shield, predominantly flat terrain, and the characteristics of the formation of glacial and water-glacial deposits The southern-Polish and Dnieper glaciations and deposits of the Quaternary period are associated with anthropogenic activity. Soils and their parent rocks in the Polisska part of the region, north of the city of Zhytomyr, are mainly formed on glacial and water-glacial deposits, except for the Slovechansko-Ovruchsky ridge. The close proximity of crystalline rocks to the surface of the earth leads to the development of swamp formation processes, which slow down soil formation in the Polisska region, resulting in the formation of peat bogs and peat-swamp soils in low-lying areas. On elevated areas and areas with thick layers of glacial deposits, the processes of formation of sod-podzolic sandy and loamy soils with acidic soil solution occur. Among the diverse soil cover in the region, the most fertile soils are concentrated in the southern part: gray forest soils, dark gray podzolized soils, and podzolized chernozems - 119.3 thousand hectares, typical chernozems - 205.6 thousand hectares, meadow and chernozem-meadow soils - 35.8 thousand hectares, derelvic gleysols - 21.5 thousand hectares. Lands with highly fertile soils are represented by the following composition:

- non-eroded, non-salinized clayey chernozems on forest rocks - 112.5 thousand hectares;
- non-salinized, non-salinized loamy meadow-chernozem and chernozem-meadow - 79.7 thousand hectares;
- dark gray podzolized and podzolized chernozems with gleying in forests - 38.6 thousand hectares;
- podzolic-dernovo silt loams - 0.1 thousand hectares;
- deep and moderately deep drained peatlands - 0.8 thousand hectares.

The total area of lands with highly fertile soils is about 232 thousand hectares, and the area of agricultural lands is 1,510.1 thousand hectares or 50.6% of the territory. The current state of agricultural soils is quite problematic. Erosion, reduction in humus content, salinization, acidification, and compaction of soils are widespread phenomena in the territory. The ecological and agrochemical state of the soil cover of agricultural lands in the region is assessed at 37 points, while arable lands are assessed at 39 points. On average, across Ukraine, the assessment of such lands is 55 points, which is 1.3 times higher than in the region. Arable lands in the Forest-Steppe zone of the region have an average score of 51 points, while in the Polisska zone, it is 32 points [2].

The determination of the probability of changes in the current state of the environment without planned activities was carried out using the method of analyzing the changes in pollution indicators of the main factors of the environment over the past years. The formation of the chemical composition of river water occurs under the influence of a complex of natural and anthropogenic factors.

Biological pollution of river water occurs as a result of natural processes of biomass growth of hydrobionts, primarily hydrophytes, followed by their decay and decomposition, as well as the influx of organic substances formed in forest or meadow subsystems. Had excessive and intensive use of rivers and water catchments in the national economy disrupts their natural hydrochemical and hydrobiological regime, reduces water flow and depth, causes river siltation and overgrowth, and increases eutrophication due to the accumulation of nitrogen, phosphorus, and potassium compounds. All these factors contribute to the deterioration of river water quality. The main reason for the decline in quality lies in the significant impairment of their self-purification capacity. Both physico-chemical and biological mechanisms of self-purification are disrupted. In the former case, the increase in suspended matter, which would typically settle during self-purification, has been caused by the content of these substances greatly increasing as a result of land reclamation works. The biochemical processing of dissolved substances through oxidation has also become significantly hindered. To prevent the negative impact of polluted wastewater on water bodies and human health, there are requirements for discharge conditions and a range of wastewater treatment methods. Wastewater treatment involves the destruction or removal of specific substances and the disinfection of pathogens. The main method of protecting water bodies from pollution by wastewater is the construction or reconstruction of existing treatment facilities. The diversity of pollutants necessitates the use of various methods and structures for wastewater treatment.

The town of Myropil has partial sewage infrastructure. Some of the wastewater goes to private treatment facilities owned by Myropil Paper Factory , while the rest accumulates in septic tanks. However, these treatment facilities are unable to handle wastewater from all users. Currently, the local council has been notified not to accept wastewater from the population at Myropil Paper Factory. There have been constant complaints from the local residents regarding the unauthorized discharge of untreated wastewater into the Sluch River. The commissioning of the designed facility will ensure a high level of wastewater treatment, improve the environmental condition in the settlement, and be safe for the water bodies in the area.

The main objective of this project is to provide the settlement with wastewater treatment facilities based on the "KUBO-170" installation for the biological treatment of domestic wastewater. The commissioning of these facilities will also reduce the load on the wastewater treatment facilities of Myropil Paper Factory.

The efficiency of cleaning of economic and domestic wastewater, when using the designed technology, is 87-99% and is safe for the natural environment (see Appendix A)[7].

Chapter 3

ANALYTICAL PART OF THE THESIS

3.1. Description and evaluation of the possible impact on the environment planned activity

The development of industry, transport, energy, industrialization of agriculture led to the fact that the anthropogenic impact on the environment took on a global character. Increasing the effectiveness of environmental protection intentions is primarily associated with the wide implementation of resource-saving, low-waste and zero-waste technological processes, reduction of air and water pollution. Environmental protection is a very multifaceted problem, the solution of which is dealt with by engineering and technical workers of almost all specialties that are related to economic activity in settlements and industrial enterprises, which can be a source of air and water pollution.

Reservoirs are polluted mainly as a result of the discharge of wastewater from industrial enterprises and settlements into them. As a result of wastewater discharge, the physical properties of water change, sediment forms at the bottom, the chemical composition of water changes (the content of organic and inorganic substances increases, toxic substances appear, the oxygen content decreases, the active reaction of the environment changes, etc.), the quantitative and qualitative changes bacterial composition, pathogenic bacteria appear. Contaminated reservoirs become unfit for drinking, and often for technical water consumption, lose their fishing purpose, etc. The general conditions for the discharge of wastewater of any category into surface water bodies are determined by their economic purpose and the nature of water consumption. After the discharge of wastewater, some deterioration of water quality in reservoirs is permissible, but this should not affect life and the possibility of further use of the reservoir as a source of water consumption for cultural, sports events and for fishing purposes.

When carrying out construction works, including preparatory, the impact on the environment will be associated with:

- temporary, short-term emissions into the atmosphere: emissions of pollutants during the operation of internal combustion engines of motor vehicles and construction equipment;

- Solid materials of undifferentiated composition during earthworks performed by construction equipment.
- Welding aerosols and solid substances during welding operations.
- Temporary, short-term noise impact from construction equipment operating on the construction site and from vehicular traffic while moving within the construction area.
- Mechanical disturbance of the soil cover within the boundaries of the own land plot during construction works.
- Generation of construction waste and solid domestic waste.
- There will be no other impacts during the construction period.

There will be no vibrations, light pollution, thermal pollution, radiation contamination, or emissions resulting from preparatory and construction works or planned activities. The impact scale of construction works is limited to the construction site. There is no cross-border impact [7].

3.2. Air and climate

The project may affect air quality during construction:

• dust after absorption of asphalt pavement, excavation of land, loading, transportation and unloading, mixing of concrete, transportation of construction materials, as well as soil from construction sites, especially during dry and windy days.

• emissions from construction machines and vehicles, diesel machines and equipment. Dust and emissions of pollutants, which are formed during the movement of vehicles and heavy equipment on the way and during transportation.

Mitigation measures will include:

• proper planning of transportation and other activities that generate dust;

• storage of oil products or other harmful substances in appropriate places to minimize their impact;

• covering materials during cargo transportation to avoid leakage or dust formation.

Use of vehicles and construction machinery in good condition to ensure efficient fuel combustion and compliance with national emission standards [7].

3.3. Soils and geology

During construction, the main impact on the soil and geology will occur as a result of the construction of new networks and the construction of new sewage treatment plants (STP). Soil destruction will occur during construction when the topsoil and vegetation are disturbed. Potential consequences include:

• soil contamination due to accidental leakage of fuel, lubricants, etc., used as part of the construction process.

• soil pollution can be a result of improper transportation, storage of oil products, chemicals, hazardous materials, liquids and solid waste;

• soil pollution through the penetration of leachate from uncontrolled deposits of building materials;

• improper handling of asphalt pavement during and after construction.

However, it is important to note that in connection with the construction of networks or new treatment facilities, any problems will be temporary. Thus, for example, the possibility of soil contamination due to leakage of pollutants will be insignificant. Any minor impacts as a result of earthworks will be controlled as above.

There is no need to allocate additional land plots for the construction of treatment facilities.

During operation, project activities will have a limited impact on soil and geology [7].

3.4. Aquatic resources

Surface waters

The contractor will be required to store all potentially hazardous materials in an area with sealed surfaces and handle them in a manner that prevents spoilage or leakage of contaminants.

During operation.

After the construction of treatment facilities, it is planned to reduce the pollution of the river Sluch by sewage. Since the risk of river water pollution is associated with the discharge of untreated or poorly treated wastewater. It should be noted that currently the water quality of the Sluch River suffers due to high technogenic influence. The absence of anthropogenic load, that is, the direct or indirect impact of economic activity on the river basin, will lead to the change of the river ecosystem to a new one, with the establishment of a new natural state.

In accordance with the current Ukrainian environmental protection legislation, control over compliance with the maximum permissible discharges of polluting substances entering the river with return waters should be carried out directly by the enterprise and state supervision (control) bodies.

Measures to prevent surface water pollution at the operational stage:

• control of the maximum allowed discharge of polluting substances;

The possibility of sampling effluents and treated water before discharge into the river will be considered

• in case of exceeding the maximum allowed discharge of polluting substances, appropriate measures will be taken to immediately correct the situation (appropriate repair work will be carried out);

• systematic control over the implementation of measures considered in the waste management plan;

• control of the efficiency of operation of treatment facilities and, in the event of a possible malfunction, the implementation of appropriate corrective measures;

• personnel instructions on environmental and safety issues.

Underground waters

During construction

There are certain risks of groundwater pollution during the construction stage (earthworks). Deterioration of the quality of underground water can be caused by accidental leakage of oil products and penetration of pollutants into the deep layers of the soil, as well as due to excavations. Given the specifics of the project, the direct impact of the construction of treatment facilities will be minimal. The scale of the impact is very small and can be described as insignificant.

Measures to reduce the impact at the construction stage:

• to ensure proper maintenance of vehicles and equipment, in case of damage and leakage of fuel, oil, they should be repaired immediately. It is forbidden to operate damaged vehicles on the construction site

• strict observance of sanitary protection zones (SZZ) in order to prevent possible contamination of "neighboring" territories, soil damage, etc.;

• machinery, equipment and potentially polluting substances should be located at least 50 meters from a surface water body (where possible). If this is not possible, control and safety measures must be taken to prevent water contamination;

• proper handling of materials and waste;

• all possible pollutants must be removed after completion of work;

• cleaning and reclamation of the area after completion of works.

During operation

The risk of groundwater pollution during the operation stage will be associated only with damage to the equipment and technological pipeline of treatment facilities, namely: spillage of wastewater on the territory of the WWTP. At this stage, the risks of negative impact on groundwater will be fully related to the effectiveness of measures to reduce the consequences of surface water pollution prevention and soil pollution.

The proposed measures to reduce the impact at the operational stage are as follows:

• systematic control of technical equipment and technological pipelines of the CHP. If necessary, appropriate corrective measures should be taken [7].

3.5. Assessment of the impact on flora and fauna

The location of the projected facility does not belong to nature reserves or agricultural facilities. There are no green spaces on the territory designated for construction. No species listed in the Red and Green Books of Ukraine were found, and no particularly valuable species of flora were recorded either.

The project for the construction of a complex of sewage treatment facilities provides for the landscaping of the territory of the enterprise with the arrangement of footpaths and platforms made of paving tiles. Tree species with a thick crown, which have photocidal properties, will be used for landscaping. At the same time, landscaping acts as a barrier against noise and gas pollution. Lawns are made of trampling-resistant grasses with a dense root system to prevent the fertile layer from being washed away during rains. The construction and operation of the designed object will not create prerequisites for a negative change in the quality of the flora [7].

3.6. Description of the impact of pollutants on human health

Domestic sewage leads to biological pollution of water, which can cause infectious diseases in people (cholera, typhus, hepatitis). Particularly dangerous are waste water from points of sanitary treatment of linen, workwear, sewage from hospitals, which often contain causative agents of helminthic diseases). Organic pollution often leads to a decrease in the content of oxygen dissolved in water, which results in the death of aquatic organisms and phytoplankton. Excess nitrogen and phosphorus in water lead to its blooming and disturbance of the biological balance of water bodies. Radioactive substances, entering water, cause its ionization, which adversely affects development of living organisms.

In addition, plankton and fish are able to accumulate a large amount of radioactive isotopes in the body (cumulation effect). Consumption of such fish is dangerous for human health. In order to prevent the negative impact of polluted wastewater on reservoirs and human health, there are requirements for the conditions of descent and a number of methods of wastewater treatment. The conditions for the discharge of wastewater into water bodies are determined taking into account the degree of possible mixing and dilution of wastewater with the water of the facility on the way from the point of discharge of wastewater to the control point of the nearest points of economic-drinking, cultural-domestic and fishery water use.

Wastewater treatment is the destruction or removal of certain substances, pathogenic microorganisms (decontamination). The main way to protect water bodies from their sewage pollution is the construction or reconstruction of existing treatment facilities. The variety of polluting chemical compounds necessitates the use of various methods and facilities for wastewater treatment.

Another such environmental factor that affects the health of the population is the quality of atmospheric air. In the system of measures to protect the population from the negative impact of harmful factors created by industrial and other production facilities, an important place is occupied by planning measures and, in particular, the established sanitary protection zone.

To determine the potential level of atmospheric air pollution by the planned activity, the maximum one-time concentrations of pollutants in the atmospheric air of populated cities were taken into account, according to the list of "Limited Permissible Concentrations (MPCs) and Estimated Safe Action Levels (AELs)", Kyiv 2000 and Resolutions of the Main State of the sanitary doctor of Ukraine No. 9 dated April 15, 2013 "On approval of the values of hygienic standards of chemical substances in the atmospheric air of populated areas."

The maximum one-time GDKm.r. - the main characteristic of the dangerousness of a harmful substance, which is established to prevent reflex reactions in humans (sense of smell, light sensitivity, changes in the bioelectric activity of the brain, etc.) during short-term exposure to atmospheric impurities.

Climatic factors (including climate change and greenhouse gas emissions) – no negative impacts are expected. The microclimate is not expected to change as a result of the planned activity. There are no significant releases of heat, inert gases, moisture. Features of climatic conditions that contribute to the increase in the intensity of the effects of the planned activity on the environment are absent.

The wastewater treatment facilities based on the "CBTP-170" unit (Compact Biological Treatment Plant), according to the findings of the state sanitary and epidemiological expertise of the Ministry of Health of Ukraine dated January 23, 2020, No. 12.-18-1/101.6 and TU U 37.0-31830396-007:2015, are safe for human health and comply with the requirements of the State Sanitary Rules for Planning and Construction of Settlements (DSP 173-96). The equipment ensures the treatment of wastewater in accordance with regulations and normative requirements. The properly treated water does not harm the environment, has no adverse effects on human health, and does not deteriorate the condition of flora and fauna [7].

CONCLUSIONS

During the performance of qualification work, we received comprehensive information about the state of operation of sewage treatment facilities in the village of Myropol, performed an analysis of their impact on the environment during operation and fulfilled all the assigned tasks.

1. We analyzed technical documentation, treatment schemes, literary sources and other documentation on the operation of treatment facilities. The main source of information for our research was the Unified Environmental Impact Assessment Register of the Department of Ecology and Natural Resources of the Zhytomyr Regional State Administration.

2. They studied the types of treatment facilities and methods of wastewater treatment. New technologies and methods are constantly appearing. Their development and implementation at the legislative level is a necessary step for the preservation of ecology, the surrounding world and man himself, Modern automated systems are equipped with emergency mechanisms, so the risk of dumping dangerous or toxic untreated waste is practically reduced to zero.

Water purification is carried out by mechanical, physico-chemical and biological methods.

3. They investigated the current state of sewage treatment facilities in the village. Myropol The village of Myropil is located on the banks of the Sluchi, Ruda and Krykukha rivers. The distance to the city of Zhytomyr - the district and regional center is 85 km.

As of May 2022 in the village of There are no sewage treatment plants in Myropil. Currently, the project has been developed and the construction of treatment facilities has started (see Annexes). The purpose of the planned activity is to ensure environmental protection from sewage pollution, improve the ecological situation, reduce the risk of emergency situations during the operation of treatment facilities; ensuring maximum permissible concentrations when discharging wastewater into a water body and, accordingly, creating safe living conditions for the population.

4. An assessment of the impact on the environment of the future treatment facilities of the village was carried out. Myropol The working project "New construction of sewage treatment facilities in the village of Myropyl, Zhytomyr District, Zhytomyr Oblast" provides for the technology of household wastewater treatment, which is based on the use of mechanical (filtration, settling), biological (aerobic oxidation) methods. The construction and operation of the compact biological treatment plant "CBTP" is safe for human health.

5. They analyzed the current state of operation of treatment facilities and the prospects for their improvement.

From February 2022, in connection with the state of war in Ukraine, the construction of sewage treatment facilities in the village of Myropol is suspended. Completion of construction and start of operation of new treatment facilities is planned after the lifting of martial law in the country.

The designed technology is optimal for this object.

The efficiency of the purification of economic and domestic wastewater, when using the designed technology, will be 87-99%, which will ensure the conditions for the removal of purified water into the water body.

In the qualification paper, the theoretical and practical points regarding the condition and operation of sewage treatment plants of the town were considered. Myropol A detailed description of the plan for the construction of treatment facilities and an assessment of their impact on the environment are presented. This work will contribute to informing the residents of the village. Myropol and local self-government bodies on the operation of sewage treatment plants.

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Recommendations

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Methodological recommendations of MR 2.2.12-142-2007. Assessment of the risk to public health from atmospheric air pollution. Approval by order of the Ministry of Health of Ukraine dated 04.13.07 No. 184. Kyiv, 2007.

ELECTRONIC RESOURCES

Main Department of the State Geocadastre in Zhytomyr region https://zhytomyrska.land.gov.ua/.

State Agency of Water Resources of Ukraine https://www.davr.gov.ua/

Zhytomyr Regional Department of Forestry and Hunting https://zt-lis.gov.ua/golovna.html.

Wastewater treatment methods. https://cutt.ly/dwtw0WSd

The concept of sewage treatment plants. Types of treatment facilities. https://cutt.ly/hwtw0AjF

The concept of sewage treatment plants. https://center-ltd.com.ua/proektuvannya-ochysnyh-sporud/

Department of Ecology and Natural Resources of the Zhytomyr Regional State Administration.https://eprdep.zht.gov.ua/

<u>Appendix</u> A

<u>Conclusion of the state sanitary-epidemiological examination</u>

ДЕРЖАВНА СЛУЖБА УКРАЇНИ З ПИТАНЬ БЕЗПЕЧНОСТІ ХАРЧОВИХ ПРОДУКТІВ ТА ЗАХИСТУ СПОЖИВАЧІВ

вул. Б. Грінченка, 1, м. Київ, 01001, тел. 279-12-70, 279-75-58, факс 279-48-83,
e-mail: info@consumer.gov.ua

ЗАТВЕРДЖУЮ
Т. в.о. Голови Держпродспоживслужби
________ О. П. Шевченко
М.П.

ВИСНОВОК
державної санітарно-епідеміологічної експертизи

від 23 01 **2020 р.** **№ 12.2-18-1/** 1016

Об'єкт експертизи Установки очистки стічних вод «Кубо»

виготовлений у відповідності ТУ У 37.0-31830396-007:2015 «Установки очистки стічних вод «Кубо». Технічні умови»

Код за ДКПП 37.00.11-00.00

Сфера застосування та реалізації об'єкта експертизи призначені для повної біологічної очистки господарсько-побутових та подібних до них за складом стічних вод, реалізації у торговельній мережі

Розробник ТзОВ «Комфорт Еко», юридична адреса: Україна, 33018, м. Рівне, вул. Д. Галицького, 16; фактична адреса: 33027, м. Рівне, вул. Д. Галицького, 19, офіс 603; тел./факс (0362) 62-05-73, komforteko1@ukr.net; код за ЄДРПОУ 31830396.
(адреса, місцезнаходження, телефон, факс, E-mail, веб-сайт)

Дані про контракт на постачання об'єкта в Україну не потрібний, вітчизняна продукція

Заявник експертизи ТзОВ «Комфорт Еко», юридична адреса: Україна, 33018, м. Рівне, вул. Д. Галицького, 16; фактична адреса: 33027, м. Рівне, вул. Д. Галицького, 19, офіс 603; тел./факс (0362) 62-05-73, komforteko1@ukr.net; код за ЄДРПОУ 31830396.
(адреса, місцезнаходження, телефон, факс, E-mail, веб-сайт)

Об'єкт експертизи відповідає встановленим медичним критеріям безпеки/показникам:
За результатами ідентифікації, розгляду і аналізу документації, оцінки ризику для здоров'я населення, а також результатами перевірки наданої заявником документації, на межі санітарно-захисних зон для установок «Кубо» – 20 м (для установок локальних очисних споруд продуктивністю від 201 м^3/добу до 500 м^3/добу включно); 15 м (для установок локальних очисних споруд продуктивністю до 200 м^3/добу включно); 5 м (для установок продуктивністю від 1 м^3/добу до 25 м^3/добу включно, що використовуються для очищення господарсько-побутових стічних вод житлових та громадських будівель): еквівалентний рівень шуму – дод. №16 ДСП 173-96 і ДСН 463-19 «Державні санітарні норми допустимих рівнів шуму в приміщеннях житлових та громадських будинків і на території житлової забудови» (до 50 дБА); гранично допустимі викиди шкідливих речовин в атмосферу – ГН «Гранично допустимі концентрації хімічних і біологічних речовин в атмосферному повітрі населених місць»,

затвердженим т.в.о. головного державного санітарного лікаря України 03.03.15 р., зокрема (мг/м^3): аміаку ГДК максимально разова – 0,2, середньодобова – 0,04; сірководню ГДК максимально разова – 0,008; ангідриду сірчистого ГДК максимально разова – 0,5, середньодобова – 0,05; фенолу ГДК максимально разова – 0,01, середньодобова – 0,003. Параметри очищених стічних вод дозволяють їх скид: у водні об'єкти відповідно до постанови КМУ № 465 від 25.03.1999 р. Про затвердження «Правил охорони поверхневих вод від забруднення зворотними водами», при погодженні з місцевими регулюючими органами у існуючі дренажні та меліоративні системи, у ґрунтовий потік після фільтрування через фільтруючі колодязі, траншеї тощо, а також на рельєф (канави, кювети, балки, природні дощові водостоки тощо) після їх доочищення та обов'язкового знезаражування згідно з ДБН В.2.5-75:2013 «Каналізація. Зовнішні мережі та споруди».

Необхідними умовами використання/застосування, зберігання, транспортування, утилізації, знищення є: Здійснювати експлуатацію установок очистки стічних вод «Кубо» згідно з встановленими у цьому висновку критеріями безпеки та рекомендаціями виробника. У разі використання установок в процесі роботи очисних споруд централізованого водовідведення населених пунктів можливе повторне використання очищених стічних вод, а за дозволом регулюючого органу й їх осадів, згідно з «Порядком повторного використання очищених стічних вод та осаду», затвердженим наказом Мінрегіонбуду від 12.12.18 р. № 341, зареєстрованим у Міністерстві юстиції України 22.01.19 р. за № 75/33046. У разі використання установок для очищення господарсько-побутової стічної води житлових та громадських будівель вода може використовуватися для підґрунтового поливу в курортних зонах (будинках відпочинку, санаторіях, розважальних майданчиках, аквапарках тощо), при цьому необхідно додержуватись наступних вимог: а) господарсько-побутові стічні води після глибокого біологічного очищення на установці повинні знезаражуватися, при цьому мікробний склад стічних вод повинен бути доведений до індексу БГКП < 1000 та індекса коліфагів < 1000, що буде гарантувати відсутність у воді хвороботворних кишкових мікроорганізмів; б) між садово-городніми ділянками, які зрошуються біологічно очищеними та знезараженими стічними водами, та джерелами нецентралізованого водопостачання (колодязями) повинні витримуватись відповідні зони санітарної охорони у відповідності до діючих санітарних норм; в) полив садово-городніх ділянок повинен здійснюватися способом внутрішньо-ґрунтового зрошення. Метод дощування не дозволяється. Для неплодоносних дерев та чагарників можливо застосовувати краплинний поверхневий спосіб поливу (крапання із трубок розташованих за декілька сантиметрів від поверхні землі над кореневою системою рослин); г) на ділянках, де передбачається утилізувати господарсько-побутові стічні води після очищення на установці, дозволяється вирощувати виноград, плодоносні та неплодоносні дерева і чагарники, квіти, декоративні рослини, зернові, технічні та кормові культури; д) необхідно забезпечити постійний контроль за якістю очищених та знезаражених господарсько-побутових стічних вод та їх впливом на ґрунт і рослини; е) необхідно передбачити заходи із запобігання підтоплення садово-городньої ділянки поверхневими дощовими та талими водами з вищерозташованих територій; ж) при неможливості використання стічних вод для зрошення (взимку тощо) необхідно передбачити скид біологічно очищених стічних вод у зливову каналізацію, фільтруючу траншею, фільтруючий колодязь або на біоплато. У випадку скиду очищених стічних вод у водний об`єкт необхідне обов`язкове знезараження хімічним чи іншим ефективним методом. Контроль якості очищених стічних вод забезпечується організаціями, що експлуатують каналізаційні очисні споруди. Для кожного конкретного об'єкту господарювання необхідно розробляти окремі проекти та погоджувати їх згідно із чинним законодавством.

За результатами державної санітарно-епідеміологічної експертизи об'єкт експертизи Установки очистки стічних вод «Кубо» **за наданими заявником зразками відповідає вимогам діючого санітарного законодавства України і за умови дотримання вимог цього висновку може бути використаний в заявленій сфері застосування.**

Термін придатності згідно з даними виробника

Інформація щодо етикетки, інструкції, правил тощо повинна надаватися інструкція з монтажу та експлуатації

Висновок дійсний протягом терміну дії ТУ У 37.0-31830396-007:2015 «Установки очистки стічних вод

«Кубо». Технічні умови»

Відповідальність за дотримання вимог цього висновку несе заявник

При зміні рецептури, технології виготовлення, які можуть змінити властивості об‘єкта експертизи або спричинити негативний вплив на здоров‘я людей, сфери застосування, умов застосування об'єкта експертизи даний висновок втрачає силу.

Показники безпеки, які підлягають контролю на кордоні Контролю на кордоні не підлягає, вітчизняна продукція

Показники безпеки, які підлягають контролю при митному оформленні Контролю при митному оформленні не підлягає, вітчизняна продукція

Поточний державний санітарно-епідеміологічний нагляд згідно з вимогами законодавства

Комісія з питань державної санітарно-епідеміологічної експертизи ДУ «Інститут громадського здоров’я ім. О.М. Марзєєва НАМНУ» 02094, м. Київ, вул. Попудренка, 50, тел.: (044) 292-14-49

(найменування місцезнаходження, телефон, факс, E-mail, WWW)

Протокол експертизи № 9 від 14.01. 2020 року

(№ протоколу, дата його затвердження)

Заст. голови експертної комісії **Бабій В.Ф.**

(прізвище, ім'я, по батькові) (підпис)

Appendix B

CERTIFICATE

Миропільська селищна рада
Романівський район
Житомирської області
Селище Миропіль , вул. Центральна, 38 тел. 04146-9-53-08,
Myropil_sel.r@i.ua

Вих.№ 367 від 01 .04. 2021

Виконавчий комітет Миропільської селищної ради інформує, що проєктний скид зворотних вод після очисних споруд згідно проєкту «Нове будівництво очисних споруд каналізації в смт. Миропіль, Житомирського району, Житомирської області» (розробник ТОВАРИСТВО З ОБМЕЖЕНОЮ ВІДПОВІДАЛЬНІСТЮ «КОМФОРТ-ЕКО», м. Рівне), буде здійснюватися у р. Случ за межами населеного пункту (смт. Миропіль).

Селищний голова Світлана ВЛАСЮК

Землевпорядник Анатолій КРАВЧУК

МИРОПІЛЬСЬКА СЕЛИЩНА РАДА селище Миропіль Романівського р-ну Житомирської обл. і.к. 04345204 УКРАЇНА

<u>**Appendix**</u> **C**

CONSTRUCTION CERTIFICATE

Миропільська селищна рада
Житомирської області
Селище Миропіль, вул. Центральна, 38 тел. 04146-9-53-08, Myropil_sel.r@i.ua

Вих. № 370 від 01.04.2021

Довідка

Повідомляємо, що до очисних споруд каналізації І-ша черга будівництва будуть підключені:

- Каналізована частина населення смт. Миропіль – 200 чоловік – 20 м куб/доб (фактичний показник водовідведення);
- Населення військового містечка – 900 чоловік – 100 м куб/добу. (фактичний показник водовідведення)
- Військова частина – 20 м куб/доб. (фактичний показник водовідведення);
- Перспектива каналізування на І-шу чергу будівництва – 200 чоловік

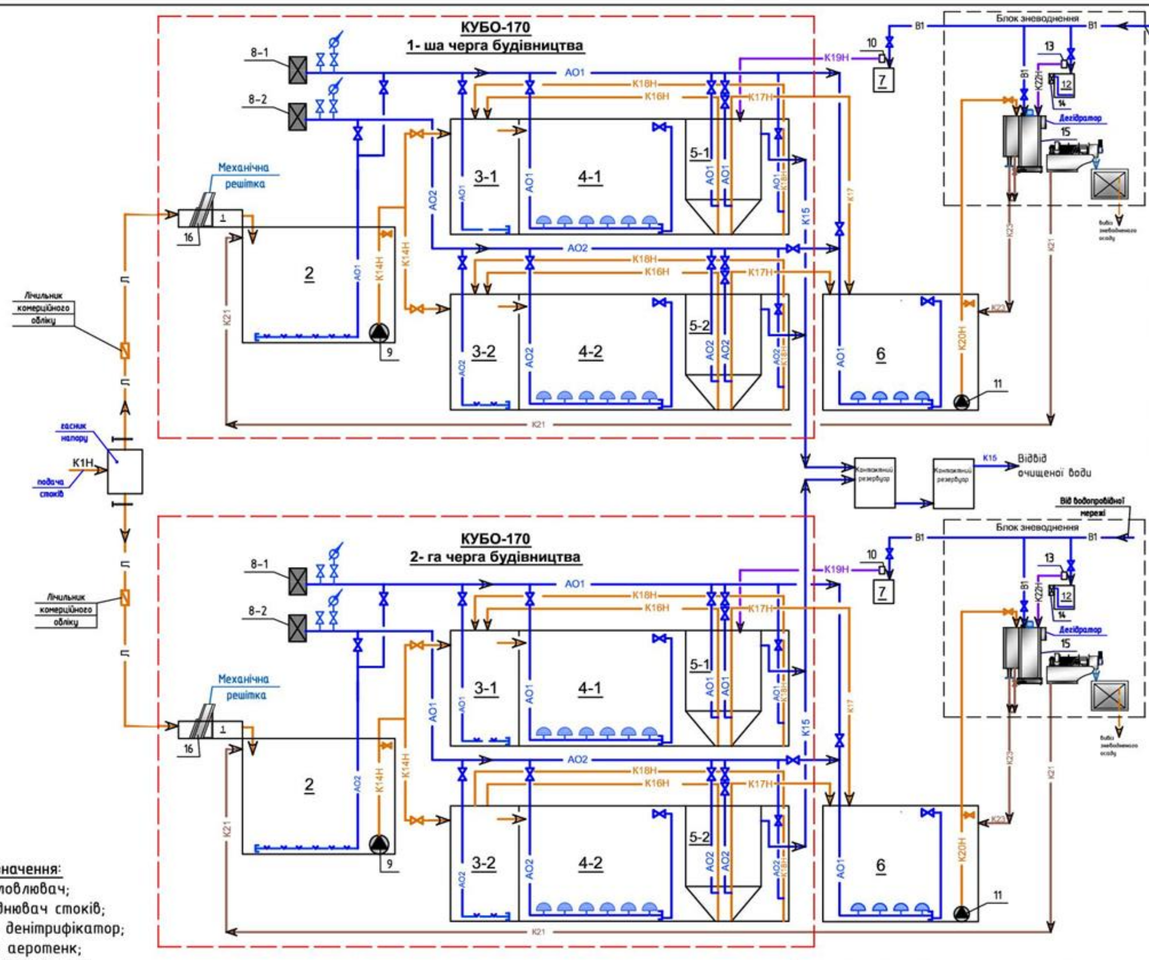
До очисних споруд каналізації ІІ-га черга будівництва будуть підключені:

- 1500 чоловік.

Селищний голова Світлана ВЛАСЮК

<u>Appendix</u> E

EXPLANATION OF PIPELINES



Умовні позначення:
1 – пісковловлювач;
2 – усереднювач стоків;
3-1, 3-2 – денітрифікатор;
4-1, 4-2 – аеротенк;
5-1, 5-2 – відстійник ;
6 – стабілізатор осаду;
7 – розчинний бак гіпохлориту натрію;
8 – повітродувка;
9, 11- погружні насоси;
10 – насос-дозатор гіпохлориту натрію;
12 – розчинний бак флокулянту;
13 – насос-дозатор флокулянту;
14 – повітродувка взмучування флокулянту
15 – установка зневоднення осаду
16 – механічна решітка.

Експлікація трубопроводів:
В1 – господарсько-питний трубопровід;
К1Н – Трубопровід подачі стічних вод на очисні споруди
К14Н – Трубопровід подачі стічних вод з усереднювача в денітрифікатор;
К15 – Трубопровід відводу очищеної води з установки КУБО
К16Н – трубопровід (ерліфт) подачі рециркуляційного активного мулу (РАМ) із вторинного відстійника в денітрифікатор;
К17Н, – трубопровід (ерліфт) відводу надлишкового активного мулу (НАМ) із вторинного відстійника в стабілізатор осаду;
К18Н – трубопровід напірний внутрішньої рециркуляції води в аеротенку;
К19Н – Трубопровід (напірний) подачі розчину гіпохлориту натрію на знезараження очищеної води
К20Н – Трубопровід (напірний) подачі осаду на установку зневоднення
К21 – Трубопровід спорожнення дегідратора
К22Н- Трубопровід (напірний) подачі флокулянту на установку зневоднення
К23- Трубопровід переливу та спорожнення камери згущення дегідратора
АО1, АО2- Трубопроводи подачі повітря на установку "КУБО"

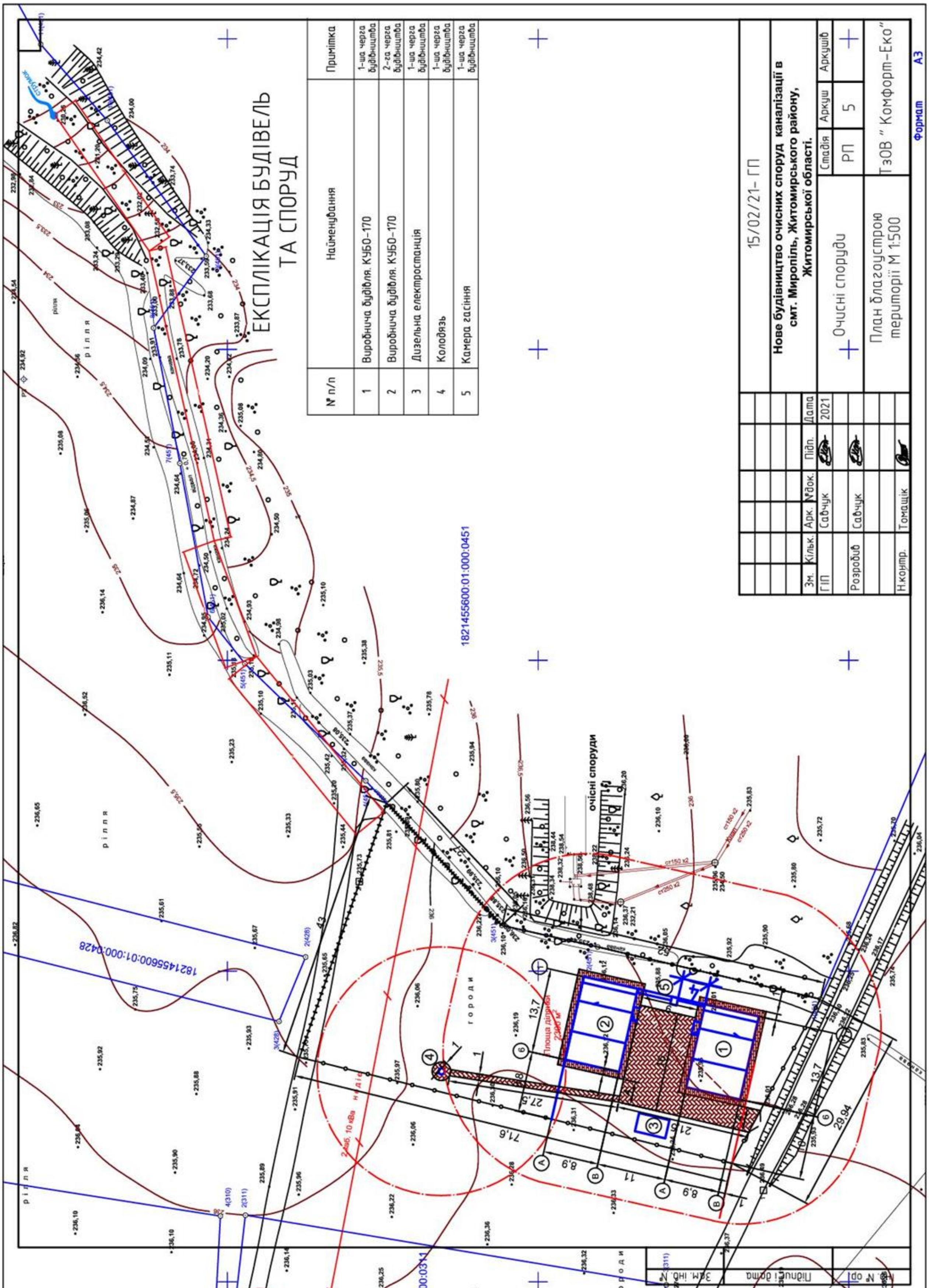
						07/04/21-01- ТХ			
						Нове будівництво очисних споруд каналізації в смт. Миропіль, Житомирського району, Житомирської області			
Зм.	Кільк.	Арк.	№док.	Підпис	Дата				
ГІП		Савчук		[signature]	2021	Очисні споруди	Стадія	Аркуш	Аркушів
							РП	3	
Виконав.		Томащік		[signature]		Технологічна схема	ТзОВ "Комфорт-Еко"		
Н. контроль		Савчук		[signature]					

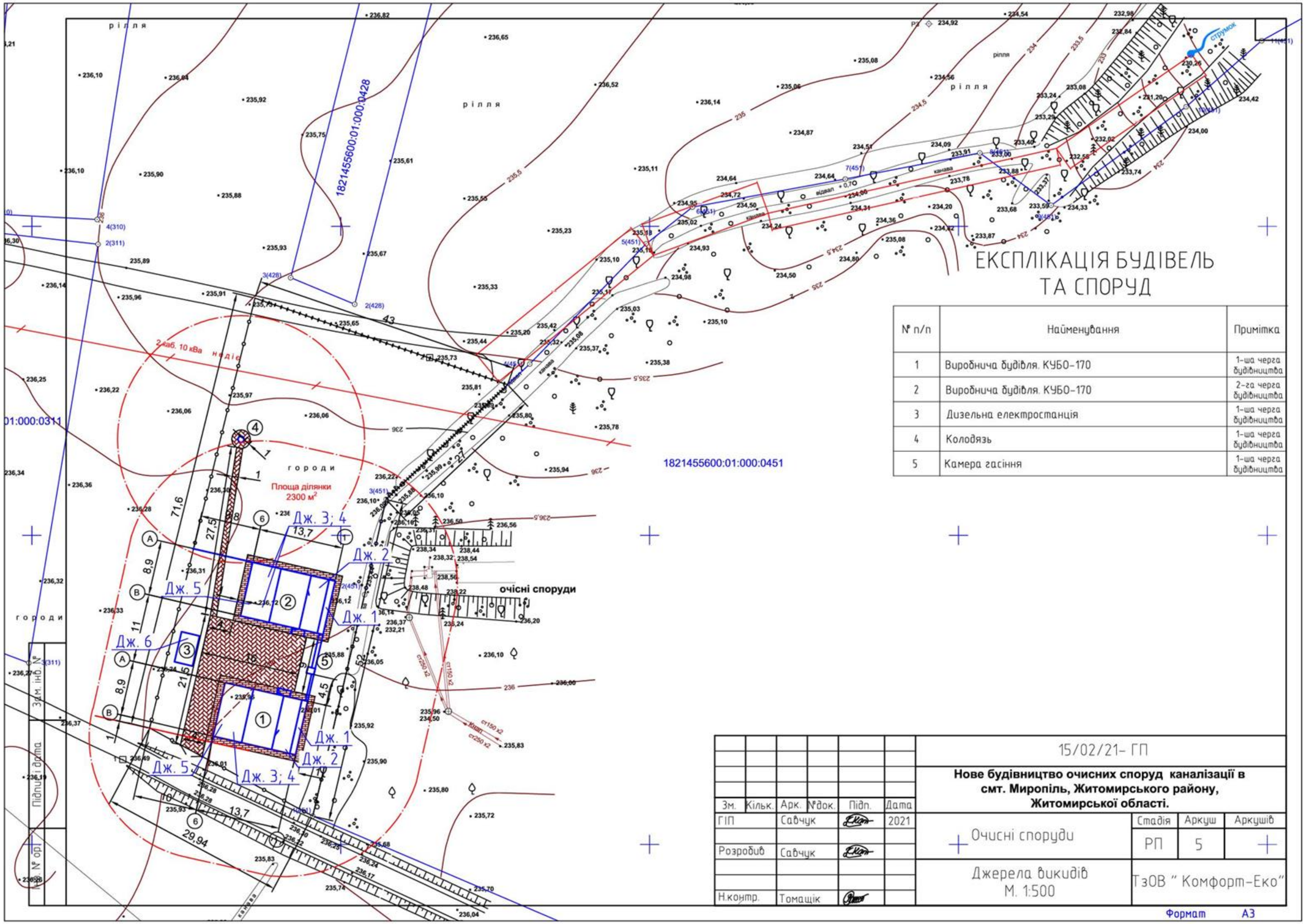
Формат А3

Зам. інв.№	Підпис і дата	Інв. № ориг.

Appendix F

EXPLANATION OF BUILDINGS AND STRUCTURES


ЕКСПЛІКАЦІЯ БУДІВЕЛЬ ТА СПОРУД
№ п/п | Найменування | Примітка
1 | Виробнича будівля. КУБО-170 | 1-ша черга будівництва
2 | Виробнича будівля. КУБО-170 | 2-га черга будівництва
3 | Дизельна електростанція | 1-ша черга будівництва
4 | Колодязь | 1-ша черга будівництва
5 | Камера гасіння | 1-ша черга будівництва
очисні споруди
1821455600:01:000:0451
1821455600:01:000:0428
рілля
городи
15/02/21- ГП
Нове будівництво очисних споруд каналізації в смт. Миропіль, Житомирського району, Житомирської області.
Очисні споруди
План благоустрою території М 1:500
Стадія | Аркуш | Аркушів
РП | 5
ТзОВ "Комфорт-Еко"
Зм. | Кільк. | Арк. | №док. | Підп. | Дата
ГІП | Савчук | 2021
Розробив | Савчук
Н.контр. | Томащік
Формат A3
Взам. інв. №
Підпис і дата
Інв. № ор.



№ п/п	Найменування	Примітка
1	Виробнича будівля. КУБО-170	1-ша черга будівництва
2	Виробнича будівля. КУБО-170	2-га черга будівництва
3	Дизельна електростанція	1-ша черга будівництва
4	Колодязь	1-ша черга будівництва
5	Камера гасіння	1-ша черга будівництва

Appendix G

PHOTOS OF CONSTRUCTION

Fig.1. Current state of defunct sewage treatment plants

Fig.2. The beginning of the first phase of construction

Fig.3. Welding works

Fig.4. Concreting

Fig.5. Pouring concrete structures

Fig.6. Construction works

Fig.7. Installation of the equipment of two clarifiers without mechanisms

Fig.8. Completion of the construction of the underground part of the structure (winter 2022)