MANAGEMENT PLAN
THE DANUBE RIVER BASIN
(2025-2030)

December 2023

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MAPS

List of abbreviations

BSC_5	biochemical oxygen consumption for 5 days
BUVR....................	water resources basin management
GDP.....................	gross domestic product
AIRBORNE	gross value added
EU WFD................	Water Framework Directive of the European Union
HCJ.....................	gross regional product
CATTLE.....................	cattle
GWEP...................	the main water and environmental problem
MPC.....................	maximum permissible concentration
HES.....................	hydroelectric power station
TWO	State Agency of Water Resources of Ukraine
DDT	state planning documents
SES	State Emergency Service of Ukraine
HOUSING AND COMMUNAL SERVICES.....................	housing and communal services
EZPD...................	operational groundwater reserves
ENIA.....................	environmental quality standard
IHLIW	Significantly altered surface water massif
CMU.....................	Cabinet of Ministers of Ukraine
KP.........................	utility company
Ministry of Agriculture	Ministry of Agrarian Policy and Food of Ukraine
Ministry of Environment...........	Ministry of Environmental Protection and Natural Resources of Ukraine
MPV.....................	surface water body
MPZV....................	groundwater body
OZ........................	security zone
OMC.....................	local self-government bodies
ONPS....................	environmental protection
PE	population equivalent
NRF.....................	nature reserve fund
PRPV...................	Forecast groundwater resources
PURB...................	River basin management plan
PURZ...................	Flood risk management plan
RBI......................	river basin area
CEO	Strategic environmental assessment
UkrDGRI...............	Ukrainian State Geological Exploration Institute
UkrCGM	Ukrainian Centre for Hydrometeorology
COD......................	chemical oxygen consumption
CEC.....................	centralised water supply and sewerage
SHMPV...................	artificial surface water body

1 GENERAL CHARACTERISTICS OF SURFACE AND GROUNDWATER IN THE **DANUBIAN RIVER BASIN REGION**

1.1 Description of the river basin

1.1.1 Hydrographic and water management zoning

The Danube transboundary basin is located on the territory of 19 countries: Austria, Bulgaria, the Czech Republic, Germany, Hungary, Slovakia, Slovenia, Romania, Croatia, Bosnia and Herzegovina, Moldova, Montenegro, Serbia, Ukraine, Italy, Poland, Albania, Macedonia, and Switzerland.

The catchment area of the basin within Ukraine is 30,059 km^2 . The basin covers 5% of Ukraine's territory.

The Danube River basin area is located within four regions of Ukraine (Zakarpattia, Ivano-Frankivsk, Chernivtsi and Odesa regions). The Tisza sub-basin is entirely located within Zakarpattia Oblast, the Prut and Siret sub-basin is located in Ivano-Frankivsk and Chernivtsi Oblasts, and the Lower Danube sub-basin is located in Odesa Oblast .

The hydrographic network of the basin includes 335 rivers with a catchment area of more than 10 km^2 and 16 lakes (with a catchment area of more than 0.5 km^2).

According to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 3 March 2017 "On Approval of the Boundaries of River Basin Areas, Sub-basins and Water Management Areas", 8 water management areas are allocated in the Danube basin.

1.1.2 Climate.

The Danube RBD is entirely located in temperate latitudes and is characterised by a temperate climate, but its fragmentation means that the manifestation of the temperate climate will vary between sub-basins. The Tisza, Prut and Siret sub-basins are located in the forested Atlantic-Continental region, and the Lower Danube sub-basin in the steppe Atlantic-Continental region.

A significant part of the Tisza, Prut and Siret sub-basins is located in the Ukrainian Carpathians. This part of the Danube RBD receives an average of 1200 mm of precipitation, with up to 1650 mm in some years. Within the Transcarpathian lowlands, the Tisza sub-basin can receive 690-1100 mm per year, and in the Carpathian sub-basins of the Prut and Siret rivers - 650-890 mm. For the Lower Danube sub-basin, annual precipitation ranges from 370 to 520 mm, but averages 500 mm. The largest amount of precipitation falls during the warm season (April-October) - 60-70%. During this period, 800-1000 mm falls in the Ukrainian Carpathians, 550-600 mm in the Transcarpathian lowlands, and 475-600 mm in the Carpathian region. The Lower Danube sub-basin receives 275-325 mm in the warm season.

During the cold season (November-March), precipitation rarely exceeds 30-40% of the annual total. For example, in the Ukrainian Carpathians, up to 500-600 mm fall during the cold season. The Transcarpathian lowland of the Tisza sub-basin receives up to 250-300 mm. In the Carpathian part of the Prut and Siret sub-basins, up to 175-300 mm fall during the cold season. The Lower Danube sub-basin receives up to 200 mm during the cold season.

The duration of snow cover varies from 70 to 150 days in the Tisza, Prut and Siret sub-basins, with the longest duration in the mountainous parts of these sub-basins. In the Lower Danube sub-basin, the annual snow cover duration rarely exceeds 40-50 days.

The distribution of air temperature in the Danube RBD is also not uniform. The average long-term air temperature in the Lower Danube sub-basin is the highest in the basin, at around 10.5℃. In the Tisza, Prut and Siret sub-basins in the Ukrainian Carpathians, the average annual temperature is around 4.0℃, but south-west of the mountains, the average annual temperature rises to 8.0-9.0℃ within the Transcarpathian lowlands of the Tisza sub-basin. To the north-east of the mountains, within the Carpathian region, the average annual temperature drops to 7.0℃.

1.1.3 Terrain

Tisza River sub-basin

The majority of the sub-basin is located in the mountains and foothills of the Carpathians, with the remainder in the Hungarian Plain (Transcarpathian Lowland).

The sub-basin is cut by three groups of ridges separated by longitudinal depressions. The main central group is the chain of the Polonyn Mountains, with the Gorgany Mountains to the north and the Vygorlat Gutyn (volcanic) range to the south. In the extreme south-east, the Hutsul Alps stand out separately.

The Transcarpathian lowland, which occupies about 35% of the basin, is a plain with some manes and hills. In the area of the city of Berehove, mountains formed by volcanic rocks are located on the plain.

Sub-basins of the Prut and Siret rivers

The Prut River sub-basin is divided into three parts based on its surface: mountainous, foothill and plain. The mountainous part of the sub-basin comprises the medium-altitude ranges of the Ukrainian Carpathians, which run almost parallel to each other from northwest to southeast, as does the entire arc of the Carpathians. The mountainous part is divided into three zones: the axial zone, the Central Carpathian Depression zone and the Skiba Carpathians zone.

The Siret River sub-basin is unevenly distributed across the altitudinal zones. The south-western part of the basin up to the village of Berehomet is located on the spurs of the Carpathians. The watersheds run along separate ridges, with mountain peaks reaching 1000-1300 metres. The ridges have rounded flat peaks, steep slopes are dissected by numerous river valleys. Gradually, the mountains give way to a foothill zone (Prykarpattia-Bukovyna) with elevations of 500-600 m, which passes into the Podilske plateau. Landslides contribute to the formation of soft surface forms. Part of the Siret sub-basin is located in the Eastern Carpathians, in the Pokutsko-Bukovyna Carpathians and on the Bukovyna foothills**.**

Lower Danube sub-basin

The sub-basin is distinguished by the Black Sea lowland, with an absolute height of 150-130 m. The lowland gradually slopes down to the Black Sea. There are landforms of various genesis in the area: accumulative, erosion, denudation, subsidence, and artificial. Wide watersheds (primary accumulative plains) are typical for the northern and north-eastern parts of the basin. In the southeast, there are Upper Pliocene marine terraces. Along the sea coast, there are marine accumulative landforms such as beaches, spits, and spits. Some of the sea shores, estuaries and lakes are abrasive, landslide and sometimes landslide.

In terms of tectonic structure, the lowland is part of the Black Sea Basin, filled with almost horizontal thick layers of sedimentary rocks, mainly marine sediments of the Paleogene and Neogene (clays, sands, sandy-clay and sandy-limestone rocks, limestone), overlying continental sediments of anthropogenic age - red-brown clays, loess, loess-like loams.

1.1.4 Geology

Tisza River sub-basin

The sub-basin is located within the young (alpine) folded structure of the Carpathians and covers the central part of the Ukrainian segment of the folded Carpathians with the adjacent Transcarpathian internal trough.

The geological structure of the territory is made up of two structural layers. The lower structural floor forms the foundation of the Transcarpathian Trough and the Folded Carpathians. The basement of the trough contains intensively deposited sedimentary, volcanogenic and metamorphic formations of the Paleozoic and Mesozoic-Cenozoic periods. The Folded Carpathians are formed by carbonate-terigenous and terrigenous Mesozoic-Cenozoic formations that comprise several structural and facies zones. They are intensively dislocated and form a package of covering structures.

Internal Carpathians: Transcarpathian Internal Trough, Vygorlat-Hutyn Ridge and Berehove Uplift and "buried" volcanoes (rhyolites, andesites, basalts, their tuffs and tuff rocks). Peninsular zone of rocks: The Pennine zone (limestones, mudstones, sandstones with gravels and conglomerates). Marmara rock zone: Monastiretske and Vezhanske rocks (conglomerates, marls, sandstones, mudstones with gravelites, limestones, siltstones). Marmarosh massif: Dilove and Bilopotocki rocks (gneisses, shales of various compositions, quartzites, marbles and marbled limestones, limestones and dolomites, granite porphyries, granite gneisses, amphibolites, gabbro, tuffs, phyllites, mudstones, siltstones, sandstones, tuffs, coal, conglomerates).External Carpathians: Magury and Rakhiv rocks (flysch, massive sandstones with limestones in some places), Kamianopotocky rocks and Krosnenska zone (sandstones, limestones, mudstones, spilites, diabases and their tuffs in some places), Porkulets, Dukliany, Chornohora and Skibovy rocks (flysch, mudstones, marls, sandstones, siltstones).

The sediments of the upper structural floor fill the Zakarpattia Internal Trough. These are Neogene-Quaternary sedimentary, volcanogenic and volcanomictic, sometimes coal-bearing molassic formations, which lie mostly subhorizontally and form a cover complex.

Sub-basins of the Prut and Siret rivers

Part of the Prut sub-basin is located in the Carpathians and is composed of Mesozoic sediments (shale, quartzite) overlain by Tertiary flysch (sandstones, clays, marls and limestones) and thicker Quaternary alluvial gravel deposits.

An analysis of the geological structure of the Prut sub-basin has shown that the most water-rich aquifers are in the southern part of the Precarpathian trough. In the areas along the left bank of the Prut, water is associated with alluvial deposits of the Eopleistocene and Lower Pleistocene. The water-bearing rocks here are sands and pebbles of the floodplain terraces up to 20 m thick.

The mountainous part of the Siret sub-basin is composed of Paleozoic mica and other metamorphic shales, the foothill part is composed of sandstones, clay shales and limestones (mainly Cretaceous), and the plain part is composed of sandstones, marls, limestones and clay shales. Aquifers with water suitable for drinking and other technical purposes are found in the sand and sandstone layers at a depth of 250-300 m, but they are not widespread.

Lower Danube sub-basin

The geological structure of the sub-basin comprises Precambrian, Paleozoic, Mesozoic and Cenozoic deposits.

The section contains fine and medium-grained calcareous sands with lenses and layers of weakly cemented sandstones, greenish and light grey marls, dense and fractured, clays and siltstones. The Neogene system is widespread and is represented by Miocene and Pliocene deposits. The Upper Pliocene amovial terrace deposits are developed in the southern part of the basin and are represented by sands of various compositions with clay interlayers and gravel and pebble inclusions. They occur at depths ranging from 1 m to 25 m.

The Upper Pliocene deposits are developed in the southern part of the basin and are represented by clay, sands, silts, and loams.

Deluvial formations are almost universally distributed on the slopes of river valleys, beams, ravines and reservoirs. They are represented by sandy-clayey rocks, sandy loam and loam, and limestone. Their thickness varies from 0.5 to 15 m.

1.1.5 Hydrogeology

Tisza River sub-basin

The Carpathian groundwater basin covers the mountainous folded structure of the Carpathians. The water-bearing rocks are almost exclusively terrigenous flysch rocks of the Cretaceous and Paleogene, crumpled into numerous folds, often faulted, overturned and complicated by thrusts. The Carpathian Basin is characterised by low flooding due to the predominantly clayey composition of the flysch rocks and intense denudation processes that impede the formation of exogenous fracture zones, which are the main places of groundwater accumulation and movement. Groundwater circulation occurs in local zones of exogenous fracturing of bedrock (weathering zone) and in zones of tectonic fracturing. Groundwater in the weathered zone is non-pressure, fresh. The waters of the tectonic fracture zones are pressurised, often mineralised. The groundwater of the Carpathian Basin is fed by precipitation and discharged by a hydrographic network.

The Zakarpattia groundwater basin covers the territory of the Zakarpattia Internal Trough. The main source of fresh groundwater is the alluvial aquifer, which is widespread, holds significant groundwater reserves and is used to supply the population with drinking water. The aquifer is free-flowing. Alluvial groundwater generally meets state sanitary standards in terms of its chemical and organoleptic characteristics, but in areas of slow water exchange, the content of naturally occurring iron and manganese exceeds the maximum permissible levels. The aquifer is insufficiently protected from surface sources of pollution due to the low thickness of the covering water-resistant sediments, and with increasing anthropogenic pressure, the risks of groundwater quality deterioration increase. The aquifer is recharged mainly through infiltration of precipitation. The main discharge of the groundwater flow is into the Tisa River and its tributaries, as well as through evaporation and artificial water extraction.

Significant reserves of fresh groundwater are accumulated in the volcanic complex of the Vygorlat-Gutynsky Ridge. Fractured, cavernous and porous tuffs, andesites, andesite-basalts, volcaniclastic conglomerates and breccias are water-bearing. The upper zone of intense weathering fracturing is associated with fractured groundwater, which is characterised by good drinking quality. The waters of the tectonic fracture zones are under pressure, often have elevated temperature and mineralisation, and a specific chemical composition. The aquifer complex is fed by precipitation and surface water. The aquifer complex is discharged into the hydrographic network and the alluvial sediment aquifer.

Groundwater in deep aquifers is confined to layers and interlayers of sands, sandstones, conglomerates, tuffs and tuffites that occur among substantially clayey strata. The distribution of groundwater is localised, with waterlogged zones of tectonic fractures containing highly mineralised, heat-powered water.

Sub-basins of the Prut and Siret rivers

Three hydrogeological areas are distinguished in the sub-basins: Volyn-Podilskyi artesian basin, Predkarpatskyi foothill artesian basin, and the Carpathian fold region.

The Volyn-Podillya artesian basin occupies the Prut-Dniester and partially the Prut-Siret interfluve. The area is covered by sedimentary rocks of the Paleozoic, Mesozoic and Cenozoic periods, which are represented by clay-sandy deposits. The area is also covered by a cover of eluvial-deluvial loams. A densely developed river network results in significant groundwater drainage and a predominance of surface runoff over underground runoff.

The Precarpathian foothill artesian basin occupies the Precarpathian trough zone and geostructurally occupies an intermediate position between the weakly dislocated sediments of the Volyn-Podilska plate and the intensely dislocated sediments of the Carpathians. A special feature is that almost all groundwater accumulated in it is highly mineralised.

The Carpathian fold region occupies the southwestern part of Chernivtsi Oblast. Its geological structure consists of flysch formations of the Paleogene and Cretaceous. Hydrogeological conditions are mainly determined by tectonic features.

Lower Danube sub-basin

The sub-basin is a part of the Black Sea artesian basin and is characterised by rather complex hydrogeological conditions.

Groundwater is found in almost all sediments. Groundwater is found in Quaternary and Neogene rocks and is characterised by a variety of depths, extraction methods and availability, distribution and quality. The direction of movement in Quaternary and Neogene sediments (groundwater) in natural conditions coincides mainly with the inclination of the earth's surface, the area of recharge coincides with the area of distribution, and discharge takes place in valleys.

There are nine aquifers in the region. Within the basin, the depth to the aquifers is usually between 20 and 30 m. Groundwater salinity ranges from 5 to 3 g/l, which is significantly higher than the standard. The chemical composition is dominated by hydrocarbonates, chloride, chloride-sulfate, sulfate, and sodium.

1.1.6 Soils

Tisza River sub-basin

Varieties of sod-podzolic soils prevail in the lowlands, brown mountain-forest and meadow-forest soils in the mountains, and meadow and meadow gley soils on the floodplain terraces of rivers.

Within the mountainous part of the territory, the vertical differentiation of soils is clearly visible. In the highland tier, mountain-meadow-brown soils are common at altitudes of 1100-1200 m; in the non-forested areas - meadows - sod-brown soils are common.

The gentler mountain slopes are covered with loamy brown earth-podzolic soils. On gentle slopes and in river valleys, meadow-brown loam soils are formed.

The Transcarpathian lowland is covered with soddy- podzolic gley and gley or brown gley soils.

In the valleys of the Borzhava and Irshava rivers, bog-gley and meadow-gley soils prevail. Light brown forest soils were formed in the upper reaches of the Uzh, Latorytsia, and Rika rivers, and brown mountain-forest soils in the upper reaches of the Borzhava, Tereblya, Teresva, Chorna, and Bila Tisa rivers. The dominant soil type in the lower reaches of the Uzh, Latorytsia and Borzhava rivers is soddy- podzolic clayey soils.

Sub-basins of the Prut and Siret rivers

In the Prut River valley, chernozems are becoming more widespread: podzolised, shallow and deep low-humus soils. In the lower reaches, moisture deficit has led to the spread of southern chernozems and chestnut soils with signs of salinity.

The part of the Prut sub-basin within the mountains consists of sandy-light and medium loamy, sometimes sod-podzolic soils in combination with podzolic, occasionally mountain peat-podzolic soils. The channel is composed mainly of sandy-pebble and pebble-stony soils.

The mountainous part of the Siret sub-basin is dominated by medium-podzolic and mountain podzolic soils, while in the foothills and on the plain they are replaced by soddy-medium podzolic surface-ashy soils, and in the river valleys by soddy-podzolic-ashy soils in combination with meadow podzolic soils. By their mechanical composition, the soils in the mountains are sandy-medium loamy, and on the plains - light loamy. The underlying layer has low water permeability**.**

Lower Danube sub-basin

The soil in the region is made up of ordinary and southern chernozems; in the Danube terraced plain and in the south-west of the watershed plain, it is exclusively micellar carbonate.

The chernozems were formed under fescue-fescue and wormwood-fescue-fescue vegetation in combination with some annual and biennial grasses. The region's chernozems are distinguished by high biological activity, which contributes to the mineralisation of organic matter, a well-defined and strong "coprogenic" structure, high porosity (up to 50-55%) and water permeability (filtration coefficient of 1.5-3.5 mm/min).

The grain-size distribution of ordinary chernozems is heavy loamy, with a slightly lighter composition towards the south, and medium loamy varieties of southern chernozems dominate the terraced plain. In the profile of ordinary chernozems at a depth of 85-120 (130) cm, the white-eye horizon (usually the Phca horizon) is well defined, while in southern chernozems it approaches a depth of 65-90 cm. The carbonate content in this horizon reaches 17-22%. The gypsum horizon is not visible in the profile of chernozems up to a depth of 2-3 m. Primary chernozems are not saline to a depth of 5-7 m, and often even deeper.

1.1.7 Vegetation

Tisza River sub-basin

There are altitudinal zones of vegetation: foothill oak, lowland beech, upper mountain spruce, subalpine shrub and meadow, and alpine.

The foothill zone, which rises to 400-500 (700) m, is dominated by oak forests, spruce-beech forests and derivative hornbeam forests, beech forests, smoky forests, aspen-willow forests are also common. The lowland belt on different slopes rises from 500-700 m to 1000-1200 m and 1350-1450 m, and is dominated by tall-stemmed beech, spruce-beech, hornbeam-beech and oak-beech forests. Pure spruce forests occupy the upper parts of the slopes of Chornohora, the Rakhiv Mountains, and the Gorgan Mountains. In the subalpine zone at altitudes of 1200-1500 m and 1650-1850 m, there are thickets of mountain pine, juniper shrubs, green alder, East Carpathian rhododendron, cereals and herbaceous meadows. The alpine belt includes herbaceous and shrubby communities above 1800-1850 m; they are fragmented.

Sub-basins of the Prut and Siret rivers

About 35% of the Prut sub-basin is covered by broadleaf and coniferous forests. The forested Carpathians have a pronounced landscape zonation. The foothill zone is characterised by oak and hornbeam forests, where winter oak and Western European beech, typical for Western Europe, grow alongside summer oak.

The lower slopes of the mountains (300-600 m) are occupied by broadleaf forests (summer oak, hornbeam, beech, maple, linden, sometimes with spruce and fir). Such forests are also found above 600 m, but are somewhat modified, with beech dominating with increasing altitude and conifers playing an increasingly important role. Spruce forests dominate at altitudes of 1350-1600 m. The mountain tops are occupied by subalpine meadows, mountain pine and alder thickets. The left-bank part of the Prut sub-basin is mostly open and ploughed, with sparse forests.

A significant part of the Siret sub-basin (41% of the total area) is covered by forests. Foothills and mountain slopes up to an altitude of 600 m are predominantly oak forests, above and up to 1000 m beech forests prevail, and even higher, up to 1300 m, coniferous forests. The upper reaches of some mountains are open and represent subalpine meadows - polonines. In the lowlands, forests have been preserved only in some places, while the rest of the area has been ploughed and covered with meadows.

Lower Danube sub-basin

The vegetation of the sub-basin is predominantly steppe. According to the current geobotanical zonation, the area is part of the Danube-Dniester geobotanical district with fescue-fescue and wormwood-fescue-fescue steppes in combination with halophytic communities and saline meadows. The Danube geobotanical floodplain-deltaic region with sedge and reed beds - floodplains - stands out separately.

Floodplain meadows are common in the river valleys and floodplain of the Danube River. The Danube lowlands are occupied by floodplains, which are characterised by a complex of aquatic and riparian vegetation comprising tall grasses (reeds, reeds, cattails), grass bogs and floodplain forests of white willow.

The southern steppe sub-zone is characterised by the predominance of fescue-fescue associations in the grass stand and a decrease in the proportion of steppe herbs, which are represented by ephemerals (croup, veronica), ephemeroids (goose onions, tulips, steppe hyacinth), and in lower reliefs by moisture-loving species (Romanian alfalfa, dry steppe sage, etc.). On the Black Sea coast, the grassland is dominated by fescue, crested rye, spikelet feather grass, and wormwood. Many of the plants are listed in the Red Book of Ukraine (water walnut, astragalus, cuckoo's feet, feather grass, etc.).

1.1.8 The animal world

Tisza River sub-basin

The total number of fauna species in the region is over 30 thousand. Both invertebrates and vertebrates are common in the region. Invertebrates include representatives of more than 20 types of organisms, most of which are protozoa. There are about 400 species of vertebrates, 80 species of mammals, 287 species of birds, including 197 breeding birds, 10 species of reptiles, 16 amphibians, 60 fish, and 100 molluscs. The most common species in Zakarpattia are: mole, fox, wolf, hare, squirrel, ermine, forest marten, wild boar, roe deer, red deer. Rare species include the Danube salmon, sterlet, eagle owl, golden eagle, alpine curlew, lynx, and otter.

Endangered species include the red-winged sparrow, the hairy owl, big and small horseshoe bats, Bechstein's, pond, Natterer's, tricoloured and other bats. The number of species of fauna listed in the Red Book of Ukraine has increased: grouse, forest cat, black stork and brown bear. New species have appeared in the breeding bird fauna: crested and white-eyed ducks. The population of the spotted salamander is stable. A relict fish species, the Kramer umber, has been preserved in the lowland areas in the system of reclamation canals.

Sub-basins of the Prut and Siret rivers

The fauna in the sub-basins is diverse. The vertebrate fauna within the Ukrainian Carpathians alone comprises 435 species. These include the inhabitants of Central European broadleaf forests, such as red deer, European roe deer, and marsh turtle; representatives of the Mediterranean Sea, such as green frogs and spotted salamanders; and inhabitants of the Siberian taiga, such as grouse and black grouse.

There are many endemic species, such as the Carpathian squirrel and the Carpathian newt. Brown bears migrate from the river valleys to subalpine bushes for the summer. Predators include martens, ferrets, lynxes, and wolves.

Almost 200 species of birds live in forests, gardens, fields and water bodies. Most of them are forest dwellers (numerous species of passerines: woodpeckers, pigeons). Wetlands are inhabited by coots, waders, herons, and storks. There are also mountain plover, jay, mountain siskin and Carpathian grouse.

The rivers of the sub-basins are home to a variety of fish species: Ukrainian lamprey, sterlet, brook trout, rainbow trout, pike, roach, verizub, bleak, rudd, tench, bream, pike perch, perch, goby, crucian carp, bream, catfish, ruff, carp, chub, silver bream, burbot, minnow, and sucker. The fast current, rocky, liquid muddy bottom, poor plankton and poorly developed vegetation determine the composition of the fish fauna. Rhyophilous, omnivorous species are common here, laying their eggs on stony or shaved sandy substrate.

Lower Danube sub-basin

The Danube Delta is one of the richest places in modern Europe in terms of the number of fauna species.

The fauna of the sub-basin is represented by steppe, forest-steppe and intrazonal species, including birds, mammals, reptiles and fish. Within the district, there are two zoogeographic districts - the Danube-Dniester and Black Sea districts and one zoogeographic area - the Lower Danube Delta intrazonal area.

The entire territory of the basin belongs to the Black Sea-Azov steppe province, within which two zoogeographical districts are distinguished. In the Danube-Dniester zoogeographical district, the main faunal complex is steppe, and in agroecosystems - forest. There are many birds here, including field harrier, blackbird, avocet, pheasant, and grey partridge. Mammals include wild rabbits, hamsters, white-toothed slipstream, and steppe ferret (light).

The fauna of the Lower Danube, which forms the Lower Danube Delta Intrazonal Area, is extremely rich. Several dozen species of fauna are listed in the Red Book of the World and the Red Book of Ukraine and are subject to protection.

1.1.9 Hydrological regime

Given the physical and geographical location of the Danube River Basin region and its climatic conditions, the hydrological regime of its watercourses varies considerably across the territory. The rivers in the Danube River Basin region are divided into three hydrological regions: the Transcarpathian (Tisza River sub-basin), the Precarpathian (Prut River sub-basin, Siret River sub-basin) and the Black Sea (Lower Danube sub-basin).

The rivers of the Tisza, Prut and Siret sub-basins (Transcarpathian and Precarpathian regions) are characterised by mixed feeding depending on snowmelt conditions in winter and spring, as well as on the amount of precipitation and its intensity in spring and summer. The rivers of the Tisza sub-basin are characterised by a low spring flood, and the water regime is marked by flood runoff in the warm and cold periods. Cold-season floods generally exceed warm-season floods. On the rivers of the Prut and Siret sub-basins, the spring flood is more pronounced. It begins mainly in the second or third decade of March. The maximum spring flood on the rivers of the Prut and Siret sub-basins is recorded in the late third decade of March - early first decade of April. The end of the floods is observed in the second or third decade of April. The duration of floods on the rivers of the Precarpathian region (Prut sub-basin, Siret sub-basin) is about 30-40 days. Floods on the rivers of these sub-basins occur mainly in the warm season. The rivers of the Lower Danube sub-basin are also characterised by a mixed runoff supply, with a distinct spring flood lasting 15-25 days on small rivers. The duration of the flood on the Danube River exceeds 50-60 days and is formed during the spring and summer.

This diverse nature of the water regime determines the extremely varied intra-annual distribution of river flows in each of the sub-basins of the Danube River Basin region. The rivers of the Tisza sub-basin are characterised by floods from March to August, during which time 55-70% of the annual runoff is generated. In winter, 10-15% is generated. Spring runoff in the Prut and Siret sub-basins is 40-45%, and 20% in summer. The watercourses of the Lower Danube sub-basin are characterised mainly by spring runoff, which in some years can reach 60-80%.

Hydrological observation network. In the Danube River basin, the hydrological monitoring network comprises 60 hydrological stations located on 32 rivers out of 310 watercourses. Of the 60 hydrological stations, 6 are located on the Danube River in the Lower Danube sub-basin, 40 hydrological stations are located on the watercourses of the Tisza sub-basin, 13 hydrological stations are located on the rivers of the Prut sub-basin and only 1 hydrological station is located in the Siret sub-basin.

1.1.10 Specifics of the river basin

The Danube RBD on the territory of Ukraine consists of three sub-basins, which differ in relief, geological formations, soil cover, etc.

The Danube River is the second-longest river in Europe in terms of length and catchment area, with a length of 2,860 km, including 174 km in Odesa Oblast, and is the main waterway in southern Ukraine for supplying water to the population and economic sectors (irrigation, drinking water, industry, shipping, etc.).

The specificity of the Ukrainian part of the Tisza RBD is that it is located exclusively within one administrative unit - the Zakarpattia Oblast. This fact has a positive impact on the management of the river sub-basin. The natural specificity of the Tisza river basin is that its Ukrainian part is located in the upper reaches of the basin, and it is here that the chemical composition of the water and most of the river runoff is mainly formed.

An important feature of the Prut and Siret rivers is their high water content. The regimes of the Tisza, Prut and Siret rivers are characterised by frequent floods of varying intensity, which poses a real threat not only to the economic sector but also to the lives of people living in these sub-basins.

The Danube River Basin region is home to Emerald Network sites and wetlands protected under the Ramsar Convention.

1.1.11 Typology of surface water bodies

The IWM typology was developed in accordance with the Methodology for Determining Surface Water Massifs (hereinafter - the Methodology) approved by the Order of the Ministry of Ecology and Natural Resources No. 4 dated 14 January 2019 to detail the hydrographic zoning of Ukraine, prepare a state water monitoring programme, and develop and evaluate the effectiveness of the RBMP implementation.

The Danube RBF defines MNRs for five categories of surface waters - rivers, lakes, artificial and significantly modified surface waters, transitional and coastal waters.

For the typology and delineation of rivers and lakes, the EU WFD system A was used (Table 1, Table 2).

Table 1. Descriptors for rivers (system A)

Descriptors		
Catchment height, m	**Catchment area, km²**	**Geological rocks**
• midlands: over 800 • lowlands: 500 - 800 • upland: 200 - 500 • lowland: < 200	• small: 10 - 100 • average: >100 - 1000 • Large: >1 000 - 10 000 • very large: > 10 000	• limestone • silicate • organic

Table 2: Descriptors for lakes (system A)

Descriptors			
Catchment height, m	**Average depth, m**	**Water mirror area, km²**	**Geological breeds**
• upland: 200 - 500 • lowland: < 200	• shallow: <3 • average in depth: 3 - 15 • deep: >15	• small: 0,5 - 1 • average: 1 - 10 • large: 10 - 100	• limestone • silicate • organic

The EU WFD system B is used for the typology of MNRs of the "transitional waters" and "coastal waters" categories. For "transitional waters", in addition to ecoregion and salinity, an additional indicator is used among the mandatory descriptors - origin (Table 3). This indicator, as an additional descriptor, was included following the example of Romania and Bulgaria.

Table 3: Descriptors for transitional waters (system B)

Eco-region	Salinity, ‰	Origin.
• Black Sea	• oligohaline 0.5 to < 5 • mesogastric 5 to < 18 • polygamous 18 to < 30 • euryhaline < 40	• seashore • estuaries are open • estuaries are closed

For "coastal waters", in addition to the ecoregion and salinity, additional indicators are used - exposure (protection from waves and wind), the prevailing composition of bottom sediments (Table 4).

Table 4. Descriptors for coastal waters (system B)

Eco-region	Salinity, ‰	Exposition	Bottom deposits
• Black Sea	• desalinated < 0.5 • oligohaline 0.5 to <5 • mesogastric 5 to <18 • polygamous 18 to <30 • euryhaline 30 to <40	• protected (bays, bays) • open (cape zones, direct coast)	• clay-silt • silty sandy • sandy

The Danube RBD is located within five ecoregions:

- MNRs of the "rivers" and "lakes" categories belong to ecoregions: Carpathians (number 10), Hungarian Lowlands (number 11), Pontic Province (number 12), Eastern Plains (number 16);
- MPAs of the "transitional waters" and "coastal waters" categories are located in the Mediterranean ecoregion and belong to the sub-region: Black Sea.

The rivers of the basin are classified as small (with a catchment area of less than 100 km²), medium (100 to 1000 km²), large (1000 to 10,000 km²) and very large (>10,000 km²) rivers by catchment area.

According to the altitude of the catchment area, the rivers of the basin are located in the midlands (over 800 m), lowlands (500 to 800 m), uplands (200 to 500 m) and lowlands (less than 200 m)

The basin's geological rocks are of two types: organic (O) and silicate (Si).

Table 5. Types of IBAs in the "rivers" category

№	Type code	Type
1	UA_R_10_L_1_Si	a large river in the lowlands in silicate rocks
2	UA_R_10_M_1_Si	medium-sized river in the lowlands in silicate rocks
3	UA_R_10_S_1_Si	a small river in the lowlands in silicate rocks
4	UA_R_16_S_3_Si	a small river in the lowlands in silicate rocks
5	UA_R_10_S_2_Si	a small river on a hill in silicate rocks
6	UA_R_10_S_3_Si	a small river in the lowlands in silicate rocks

№	Type code	Type
7	UA_R_10_S_4_Si	a small river in the middle mountains in silicate rocks
8	UA_R_10_M_2_Si	medium-sized river on a hill in silicate rocks
9	UA_R_10_M_3_Si	medium-sized river in the lowlands in silicate rocks
10	UA_R_10_M_4_Si	a medium-sized river in the midlands in silicate rocks
11	UA_R_10_L_2_Si	a large river on a hill in silicate rocks
12	UA_R_11_S_1_Si	a small river in the lowlands in silicate rocks
13	UA_R_11_S_2_Si	a small river on a hill in silicate rocks
14	UA_R_11_M_1_Si	medium-sized river in the lowlands in silicate rocks
15	UA_R_11_L_1_Si	a large river in the lowlands in silicate rocks
16	UA_R_11_XL_1_Si	a very large river in the lowlands in silicate rocks
17	UA_R_12_S_1_Si	a small river in the lowlands in silicate rocks
18	UA_R_12_M_1_Si	medium-sized river in the lowlands in silicate rocks
19	UA_R_12_XL_1_Si	a very large river in the lowlands in silicate rocks
20	UA_R_12_XL_1_O	very large river in the lowlands in organic rocks
21	UA_R_16_S_1_Si	a small river in the lowlands in silicate rocks
22	UA_R_16_S_2_Si	a small river on a hill in silicate rocks
23	UA_R_16_M_1_Si	medium-sized river in the lowlands in silicate rocks
24	UA_R_16_M_2_Si	medium-sized river on a hill in silicate rocks
25	UA_R_16_L_1_Si	a large river in the lowlands in silicate rocks
26	UA_R_16_L_2_Si	a large river on a hill in silicate rocks

The category "lakes" includes 7 types of MPAs (Table 6).

Table 6: Type of MPAs in the "lakes" category

№	Type code	Type
1	UA_L_12_XL_1_SH_Si	very large lake in the lowlands, shallow in silicate rocks
2	UA_L_12_S_1_SH_Si	a small lake in the lowlands is shallow in silicate rocks
3	UA_L_12_S_1_SH_O	small lake in the lowlands shallow in organic rocks
4	UA_L_12_M_1_SH_Si	The middle lake in the lowlands is shallow in silicate rocks
5	UA_L_12_M_1_SH_O	The middle lake in the lowlands is shallow in organic rocks
6	UA_L_12_L_1_SH_Si	a large lake in the lowlands is shallow in silicate rocks
7	UA_L_12_L_1_SH_O	a large lake in the lowlands is shallow in organic rocks

In the category of "transitional waters", 1 type of MWR was identified (Table 7).

Table 7. Types of IWPs in the "transitional waters" category

№	Type code	Type
1	UA_TW_M5_M_M	mesohaline estuaries

One type of MPA of the "coastal waters" category was identified (Table 8)

Table 8. Types of MPAs in the "coastal waters" category

№	Type code	Type
1	UA_CW_M5_M_SH_D_SS	mesogaline open deep silty-sandy

1.1.12 Reference conditions

The assessment of the ecological state of the MPA is based on a comparison of biological indicators (benthic macroinvertebrates, macrophytes, phytobenthos, phytoplankton and fish) with reference conditions that characterise the state of the MPA, which has not been subjected to anthropogenic impact or is minimal.

Reference conditions are determined on the basis of data obtained from reference sites, through modelling (predictive models or retrospective forecasting methods that take into account historical, paleogeographic and other available data that provide a sufficient level of confidence in the values for reference conditions for each type of MPE) or a combination of these methods or based on expert opinion.

In order to establish reference values for biological indicators based on data from reference sites, it is necessary to establish such sites for each type of MPA in all natural categories. The network should cover a sufficient number of sites to provide a sufficient level of confidence and to account for the variability of values for indicators that correspond to the different ecological status of the MPA type.

Key criteria for selecting reference sites:

- characterise the state of the MPA without anthropogenic impact or with minimal impact;
- There is no industry or intensive agriculture;
- concentrations of specific synthetic pollutants are zero or below the detection limits;
- no morphological changes;
- water abstraction and flow control cause only minor fluctuations in water levels and do not affect surface water quality;
- the vegetation of the coastal zone is appropriate for the type of MPA and geographical location;
- no invasive species;
- fishing and aquaculture do not affect the functioning of the ecosystem.

In accordance with subpara. 2, clause VII. of the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14.01.2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Conditions of a Surface Water Body, as well as Assigning an Artificial [...]", type-specific reference conditions may also be determined based on existing reference sites in other countries for the same type of MWB or by combining the procedures described above.

Given that reference conditions for all types of MSPs are not currently defined in Ukraine, it was suggested to use the reference conditions established for the same or similar types in neighbouring EU countries, namely the Slovak Republic and Romania.

The methodology includes four hydrobiological indicators (benthic macroinvertebrates, phytoplankton, phytobenthos, macrophytes, macroalgae and eutrophication, respectively) for four natural categories of surface waters (rivers, lakes, transitional waters and coastal waters) that have been identified in Ukraine.

A draft order has been developed to approve environmental water quality standards for the MWR and to amend certain regulatory acts that establish reference conditions and type-specific classifications.

1.2 Defining arrays

1.2.1 Surface water and

In the Danube River Basin RBM, the MWC was determined on 335 rivers and 16 lakes (according to the Water Resources of Ukraine geoportal of the State Agency of Water Resources of Ukraine).

Within the Danube RBM, 885 MEAs have been identified (Annex 1). The designated MPAs belong to the following categories of surface water:

- rivers;
- lakes;
- artificial (AIU) and significantly modified (SMA);
- transitional waters;
- coastal waters.

Category "rivers"

According to the Methodology, 676 MPEs were identified. The number of identified MPEs depending on descriptors and types is shown in Tables 9 and 10.

Table 9. Distribution of IBAs of the "rivers" category by descriptors

Descriptor	Indicator.	Number of MWPs
by eco-region	Eastern plains	110

Descriptor	Indicator.	Number of MWPs
	Pontic province	27
	Hungarian lowlands	34
	Carpathians	505
by catchment area	small (S)	537
	average (M)	101
	large (L)	21
	very large (XL)	17
by the height of the catchment area	in the midlands	115
	in the lowlands	176
	on a hill	244
	in the lowlands	141
by geological type	in silicate rocks	675
	in organic rocks	1

Table 10. Distribution of IBAs of the "rivers" category by type

№	Type code	Type	Number of designated MPAs
1	UA_R_10_L_1_Si	a large river in the lowlands in silicate rocks	4
2	UA_R_10_L_2_Si	a large river on a hill in silicate rocks	6
3	UA_R_10_M_1_Si	medium-sized river in the lowlands in silicate rocks	12
4	UA_R_10_S_1_Si	a small river in the lowlands in silicate rocks	37
5	UA_R_10_S_2_Si	a small river on a hill in silicate rocks	123
6	UA_R_10_S_3_Si	a small river in the lowlands in silicate rocks	155
7	UA_R_10_S_4_Si	a small river in the middle mountains in silicate rocks	112
8	UA_R_10_M_2_Si	medium-sized river on a hill in silicate rocks	33
9	UA_R_10_M_3_Si	medium-sized river in the lowlands in silicate rocks	20
10	UA_R_10_M_4_Si	a medium-sized river in the midlands in silicate rocks	3
11	UA_R_11_L_1_Si	a large river in the lowlands in silicate rocks	6
12	UA_R_11_M_1_Si	medium-sized river in the lowlands in silicate rocks	8
13	UA_R_11_S_1_Si	a small river in the lowlands in silicate rocks	14
14	UA_R_11_S_2_Si	a small river on a hill in silicate rocks	4
15	UA_R_11_XL_1_Si	a very large river in the lowlands in silicate rocks	2
16	UA_R_12_S_1_Si	a small river in the lowlands in silicate rocks	9
17	UA_R_12_XL_1_O	very large river in the lowlands in organic rocks	1
18	UA_R_12_XL_1_Si	a very large river in the lowlands in silicate rocks	14
19	UA_R_12_M_1_Si	medium-sized river in the lowlands in silicate rocks	3
20	UA_R_16_L_1_Si	a large river in the lowlands in silicate rocks	2
21	UA_R_16_L_2_Si	a large river on a hill in silicate rocks	3
22	UA_R_16_S_1_Si	a small river in the lowlands in silicate rocks	18
23	UA_R_16_S_2_Si	a small river on a hill in silicate rocks	64
24	UA_R_16_S_3_Si	a small river in the lowlands in silicate rocks	1
25	UA_R_16_M_1_Si	medium-sized river in the lowlands in silicate rocks	11
26	UA_R_16_M_2_Si	medium-sized river on a hill in silicate rocks	11

Category "lakes"

16 MPAs have been identified (Table 11) in the Danube RBM.

Table 11. MPAs of the "lakes" category

№	Type code	Type	Quantity of the designated MPOs
Ecoregion 12 Pontic Province			
1	UA_L_12_L_1_SH_O	a large lake in the lowlands is shallow in organic rocks	1
2	UA_L_12_L_1_SH_Si	a large lake in the lowlands is shallow in silicate rocks	3
3	UA_L_12_M_1_SH_O	The middle lake in the lowlands is shallow in organic rocks	4
4	UA_L_12_M_1_SH_Si	The middle lake in the lowlands is shallow in silicate rocks	4
5	UA_L_12_S_1_SH_O	small lake in the lowlands shallow in organic rocks	2
6	UA_L_12_S_1_SH_Si	a small lake in the lowlands is shallow in silicate rocks	1
7	UA_L_12_XL_1_SH_Si	very large lake in the lowlands, shallow in silicate rocks	1

Category "transitional waters"

One MSP in the Danube RBM has been identified:

- TW - transitional waters;
- M5 - Black Sea - sub-ecological region;
- M - mesohaline: average annual salinity ranges from 5 to 18 ‰;
- M is for the seaside by origin.

Table 12. Types of IWPs in the "transitional waters" category

№	Type code	Type	Quantity of the designated MPOs
1	UA_TW_M5_M_M	mesohaline estuaries	1

Category "coastal waters"

One MSP in the Danube RBM has been identified:

- CW - coastal waters;
- M5 - Black Sea - sub-ecological region;
- M - mesohaline: average annual salinity ranges from 5 to 18 ‰;
- SH - open (cape zones, straight coast);
- D - deep: over 50 m;
- SS - silty-sandy bottom sediments.

Table 13. Types of MPAs in the "coastal waters" category

№	Type code	Type	Quantity of the designated MPOs
1	UA_CW_M5_M_SH_D_SS	mesogaline open deep silty-sandy	1

Category "significantly altered surface water bodies"

There are 155 IBAs identified in the basin. The share of IWMPs in the total number of MSPs in the Danube RBM is 18%. The bulk (95 MSPs) are classified as IZMVs due to diversion.

37 MNEs are classified as MSMEs due to overregulation.

23 MWRs are classified as IWRM due to a combination of regulation and channel straightening (Fig. 1).

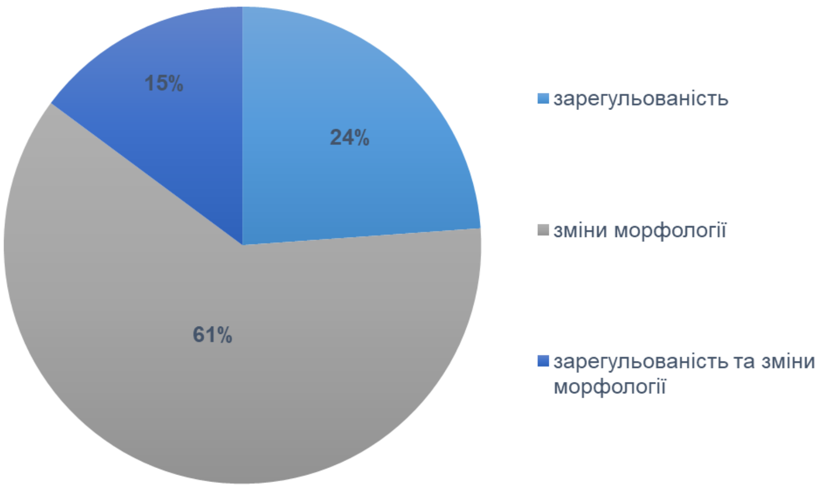


Figure 1. Distribution of IHMW by causes of hydromorphological stress, %.

Category "artificial surface water bodies"

In the Danube basin, 36 SWMS have been identified, of which 34 are canals and 2 are floodplains.

The percentage distribution of the identified MSPs in the Danube RBM by category is shown in Figure 2.

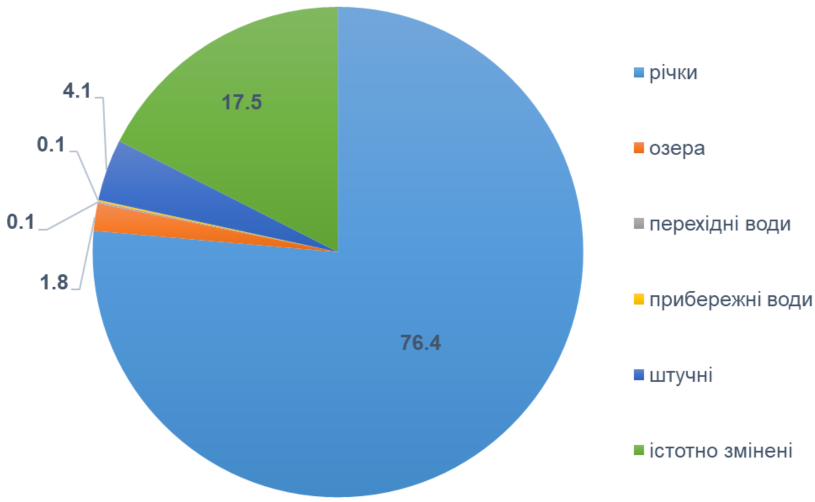


Figure 2. Breakdown of identified MSPs by category, %.

Each of the 885 MSPs identified in the Danube RBM has been assigned a unique code, which looks like this:

UA_ M5.3.X_YYYY, where*:*

- *UA* - Ukraine;
- *M5.3* - Danube RBM code (according to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 29 March 2017 "On Approval of the Boundaries of River Basin Areas, Sub-basins and Water Management Areas");
- *X* - code of the Danube sub-basin (1 - Tisza sub-basin, 2 - Prut sub-basin, 3 - Siret sub-basin, 4 - Lower Danube sub-basin);
- *YYYY is the* unique number of the designated MSP in the Danube RBD.

Each linear IBA (categories "rivers", "artificial or significantly modified IBA") has a length (km). The length of the RBMs in the Danube RBZ ranges from 0.26 km (UA_M5.3.1_0453 - Bachava River) to 119.7 km (UA_M5.3.2_0007 - Prut River).

Figure 3 shows the distribution of the identified linear MPAs in the Danube RBM by length.

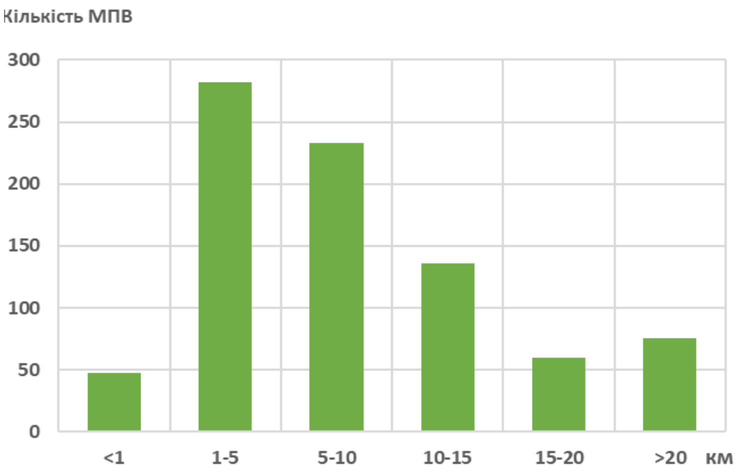


Figure 3. Distribution of the identified linear IPPs by length

Each polygonal MPA (categories "lakes", "artificial or significantly modified MPAs", "transitional waters", "coastal waters") has an area (km^2). The area of MNRs in the Danube RBZ ranges from 0.16 km^2 (UA_M5.3.2_0229 - Glodos reservoir) to 242.4 km^2 (UA_M5.3.4_0105 - transitional waters).

Figure 4 shows the distribution of the identified polygonal MPAs by area.

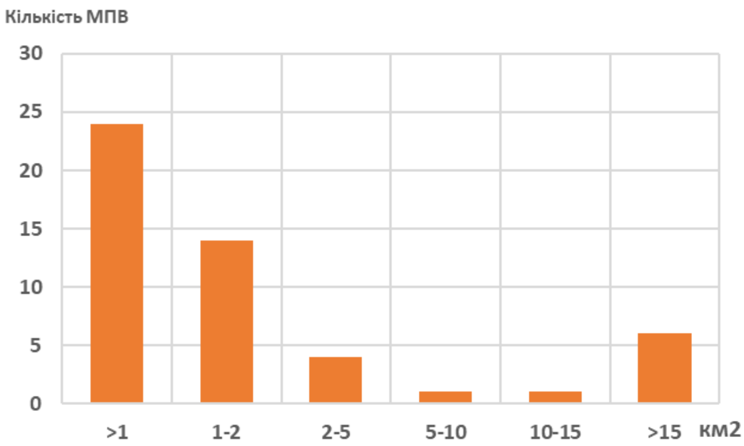


Figure 4. Distribution of identified polygonal MPAs depending on the area

1.2.2 Groundwater

The boundaries of hydrogeological structures of aquifers were compared when identifying the MPZs within the Danube River basin. All aquifers with groundwater intakes of more than 10 m^3 /day and separately drilled exploration wells that have produced such flow rates were analysed. The main criteria for determining the boundaries of the MPZV were the geological and stratigraphic boundaries of aquifers, flow lines or groundwater watershed lines (for quaternary aquifers), as well as drilling data and hydrogeological survey results for them. In addition, the anthropogenic load and available data on the quantitative and qualitative state of groundwater were taken into account.

The determination of the MWRs started with the first aquifers from the surface. As a result, the following were identified: non-pressure quaternary aquifers, pressure aquifers, and main aquifers used for centralised water supply. The study did not consider the presence of IPZV in deep aquifers that are not used for water supply, are unsuitable due to their natural quality, or for technical or economic reasons.

Non-pressure aquifers are virtually unprotected from surface pollution by their natural characteristics. The vulnerability of groundwater depends on the characteristics of the rocks in the aeration zone, namely its thickness and lithological composition.

Pressure aquifers are mostly reliably protected from contamination, as the roof is covered by water-resistant sediments with a thickness of more than 10 m.

As a rule, pressure groundwater is also protected by hydrodynamic parameters. Within the area of depression sinkholes, there are prerequisites for the flow of water with increased salinity or pollutants into the aquifer. Groundwater is particularly vulnerable in areas of intense anthropogenic impact, especially as a result of mining and ore processing operations. In addition, as the volume of water intake increases, there is a risk of aquifer depletion.

The following maps were used to identify the MSPs:

- of the main aquifers;
- water availability of aquifers;
- existing and potential sources of pollution;
- hydrochemical map of the main aquifers;
- protection of groundwater;
- groundwater monitoring.

The HAZMATs are identified according to their quantitative and chemical state.

The aquifer coding system adopted in Ukraine in the AIS SQC (automated information system of the State Water Cadastre) maintained by the SE Geoinform of Ukraine was used to formulate the MAPZV code.

In the process of performing the work, we used the MPZV by analogy with the codes of surface water arrays. For example, the array code UAM5200Q100, where:

- *UA is a* country;
- *M5 is an* international maritime system code;
- *2* - river basin, according to the Water Code;
- *0* - river sub-basin, according to the Water Code;
- *Q* - geological system (geological age of water-bearing rocks);
- *100* - number of the groundwater massif.

After analysing the aquifers and complexes that are used or have potential for centralised and agricultural water supply in the Danube basin (within the administrative boundaries of Zakarpattia, Ivano-Frankivsk, Chernivtsi and Odesa oblasts), the following MSZs were identified.

Table 14. MNRBs and groups of MNRBs in the Danube River basin within Zakarpattia, Ivano-Frankivsk, Chernivtsi and Odesa oblasts

№	Unified code of the IPPC	Aquifer (complex)	Geological index	Area of the MWP, km²
Tisza River sub-basin				
1	UAM5310Q100	Group of MWPs in alluvial Upper Neopleistocene-Holocene sediments of floodplains and first floodplain terraces of rivers of the mountainous part and Solotvynska depression	aPIII+aH	1251,0
2	UAM5310Q200	A group of PGEs in weathering crust and other loose Holocene sediments of the mountain slopes of the sedimentary Carpathians	e, p, ed, dcH	7366,0
3	UAM5310Q300	MWP in lacustrine-alluvial middle-upper Neopleistocene-New Member sediments of the Minaya Formation	laPII-IIImn	1854,0
4	UAM5310Q400	MWP in lacustrine-alluvial Eopleistocene-Lower Neopleistocene sediments of the Chop Formation	laE+PIčp	1090,0
5	UAM5310Q500	MPZV in alluvial Pliocene-Lower Neopleistocene sediments of the ninth and tenth overflank terraces (Kopanska terrace)	a9-10N2-EI	118,0
6	UAM5310N100	MWP in sediments of the Pliocene Ilnytsia Formation	N2il	1307,0
7	UAM5310N200	A group of MMPs in volcanogenic Pliocene sediments of the Vygorlat-Gutynsky Ridge	N2vg	1727,0
Siret River sub-basin				
8	UAM5330Q100	MPZV in alluvial sediments of Holocene floodplains and upper Neopleistocene floodplain terraces	a1-5PIII+aH	379,0
9	UAM5330N100	MWP in Miocene sediments	N1s1, N1ks, N1tr, N1op	844
10	UAM533PG100	MWP in Paleocene-Eocene sediments	P1-2	327
11	UAM5330K100	MWR in Upper Cretaceous sediments	K2	78
Prut River sub-basin				

№	Unified code of the IPPC	Aquifer (complex)	Geological index	Area of the MWP, km^2
12	UAM5320Q100	MPZV in alluvial sediments of Holocene floodplains and upper Neopleistocene floodplain terraces	a1-5PIII+aH	810
13	UAM5320N100	MWP in Miocene sediments	N1s1, N1ks, N1tr, N1op	5400
14	UAM532PG100	MWP in Paleocene-Eocene sediments	P1-2	252
15	UAM5320K100	MWR in Upper Cretaceous sediments	K2	381
Lower Danube sub-basin				
16	UAM5340N100	MWP in the Upper Sarmatian sediments	N1s3	16478

The characteristics of the MSPs and groups of MSPs are presented in the relevant sections 1.2.2 of the Danube River Sub-basin Management Plans and in Annex 2.

GIS technologies were used in the process of identifying the MHZs and creating the relevant maps. According to Guideline No. 9 "On Implementation of Geographic Information Systems (GIS)", river basins, sub-basins and groundwater massifs were depicted on the map as polygons, and observation wells as points, etc.

2 MAJOR ANTHROPOGENIC IMPACTS ON THE QUANTITATIVE AND QUALITATIVE STATE OF SURFACE AND GROUNDWATER, INCLUDING POINT AND DIFFUSE SOURCES

2.1 Surface water

The Danube River basin is located within four regions of Ukraine (Zakarpattia, Ivano-Frankivsk, Chernivtsi and Odesa regions). The socio-economic structure of the basin creates preconditions for the formation of anthropogenic pressure that affects surface waters. The main factors of anthropogenic pressure include:

- population. The population of the basin is 3.532 million people;
- enterprises in various sectors of the economy;
- agriculture, which is one of the basin's economic sectors and is characterised by a high level of development;
- Cross structures on small and medium-sized rivers prevent the free passage of water, sediments and migration of aquatic life, and change the transit mode of rivers to an accumulation one.

The characterisation of anthropogenic load and its impact should be carried out on the basis of chemical, physico-chemical and hydromorphological indicators that reflect the conditions of existence of the biotic component of aquatic ecosystems. Changes in these parameters in the event of a significant anthropogenic load can lead to the risk of not achieving a "good" ecological status of water.

The assessment of the anthropogenic load on the MWR was carried out in accordance with the Methodological Recommendations for the Analysis of the Main Anthropogenic Loads and Their Impacts on the Surface Water Status, which were approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources on 20 April 2023, Minutes No. 2.

The methodological basis of the assessment was the DPSIR model developed by the European Environment Agency (EEA)[1] and adapted to the conditions of Ukraine. The determination of anthropogenic pressure was based on a sequential analysis of Drivers/Activities → Pressures → State → Impact → Response (Fig. 5).

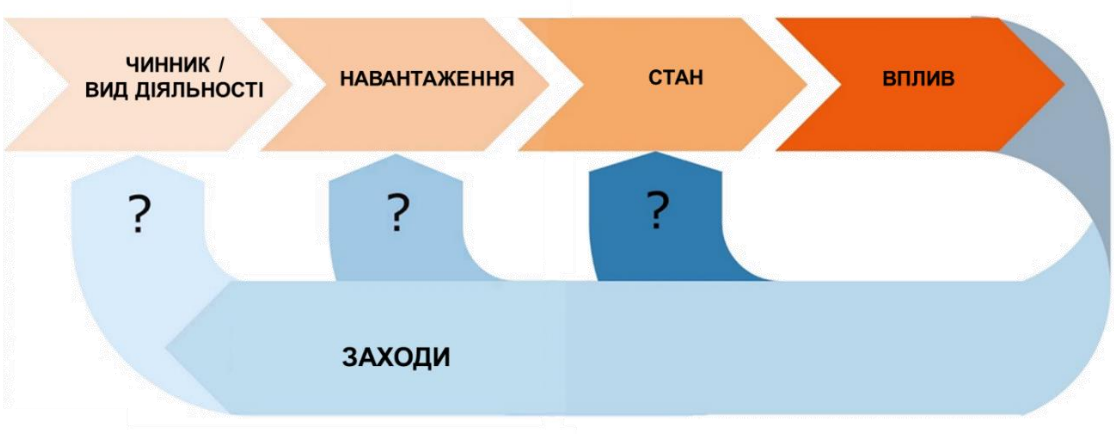


Figure 5. Conceptual model of the DPSIR

Assessing the risk of not achieving "good" environmental status

The analysis of anthropogenic load and related impacts is aimed at determining the probability of compliance/non-compliance of a water body with the objectives of environmental quality of the water environment.

Assessment of the risk of failure to achieve environmental goals from point sources of pollution

[1] CIS Guidance #3 Pressure and Impact Analysis, EU, 2003

Based on the results of the assessment of anthropogenic loads from point sources of pollution and their impact on the basin's MES, the risk of not achieving a "good" ecological status/potential was established (Fig. 6) for

- 696 MPV - "no risk";
- 90 MPV - "possibly at risk";
- 99 MPV - "at risk".

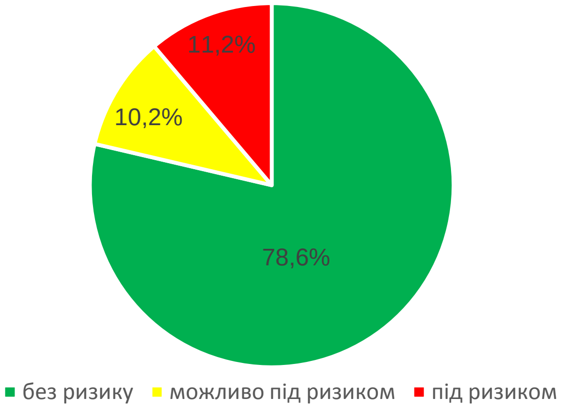


Figure 6. Risk assessment of failure to achieve "good" ecological status/potential based on the results of the assessment of anthropogenic pressures from point sources

Assessment of the risk of failure to achieve environmental goals from diffuse sources of pollution

Based on the results of the assessment of anthropogenic loads from diffuse sources of pollution and their impact on the basin's MES, the risk of failure to achieve "good" ecological status/potential was established (Fig. 7) for

- 579 MPV - "no risk";
- 175 MPV - "possibly at risk";
- 131 MPS are "at risk".

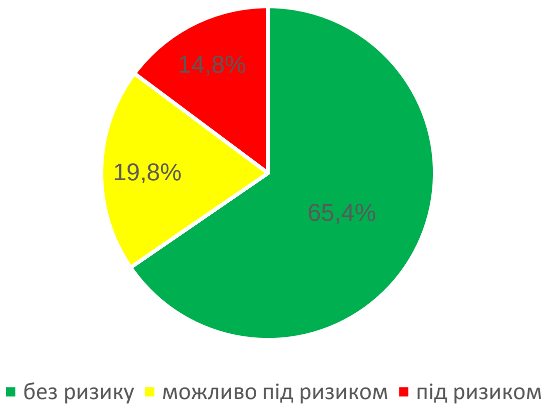


Figure 7. Risk assessment of failure to achieve "good" ecological status/potential based on the results of the assessment of anthropogenic loads from diffuse sources

Assessing the risk of not achieving environmental goals: hydromorphological changes

Based on the results of the assessment of hydromorphological changes,[2] was established:

- 694 MWP - "no risk";
- 155 MMBs are "at risk";
- 36 MPV - not defined.

[2] The risk of failure to achieve environmental objectives based on hydromorphological changes was not assessed for the SSSI

Figure 8. Risk assessment of failure to achieve "good" ecological status/potential based on the results of anthropogenic pressure assessment: hydromorphological changes

Generalised risk assessment of failure to achieve 'good' environmental status/potential

The risk of not achieving a "good" environmental status/potential has been assessed as follows:

- 394 MWP - "no risk";
- 165 MPV - "possibly at risk";
- 326 IPPs are "at risk".

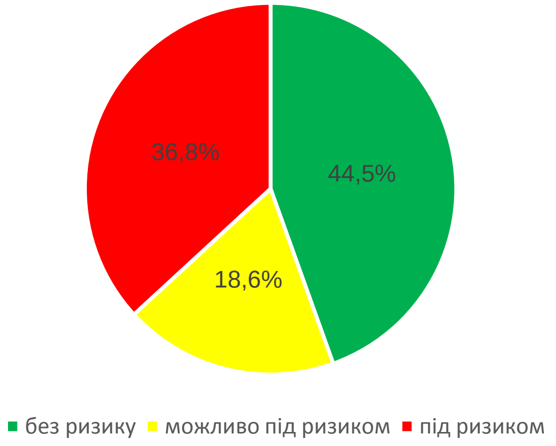


Figure 9. Generalised risk assessment of failure to achieve 'good' environmental status/potential of MNR

Impact of military operations on the state of surface water bodies

In contrast to the Lower Danube sub-basin, the Tisza, Prut and Siret sub-basins have not been affected by military operations.

1. Pollution (organic, biogenic, hazardous) substances caused by**:**

1.1 destruction, suspension, disruption of the technological process of enterprises (including warehouses, oil product depots)

Data on the destruction, suspension or disruption of the technological process of enterprises as of September 2023 are presented in Annex 3.

1.2 direct hit of pollutants from missiles, shells of military equipment, their washing, seepage in combat zones

Artillery shells, rockets and other munitions are basically composed of a metal shell filled with an explosive, propellant and a detonator.

Explosives are classified into primary explosives (mercury, lead azide, TNT) and secondary explosives (THE, hexogen, tetryl, TNT, picric acid, plastid-4, ammonites, dynamites, ammonals).

Metals are associated pollutants. The most common is lead, but also antimony, copper, cadmium, chromium, mercury, arsenic, nickel, bismuth and tungsten. As a rule, metals are concentrated in the sinkhole.

Flares burn at high altitude and disperse metals over large areas. Pyrotechnics can contain barium, antimony, strontium, copper, magnesium, manganese, chromium and lead. Unlike explosives and propellants, metals occur naturally in the environment, so their background concentrations need to be measured.

The detonation of rockets, artillery shells and mines produces a number of chemical compounds, including carbon monoxide and carbon dioxide, water vapour, nitrogen oxide, nitrogen, etc. A number of toxic elements, including sulphur and nitrogen oxide, also evaporate.

Monitoring of surface water in the area of active hostilities and recently liberated territories is not currently carried out for security reasons.

2. Impossibility of water monitoring or reduction of its programme (spatially and temporally) in the temporarily occupied territories.

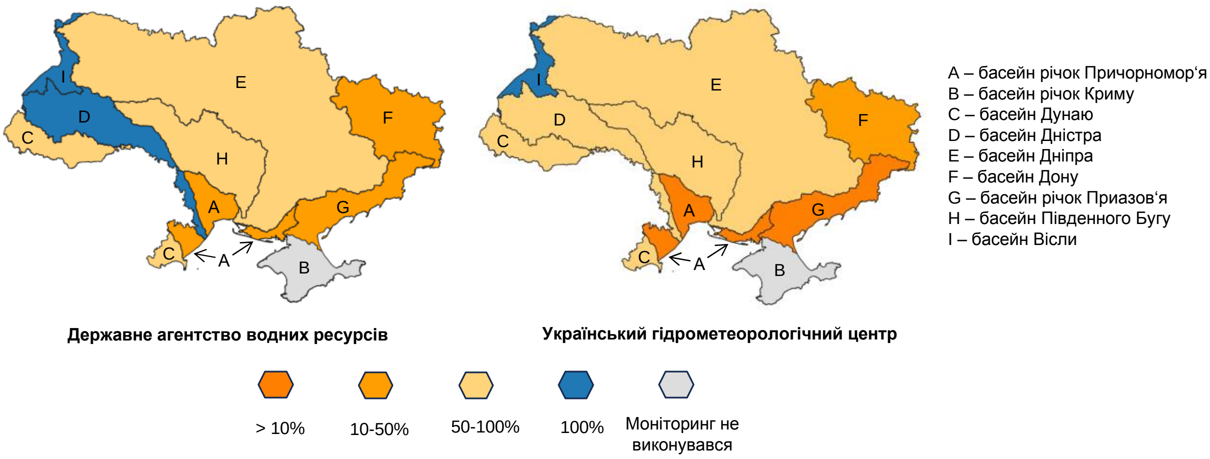


Figure 10. Surface water monitoring by river basin, 2022[3]

3. 3. Impossibility or restrictions on water management in the temporarily occupied territories.

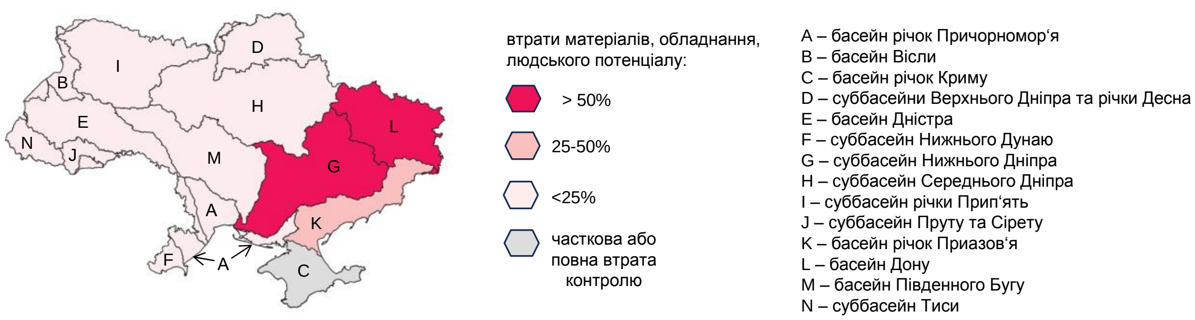


Figure 11: Impact of military operations on the ability to manage water resources[4]

2.1.1 Organic pollution

The main cause of organic pollution is insufficient or no wastewater treatment. Organic pollution can lead to significant changes in the oxygen balance of surface waters and, as a result, to changes in the species composition of aquatic life or even their death. The input of organic matter with wastewater is usually assessed by the indirect indicators of BOD_5 and COD.

Diffuse sources

[3] Information prepared by the Zoy Environmental Network for the OSCE Project Co-ordinator in Ukraine
[4] Information prepared by the Zoy Environmental Network for the OSCE Project Co-ordinator in Ukraine

Organic pollution from diffuse sources is mainly caused by rural households that are not connected to sewerage networks. Such individual households dispose of wastewater by accumulating it in lagoons, from which it is filtered into the nearest groundwater horizons.

The load from the rural population was assessed using the calculation method. For this purpose, we used the coefficients of organic matter intake due to the vital activity of 1 person. In European countries, the generation of load from the population is calculated using the following indicators: BOD_5 - 60 g/day/person, COD - 110 g/day/person.

During a calendar year, the total organic matter (BOD_5 , COD) inputs to the WRB from distributed sources of pollution in the basin are significantly higher than from point sources. The reason for this is the low level of connection of the basin's population to sewage treatment plants.

In rural areas of the region, as well as in small towns and some cities, wastewater is discharged into sumps and pits, from where pollutants easily enter groundwater and are transported to surface water.

The following rivers play a key role in organic pollution of the basin from diffuse sources: the lower reaches of the Tisa (Berehovo district), the Latorytsia (Mukachevo and Uzhhorod districts), the Borzhava (Khust district, Berehovo district (from the village of Velyki Komyaty to the mouth)), the Prut (Khust district), the Velyki Komyaty to the mouth)), Prut, Peremyska, Lyubizhna, Oslava, Bila Oslava, Krasna, Tovmachyk, Tovmach, Pistynka, Brusturka, Lyuchka, Akra, Rybnytsia, Volytsia.

Point sources

The main cause of organic pollution is insufficient or non-existent wastewater treatment after use by settlements, industrial and agricultural enterprises. Such pollution can affect the composition of aquatic species and the ecological status of water bodies. The decomposition of organic matter consumes a lot of oxygen, which reduces the water's oxygen content and causes aquatic organisms to die. Organic pollution from these sources is assessed by BOD and $COD._5$

According to the water use reports in the form No. 2TP-Vodkhoz (annual), in 2020, the total volume of wastewater discharged into the surface water bodies of the Danube River basin was 123.690 million m^3 , includingincluding: polluted without treatment - 21.936 million m^3 , polluted with insufficient treatment - 3.893 million m^3 , normatively clean without treatment - 46.009 million m^3 and normatively treated - 51.852 million m^3 (Fig. 12).

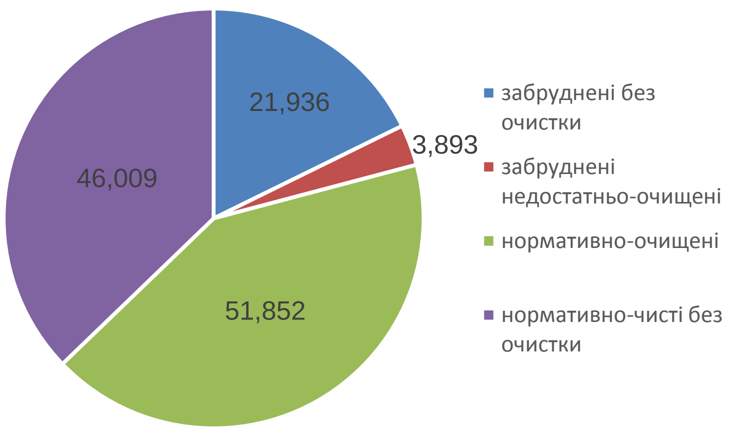


Figure 12. Water discharge in the Danube basin in 2020, million m3[3]

By economic sector, the discharge of wastewater into surface water bodies of the Danube River basin in 2020 was as follows: agriculture (including fish farming) - 65.733 million m^3, housing and communal services - 52.720 million m^3, industry - 3.141 million m^3, and other - 2.096 million m^3 (Fig. 13).

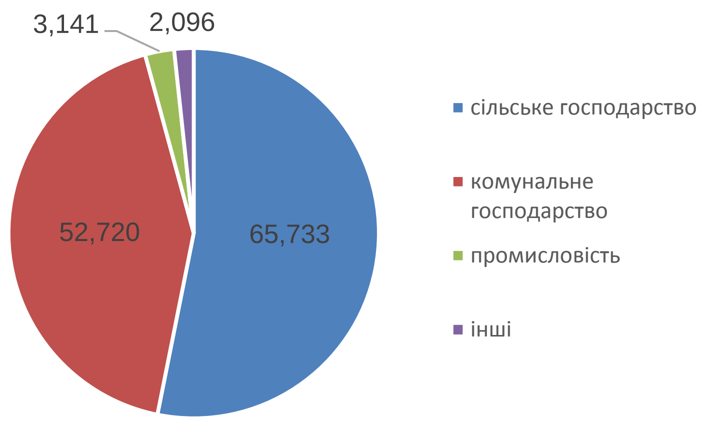


Figure 13. Discharge volumes by economic sectors in the Danube basin in 2020, million m3[3]

Since the anthropogenic load was assessed based on 2020 data, we present below the data on the total volumes of organic matter discharged into the basin in 2020. Thus, BOD_5 was 952.3 tonnes, COD - 2116.6 tonnes.

Organic pollution from municipal services

The pollution of the basin's surface waters is caused by point sources, such as utility companies. Most of the agglomerations are connected to the CWS. For agglomerations not connected to the CWS, wastewater is collected in individual septic tanks or cesspools, which are not treated and may be one of the potential sources of pollution of both surface water and underground aquifers in the basin.

In 2020, organic pollution from municipal point sources amounted to 785.4 tonnes of BOD_5 and 1982.5 tonnes of COD. The largest cities account for the dominant share of organic pollution: Uzhhorod, Chernivtsi, Mukachevo.

The degree of wastewater treatment at WWTPs varies considerably. The WWTPs in most cities are in an extremely dilapidated state, having been built in the Soviet era. Over the past 30 years, urban development has led to an increase in the amount of wastewater that is several times higher than the design capacity of the WWTPs, resulting in a significant amount of insufficiently treated or untreated wastewater entering the Danube basin.

Organic pollution from industry and other facilities (water users)

The organic pollution of the WSS of the Danube sub-basins is mainly due to the paper and food industries. Pollution by organic matter from industrial point sources amounted to 9.1 tonnes in terms of BOD_5 and 98.9 tonnes in terms of COD.

Organic pollution from agricultural point sources is insignificant and in 2020 amounted to 1.3 tonnes for BOD_5 and 0.9 tonnes for COD.

2.1.2 Pollution by nutrients

The flow of nutrients into the surface waters of the basin is the driving force behind eutrophication, which leads to an increase in primary production and accumulation of organic matter. The enrichment of water with nutrients stimulates the development of autotrophic aquatic organisms, resulting in an undesirable imbalance of organisms in the aquatic environment and a decrease in water quality.

Among the nutrients, phosphorus and nitrogen compounds play a dominant role, and in some cases, ferrous may have an impact. Of the first two, phosphorus plays a greater role, while nitrogen is much less likely to limit the development of autotrophic organisms, due to the ability of many bacteria and cyanobacteria to fix it.

Nutrients can come from both point and diffuse sources. The main sources are untreated wastewater from municipal and industrial facilities. The widespread use of phosphorus-containing detergents and washing powders with insufficient treatment of waste water increases nutrient pollution. Ukraine has established phosphate content limits in detergents that are in line with European Parliament regulations. The efficiency of phosphorus removal from wastewater at most WWTPs does not exceed 20%, and due to outdated technological equipment, the efficiency of phosphorus removal does not even reach the design values.

Nutrients enter the Danube sub-basins from point sources (agglomerations, industry, agriculture) and diffuse sources (surface runoff, precipitation). Diffuse sources are partly of natural and anthropogenic origin (mainly agriculture).

Diffuse sources

Diffuse sources are defined as the washing away of substances from the surface of the catchment and the soil layer of the soaking zone. This type of pollution is the most difficult to assess, as it cannot be directly measured, but must be estimated through probable pathways. Diffuse runoff can be caused by both natural factors (precipitation, geological structure and soil composition) and anthropogenic factors, which in this case act as indirect factors (degree of ploughing, crop yields).

Land cover type is the dominant factor in the anthropogenic load from diffuse sources.

According to the physical and geographical division, there are clear differences in land cover types, which significantly affects the emission of elements. For example, in the direction from the source to the mouth of the Prut and Siret rivers, there is a decrease in the degree of forest cover, while the share of agricultural land, which provides the main supply of nutrients, is increasing. The disturbance of soil cover due to ploughing leads to significant losses of nutrients due to deflation and water runoff.

Another important indicator of the anthropogenic load from diffuse sources of pollution is the intensity of agriculture, which is expressed primarily in the amount of fertilisers applied. Most of the mineral fertilisers applied to various crops are nitrogen fertilisers.

There is no intensive agricultural production in the upper reaches of the Prut and Siret rivers, in a mountainous area with low temperatures and high rainfall. Meat and dairy farming and sheep breeding are developed here.

The organic fertiliser load is not provided in the statistical information. This indicator is calculated on the basis of data on the number of livestock, manure yields and the nitrogen and phosphorus compounds in their composition.

Despite the fact that the livestock industry in Ukraine has shrunk significantly since the change in the economic structure and is recovering slowly, there are still a large number of domestic animals, especially birds, in the Lower Danube sub-basin.

In the Tisza sub-basin, diffuse pollution from the territory of former timber and chemical enterprises (Perechyn, Velyky Bychkiv and Svalyava timber and chemical plants) and solid waste disposal sites is a particular danger.

Point sources

Pollution by nutrients from point sources is caused mainly by the discharge of insufficiently treated or untreated wastewater into surface water bodies (after use by settlements, industry and agriculture), which significantly increases their concentration in water bodies.

Within the Danube basin, there were no discharges of wastewater in 2020:

- 182.8 tonnes of ammonium nitrogen;
- 107738.1 kg of total nitrogen;
- 941.4 tonnes of nitrates;
- 27.6 tonnes of nitrite;
- 116101.5 kg of phosphates;
- 17869.9 kg of total phosphorus.

The largest cities account for the dominant share of nutrient pollution: Uzhhorod, Chernivtsi, Mukachevo.

Pollution from industrial wastewater is negligible.

A large proportion of pollution is generated by the return (waste) water of healthcare facilities, mainly sanatoriums in Zakarpattia. The composition of the return (waste) water of these institutions is similar to that of municipal enterprises and is represented mainly by nitrogen and phosphorus compounds. In most cases, sanatoriums, in addition to health improvement functions, also perform the role of public utilities in the settlements where they are located.

2.1.3 Pollution by hazardous substances

Hazardous substances are represented by priority pollutants subject to control in accordance with the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45 dated 06.02.2017 "On Approval of the

List of Pollutants for Determining the Chemical State of Surface and Groundwater Massifs and the Ecological Potential of an Artificial or Significantly Modified Surface Water Massif" (hereinafter - the Order) and the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14.01.2019 No. 5 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial or Significantly Modified Surface Water Body to One of the Classes of Ecological Potential of an Artificial or Significantly Modified Surface Water Body".

The available information on the discharge of priority pollutants in the Danube sub-basins is currently quite limited. According to the state water use accounting and reporting on water use in the form No. 2TP-water farm (annual), approved by Order No. 78 of the Ministry of Ecology and Natural Resources of Ukraine on 16.03.2015, for the period 2016-2021, no business entity in the Danube basin reported the presence of pollutants in its wastewater discharges that were included in the list of priority pollutants by Order No. 45 of the Ministry of Ecology and Natural Resources of Ukraine.

Monitoring of the content of priority and other hazardous substances in surface waters and sediments of the Tisza, Prut and Siret sub-basins showed that the water and sediments contain organic substances, including priority substances such as pesticides, pharmaceuticals, polyaromatic hydrocarbons, halogenated hydrocarbons, and heavy metals (cadmium, lead, nickel).

The monitoring results showed that the concentration of diphthalates (2-ethylhexyl) (a widely used plasticiser), naphthalene, cadmium, lead and nickel exceeded the environmental quality standard for priority substances in water. In addition, elevated concentrations of polyaromatic hydrocarbons, which are indicators of oil products, were found in each of the surface water samples collected in the Tisa River sub-basin.

In accordance with the Resolution of the Cabinet of Ministers of Ukraine of 19.09.2018 No. 758 "On Approval of the Procedure for State Water Monitoring", the laboratories of the Tisza River Basin and the Prut and Siret River Basin were sampling water on a monthly basis during 2019-2020 to determine chemical and physicochemical parameters at 30/15 (2019), 45/19 (2020), respectively, at the observation points of surface water massifs from which water is taken to meet the drinking and household needs of the population.), respectively, at the observation points of surface water massifs, from which water is abstracted to meet the drinking and household needs of the population in a volume of more than 100 m^3 /day; massifs at risk based on anthropogenic impacts on the qualitative and quantitative state, and surface water massifs in transboundary areas identified in accordance with interstate agreements on water management in border waters between the Government of Ukraine and the Governments of Hungary, the Slovak Republic, Romania and the Republic of Moldova.

Water samples from surface water massifs were transferred to the water monitoring laboratory of the Western Region of the Dniester BWR in compliance with the requirements of regulatory documents (DSTU ISO 6468-2002, DSTU ISO 10301:2004, DSTU ISO 5667-1:2009, DSTU ISO 5667-2:2009, DSTU ISO 5667-6:2009) for measurements of priority pollutants approved by the relevant Order.

Based on the results of the monitoring of priority pollutants in the Tisza, Prut and Siret sub-basins, 32 hazardous specific pollutants (27 synthetic pollutants and 5 non-synthetic pollutants (heavy metals: cadmium, nickel, mercury, lead, zinc) were identified. The list of hazardous substances is presented in Table 15.

Table 15. Specific pollutants (synthetic pollutants) for the Tisza, Prut and Siret sub-basins

Chemical registration number	Indicators for determining the environmental status of the MPE	Average annual concentration, $\mu g/dm^3$	Maximum concentration, $\mu g/dm^3$
74070-46-5	Aklonifene mcg/dm^3	-	0,14
62-53-3	Aniline, $\mu g/dm^3$	1,5	16,0
98-10-2	Benzenesulfonamide, $\mu g/dm^3$	100,0	n.a.
95-16-9	Benzothiazole, $\mu g/dm^3$	2,0	n.a.
92-52-4	Biphenyl, $\mu g/dm^3$	1,0	3,6
80-05-7	Bisphenol A, $\mu g/dm^3$	10,0	460,0
1702-17-6	Clopyralid, $\mu g/dm^3$	70,0	300,0
13684-56-5	Desmedipham, $\mu g/dm^3$	1,0	15,0
84-74-2	Dibutyl phthalate, $\mu g/dm^3$	10,0	48,0
122-39-4	Diphenylamine, $\mu g/dm^3$	1,6	31,0
26225-79-6	Etgofumesate, $\mu g/dm^3$	6,4	50,0

Chemical registration number	Indicators for determining the environmental status of the MPE	Average annual concentration, μg/dm³	Maximum concentration, μg/dm³
67-66-3	Trichloromethane (chloroform) μg/dm³	3,24	-
85-01-8	Phenanthrene, μg/dm³	0,38	2,0
50-00-0	Formaldehyde, μg/dm³	5,0	50,0
206-44-0	Fluoranthene μg/dm³	0,046	0,35
205-99-2	Benzo (b) fluoranthene μg/dm³	-	0,053
207-08-9	Benzo(k) fluoranthene μg/dm³	-	0,045
1071-83-6	Glyphosate, μg/dm³	15,0	n.a.
74-90-8	Cyanides, μg/dm³	5,0	n.a.
94-74-6	MCPA, μg/dm³	1,6	15,0
128-37-0	4-methyl-2,6-di-tert butylphenol, μg/dm³	1,4	17,0
1336-36-3	Polychlorinated biphenyls and their derivatives, μg/dm³	0,01	n.a.
40487-42-1	Pendimethalin, μg/dm³	0,3	2,0
79-00-5	1,1,2-trichloroethane, μg/dm³	300,0	n.a.
108-88-3	Toluene, μg/dm³	100,0	n.a.
100-42-5	Vinyl benzene (styrene), μg/dm³	0,63	60,0
1330-20-7	Xylene (isomers), μg/dm³	10,0	n.a.

The preliminary assessment of synthetic and non-synthetic specific substances will be based on the assessment of compliance with the relevant environmental quality standards and expressed as an annual average and as a maximum permissible concentration. Failure to comply with an environmental quality standard will be established if the arithmetic mean of the measured concentrations is higher than the value of the relevant environmental quality standard. When assessing the values of non-synthetic specific substances, background concentrations of heavy metals for each sub-basin MPA should be taken into account.

Control over the content of hazardous pollutants in the discharges of waste water from business entities mainly consists of determining the content of only the parameters stipulated in the draft maximum permissible discharges of water users (mainly pollution with organic and nutrients). The actual presence of hazardous substances, volumes and values need to be additionally verified, confirmed by research monitoring data and screening results of samples of wastewater discharged into sub-basin MWBs.

Sources of hazardous pollutants in the Tisza sub-basin may include industrial sources, including machine building, the forestry and chemical industry, mining facilities, livestock and food production, industrial and municipal waste.

2.1.4 Accidental pollution and impact of contaminated areas (landfills, sites, zones, etc.)

There is little "hazardous" industrial activity in the Danube basin, but there are potential sources of accidental pollution both through wastewater discharges and runoff from sites where industrial waste is stored.

The mechanism for preventing and minimising the risk of accidental pollution is established in the EU member states through the implementation of the Seveso-III Directive (Directive 2012/18/EU), the Industrial Waste from Mining Directive (2006/21/EC)10 and the Industrial Emissions Directive-IED (2010/75/EU)11 and for non-EU countries through the implementation of the recommendations of the UNECE Convention on the Transboundary Effects of Industrial Accidents.

At the Danube basin level, a list of potential accident risk sites has been developed, including operating industrial facilities with a high risk of accidental pollution due to the nature of chemicals stored or used at industrial facilities, contaminated sites, including landfills and dumps located in flood zones. This register includes facilities that pose risks of accidental pollution, primarily CWS, sites where industrial waste is stored, sludge ponds and tailing pits.

Recent studies in the Tisza, Prut and Siret sub-basins have revealed an excess of synthetic substances: pesticides, pharmaceuticals and substances used in perfumery, polyaromatic hydrocarbons, halogenated hydrocarbons, heavy metals: zinc, copper, cadmium, nickel and lead, which confirms a significant anthropogenic load on the sub-basin MPAs.

The Ministry of Environmental Protection and Natural Resources of Ukraine has launched an electronic service that also contains the Register of Waste Disposal Sites and the List of Facilities that are the largest polluters of the environment in terms of discharging pollutants into water bodies.

Table 16. Register of facilities in the Danube basin that are at risk of accidental pollution

№	Name of the object
1	Municipal enterprise "Vodokanal Uzhhorod", Uzhhorod
2	Municipal enterprise "Miskvodokanal" of the Mukachevo City Council, Mukachevo
3	Limited Liability Company "Vodokanal Karpatviz", Beregovo
4	Municipal enterprise of the Chop City Council "Vodokanal of Chop. Chop", Chop city
5	"Khust Production Department of Water Supply and Sewerage, Khust
6	Vodokanal municipal enterprise of the Tyachiv City Council, Tyachiv
7	Municipal enterprise of Volovets Village Council "Vodokanalservice", Volovets village
8	"Vynohradiv Production Department of Water Supply and Sewerage, Vynohradiv
9	Communal Service, Velykyi Bereznyi village
10	Mizhhirya Village Council's communal enterprise Mizhhirya VUZHKH, Mizhhirya village
11	Rakhiv municipal enterprise Rakhivteplo, Rakhiv
12	Solotvyno Municipal Utility Company, Solotvyno village
13	Communal Unitary Enterprise "Kommunalnyk", Vyzhnytsia
14	Hlyboka Production Department of Housing and Communal Services, Hlyboka village
15	Kitsman Production Department of Housing and Communal Services, Kitsman
16	Chernivtsi Vodokanal, Chernivtsi city
17	Storozhynets Utility Company, Storozhynets
18	Municipal enterprise Novoselytsia City Heating Network, Novoselytsia
19	Verkhovyna Water Supply and Sewerage Enterprise, Verkhovyna village
20	Kolomyiavodokanal, Kolomyia city
21	Hvizdetsky Combine of Utilities, Hvizdets village
22	Zabolotivskyi KKP, Zabolotiv village
23	Housing and communal services company Technoservice, Pyadyky village
24	Municipal enterprise "Selyshche KP", Vorokhta village
25	Municipal enterprise "Village water worker", Turka village
26	Kommunalnyk, Perechyn, Ukraine
27	PJSC "ICCC", Izmail
28	Municipal enterprise "Svitlo", Kilia

According to the register of waste disposal sites (hereinafter referred to as WDS), there are 85 certified WDS in the Tisza, Prut and Siret sub-basins (62 in Zakarpattia Oblast, 10 in Chernivtsi Oblast, and 13 in Ivano-Frankivsk Oblast):

64 - solid waste disposal sites;
3 - wood waste (sawdust);
7 - landfills;
5 - manure storage facilities;
1 - waste of artificial fur;
1 - oil and sludge pond;
1 - waste industrial oils;
1 - sludge from treated wastewater;
1 - storage of recyclable waste;
1 - refined oil and fat residues.

One of the most acute environmental problems remains the issue of waste (its generation, accumulation, utilisation, disposal, removal to unorganised storage sites, etc.) Most of the existing landfills have exhausted their capacity, being 80-85% full, and the lifetime of the landfills in the city of Vynohradiv, Zakarpattia Oblast, has reached the end of its useful life. Due to its mountainous nature, high population density, proximity to 4 EU countries, a single water basin of the Tisza River, and protected areas, a number of settlements in Zakarpattia Oblast are deprived of the opportunity to choose land plots for landfills. This applies to cities: Rakhiv, Tyachiv, Vynohradiv, Berehove, Perechyn, Velykyi Bereznyi, and rural settlements in mountainous areas. Centralised collection and disposal of solid waste in the region is carried out by 36 specialised enterprises, the largest of which are: ABE Uzhhorod, ABE Vynohradiv, ABE Mukachevo and Bereg Vertical. These entities collect municipal solid waste from 199 settlements in the region. In total, centralised solid waste collection in the region is organised in 491 settlements, which is 80.75% of the total number (608) of settlements in the region. Household waste is also collected from households and business entities independently by enterprises and organisations, some private structures and specialised communal services under village councils. There are no household waste disposal facilities.

Separate collection of solid waste (glass, plastic, waste paper and scrap metal) has been introduced in the cities of Uzhhorod, Perechyn, Irshava, Rakhiv, Svaliava, V. Bychkiv and 23 territorial communities (187 settlements in total). Resource-intensive components of solid waste are transferred to specialised enterprises (52 business entities in the region). The collected waste is mostly transferred for disposal outside the region. According to the Main Department of Statistics, there are 1 hazardous waste disposal facility, 24 waste incineration facilities for energy production, 5 waste incineration facilities for thermal processing, and 35 other waste disposal facilities (other than incineration) in the region.

Wood waste is disposed of by briquetting and burning in boilers as an additional energy resource. New technologies for sawdust processing are implemented at the expense of the companies' own funds and investments.

In order to maximise the use of resource-rich waste components, the region is creating appropriate conditions for attracting investors to build waste processing plants, introduce alternative fuel technologies, establish a system for collecting, sorting and recycling solid waste, and reduce the number of waste disposal sites.

There is no storage of unsuitable and banned pesticides and pesticide chemicals in the Zakarpattia region. However, according to the Mukachevo District State Administration, there are 41 reinforced concrete containers in 8 settlements of Mukachevo District that contain chemical plant protection products. In addition, 225 tonnes of pesticide-contaminated soil is stored in Rokosovo village, Khust district, which, according to the Ukrainian Research Institute of Environmental Problems (Kharkiv), is toxic waste of classes I and II hazard to public health and requires urgent removal outside the region.

The main method of solid waste management in Chernivtsi Oblast is landfilling. The majority of solid waste is disposed of at 1 landfill in Chernivtsi and 282 organised landfills with a total area of 260 hectares. Today, the situation has become particularly acute: landfills in the region are a big problem, and their number is growing every year. Landfills are one of the main sources of environmental pollution. Tonnes of garbage are dumped on the sides of roads and forests. The region has separate household waste collection in 39 settlements. 17 enterprises in the region have 50 waste incineration facilities and 3 enterprises have 4 waste disposal and recycling facilities with a total capacity of 28.7 thousand tonnes per year and 2.3 thousand tonnes per year, respectively.

There are 15 permanent solid waste landfills in Ivano-Frankivsk Oblast, of which 8 have been certified. The largest landfills in the Prut sub-basin are located near Kolomyia and Nadvirna (village of Pniv). Separate solid waste collection has been partially introduced in 57 settlements and 6 cities of regional significance.

Thus, given the current situation, addressing the problem of solid waste management should be included in the programme of measures to achieve good environmental status of the MNEs.

2.1.5 Hydromorphological changes

Hydromorphological changes are one of the main water-environmental problems (WEPs) that impede the achievement of environmental objectives set and enshrined in the RBMP. Hydromorphological changes, as a result of economic activity, affect the conditions of existence of aquatic communities. The presence of hydromorphological changes in MPAs leads to the deterioration of the ecological status of many MPAs in the Danube basin.

Hydromorphological changes are divided into types:

- disruption of the continuity of water flow and habitats - longitudinal disruption of the continuity of rivers and habitats (transverse artificial structures in the river channel, interruption of water flow, disruption of the free flow of rivers, movement of sediments, migration of fish and other aquatic life);
- disruption of the hydraulic connection between river channels and their floodplains;
- hydrological changes (water abstraction, hydropicking/ fluctuations in water levels of artificial origin);
- Morphological changes (modification of the morphology of the riverbed, banks, and adjacent parts of the floodplain, e.g. straightening).

Dams and other artificial cross structures located in river channels were built primarily to accumulate water, with its subsequent use for agricultural, public and industrial purposes. In the Danube basin, 60 MPAs have been identified where the continuity of water flow and the environment is disturbed (overregulation).

The accumulation of water in ponds and reservoirs upstream of dams also provides flood protection for areas downstream of dams. According to the State Agency of Water Resources of Ukraine, a significant number of ponds are in poor technical condition. Most of them were built in 1960-1980 according to simplified design documentation. The dams are earthen, with loose slopes, and many of them are eroded. Spillway structures usually do not meet modern requirements in terms of their technical condition.

The presence of dams and other structures across the river channel disrupts the continuity of water flow and sediment movement, as well as the migration of fish and other aquatic life.

No fish passages have been built in the transverse structures and, as a result, populations of various fish species have declined or disappeared. To date, the construction of fish passages on existing dams on the basin's rivers looks rather problematic due to the lack of not only funds, but also the very assessment of the economic feasibility of building a fish passage.

Disruption of the hydraulic connection between river channels and floodplains. The hydraulic connection between the riverbed and the floodplain plays an important role in the functioning of aquatic ecosystems, providing water for important habitats for fish and aquatic life, and has a positive impact on the condition of surface and groundwater.

The assessment of this type of hydromorphological changes is included in the hydromorphological protocol for assessing the MWP used by the SES in the course of state monitoring of surface waters (indicators No. 10: "Interaction between the channel and the floodplain: 10a - Possibility of floodplain inundation, 10b - Limiting factor for the development of horizontal deformations of the channel").

Hydrological changes. Hydrological changes affect water bodies through water abstractions and fluctuations in water levels below dams, and, as a result, lead to changes in the regime and distribution of river flows. Discharges, water abstractions and artificial periodic fluctuations in water levels (hydroelectricity) are key pressures that require compensatory measures to be implemented on a river basin-wide scale.

In the Danube basin, there are no MPAs with hydrological changes.

Decreased natural flows in the context of global warming and natural water shortages, reduced flow velocities and the formation of stagnant zones contribute to eutrophication processes, and, as a result, lead to a deterioration in biodiversity and degradation of aquatic ecosystems.

Morphological changes. *The* main factors that negatively affect the natural morphology of the Danube River basin's channels, banks and floodplains are urbanisation, flood protection, agriculture and shipping. As a result of these activities, the rivers in certain areas are straightened, dredged, banks are reinforced, the floodplain adjacent to the channel is ploughed up, and the natural vegetation changes.

In the basin, 118 MWRs have undergone modification of river morphology (straightening). Reduced variability in channel depth and width, disruption of the natural balance of erosion and accumulation, narrowing of the inter-dam space and restriction of free meandering lead to an impoverishment of the composition and reduction in the number of biological indicators, such as fish, benthic invertebrates, higher aquatic vegetation, and phytoplankton.

In the Danube basin, 885 MPVs have been identified. Based on data on existing cross structures in the channel, water intake locations and level fluctuations, as well as using satellite imagery, topographic and cadastral maps, 155 of the IWMS (18% of all identified IWMS) were identified as IZMW and 36 IWMS were identified as artificial IWMS. Of these:

- 37 IWRs are classified as significantly altered due to disruption of the free flow of rivers (overregulation);
- 95 MWP - due to modification of river morphology (straightening of river channels);
- 23 MPV - due to a combination of overregulation and directionality;
- 36 IWPs are artificial IWPs (Fig. 14, Table 17).

Table 17. Hydromorphological changes in the Danube basin MPAs

№	Hydromorphological changes	Load	Quantity IHRM	% of the total number of MPAs
1	disruption of the continuity of water and media flow	regulation (water accumulation)	37	4,2
2	morphological changes	straightening	95	10,7
3	disruption of the continuity of water and media flow and morphological changes	regulation (water accumulation) and directivity	23	2,6
4	artificially created IAPs	water storage	36	4,1

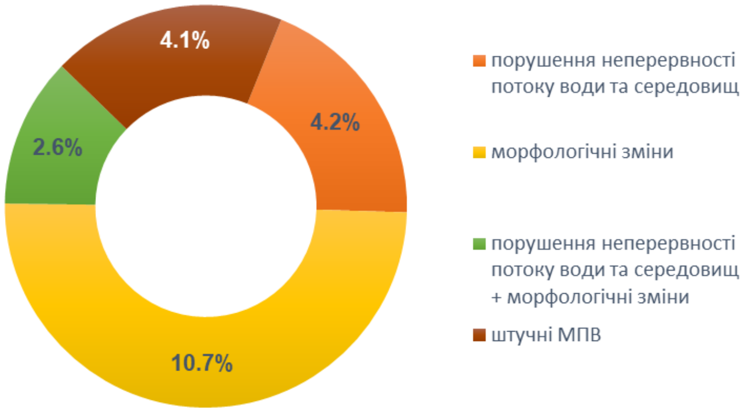


Figure 14. Distribution of IHMW by types of hydromorphological loads

All of these MEAs should be considered as having a risk of not achieving "good" environmental potential.

The criteria for assessing the failure to achieve "good" environmental potential are as follows:

- disruption of the continuity of water flow and environments (transverse artificial structures in the riverbed, disruption of the continuity of water flow and sediment movement and migration of fish and other aquatic life);
- water withdrawals (small and medium-sized rivers - water withdrawals exceeding 75% of the supply; large and very large rivers - water withdrawals exceeding 90% of the supply);
- water accumulation (ponds with a ponding area of more than 1 km or several ponds with a ponding area of less than 1 km, but their total length is more than 30% of the length of the MPA, as well as reservoirs with a volume of more than 1 million m);[3]
- fluctuations in water levels below the dam (water level fluctuations exceeding 0.5 m per day for most of the year);
- disturbance of natural morphological characteristics of rivers (hydromorphological class below the third according to the monitoring results, or straightening of more than 70% of the length of the main river channel in the absence of monitoring data).

Based on the analysis of the main water and environmental problems associated with hydromorphological loads in the Danube basin, it can be concluded that 155 MPAs in the basin, defined as IWMPAs, require restoration (revitalisation).

Most cases of hydromorphological changes occur on small rivers in the Danube basin. According to the classification of rivers by basin area, which was used to determine the MNR, small rivers are rivers with a basin area of up to 100 km^2 .

2.2 Groundwater

2.2.1 Pollution

The anthropogenic impact on the geological environment has a significant impact on the state of groundwater. The main anthropogenic factors that affect the state of the underground hydrosphere include groundwater abstraction for water supply, use of surface water for reclamation purposes, use of mineral fertilisers and pesticides in agricultural production, and discharge of industrial and municipal wastewater.

The Tisza, Prut and Siret sub-basins are dominated by rural urbanisation. There are no large urban agglomerations or large industrial facilities associated with the extraction and processing of significant amounts of natural resources. Largest cities by population: Uzhhorod, Chernivtsi, Mukachevo, and Kolomyia.

In the context of rural urbanisation, the anthropogenic load on the MHPS is associated with agricultural activities of the population: intensive farming and gardening with intensive use of fertilisers, pesticides and herbicides prevails. Cattle are raised mainly in stationary conditions.

The mountains are dominated by pasture farming and forestry.

Among the hydraulic engineering types on the plain, amelioration and, to some extent, fisheries are very common.

Research carried out in the early 1990s to study the elements of the groundwater regime showed that land reclamation measures disrupt the natural hydraulic and hydrochemical connection between aquifers and contribute to the deterioration of groundwater and surface water quality.

When the main drainage channels were laid, the surface layer of low-permeability rocks was completely or partially destroyed, which led to a deterioration in the protection of the MPZV throughout the plain. Negative processes of groundwater quality deterioration are observed during flood filling of the canals and in the post-flood filtration period. Within the reclamation systems, the intensity of surface and groundwater pollution due to agricultural production (mineral and organic fertilisers, pesticides, etc.) is increasing. The filtration of flood water enriched with oxygen from canals leads to an increase in oxidised iron in the water and its accumulation in soils. In addition, during the flood period, an increase in groundwater salinity and soil salinity was observed in a number of areas.

At present, a significant part of the reclamation network is out of order - the canals are silted up, overgrown with various vegetation, and the locks are out of order.

The mining and industrial type of anthropogenic load is very common in the development of MNR. It includes water intakes of fresh and mineral groundwater, open and underground mining, and oil and gas exploration sites.

An important place among the types and objects of technogenic (anthropogenic) load that negatively affects the MHPS is occupied by domestic pollution due to the lack of centralised sewage systems with treatment and discharge of domestic wastewater in rural areas and partially in cities. There are solid waste dumps near almost every settlement. There is no industrial-scale sorting and recycling of this waste.

Groundwater resources in non-pressure horizons within the Lower Danube sub-basin are conditionally protected. The groundwater cover consists of loams and clays with a total thickness of 20-40 m. Contamination of the aquifers is possible through defective production wells and irrigation areas. There is spotty contamination of groundwater with nitrogen compounds within settlements. In addition, the presence of synthetic surfactants, oil products, and pesticides in aquifers is recorded in concentrations that do not exceed the maximum permissible levels. In the areas of intensive exploitation, the impact of technogenesis affects the level regime.

The impact of technogenesis on groundwater massifs in pressure aquifers is mainly reflected in the level regime. As a result of long-term intensive exploitation, depression sinkholes have formed. The reduction in groundwater extraction observed in recent years is contributing to the recovery of groundwater levels.

The groundwater reservoirs in the pressure horizons lie beneath a layer of water-resistant sediments, which significantly hinders their connection with surface ecosystems and provides a relatively high level of protection against surface pollution.

In the pressure aquifers in production wells, there is also spot pollution of groundwater with nitrogen compounds, and the presence of synthetic surfactants, oil products, and pesticides in concentrations that do not exceed the maximum permissible levels.

A detailed assessment of the current state of the anthropogenic load on the MWR is required.

2.2.2 Volumes/inventories

Estimated groundwater resources (EGWR) are the volumes of groundwater estimated on the basis of geological surveys that characterise the potential for their extraction from the subsoil in the respective territory. The estimated groundwater resources in the Tisza sub-basin (Zakarpattia region) amount to 1081.60 thousand m^3 /day, in the Prut and Siret sub-basins - 590.54 thousand m^3 /day (in Ivano-Frankivsk region - 260.86 thousand m^3 /day, in Chernivtsi region - 329.67 thousand m^3 /day), their distribution over the territory is uneven, which is explained by the difference in geological, structural and physical geographical conditions. The exploration of forecasted groundwater resources in Ukraine is insignificant - 26%, for Zakarpattia region this figure is 32%, for Ivano-Frankivsk region - 38%, for Chernivtsi region - 43%. A detailed assessment of the current state of the anthropogenic load on the MWR is required.

Out of the total number of the EORPs, the explored and approved exploitable groundwater reserves amount to 344.10 thousand m^3 /day in Zakarpattia region, 99.13 thousand m^3 /day in Ivano-Frankivsk region, and 141.76 thousand m^3 /day in Chernivtsi region. Operational groundwater reserves are calculated based on the data of geological study of groundwater that can be extracted from the subsoil by rational technical and economic water intakes in a given extraction mode, provided that the quality characteristics of groundwater meet the requirements of their intended use and the permissible degree of environmental impact during the estimated period of water use.

The development of projected groundwater resources is most intensive in densely populated areas with high economic potential. Most groundwater is abstracted in areas with high population density and developed industry. The exploitable resources of mineral waters amount to about 10.0 thousand m^3 /day and belong to 20 types of mineral waters. In 2020, the volume of mineral water use did not exceed 10-15%

of the total resource. Mineral waters are used for balneology and industrial bottling. The resources of heat and power waters, which are also therapeutic, amount to about 50.0 thousand m /day.[3]

According to statistical reporting No. 2TP-Vodkhoz (annual), groundwater abstraction from natural bodies in the Danube basin in 2020 was 27.529 million m^3 (4.7%). The Tisza sub-basin has a high degree of groundwater use (compared to surface water). The water supply in Zakarpattia, as well as in the Prut and Siret sub-basins, is largely dependent on groundwater.

Table 18. Extraction of drinking and industrial groundwater and its use in Zakarpattia, Ivano-Frankivsk and Chernivtsi regions

Year	Mining, million m /year^3	Use, million m /year^3					Groundwater discharge without use, million m3 /year^3
		Total	Household and drinking water	Production and technical	Agricultural	Irrigation	
Transcarpathian region							
2020	19,415	10,690	8,230	2,352	0,029	0,083	0,167
Chernivtsi region							
2020	5,056	2,075	0,385	1,526	0,164	-	-
Ivano-Frankivsk region							
2020	0,562	0,492	0,122	0,354	0,017	-	-

State accounting of groundwater extraction and use from explored, preliminary explored deposits and subsoil areas with unevaluated reserves is carried out within Zakarpattia, Ivano-Frankivsk and Chernivtsi regions. Groundwater extraction is subject to mandatory accounting based on the statistical reporting No. 2TP-Vodhosp (annual) of the State Agency of Ukraine for Water Resources.

The current water supply of the regions is based on a network of centralised and dispersed water intakes and a dense network of individual production wells located in large settlements and rural areas.

The State Research and Production Enterprise Geoinform of Ukraine annually analyses the groundwater regime under natural and disturbed conditions of its formation. The regime observation network of the state groundwater monitoring consists of a number of observation points that are studied in the area of water intake impact: Uzhhorod "Mynai" and Khust "Rika".

2.3 Other significant anthropogenic impacts

2.3.1 Climate change

One of the main manifestations of regional climate change against the backdrop of global warming is a significant increase in air temperature, changes in the thermal regime and precipitation patterns, an increase in the number of dangerous meteorological events and extreme weather conditions, and the damage they cause to various sectors of the economy and the population. These trends are typical for Ukraine in general and the Danube sub-basins in particular. The greatest changes have been observed over the past thirty years, which have been the warmest for the period of instrumental weather observations.

The rise in air temperature is observed not only near the Earth's surface but also in the lower troposphere, accompanied by an increase in tropospheric moisture content, and causes an increase in atmospheric instability and convection intensity. These changes have led to an increase in the frequency and intensity of convective weather phenomena: thunderstorms, showers, hail, squalls, and an increase in the maximum intensity of precipitation and its storm component.

Representative concentration trajectories (RCPs) of greenhouse gases have different trajectories of emissions and concentrations in the atmosphere, emissions of pollutants, and specifics of land use in the 21st century (in particular, changes in the area of forested areas) and their corresponding consequences. Two RTC scenarios were selected for this study: "soft" scenario 2.6, which, in accordance with the Paris Agreement, provides for a reduction in greenhouse gas emissions, and "hard" scenario 8.5, which does not take into account any adaptation or mitigation measures. All scenarios demonstrate a steady increase in average annual temperature throughout the 21st century in all regions. By the end of the century, the average annual temperature averaged across regions under different scenarios is expected to increase by 2-5°C. Global greenhouse gas emissions scenarios (Sources: USGCRP/GlobalChange.gov, UHMI 2014) The study calculated simulated changes in the average annual river flow (flow rate) of the RBD of Ukraine for two future periods (2041-2070 and 2071-2100) under GWP 2.6 and GWP 8.5 scenarios

The water-heat balance of river basins is highly sensitive to climate change. Rising air temperatures and changes in precipitation patterns affect not only the hydrological regime of rivers, but also the overall water resources. Climate change is increasing the frequency of floods and droughts, which makes agriculture, energy, transport and the social sector vulnerable, as they depend on water resources.

The average annual runoff is expected to fluctuate between 2041 and 2070. Increased water flow in the rivers of the Carpathian region will manifest itself in the formation of catastrophic floods on mountain rivers and may lead to significant economic losses in all sectors of the economy and in territorial communities in the sub-basins of the Tisza, Prut and Siret. Small rivers in the southern regions are experiencing severe water stress due to a reduction in surface runoff (by 5-25%) and its redistribution over the seasons.

2.3.2 Pollution of water bodies with solid household waste, including plastic

The pollution of water bodies by solid waste, primarily plastic, is one of the pressures that leads to the deterioration of the ecological and chemical state of surface waters. This problem is not specific to a particular river basin, but to the whole country and reflects the problem of waste management at both national and local levels.

Gaps in national legislation, an inefficient system of waste collection, transport and disposal, and a low culture of waste management are manifested in a large number of unauthorised and spontaneous landfills, including on river banks. Some of the waste ends up directly in rivers and water bodies, which is not only an aesthetic problem, but also leads to chemical pollution of water, poisoning of living organisms and deterioration of their living conditions.

The pollution of the rivers of the Tisza sub-basin by municipal waste is a major concern for neighbouring countries. In particular, since 2020, there have been more than 50 cases of municipal waste pollution on Hungarian territory during floods. First and foremost, these are PET bottles, the number of which in the Tisza during floods is 50-100 bottles per minute, sometimes this figure reaches 300 bottles per minute.

Over time, plastic breaks down and turns into microplastics, which get into living aquatic organisms, contributing to the accumulation of toxins.

Microplastics are less than 5 mm in size and fall into two groups: primary and secondary. Primary microplastics are part of cosmetics (toothpastes, scrubs, shower gels, etc.), industrial cleaning products, and are also formed as a result of wear and tear on car tyres and when washing synthetic products.

Recycled plastic is produced by shredding large plastic waste such as bottles, disposable tableware, packaging, etc.

In 2021, surveys were carried out on the watercourses of Zakarpattia to identify unauthorised landfills on river floodplains and blockages, and 32 unauthorised landfills and 23 garbage jams were found.

No special studies have been conducted on the amount of waste on the banks and directly in the rivers and water bodies in the Prut and Siret sub-basins and the lower Danube, nor on their direct impact on the ecological and chemical state of water bodies.

Given the current situation, solving the problem of solid waste management should be included in the programme of measures to achieve "good" environmental status of the Danube sub-basins.

2.3.3 Invasive species

Invasions of alien species outside their "native" habitats are global in nature. The naturalisation and further spread of invaders can cause irreversible environmental damage and undesirable economic and social consequences.

Currently, biological invasions are considered to be biological pollution, but unlike most pollutants that can decompose in natural ecosystems through self-purification processes and whose content is controlled by humans, alien organisms that have successfully invaded begin to multiply uncontrollably and spread rapidly in the environment. This phenomenon can have unpredictable and irreversible consequences.

In addition, the introduction of alien species leads to irreparable losses of biodiversity, both through direct destruction of native species by predators, food and spatial competition, and as a result of displacement of native species, changes in their habitats and hybridisation. The emergence of any alien species is an indicator and, at the same time, a cause of the deterioration of the ecological state of a water body. All this causes a special danger of invasions and determines the specifics of control measures in terms of the risks of not achieving a "good" ecological state of MPAs where the process of invasion of adventive species is carried out. It is possible that alien species pose a threat as agents of biological interference or are intermediate hosts of human and domestic animal diseases and can be used for sabotage. Therefore, this problem is becoming increasingly urgent in terms of ensuring the environmental safety of the river basin, part of which is located in the temporarily occupied territory.

According to the Convention on Biological Diversity (The Hague, 2002), measures aimed at mitigating the effects of invasions by alien species should be mainly preventive, but it is usually not possible to effectively control the process of invasions, primarily due to the lack of a biodiversity monitoring system.

Therefore, after mandatory special studies of alien aquatic species in the Danube sub-basins and determination of the list of species and their location, the first and most important control measure is the creation of a basin-wide monitoring system for invasions in the IWR.

Monitoring should be focused on identifying and analysing the species composition of alien species, invasive corridors, vectors, geography and dynamics of invasions; population dynamics of the most significant invasions from emergence to naturalisation, as well as of invasive species that have already been naturalised and the consequences of their impact on habitats, native species, communities and ecosystems; geographical location of invasive sub-corridors and ecosystems vulnerable to invasions. The most likely centres for the penetration, naturalisation and spread of alien species are places in the area of municipal wastewater outflows from large cities, where the aquarium services market is developed, as well as discharges of heated water from thermal power plants and large industrial enterprises. Therefore, an inventory of such possible entry points and their survey should be the first step in implementing a monitoring system.

3 ZONES (TERRITORIES) TO BE PROTECTED AND THEIR MAPPING

3.1 Emerald Network facilities

The Emerald Network is an ecological network consisting of special areas for the conservation of biological diversity created (designated) in accordance with the Convention on the Conservation of Wild Flora and Fauna and Natural Habitats in Europe (Bern Convention). Its goal is to ensure the long-term survival of species and habitats listed in the Bern Convention that require special protection.

On 30 November 2018, six countries: Belarus, Georgia, the Republic of Moldova, Norway, Switzerland and Ukraine officially approved the lists of Emerald Network sites on their territories. The updated list of Emerald Network sites was approved on 2 December 2022. The Emerald Network of Ukraine includes 377 territories[5] , and covers about 8% of Ukraine's territory.

There are 25 Emerald Network sites in the Danube basin, covering approximately 16.8% (5059.07 km^2) of the basin area.

According to the categories (Fig. 15), the facilities of the Emerald Basin Network are divided into:

- Biosphere Reserve - 1;
- Biosphere Reserve - 1;
- a nature reserve - 7;
- protected area - 1;
- reserve - 1;
- National Nature Park - 8;
- regional landscape park - 6.

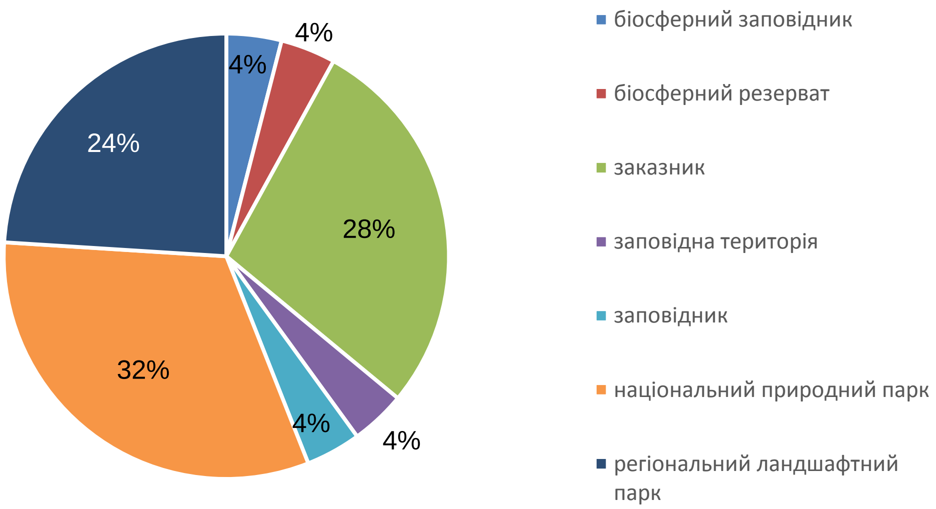


Figure 15. Breakdown of Emerald Network facilities by category, %.

None of the sites has a management and development plan in place. A list of the Danube Emerald Network sites is provided in Annex 4.

3.2 Sanitary protection zones

Sanitary protection zones include the areas where water intakes for drinking water supply are located. According to the Resolution of the Cabinet of Ministers of Ukraine on the Legal Regime of Sanitary Protection Zones of Water Bodies No. 2024 of 18 December 1998, these zones are classified as the so-called first zone (strict regime) of compliance with the use regime. The Resolution provides for a number of permitted and prohibited activities within drinking water intakes.

According to the EU WFD (Art. 7), "Member States shall identify in each RBI:

[5] UPDATED LIST OF OFFICIALLY ADOPTED EMERALD SITES (DECEMBER 2022) https://rm.coe.int/pa10e-2022-updated-list-officially-adopted-emerald-sites/1680a93ca5

- All surface/groundwater bodies used for abstraction of water intended for human consumption, providing an average of more than 10 m³ of water per day or providing water consumption for more than 50 people and
- Those water bodies that are intended for future use for the same purpose."

There are 229 water intakes in the Danube basin that withdraw more than 10 m³ of water per day, including 149 underground water intakes and 80 surface water intakes.

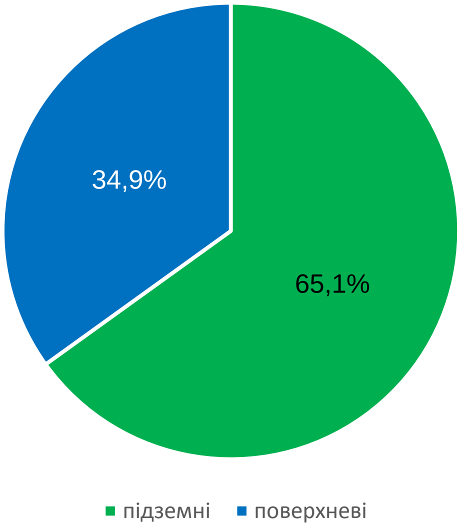


Figure 16. Drinking water withdrawals in the Danube basin, %.

The State Agency of Water Resources of Ukraine is responsible for maintaining state water accounting.

3.3 Protection zones for valuable aquatic bioresources

Areas designated for the protection of economically important aquatic species or areas for the protection of valuable aquatic bioresources include those areas where such aquatic resources of significant economic value are found or cultivated.

Depending on the specifics of the protection zone for valuable aquatic bioresources, the monitoring programme may include additional indicators or sampling frequency.

According to the Resolution of the Cabinet of Ministers of Ukraine No. 1209 "On Approval of Tariffs for Calculating the Amount of Compensation for Damage Caused by Illegal Harvesting (Collection) or Destruction of Valuable Aquatic Bioresources" dated 21 November 2011 (as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 1039 dated 6 October 2021), the list of valuable bioresources includes both rare and common fish species throughout Ukraine.

At the same time, according to Article 1 of the Law of Ukraine "On Fisheries, Commercial Fishing and Protection of Aquatic Bioresources", a fishery water body (or part thereof) is a water body (or part thereof) that is used or may be used for fisheries purposes.

Thus, taking into account the above, as well as the lack of an appropriate legislative and regulatory framework, the protection zones for valuable bioresources in Ukraine have not been defined.

3.4 Arrays of surface/ground water used for recreational, medical, resort and health purposes, as well as water intended for bathing

Recreation areas of water bodies are land plots with adjacent water space intended for organised recreation of the population on the coastal protective strips of water bodies. Places of mass recreation are determined by local governments in accordance with the powers vested in them every year before the start of the summer swimming season. Water protection zones are established along rivers, around lakes, reservoirs and other water bodies, within which land plots are allocated for coastal protection strips.

It is prohibited in water protection zones and coastal protection zones:

- storage and use of pesticides and fertilisers;

- construction of cemeteries, summer camps for livestock, manure storage facilities, cattle cemeteries, waste dumps, filtration fields, liquid and solid waste storage facilities, etc;
- discharge of untreated wastewater;
- construction of any structures (except for hydrotechnical, hydrometric and linear structures), including recreation centres, summer cottages, garages and car parks;
- Washing and maintenance of vehicles and equipment.

Requirements for the location and organisation of water body recreation areas:

- To organise recreational areas on water bodies, their owners or lessees are required to agree the operation of the beach with the State Service of Ukraine for Food Safety and Consumer Protection before the start of each swimming season;
- the recreation area should be located outside the sanitary protection zones of industrial enterprises. The recreation area should be located at the maximum possible distance (at least 500 m) from sluices, hydroelectric power plants, wastewater discharge sites, stables, livestock watering places and other sources of pollution;
- beaches should not be located within the first zone of the sanitary protection belt of drinking water sources.

Environmental goals for recreational areas:

- The water quality of reservoirs and rivers used in recreational areas must meet the requirements of sanitary legislation;
- the composition and properties of water in the area of recreational water use must meet the requirements for physical, chemical and sanitary-microbiological indicators.

Requirements for water monitoring in recreational areas:

- water sampling for departmental control in water bodies should be carried out annually by local self-government bodies at least 2 times before the start of the swimming season (at a distance of 1 km upstream from the swimming area on watercourses and at a distance of 0.1-1.0 km in both directions from it on water bodies, as well as within the swimming area);
- during the swimming season, such water sampling shall be carried out at least twice a month at at least two points selected in accordance with the nature, length and intensity of use of swimming areas.

Pursuant to CMU Resolution No. 264 of 06.03.2002 "On Approval of the Procedure for Registration of Places of Mass Recreation on Water Bodies", local executive authorities and territorial fishery protection authorities are required to identify on maps and schemes land plots and water areas suitable for the organisation of beaches, boat rental facilities, water attractions, as well as places for water sports and places for amateur and sport fishing in winter.

Approved copies of the map schemes shall be submitted to the emergency rescue services serving water bodies in their area of responsibility and to the regional coordination emergency rescue centres of the State Specialised Emergency Rescue Service on Water Bodies of the State Emergency Service of Ukraine (hereinafter referred to as the SES).

Information on places of mass recreation is submitted annually by 1 April by local governments, and information on places of recreational and sport fishing is submitted on 10 February and 30 October by territorial fish protection authorities to the regional coordination emergency rescue centres of the SES.

As of July-August 2023, there are 8 recreation and leisure facilities in the Danube basin (Annex 5). According to the SES in Odesa Oblast, due to martial law, recreation and leisure areas were not used in the Lower Danube sub-basin in 2022-2023.

3.5 Areas vulnerable to (accumulation of) nitrate

Ukraine has approved a methodology for determining nitrate vulnerable zones (Order of the Ministry of Ecology No. 244 dated 15.04.2021), as required by the EU Nitrate Directive. The methodological approach relies heavily on a large amount of high-resolution spatial and temporal data, mainly surface and groundwater monitoring data, but statistical data such as livestock numbers, fertiliser application and nitrogen surplus calculations should also be used to identify these zones. All of this information is needed to identify nitrate vulnerable areas, and it needs to be of high quality and with a sufficient level of confidence. At the moment, the existing surface water monitoring network is not sufficient in its continuity and spatial coverage to apply the developed method, and groundwater monitoring is not carried out at all.

Therefore, and taking into account the fact that in Ukraine

-the highest percentage of ploughed land in the world (53.9%, 2021 data), and the rate of ploughed agricultural land is 78.2%;

-there is a lack of representative and reliable information on the content of nutrients in surface and groundwater;
-Eutrophication of water bodies is a widespread phenomenon;
-Initial level of implementation of the Nitrate Directive,

for the period 2025-2030, it is proposed to define the entire territory of Ukraine as a nitrate vulnerable zone. This is in line with the requirements of the EU WFD, which provides for the "protection of seas and coastal waters" and the prevention of deterioration of MPAs and MEAs (it is more appropriate to classify more MPAs as vulnerable than to change their status from "good" to "poor"). This "whole country" approach is also used in many EU countries. Areas vulnerable to nitrate accumulation can be refined or defined in subsequent river basin management plan cycles based on improved, more accurate information.

This approach makes it possible to extend the main measures to the entire territory of the country and plan more specific measures for surface and groundwater bodies where there is a risk of not achieving environmental objectives due to the impact of agriculture based on confirmed data.

During the period 2025-2030, the focus should be on improving the monitoring network (both groundwater and surface water) and the database to ensure a more detailed approach to zone designation and monitoring and thus achieve full compliance with the EU WFD during the 2nd cycle of the river basin management plan (2031-2036).

3.6 Vulnerable and less vulnerable areas identified in accordance with the criteria approved by the Ministry of Environment

As of 2023, no vulnerable or less vulnerable zones have been identified in Ukraine.

The regulatory document governing this issue is the Order of the Ministry of Ecology and Natural Resources of 14 January 2019 No. 6 (registered with the Ministry of Justice of Ukraine on 5 February 2019 under No. 125/33096) "On Approval of the Procedure for Determining the Population Equivalent of a Settlement and the Criteria for Determining Vulnerable and Less Vulnerable Zones".

Also, in accordance with Article 12. *Powers of Local Self-Government Bodies of the* Law of Ukraine "On Water Disposal and Wastewater Treatment" of 12 January 2023 (to enter into force on 07 August 2023), the powers of local self-government bodies in the field of water disposal include:

-upon submission of the central executive body implementing the state policy in the field of water sector development, identification of vulnerable and less vulnerable zones in accordance with the criteria approved by the central executive body ensuring the formation of the state policy in the field of environmental protection.

The State Agency of Ukraine for Water Resources has prepared and sent submissions to local authorities. The process of making relevant decisions by the competent authorities is ongoing.

4 MAPPING OF THE MONITORING SYSTEM, RESULTS OF MONITORING PROGRAMMES FOR SURFACE WATER (ECOLOGICAL AND CHEMICAL), GROUNDWATER (CHEMICAL AND QUANTITATIVE), AREAS (TERRITORIES) SUBJECT TO PROTECTION

4.1 Surface water

Surface water monitoring is carried out in accordance with the Procedure for State Water Monitoring approved by the Cabinet of Ministers of Ukraine on 19 September 2018, No. 758. The Ministry of Ecology, the State Agency of Water Resources and the State Emergency Service are the subjects of state water monitoring.

Every year, starting from 2020, surface water monitoring programmes are approved by the relevant orders of the Ministry of Ecology (Order No. 410 of 31.12.2020 "On Approval of State Water Monitoring Programmes", Order No. 3 of 05.01.2022 "On Approval of the State Water Monitoring Programme", Order No. 27 of 17.01.2023 "On Approval of the State Water Monitoring Programme").

4.1.1 Monitoring system

Surface water monitoring is carried out in accordance with the State Water Resources Agency's Order No. 18 of 25 January 2023, which approved the list of monitoring points for the IWM in terms of diagnostic, operational and research monitoring of pollutants to determine the state of the IWM. The monitoring programme includes chemical, physico-chemical, biological and hydromorphological parameters.

In the Danube basin in 2022, monitoring was carried out at 101 monitoring sites at 83 MPAs (Annex 6), including:

- at transboundary IBAs identified in accordance with intergovernmental cooperation agreements - 18;
- 11 at WSPs from which water is abstracted to meet the drinking and household needs of the population.

4.1.2 Hydromorphological assessment / condition

The hydromorphological condition is assessed in accordance with the Methodology approved by the Order of the Ukrainian State Geological Survey No. 23 of 19.02.2019, in five classes.

Hydromorphological monitoring was carried out at 58 WBMs (Annex 7). According to the monitoring results, 25 WBMs are classified as first class (high status), and 33 WBMs are classified as second class (Fig. 17).

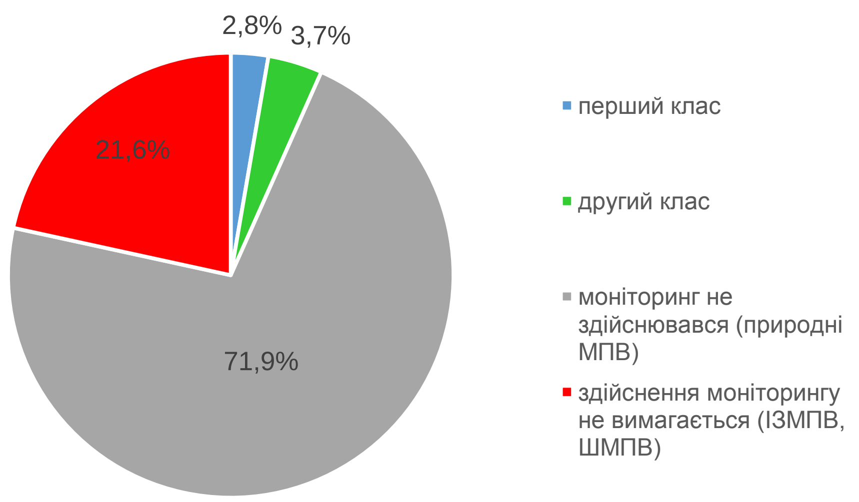


Figure 17. Hydromorphological state of the MWP, %.

4.1.3 Assessment of the chemical state

The assessment of the chemical state of the IWM is based on the determination of the concentrations of priority substances specified in Directive 2008/105/EC, taking into account Directive 2013/39/EU250, which sets the limit values of environmental quality standards. In Ukraine, the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45 of 6 February 2017, registered with the Ministry of Justice of Ukraine on 20 February 2017 under No. 235/30103, defines a list of indicators for which environmental quality standards are set in Annex 8 of the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 of 14.01.2019 No. 5 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial or Significantly Modified Surface Water Body to One of the Classes of Ecological Potential of an Artificial or Significantly Modified Surface Water Body".

Directive 2009/90/EC (Article 5) sets out technical requirements/criteria for the processing of monitoring data, which were also taken into account when assessing the chemical state of the WTG:

- If the measured value was below the limit of quantification (LOQ), the calculation uses the value of half the LOQ for that indicator;

- When summarising the results of individual isomers or mixtures (e.g. polycyclic aromatic hydrocarbons, cyclodiene pesticides, DDT), in the case of values measured below the LOQ, zero "0" should be used to calculate the average concentrations.

In addition, Article 4 of Directive 2009/90/EC stipulates that the methods for measuring the content of indicators must meet the minimum criteria: have a measurement uncertainty value below 50% (k=2) and a quantification limit equal to or below 30% of the relevant environmental quality standard.

Valuation reliability

The reliability of the chemical state assessment was performed using the criteria for establishing the reliability of the correct determination of the environmental and chemical states of the MSW specified in Annex 11 of the Order of the Ministry of Ecology and Natural Resources No. 5 of 14.01.2019.

According to the established criteria, a three-stage scheme was used to assess the reliability of the correct determination of the chemical state of the MPV:

- A high level of assessment reliability means that most of the requirements have been met, namely: measurement data are available for all indicators specified in the List of Pollutants for Determining the Chemical State of Surface and Groundwater Massifs and the Ecological Potential of an Artificial or Significantly Modified Surface Water Massif in accordance with the Order of the Ministry of Environment No. 45 dated 6 February 2017, hereinafter referred to as the List, which meet the requirements of the Procedure (almost all relevant requirements for the list of indicators, methods and frequency have been met); the aggregation of MPEs demonstrates reliable results;
- The medium level of reliability of the assessment of the state of the IAP is established in the absence of sufficient monitoring data, frequency and measurement of all indicators identified in the List;

- The low level of reliability of the assessment of the state of IWM means that the assessment of the state of IWM was based on risk assessment, transfer of monitoring data through aggregation of IWM according to certain criteria.

To assess the chemical state of the MPA, we used statistically processed data of measurements of pollutant content in surface waters conducted at 109 monitoring points, namely, the average and maximum values.

Background concentrations for non-synthetic substances (mercury, lead, cadmium, nickel) were not taken into account when assessing the chemical state of the MPW.

Compliance of the measurement results with the environmental quality standards set for the annual average and maximum permissible concentrations is considered to be compliance with the requirements set for the "good" chemical condition of the Waste Water Treatment Plant.

For MPEs where no monitoring was carried out, the chemical state was assessed by interpolating (transferring) the assessment results from the monitored MPEs according to the MPE aggregation.

The following parameters were not measured: brominated diphenyl ethers (esters), chloralkanes, C $_{,10\text{-}13}$ di-(2-ethylhexyl)-phthalate, diuron, isoproturon, pentachlorophenol, tributyltin compounds (tributyltin cation), perfluorooctane sulfonate and its derivatives (PFOS), dioxins and dioxin-like compounds, hexabromocyclo-dodecane (HBCDD).

For the indicators fluoranthene, hexachlorobenzene, hexachlorobutadiene, mercury and its compounds, dicofol, heptachlor and heptachloroepoxide, for which the recommended object of control is biota, due to the lack of technical capabilities and measurement methods, concentrations were determined only in surface water samples.

The chemical state was assessed on the basis of monitoring data obtained as part of the diagnostic and operational monitoring of WIPPs in 2022 for 91 WIPPs (Annex 8).

The results of the assessment of the chemical state of the MPW based on monitoring data (Table 19):

- chemical condition is "good": 26 linear MPEs (3.1% of the total number of linear MPEs), by the length of MPEs it is 526.5 km (6.7% of the total length of linear MPEs); 1 polygonal MPE (2% of the number of polygonal MPEs), by the area of MPEs it is 1.43 km^2 (0.2% of the area of polygonal MPEs);
- chemical status "not achieving good": 55 linear MPEs (6.6% of the total number of linear MPEs), by MPE length this amounts to 1235.54 km (15.7% of the total length of linear MPEs); 9 polygonal MPEs (18.4% of the total number of polygonal MPEs), by MPE area this amounts to 444.82 km^2 (59.8% of the total area of polygonal MPEs).

Table 19: Chemical state of the WRF for the period 2020-2022 (according to monitoring data)

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	total area of the MWP, km^2
"good"	26	526,5	1	1,43
"underachievement good"	55	1235,54	9	444,82

The following substances have been found to exceed the MAC$_{MAX}$ - maximum permissible concentration and/or MAC$_{CP}$ - average annual concentration:
- cadmium (for 4 MPVs);
- nickel and its compounds (for 5 MPV);
- lead and its compounds (for 1 MPE);
- mercury and its compounds (for 2 MPVs);
- fluoranthene (for 25 MPV);
- benzo(*a*)pyrene (for 68 MPV);
- benzo(*b*)fluoranthene (for 9 MPV);
- benzo(*k*)fluoranthene (for 8 MPV);
- benzo(*g,h,i)* perylene (for 15 MPV);
- Cypermethrin (for 21 MPVs);
- dicofol (for 12 MPV);
- dichlorvos (for 1 MPV);
- of lucitrins (for 8 MPVs);
- anthracene (for 1 MPE).

Based on interpolation of the monitoring results according to the aggregation of IAPs (low level of reliability of the IAPs assessment) (Table 20), the following was established:

- chemical condition is "good": 92 linear MPPs (11% of the total number of linear MPPs), with a length of 547.04 km (7% of the total length of linear MPPs);
- chemical condition "failure to achieve good": 280 linear MPVs (33.4% of the total number of linear MPVs), by MPV length this amounts to 2728.31 km (34.8% of the total length of linear MPVs); 4 polygonal MPVs (8.2% of the number of polygonal MPVs), by MPV area this amounts to 3.35 km^2 (0.5% of the area of polygonal MPVs).

Table 20. Chemical state of the WRF based on interpolation of monitoring data

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	total area of the MWP, km^2
"good"	92	547,04	0	0
"underachievement good"	280	2728,31	4	3,35

A general assessment of the chemical state of the WBF for the period 2020-2022 (monitoring data and interpolation of monitoring data) is presented in Table 21 and Figures 18-19 (Annex 9).

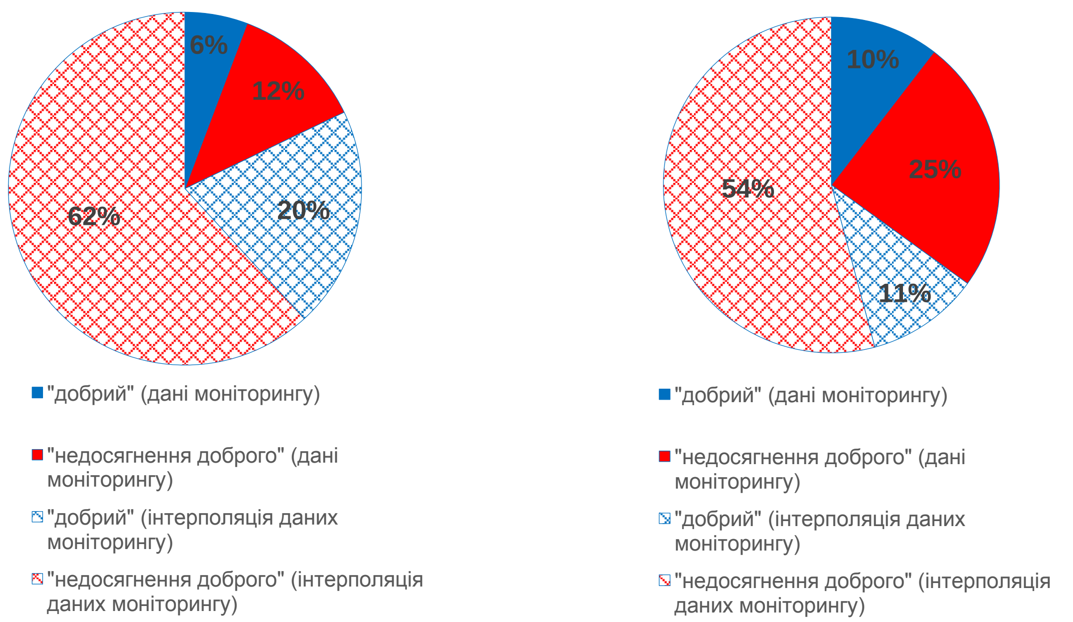
Table 21. General assessment of the chemical state of the WRF for the period 2020-2022 (monitoring data and interpolation of monitoring data)

Chemical state	number of linear MPVs	total length of linear IPPs, km	number of polygonal MPAs	total area of polygonal landfill sites, km^2
"good"	118	1073,54	1	1,37
"underachievement good"	335	3963,85	13	448,17

For 91 MPEs, the reliability of the assessment of the correct chemical state determination corresponds to the average level of reliability.

376 WSCs were assessed with a low level of confidence based on the transfer of results obtained from the surface water quality monitoring programme to WSCs where no monitoring was carried out, according to the WSC aggregation.

Taking into account the interpolation of monitoring data, the chemical state was assessed for 453 linear MPAs, which is 5037.39 km in length, and 14 polygonal MPAs, which is 449.54 km in area^2 .



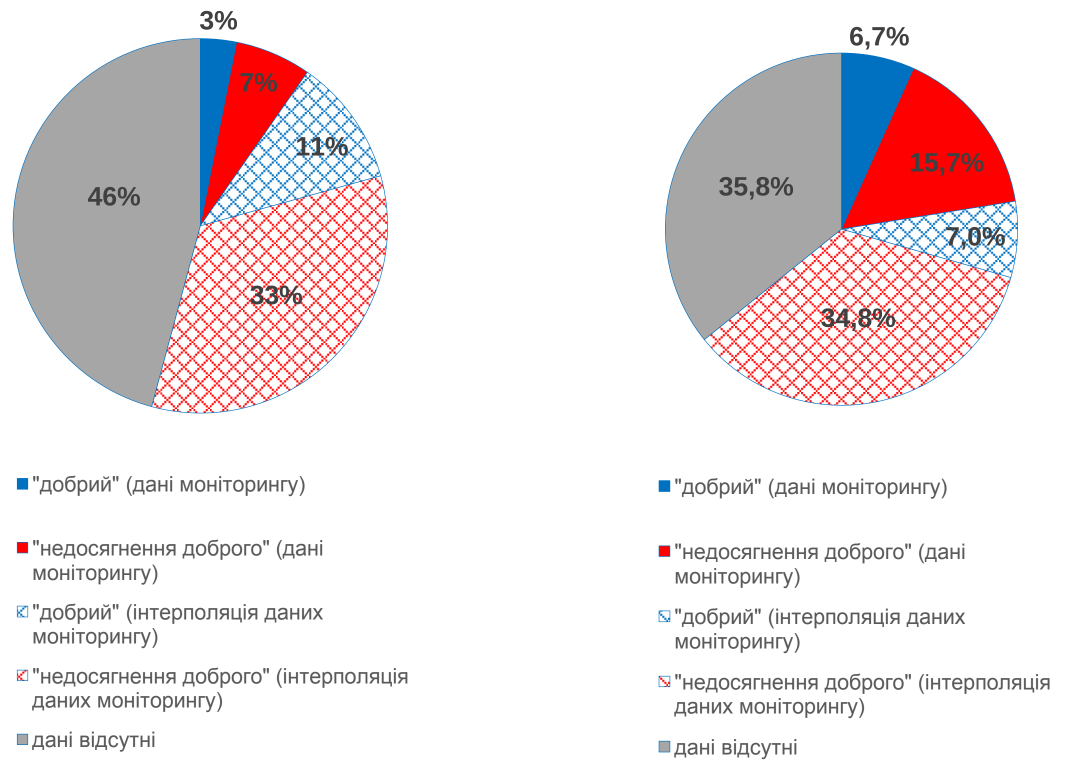
a) by the number of IPAs b) by the length of IPAs

Figure 18. Assessment of the chemical state of linear MPVs (monitoring data and interpolation of monitoring data)

a) by the number of IPPs b) by the area of IPPs

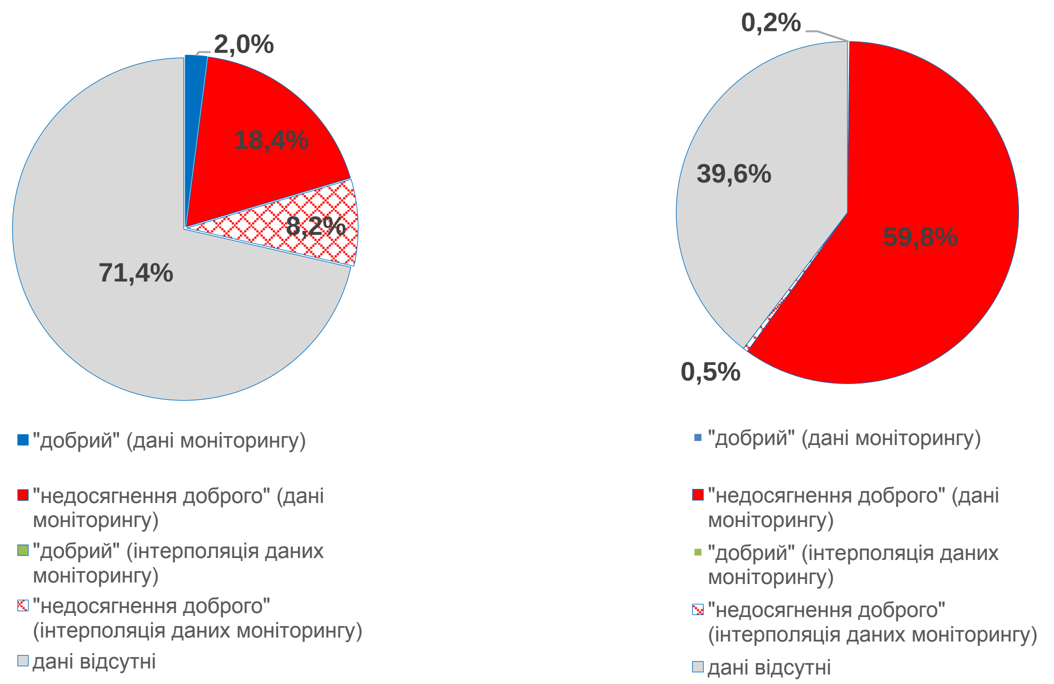
Figure 19. Assessment of the chemical state of landfill MRFs (monitoring data and interpolation of monitoring data)

Summarised assessments of the chemical status of the linear MPAs and polygonal MPAs in the Danube basin are shown in Figures 20 and 21.



a) by the number of IPAs b) by the length of IPAs

Figure 20. Overall assessment of the chemical state of the Danube basin's linear MPAs



a) by the number of IPPs b) by the area of IPPs

Figure 21. Summary assessment of the chemical state of landfill sites in the Danube basin

4.1.4 Environmental assessment

The assessment of the environmental status of the Danube basin's MPAs is carried out in accordance with the criteria and list of indicators set out in the Order of the Ministry of Ecology and Natural Resources No. 5 of 14 January 2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Environmental and Chemical Status of a Surface Water Body, as well as Assigning an Artificial or Significantly Altered Surface Water Body to One of the Classes of Environmental Potential of an Artificial or Significantly Altered Surface Water Body".

Five classes are used to classify the ecological status of a surface water body: "excellent", indicated in blue, "good", indicated in green, "satisfactory", indicated in yellow, "poor", indicated in orange, and "very poor", indicated in red.

As of the end of 2023, the environmental status of any of the MPFs had not been determined.

In 2022, biological indicators were monitored at 75 MPAs:

- phytoplankton;
- microphytobenthos;
- vascular plants;
- bottom macroinvertebrates.

No fish monitoring was carried out.

The assessment of the state of the MNR by biological indicators (except fish) is presented in Figure 22.

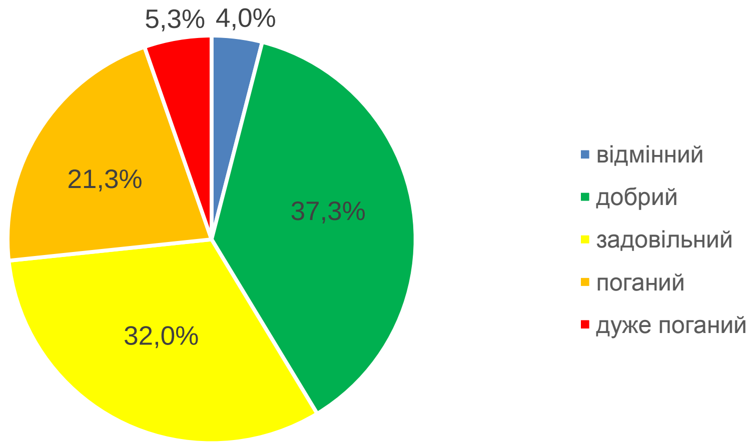


Figure 22. Evaluation of MPAs by biological indicators, %.

4.1.5 Assessment of environmental potential

The assessment of the environmental potential of the Danube River Basin MPAs is carried out in accordance with the criteria and list of indicators set out in the Order of the Ministry of Ecology and Natural Resources No. 5 of 14 January 2019 "On Approval of the Methodology for Assigning a Surface Water Body to a Class of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial or Significantly Modified Surface Water Body to a Class of Ecological Potential of an Artificial or Significantly Modified Surface Water Body".

For an artificial or significantly altered surface water body, the ecological potential is determined, for which four classes are used - "good", indicated by parallel bars of green and grey, "satisfactory", indicated by parallel bars of yellow and grey, "poor", indicated by parallel bars of orange and grey, and "very poor", indicated by parallel bars of red and grey.

No assessment of the environmental potential of significantly altered and artificial MPAs has been carried out.

4.2. Groundwater

4.2.1 Monitoring system

The quantitative and chemical state of groundwater is monitored within the framework of the state groundwater monitoring system, and changes in the state are predicted both under natural conditions and under the influence of human activity. Quantitative and chemical monitoring is carried out in the same observation wells. The monitoring is carried out in both non-pressure and pressure aquifers under natural, slightly disturbed and disturbed conditions. The disturbed conditions are investigated within the operational water intakes.

The state groundwater monitoring includes diagnostic and operational monitoring, the indicators and frequency of which are defined in accordance with the WFD and are set out in Annex 2 of the Procedure for State Water Monitoring. The components of state monitoring of groundwater bodies include monitoring of quantitative, chemical and physico-chemical indicators. The Procedure for State Water Monitoring does not define the monitoring network (in particular, the number of monitoring points), but establishes the frequency and indicators to be monitored.

As of 01.01.2018, the groundwater monitoring network in Ukraine consisted of 892 observation points: 288 wells in non-pressure aquifers, 214 wells in pressure aquifers and 390 wells at production water intakes. In 2018, groundwater levels in Ukraine were monitored at 179 observation points, and chemical composition at 103 observation points.

Groundwater monitoring has not been carried out since 2018, and the condition of the water intake facilities is unknown.

4.2.2 Chemical assessment/risk assessment

The frequency of observations and the list of monitored indicators are defined in Annex 2 of the State Water Monitoring Procedure.

Given the long period of absence of monitoring, as well as the limited number of observation points, it is necessary to conduct diagnostic monitoring of groundwater quality indicators of all identified MHWs at all observation wells.

The frequency and list of monitored indicators of operational monitoring shall be determined taking into account the results of diagnostic monitoring.

As of the end of 2023, the environmental assessment/risk assessment of the Mine was not conducted.

4.2.3 Estimation of groundwater volumes/reserves

As of the end of 2023, no assessment of groundwater volumes/reserves had been made.

5 A LIST OF ENVIRONMENTAL OBJECTIVES FOR SURFACE WATERS, GROUNDWATER AND PROTECTED AREAS (TERRITORIES) AND DEADLINES FOR THEIR ACHIEVEMENT (IF NECESSARY, JUSTIFICATION FOR SETTING LESS STRINGENT OBJECTIVES AND/OR POSTPONEMENT OF THEIR ACHIEVEMENT)

Environmental targets for surface water, groundwater and protected areas (territories) are set separately.

Surface water:

- Prevent deterioration of all arrays;
- Achievement/maintenance of "good" ecological and chemical status of all natural MPAs (rivers, lakes, transitional and coastal waters);
- Achievement/maintenance of "good" ecological potential and chemical state of significantly altered and artificial MPAs;
- Gradual reduction of pollution by hazardous substances to zero.

Groundwater:

- Prevent deterioration of all arrays;
- Achievement/maintenance of "good" quantitative and qualitative condition of all MNRPs;
- Preventing and limiting groundwater pollution.

Areas (territories) to be protected:

Achieving standards and targets as required by applicable law for:

- Emerald Network facilities;
- sanitary protection zones;
- protection zones for valuable aquatic bioresources;
- surface/ground water bodies used for recreational, medical, resort and health purposes, as well as water intended for bathing;
- areas vulnerable to (accumulation of) nitrates**;**
- vulnerable and less vulnerable zones identified in accordance with the Law of Ukraine "On Drinking Water, Drinking Water Supply and Sewerage".

MHB and MHZB are determined according to the Methodology for Determining Surface and Groundwater Massifs (Order of the Ministry of Ecology No. 4 of 14.01.2019). The assessment of the status or potential of MHBs is carried out in accordance with the Methodology for assigning a surface water body to one of the classes of ecological and chemical status of a surface water body, as well as assigning an artificial or significantly altered surface water body to one of the classes of ecological potential of an artificial or significantly altered surface water body (Order of the Ministry of Ecology No. 5 of 14.01.2019).

In cases where several objectives are set for a particular water body, the most stringent ones should be applied, while all other objectives should also be met.

In some cases, the timing of environmental targets or the targets themselves may be changed as an exception.

It is allowed to postpone the date of achievement of the target for a period not longer than 12 years from the end of the implementation of the first cycle of the RBMP (i.e., until the end of 2042).

The exemption applied to a particular MNV or MNZV shall not create a risk of not achieving the environmental objectives of the massif or massifs located nearby.

The exceptions include:

– **Achievement of less stringent targets or postponement of the date of** its achievement due to technical reasons (e.g. lack of a technical solution, technical impracticality or impracticability), disproportionately high cost or the existing natural state of the water body that does not allow for its improvement in time. The presence or absence of disproportionality is determined by the results of an economic assessment of costs and benefits;

– **Temporary deterioration of the state (goals) as a result of an unforeseen force majeure of** natural origin (e.g. extreme flood, drought) or anthropogenic (accident);

– **New physical modifications of a water body as a result of new infrastructure projects** aimed at economic development (e.g., a road or railway, a hydroelectric power plant). In other words, hydromorphological changes to the MPA are allowed (up to the point of classifying it as "significantly altered"), but any water pollution from point or diffuse sources is not allowed. New physical modifications of a water body are allowed when the benefits to society outweigh the environmental benefits and there is no other option to avoid these modifications for technical and/or financial reasons.

All exceptions should be carefully justified and written in the RBMP in the form of text in section 5 and tables in a separate annex. The reason for postponing or setting less stringent targets (one or more of the three), as well as the timeframe for postponement (first or second cycle of the RBMP update) should be clearly stated.

For transboundary river basins (primarily those shared with EU countries), the application of exemptions to a particular water body should be coordinated and agreed upon.

5.1 Environmental targets for surface water

Based on the results of the assessment of the anthropogenic impact on the MPAs of the Danube basin:

- 394 MNEs are "at no risk" of not achieving "good" environmental status/potential, 165 MNEs are "possibly at risk", and 326 MNEs are "at risk";
- 752 MPEs are "without risk" of not achieving "good" chemical status, 35 MPEs are "possibly at risk", and 98 MPEs are "at risk".

By 2030, 438 MNPs will achieve "good" environmental status/potential, of which 394 MNPs are currently "without risk" (they need to maintain this status), 31 MNPs are 5% of MNPs that are "at risk" or "possibly at risk" of not achieving environmental objectives based on the results of the anthropogenic load assessment and will achieve environmental objectives through the implementation of PA measures.

The remaining 'at risk' or 'possibly at risk' MPSs in the basin (447 MPSs) could achieve 'good' ecological status/potential by 2036 or 2042, subject to the implementation of remedial measures.

By 2030, 823 MPAs will have achieved "good" chemical status, of which 752 MPAs are currently "no risk" (they need to maintain this status), and 62 MPAs, which are "at risk" or "possibly at risk" according to the results of the anthropogenic load assessment, will achieve the environmental objectives not earlier than 2036 or 2042, subject to the implementation of environmental protection measures.

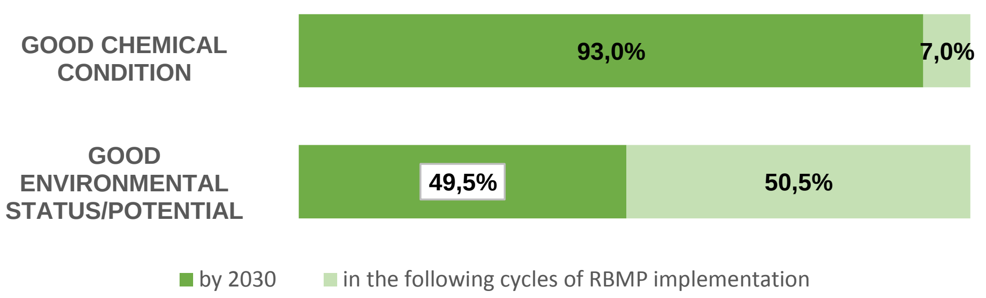


Figure 23: Timeframe for achieving environmental targets for MPEs, %.

Annex 10 (Table 1) lists the environmental targets of the MIP, the timeframe for achieving them, reasons for postponement and setting less stringent targets.

5.2 Environmental objectives for groundwater

Environmental targets are set for each MPZ, both in terms of their quantitative and qualitative (chemical) status. According to the WFD, the main objective is to achieve "good" groundwater status.

Additional targets for each individual IWR are defined depending on the existing quantitative and qualitative state of IWR, their use or potential use for water supply to the population, anthropogenic pressure and possible impact on surface ecosystems.

The main criterion for the "good" quantitative state of the MHW should be the absence of groundwater depletion. Depletion is considered to be the state of aquifers in which, under the influence of artificial drainage, the decline in groundwater levels has reached such indicators that exclude the possibility of further use of the horizon to meet the needs of society using traditional technical means.

The assessment of the depletion of an ASBM is based on information on the level regime, data on groundwater extraction volumes and their comparison with resources and approved operational reserves. In addition, for non-pressure ASFs, the criterion of "good" condition is the appropriate condition of the associated surface water bodies and the absence of negative impact on surface ecosystems, primarily vegetation suppression.

The criteria for the "good" quality (chemical) state of the MPW are the natural background content of chemical elements and compounds, as well as the standards set for drinking water by the State Sanitary Norms and Rules "Hygienic Requirements for Drinking Water Intended for Human Consumption" (hereinafter - SanPiN 2.2.4-171-10).

Quantitative state of non-pressure MPPs

The environmental goal is to avoid groundwater depletion and not to deteriorate its quantitative state. Groundwater depletion is an irreversible decrease in groundwater resources due to the excess of groundwater extraction over groundwater recharge.

Qualitative (chemical) state of non-pressure water treatment plants

Given the almost complete absence of groundwater monitoring data, the only environmental goal for non-pressure groups of MWRs can only be the stability of quality indicators (no deterioration).

Quantitative state of pressure vessels

The quantitative state of pressure IWRMs is assessed by comparing the volumes of water withdrawal from these IWRMs at water intakes with the volumes of projected groundwater resources.

The environmental objective is the stability of the quantitative state and the absence of groundwater depletion. At groundwater abstractions, the volume of water withdrawal should not exceed the estimated operational reserves (within groundwater deposits).

Chemical state of pressure vessels

Since groundwater of all the pressure WTPs is used for centralised drinking water supply to the population, the criteria of "good" chemical condition was chosen as compliance of groundwater chemical parameters with the State Sanitary Norms and Rules "Hygienic Requirements for Drinking Water Intended for Human Consumption" (SanPiN 2.2.4-171-10).

This document is mandatory for executive authorities, local governments, enterprises, institutions, organisations, regardless of ownership and subordination, whose activities are related to the design, construction and operation of drinking water supply systems, production and circulation of drinking water, supervision and control over the supply of drinking water to the population and citizens.

The Sanitary and Epidemiological Norms and Regulations 2.2.4-171-10 sets standards for drinking water, including tap water, water from bottling sites and pump rooms, as well as water from wells and springs, in terms of sanitary, chemical and epidemiological safety of drinking water.

Exceptions are indicators exceeded in groundwater due to natural factors.

Non-pressure groundwater bodies in the Danube basin are naturally conditionally protected and protected; pressure groundwater bodies are protected. At the same time, in some areas, spot pollution of groundwater with nitrogen compounds is periodically observed, which, in the absence of a source, may indicate the inflow of pollution from overlying aquifers through defective wells.

The basin's groundwater is used for water supply, including centralised water supply. Therefore, the groundwater resources are under pressure. However, groundwater extraction does not exceed the value of forecasted resources and operational groundwater reserves. Groundwater exploitation has not led to significant changes in the water level regime, and the reduction of the operational load in recent years has contributed to the recovery of water levels.

Thus, according to preliminary data, the identified MPZV are in "good" quantitative and "good" qualitative condition. This also applies to groundwater common in the southwest and south, which is characterised by naturally high content of chlorides, sulphates, sodium, and mineralisation.

The environmental objectives for the Danube RBM are to preserve the current state of the RBM. Failure to achieve the environmental objectives is possible in the event of continued uncontrolled use of groundwater (construction of wells without designs, with violations of drilling technology, using plastic casing); failure to identify and eliminate idle unmanaged wells.

However, the primary goal is to resume groundwater monitoring in the basin, which has been virtually suspended in recent years. In the absence of groundwater monitoring, it is unlikely that all of these goals will be achieved. The unsatisfactory state of groundwater monitoring over the past decades, and, accordingly, insufficient information on the current state of the MMP, allows us to define environmental objectives only in the most general terms. In the course of monitoring, the environmental objectives for each MPZ should be specified.

Appendix 10 (Table 2) lists the environmental targets of the MNEs and their groups, the timeframe for achieving them, reasons for postponing them and setting less stringent targets.

Among the current stage of work, all 7 groups of MPSs and their groups of "good" quantitative and chemical status in the Tisza sub-basin (3 non-pressure, 2 pressure and 2 pressure-non-pressure) are projected to be achieved only in the 2nd RBMP cycle, not earlier than 2042, and only if the proposed measures for both surface and groundwater are implemented. 100% of the Prut and Siret sub-basins are projected to remain in "good" quantitative and qualitative status by 2030. In the Lower Danube sub-basin, only 1 and only one MNRB will reach "good" quantitative status by 2030, and it will reach "good" chemical status in 2042.

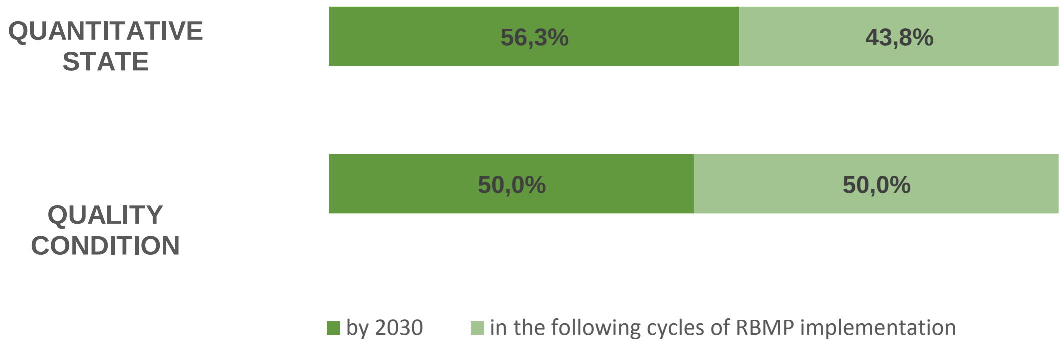


Figure 24. Timeframe for achieving environmental targets for MMPPs, %.

6 ECONOMIC ANALYSIS OF WATER USE

6.1 Economic development of the basin area

Territorially, the Danube River Basin region partially covers 3 oblasts and fully 1 oblast, and accounts for 5% of Ukraine's territory (Table 22).

The total population of the river basin is about 3.532 million people, which is 8.5% of Ukraine's population.

Table 22. Share of area and population of oblasts within the Danube RBM[6] , %.

Areas.	Share of the region's area within the basin	Share of the region's population within the basin
Transcarpathian	100	100
Ivano-Frankivsk	35	30
Chernivetska	81	86
Odesa	21	14

Thus, there is a relative balance between the area of oblasts within the basin and the population living in the oblasts. The majority of the population lives in the Tisza sub-basin, which corresponds to the territory of the Transcarpathian region.

Analysis of the RDB Danube's GRP. In 2019, the RDB Danube's GRP amounted to UAH 164.366 billion. The dynamics of this indicator over the entire study period of 2015-2019 shows a tendency to grow at different rates in different periods - the highest GRP growth rate was observed in 2017 (at 30%), while in 2019 this rate decreased (to 17%). The share of the basin's GRP in the country's total GDP is almost 4% (Table 23).

Table 23: Evolution of GRP of the Danube RBM, 2015-2019[7]

Indicators.	2015	2016	2017	2018	2019
GRP in actual prices, UAH billion	71,847	81,921	106,490	127,864	148,910
Share of river basin GRP in the total GDP of Ukraine, %.	3,6	3,4	3,6	3,6	3,7
Growth rate of the basin's GRP, % compared to the previous year	100	114,0	130,0	120,1	116,5

In the Danube RBD, Zakarpattia region has the largest share of GRP by region (41% of the basin's GRP). Within Chernivtsi region, 24% of the basin's GRP is generated, while Ivano-Frankivsk and Odesa regions account for 17% of GRP each. At the same time, the population share is only 14%. This indicates a more developed economic activity in Odesa region.

The GRP per capita in the Danube basin is UAH 54.5 thousand, which is almost half the level of the whole of Ukraine (as of 2019, the GRP per capita was UAH 94.7 thousand).

Danube RBD GVA analysis. The value of GVA in actual prices is UAH 131.092 billion for the basin, or 3.8% of Ukraine's total GVA.

Agriculture, forestry and fisheries account for the largest share in the overall structure of the basin's GRP, accounting for UAH 18.6 billion or 14%, and its share in the total GRP of Ukraine is 5.2%. GVA by economic activity in the Danube basin is shown in Table 24. Among the water-dependent economic sectors, the processing industry has a fairly high share in the overall structure of the basin's GRP - UAH 12.7 billion or 9.7%, which corresponds to 3.0% of Ukraine's total GRP. The share of water-dependent economic activities in the basin is 41.5%. Other, non-water-dependent economic activities in the Danube basin account for almost 60% of the total GVA.

Table 24. GVA of the RDB Danube by economic sector, 2019

Sectors of the economy	AIRBORNE FORCES , million UAH	Share in Ukraine's	Share in the basin's GVA, %.

[6] Determined by working with shapefiles from the Water Resources of Ukraine geoportal and population using ArcGIS

[7] Calculated based on data from the State Statistics Service of Ukraine *http://www.ukrstat.gov.ua/*

		airborne troops, %.	
Agriculture, forestry and fisheries	18585,2	5,2	14,2
Mining and quarrying	2367,03	1,1	1,8
processing industry	12705,4	3,0	9,7
supply of electricity, gas, steam and air conditioning	5165,77	4,1	3,9
Water supply; sewerage, waste management	511,52	3,5	0,4
transport, warehousing, postal and courier services	15069,2	5,7	11,5
TOTAL water-dependent economic activities	54404	3,9	41,5
Other types of economic activity	76688	3,8	58,5
IN TOTAL ACROSS THE POOL	**131092**	3,8	**100**

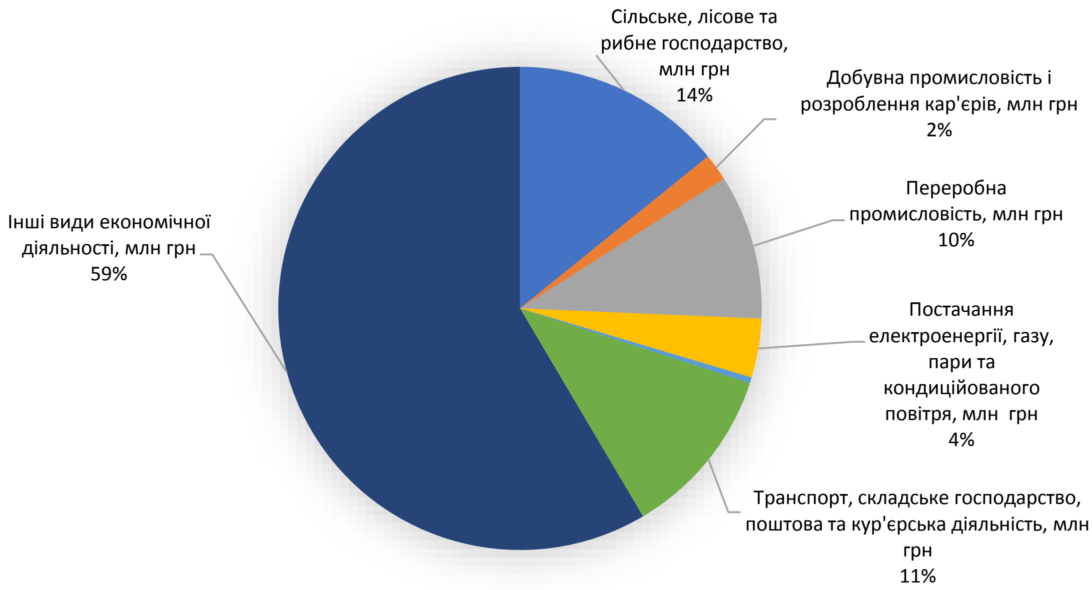


Figure 25: Gross value added by region within the Danube basin by economic sector (2019)

The dynamics of the GVA of water-dependent economic activities in the Danube River basin in 2015-2019 decreased from 48% in 2016 to 41.6% in 2019 of the basin's GVA and shows a downward trend. The decline in the total value of the GVA of water-dependent sectors was due to the decline in the GVA of agriculture, forestry and fisheries over the past 5 years. Other water-dependent sectors of the economy show fluctuations in GVA, with the processing industry showing a slight increase in its share of GVA. In turn, the growth of the total GVA of the Danube basin is mainly driven by other non-water-dependent sectors of the economy.

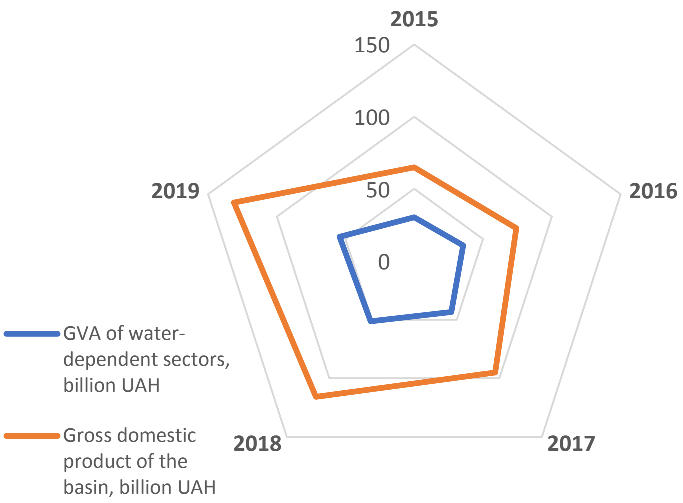


Figure 26. Dynamics of the share of GVA of water-dependent economic activities in the total GVA of the Danube basin, 2015-2019, billion UAH

6.2 Characteristics of modern water use

In 2019, water users withdrew 747.1 million m³ of water from groundwater and surface water bodies in the Danube basin, which is about 7% of water withdrawals in Ukraine.

The main source of water withdrawal is surface water (94% of the Danube basin's water withdrawal). In terms of sub-basins, 95% of surface water abstraction is taken from the Lower Danube sub-basin in Odesa Oblast. In the Tisza, Prut and Siret sub-basins, groundwater abstraction accounts for at least 40% of the total abstraction in the basin.

Figure 27: Sources of water abstraction in the Danube basin

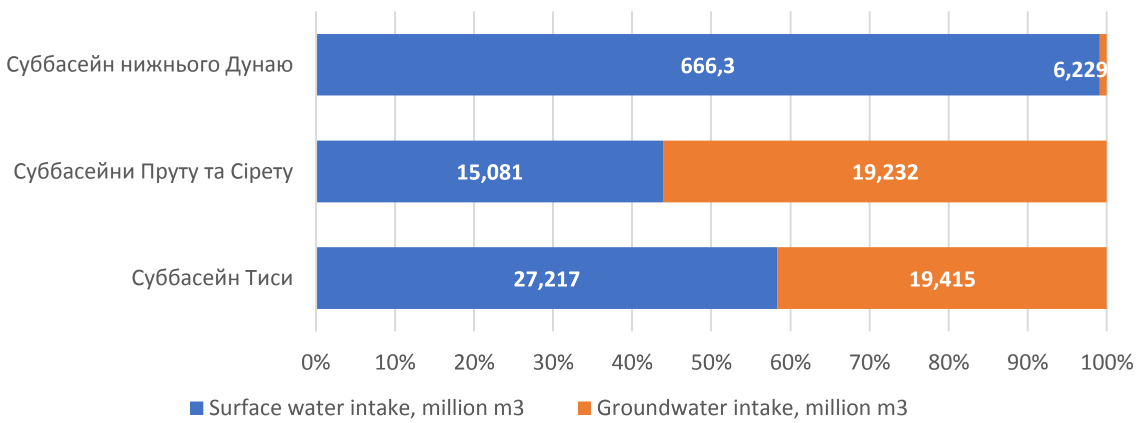


Figure 28. Distribution of water sources by sub-basin

The bulk of the water intake is carried out in the Lower Danube sub-basin within the Odesa region, which is associated with water supply for irrigation for agricultural producers.

The main water users within the basin are the following economic sectors: agriculture, housing and communal services, industry and transport.

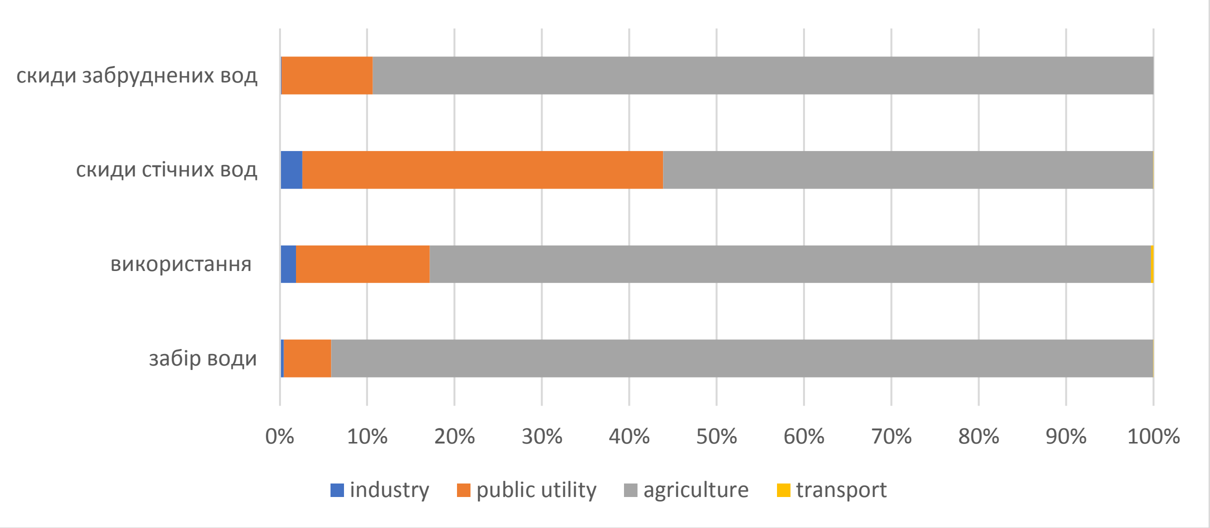


Figure 29: Characteristics of water use in the Danube basin[8]

The structure of water use is as follows: 94% of water resources are consumed by agriculture, 5.4% by housing and communal services, and less than 1% by industry, transport and other sectors.

The volume of water used in the basin is 203.9 million m^3 .

A detailed description of water use in the Danube basin by economic sector is presented in Annex 11.1.

As for the structure of wastewater discharge, 55% of wastewater is discharged into surface water bodies by agriculture, 40.5% by housing and communal services, and only 2.5% by industrial water users.

About 40% of the wastewater volume is normatively treated at wastewater treatment plants, 31% is normatively clean without treatment and 28% is polluted wastewater.

Almost all (89%) of polluted wastewater comes from agricultural water users.

Information on wastewater discharges to water bodies by categories of discharged water is provided in Annex 11.2.

To assess the socio-economic importance of water for economic sectors, we used a ranking of water users by 5 indicators adapted to the recommendations of the methodology[9] :

- GVA generated by the industry is an economic indicator of the sector's weight in the sub-basin economy;
- the volume of water withdrawn by the industry;
- water intensity of the industry compared to other industries;
- The industry's dependence on water quality;
- pollution of water bodies by the industry's waste water.

Table 25: Water intensity of economic sectors

Industry sector	Water intake, million m^3	Gross domestic product, UAH million	Water intensity of airborne troops, m^3 /1000 UAH
Industry	3,496	20238,15	0,17
Housing and utilities	40,24	511,52	78,67

8 Data source: State water cadastre data, section "Water use", 2019 State Agency of Water Resources of Ukraine

9 Report of the European Union "The Economic Value of Water - Water as a Key Resource for Economic Growth in the EU"

Agriculture	699,0	18585	37,61
Transport	0,3	15069	0,02
Total for the pool	**747,1**	**131092**	**0,59**

Table 26. Socio-economic weight of the main water users

Sectors of the economy	Scope of airborne forces creation	Water intake by the industry	Water intensity of the industry	Dependence on water quality	Waste water contamination
Energy	moderate	low	moderate	low	moderate
Ferrous metallurgy	moderate	low	low	low	low
Chemical industry	moderate	moderate	low	low	low
Mechanical engineering and metalworking	moderate	moderate	low	low	moderate
Woodworking	moderate	moderate	low	low	moderate
Food industry	moderate	moderate	moderate	high	moderate
Coal industry	moderate	low	low	low	low
Housing and utilities	moderate	high	high	high	high
Fisheries	high	high	high	moderate	moderate
Operation of irrigation systems (including irrigation)	high	high	high	high	high
Other types of agriculture (including livestock and crop production)	high	moderate	high	high	low
Transport	high	moderate	low	low	moderate
Recreation and healthcare	moderate	low	moderate	high	moderate
Trade	high	low	low	low	low

Based on the results of the assessment of dependence on the five criteria above, the economic sectors are divided into 5 groups according to their socio-economic importance in the Danube basin.

Group 1 "Full dependence" includes water users that are highly dependent on all 5 or 4 indicators - on water quality, high water intensity, exert significant pressure on water resources and produce small amounts of GWP, for example, irrigation (operation of irrigation systems) and housing and communal services. Water in these sectors is a key factor for their operations.

Group 2, "Multiple dependence" - have high dependence on at least two indicators - fisheries and agriculture.

Group 3, "Specific dependence", includes the food industry, transport, trade, recreation and healthcare, which are highly ***dependent*** on one indicator.

Group 4 "Moderate dependence" - have moderate dependence on at least 2 indicators - energy, chemical industry, machine building and metalworking, woodworking.

Group 5, "Dependence without water use", includes economic sectors that use water without abstraction from natural water bodies, generate low volumes of GWP and are minor polluters. This group includes the coal industry and ferrous metallurgy.

<table>
<tr><th>high</th><th>significant</th><th>moderate</th><th>low</th><th>minor</th></tr>
<tr><td colspan="4">Coal industry</td><td rowspan="4">Black metallurgy</td></tr>
<tr><td colspan="4">Energy Woodworking</td></tr>
<tr><td colspan="3">Recreation
and healthcare Transport</td><td rowspan="2">Chemical industry</td></tr>
<tr><td colspan="2">Fisheries</td><td>Trade</td></tr>
</table>

Irrigation (operation of irrigation systems) Housing and utilities	Other types rural farms (crop and livestock production)	Food industry	Mechanical engineering and metalworking	

Figure 30. Socio-economic importance of economic sectors

According to the assessment of the socio-economic significance of irrigation (operation of irrigation systems) and housing and communal services, they are completely dependent on water resources and are the most water-intensive sectors of the economy (78.67 m^3 /1000 UAH).

6.2.1 Municipal water use

The Danube RBF is characterised by different priorities for economic sectors in terms of water use in its sub-basins. For example, in the Tisza, Prut and Siret sub-basins, the main water user is the housing and utilities sector. Whereas in the Lower Danube sub-basin, irrigation (operation of irrigation systems) is predominant.

Municipal water use is aimed at meeting the drinking and household needs of the population, household and public utilities, public services, and industrial enterprises in settlements connected to local water supply systems. The volume of municipal water consumption depends on the number of residents, the degree of urbanisation and climatic conditions. Municipal water use is mainly concentrated in large settlements, such as Chernivtsi, Kolomyia, Kosiv, Verkhovyna, Yaremche, Sniatyn, Kitsman, Storozhynets, Hlyboka, Mukachevo, Svaliava, Izmail, Bolhrad, Kilia, Vilkovo, etc.

In 2019, water users in the residential and communal sector withdrew 40.24 million m^3 of water (5.4% of the total water withdrawal in the basin) and used 30.37 million m^3 of water.

The largest water users in this sector in the basin are Mukachevvodokanal - 8.978 million m3^3 , Municipal Enterprise "Vodokanal of Uzhhorod" - 8.749 million m^3 , "Chernivtsi Vodokanal" - 4.766 million m^3 , "Izmail VUVKG" - 1.862 million m^3 , "Vynohradiv VUZHKG" - 1.003 million m^3 , Khust VUVKG - 0.740 million m^3 , Svalyava RKPVV - 0.705 million m^3 , Storozhynets VUVKG - 0.257 million m^3 , Kitsman VUVKG - 0.226 million m^3 , ME "Svitlo" m. Kiliya - 0.173 million m^3 , Municipal Enterprise of the Bolgrad City Council "Horvodokanal" - 0.141 million m^3 , Hlybotske VUZHKG - 0.131 million m^3 , Municipal Enterprise "Vilkovo Miskodokanal" - 0.084 million m^3 .

Water losses during transportation for own needs in the municipal sector are significant and amount to 14.818 million m^3 . The housing and utilities sector is the second largest polluter in the basin after agriculture, as it discharged 3.804 million m^3 of polluted wastewater in 2019 (10.4% of the total discharge of polluted water within the basin).

The rate of physical deterioration of water supply and sewerage facilities outstrips the dynamics of their renewal and development, which directly depends on the capacity of the state and local budgets to finance these activities. The main problems of housing and communal services are the uneven nature of water supply coverage (for example, in the Tisza sub-basin, only 7 cities and 9 urban-type settlements receive round-the-clock water supply services. Other settlements are provided with water according to a schedule), insufficient coverage of the population by sewage systems, deterioration of the water supply and sewage network, inefficient operation of treatment facilities, which leads to the supply of water of inadequate quality to consumers and discharge of polluted water into water bodies. The current increase in the quantitative indicators of sanitary standards for drinking water necessitates the re-equipment of existing water treatment plants with the introduction of the latest water treatment technologies and the construction of new ones.

6.2.2 Industrial water use (by major water users, including energy)

Water abstraction by industrial water users in 2019 amounted to <1% of the basin (3.496 million m3^3). The needs of industrial water users are met both from groundwater bodies and surface water bodies. The water used by industry is 3.691 million m^3 .

The largest consumers of water are the forestry and woodworking industries (1.886 million m3^3), food processing (0.639 million m3^3) and pulp and paper (0.480 million m3).[3]

The main industrial water users in the basin are the following enterprises: PJSC "Pulp and Cardboard Mill", ALC "Perechyn Timber and Chemical Plant" - 0.502 million m^3 , Mamalyhiv Gypsum Plant - 0.284 million m^3 , SE "Ukrspirt" Zaluchanske MPD Sniatyn district - 0.213 million m^3 , UAP LLC "Fischer-Mukachevo" -

0.120 million m^3 , PJSC "Khust Quarry" - 0,108 million m^3 , ALC "Svalyava Mineral Waters" - 0.092 million m^3 , Gravel and sand quarry (Nepolokivtsi) - 0.071 million m^3 , Bukovyna Factory LLC, GKD "Lamel", Krasnoilsk, Storozhynets district - 0.06 million m^3 , Chernivtsi Oil and Fat Plant (Chernivtsi). Chernivtsi) - 0.051 million m^3 , Flextronics LLC - 0.040 million m^3 , PJSC Ukrnafta Nadvirna oil and gas production division, Nadvirna Nadvirna - 0.031 million m^3 , LLC KKNK Technobud - 0.023 million m^3 , LLC Leonie Varing Systems UA GmbH m. Kolomyia - 0.022 million m^3 .

There are no water losses during transportation for own needs in the industry.

The share of wastewater discharges from industrial water users is only 2.5% (3.281 million m^3), of which 0.077 million m^3 .

Analysis of trends in industrial water use in the Danube basin shows a significant reduction over the past 20 years. There are two reasons for this. Firstly, the country's economy as a whole has undergone a significant restructuring, which has resulted in a significant reduction in industrial production. Secondly, economic factors encourage companies to introduce waterless technologies, switch to water recycling or modern technologies for economical water consumption.

6.2.3 Water use in agriculture

Agriculture is the largest water consumer in the Danube basin. Non-returnable water consumption in agriculture accounts for 56.5% of all non-returnable water consumption in Ukraine.

The main areas of water use in agriculture are irrigation (the main share is concentrated in the Lower Danube sub-basin), watering, fisheries (predominantly in the Tisza, Prut and Siret sub-basins, including trout farms), livestock, crop production and poultry farming. Water use in agriculture is a very important and significant area in its socio-economic development. Unlike in industry, where water can sometimes be replaced in the technological process, in agriculture it cannot be replaced by anything else, and irrigation of crops allows for good results.

According to state water use accounting data for 2019, agricultural entities in the basin withdrew 699.0 million m^3 of water (94% of the total water withdrawal within the basin). The agricultural water supply needs in the basin are met mainly from surface sources. Water was used - 164.0 million m^3 .

The largest water use was carried out by: Mayak - 30.166 million m^3 , Debut-2005 LLC - 23.395 million m^3 , Rice of Bessarabia LLC - 23.239 million m^3 , Kamolino-Holding LLC - 11.206 million m^3 , Transcarpathian Fish Factory ALC - 8,770 million m^3 , LLC JV "Dunay-Agro" - 6.842 million m^3 , UTMR Vynogradiv District Organisation - 0.957 million m^3 , FG "Konik" - 0.515 million m^3 , LLC "Pokuttya-Fruit" - 0.390 million m^3 , FOP Isayovych F.F. Isayovych - 0.211 million m^3 , Klyachanivskyi Pond - 0.167 million m^3 , VK Firm Varto LLC - 0.068 million m^3 , Poultry Farm Sniatynska Nova LLC - 0.032 million m^3 , Rodnyk Plus LLC - 0.022 million m^3 .

In 2019, agricultural water users discharged 71.34 million m^3 of return (wastewater) (55.1% of the total discharge within the basin), of which 32.56 million m^3 , 38.76 million m^3 , and 0.025 million m^3 , which were normatively clean without treatment.

6.2.4 Water use in transport

Water use in transport involves the use of water resources, both surface and groundwater, for various types of transport, including water and land.

In 2019, water users in the transport sector withdrew 0.3 million m^3 of water (<1% of total water withdrawals). Water use by transport in the basin is 0.548 million m^3 .

The largest water users in this sector: Lviv Territorial Administration - 0.712 million m^3 , Ivano-Frankivsk water supply distances of Hluboko-Bukovynska and Storozhynets stations. Storozhynets - 0.056 million m^3 , PJSC "Ukrzaliznytsia" Kolomyia state station - 0.036 million m^3 , LLC "Gas Transmission System Operator" - 0.018 million m^3 , PJSC "Ukrzaliznytsia" state station Korshiv - 0.008 million m^3 , separate enterprise "Motor-car depot Kolomyia" - 0.006 million m^3 , JSC "Uzhhorod ATP - 12107" - 0.005 million m^3 .

Water users in the transport sector discharged 0.021 million m^3 of waste water (<0.1% of the total discharge within the basin), of which 0.021 million m^3 were treated at standardised facilities.

6.2.5 Other types of water use

Other types of water use carry out insignificant water withdrawals in the amount of 4.011 million m^3 of water, which is <1% of the total water withdrawal in the basin. Other sectors of the economy include healthcare, catering, trade, logistics, construction, communications, physical education, and public education. In 2019, other types of water users discharged 2.272 million m^3 of wastewater, of which 0.089 million m^3 was polluted wastewater. Other types of water use do not exert significant pressure on the state of surface waters, as they account for only 1.8% of the total amount of wastewater in the basin.

6.3 Forecast of water demand by major economic sectors

Water demand forecasts for the basin as a whole and by major economic sectors are made for the period of the RBMP (until 2030) under three scenarios: realistic, optimistic and pessimistic.

The basis for the forecast is the total water withdrawals within the basin for the period 2015-2019, their total volume and by economic sector. The forecast of water withdrawals is based on Ukraine's GDP for the same period and its forecast value for the short, medium and long term. The increment of optimistic and pessimistic scenarios was calculated by determining the average annual deviations for previous years from the forecasted values.

The main factors affecting water use in the Danube basin include the following:

- the spread of the COVID-19 pandemic and the introduction of restrictive measures;
- economic development - mainly agriculture;
- natural and geographical: borders with EU countries, flood-prone regions, climate change → increased irrigation (the Lower Danube sub-basin is mostly used for the operation of irrigation systems (including irrigation).

Forecasting of water withdrawal for the short-term period - for 2021, based on the European Bank for Reconstruction and Development's GDP Forecast for Ukraine for 2021[10] .

For the medium-term period - 2021-2023 - the forecast is based on the "Forecast of Economic and Social Development of Ukraine for 2021-2023 of the Ministry of Economy, Trade and Agriculture of Ukraine"[11] .

The long-term forecast period - 2024-2030 - was calculated on the basis of analytical materials from USDA, World Bank, IMF, IHS, Oxford Economic Forecasting ,[12][13] , which forecasts Ukraine's GDP growth by 3.2% annually.

The global outlook remains highly uncertain due to the pandemic. Provided that effective strategies for Ukraine's recovery and development are developed, including their high-quality and smooth implementation, it is possible to eliminate the effects of the pandemic on the economy and stimulate further development of economic potential in a fairly short period of time.

The method used to forecast water withdrawal rates was to calculate the projected exponential growth based on available data.

Preliminary expert forecasts of water withdrawal trends indicate an increase in water withdrawals in line with the economic recovery.

Analysis of Figure 31 shows an increase in water use in the Danube basin in 2021, and this trend continues until 2023. In the period 2026-2028, there is a trend of consistent growth in water intake due to the growing needs of economic sectors.

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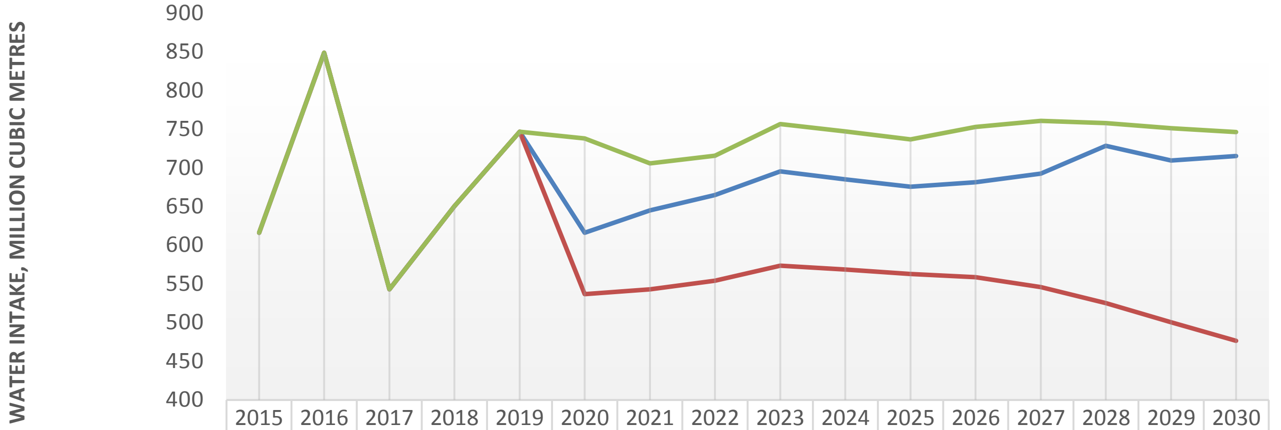
10 Anthony Williams. EBRD revises down economic forecasts amid continuing coronavirus uncertainty. European Bank for Reconstruction and Development. URL: https://www.ebrd.com/news/2021/ebrd-revises-down-economic-forecasts-amid-continuing-coronavirus-uncertainty.html.

11 Forecast of economic and social development of Ukraine for 2021-2023. Ministry for Development of Economy, Trade and Agriculture of Ukraine. URL: https://www.me.gov.ua/Documents/Detail?lang=uk-UA&id=98c3a695-56bb-42ba-b651-60ce1f899654&title=PrognozEkonomichnogoISotsialnogoRozvitkuUkrainiNa2021-2023-Roki.

12 Forecast of global economic development until 2030. Ukrainian Institute for the Future. URL: https://strategy.uifuture.org/prognoz-rozvitku-sv%D1%96tovoi-ekonom%D1%96ki-do-2030e.html.

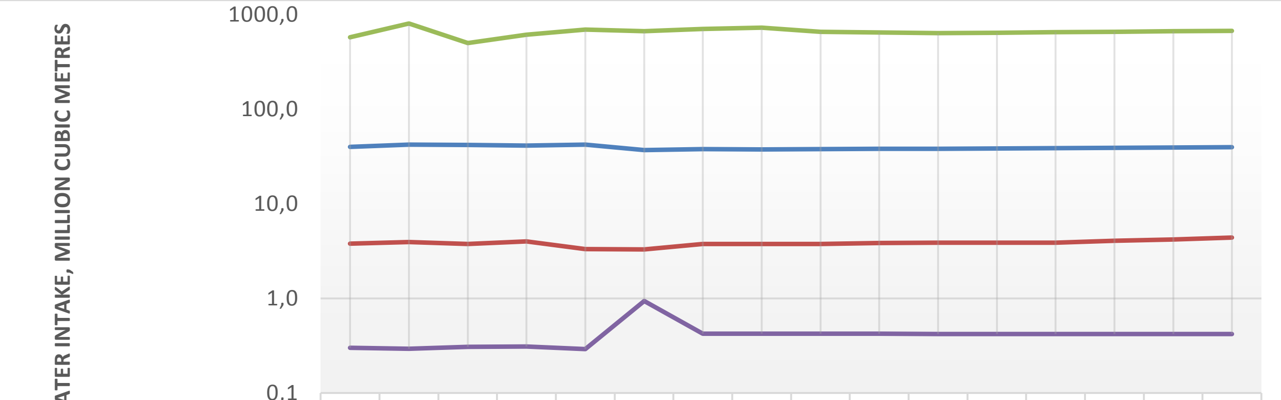
13 International Macroeconomic Data Set. United States Department of Agriculture. URL: https://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
realistic	615,91	848,63	542,7	650,43	746,51	615,94	644,8	664,9	695,2	685,2	675,3	681,2	692,5	728,3	709,3	715
pessimistic	615,91	848,63	542,7	650,43	746,51	536,74	542,9	553,9	573,6	568,4	562,8	558,5	545,7	524,9	500,1	476,4
optimistic	615,91	848,63	542,7	650,43	746,51	737,84	705,8	715,4	756,3	746,9	736,6	752,6	760,7	757,8	751,1	746,2

Figure 31. Forecast of water abstraction in the Danube basin until 2030

The results of forecasting water withdrawals in the Danube basin by 2030 by economic sector are shown in Figure 32.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Public utilities	40,0	42,4	42,1	41,2	42,4	37,2	37,8	37,8	37,9	38,1	38,3	38,5	38,9	39,2	39,5	39,7
Industry	3,8	3,9	3,8	4,0	3,3	3,3	3,8	3,8	3,8	3,9	3,9	3,9	3,9	4,1	4,2	4,4
Agriculture	578,2	809,4	502,5	612,6	698,7	670,3	707,2	727,2	657,2	647,1	637,2	642,8	653,7	658,9	669,5	674,7
Transport	0,3	0,3	0,3	0,3	0,3	0,9	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4

Figure 32. Forecast of water withdrawals by economic sector in the Danube basin until 2030

Within the basin, agriculture (mainly the operation of irrigation systems in the Odesa region) is the most developed sector, and it also abstracts the largest volumes of water, which affects the overall forecast of water abstraction in the Danube basin.

The housing and utilities sector is a significant water user in the basin. Water withdrawals by this sector are projected to decrease by 12% in 2020. In 2021, a slight increase in water abstraction for the needs of the housing and utilities sector is forecast, which is affected by quarantine restrictions and hygiene and sanitary innovations due to the impact of the COVID-19 pandemic. Starting from 2022, water withdrawals by the housing and utilities sector are forecast to stabilise.

The Danube basin industry is expected to see an increase in projected water withdrawals from 2021 due to regional economic growth.

No significant increase in water withdrawals by transport sector water users is forecast.

6.4 Tools of economic control

6.4.1 Payback of water resources use

The payback of water resources use is the ratio of funds received from the use of water resources to funds spent on the provision of water services. The description of water services and water use in the Danube basin is presented in accordance with the institutional structure of water services regulation:

I. Centralised water supply and sewerage services.

II. Special water use by economic sectors - payments and fees are paid to the budgets of all levels (rent, environmental tax for discharges into water bodies in Ukraine, lease of water bodies).

III. Water supply services for irrigation.

I. PAYBACK OF CENTRALISED WATER SUPPLY AND SEWERAGE SERVICES

In the Danube basin, centralised water supply and sewerage services are provided by licensees of the National Energy and Utilities Regulatory Commission and organisations licensed by local governments.

Table 27. Register of natural monopolies in the spheres of heat supply, centralised water supply and centralised sewerage in Zakarpattia, Ivano-Frankivsk and Chernivtsi regions[14]

№	Name of the natural monopoly entity in the field of centralised water supply and centralised sewerage
	Transcarpathian region
1	**MUNICIPAL ENTERPRISE "PRODUCTION DEPARTMENT OF WATER SUPPLY AND SEWERAGE SYSTEM OF UZHHOROD" (NERC licensee)**
2	MUKACHEVO MUNICIPAL UTILITY COMPANY "MUKACHEVVODOKANAL"
3	KHUST PRODUCTION DEPARTMENT OF WATER SUPPLY AND SEWERAGE SERVICES
4	VYNOGRADIV PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES
5	WATER SUPPLY UTILITY COMPANY OF IRSHAVA DISTRICT COUNCIL
6	SVALYAVA WATER SUPPLY AND SEWERAGE UTILITY COMPANY
7	RAKHIV MUNICIPAL ENTERPRISE "RAKHIVTEPLO"
8	MUNICIPAL ENTERPRISE "KOMMUNALNYK"
9	MUNICIPAL ENTERPRISE "VOLOVETS VILLAGE WATER SUPPLY SERVICE"
10	MUNICIPAL ENTERPRISE OF MIZHHIRYA VILLAGE COUNCIL "MIZHHIRYA PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES"
11	COMMUNAL ENTERPRISE "KOMMUNALSERVICE" OF VELYKYI BEREZNYI VILLAGE COUNCIL
12	PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES "SOLOTVYNO"
13	MUNICIPAL ENTERPRISE "PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES"
14	ROYAL BOROUGH COUNCIL'S COMMUNAL SERVICES
15	MUNICIPAL ENTERPRISE "HOUSING AND COMMUNAL SERVICES ASSOCIATION "GRAND" OF VELYKOBAKTYANSKY VILLAGE COUNCIL
16	ROZIVKA STATE UTILITY COMPANY
17	STATE UTILITY COMPANY "KOMMUNALNAYA SLUZHBA"
18	STATE MUNICIPAL ENTERPRISE "KOMMUNALNOYE KHOZYA"
19	HOUSING AND MAINTENANCE DEPARTMENT OF THE CITY OF MUKACHEVO
20	INDUSTRIAL HOUSING AND COMMUNAL ENTERPRISE
21	MUNICIPAL ENTERPRISE "VERYATSKE HOUSING AND COMMUNAL SERVICE" OF VERYATSKE VILLAGE COUNCIL
22	MUNICIPAL ENTERPRISE "MALOKOPANSKA HOUSING AND COMMUNAL SERVICE" OF MALOKOPAN VILLAGE COUNCIL
23	SUBSIDIARY COMPANY "SANATORIUM POLYANA" CJSC HEALTHCARE FACILITIES "UKRPROFOZDOROVNYTSIA"
24	SUBSIDIARY ENTERPRISE "SHAYAN SANATORIUM" CJSC HEALTHCARE FACILITIES "UKRPROFOZDOROVNYTSIA"
25	SUBSIDIARY SANATORIUM "SUNNY ZAKARPATTYA"
26	LIMITED LIABILITY COMPANY "SANATORIUM COMPLEX "DERENIVSKA KUPIL"
27	PRIVATE ENTERPRISE "EXPRESS-IR"
28	PUBLIC JOINT STOCK COMPANY "UZHGOROD MOTOR TRANSPORT ENTERPRISE 12107"

[14] according to the NERC

№	Name of the natural monopoly entity in the field of centralised water supply and centralised sewerage
29	NATIONAL CENTRE FOR SPACE CONTROL AND TESTING. WESTERN CENTRE FOR RADIO SURVEILLANCE
30	MUNICIPAL ENTERPRISE "VYSHKOVO"
31	MUNICIPAL ENTERPRISE "GEOLOG"
32	MUNICIPAL ENTERPRISE OF CHOP CITY COUNCIL "VODOKANAL CHOP"
33	LIMITED LIABILITY COMPANY "VODOKANAL KARPATVIZ"
34	MUNICIPAL ENTERPRISE "MISKVODOKANAL" OF MUKACHEVO CITY COUNCIL
35	MUNICIPAL ENTERPRISE "BUSHTINOSERVICE"
36	LIMITED LIABILITY COMPANY "KARPAT-OIL"
37	MUNICIPAL ENTERPRISE "DOBROBUT" OF ONOKIVSKE VILLAGE COUNCIL
38	MUNICIPAL ENTERPRISE "DUBIVSKE" OF THE DUBIV VILLAGE COUNCIL OF TYACHIV DISTRICT
39	MUNICIPAL ENTERPRISE "VODOKANAL" OF TYACHIV CITY COUNCIL
Ivano-Frankivsk region	
40	MUNICIPAL ENTERPRISE "VERKHOVYNA WATER SUPPLY AND SEWERAGE ENTERPRISE"
41	KOSIV MUNICIPAL UTILITY COMPANY "KOSIVMISKVODOSERVIS"
42	MUNICIPAL ENTERPRISE "VODOKANAL" OF SNIATYN
43	ZABOLOTIVSKY COMBINE OF PUBLIC UTILITIES
44	SUBSIDIARY ENTERPRISE "RURAL COMMUNAL SERVICES" OF "KOLOMYIA RAYON SELKOMUNKHOZ" LTD, KOLOMYIA DISTRICT, TURKA VILLAGE
45	MUNICIPAL ENTERPRISE "SELYTSKE MUNICIPAL ENTERPRISE" S-SHCHE VOROKHTA
46	MUNICIPAL ENTERPRISE "KOLOMYIAVODOKANAL"
47	PRODUCTION DEPARTMENT OF THE WATER SUPPLY AND SEWERAGE SYSTEM OF YAREMCHE
48	HVIZDETSKY COMBINE OF PUBLIC UTILITIES
49	KOLOMYIATEPLOENERGIA KP
50	ZAHIDTEPLOENERGOINVEST-SNYATYN LTD.
51	STRUMOK LTD.
52	KOSIVREMBUDSERVICE LTD.
Chernivtsi region	
54	**MUNICIPAL ENTERPRISE CHERNIVTSIVODOKANAL (licence holder of the National Commission for State Regulation of Energy and Utilities)**
55	BEREGOMET ENTERPRISE "KRYNITSA"
56	MUNICIPAL UNITARY ENTERPRISE "KOMMUNIK", VIZHNITSA
57	HERTSAIV PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES
58	DEEP PRODUCTION MANAGEMENT OF HOUSING AND COMMUNAL SERVICES
59	ZASTAVNA HOUSING AND MAINTENANCE DEPARTMENT HEAT AND WATER SUPPLY
60	KITSMAN PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES
61	MUNICIPAL ENTERPRISE "NEPOLOKOVETSKY COMMUNAL ENTERPRISE"
62	MUNICIPAL ENTERPRISE "NOVOSELYTSIA CITY HEATING NETWORK"
63	PUTYLA PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES
64	MUNICIPAL ENTERPRISE "STOROZHYNETSKE HOUSING AND COMMUNAL SERVICES"
65	STATE ENTERPRISE "NEPOLOKOVETS BAKERY" STATE RESERVE AGENCY OF UKRAINE
66	STATE ENTERPRISE OF ALCOHOL AND ALCOHOLIC BEVERAGES INDUSTRY "UKRSPEKT", (LUHANSK PLACE OF BUSINESS OF THE STATE ENTERPRISE "UKRSPEKT")
67	DOBROBUT 2012 UTILITY COMPANY
68	NIKOLAY IVANOVICH SINCHUK
69	HOUSING AND MAINTENANCE DEPARTMENT
70	LIMITED LIABILITY COMPANY "NEW ERA - ENERGY GROUP"
71	PRIVATE ENTERPRISE "NADPREDTEPLOSERVIS"
72	MUNICIPAL ENTERPRISE "NOVOSELYTSIA CITY HEATING NETWORK"
73	MUNICIPAL UTILITY COMPANY "CHERNIVTSIEPLOCOMUNENERGO"

In the Lower Danube sub-basin (Odesa region), centralised water supply and sewerage services are provided by more than 10 organisations licensed by local governments.

The largest revenues are received by water and sewerage companies. According to estimates, water and sewerage companies - NEURC licensees in the basin (2 licensees[15]) received about UAH 510 million in 2020[16] (including VAT).

According to the calculations, the licensees of local governments in the Lower Danube sub-basin (Odesa region) received UAH 100.24 million (including VAT) in 2020.

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15 NEURC data in the water supply and sewerage sector

16 Hereinafter, calculations were made on the basis of available statistics in Ukraine

The payback period for water supply and sewerage services is calculated as the ratio of the tariff to the cost of production in the basin. Due to the insufficient level of customer payments for services provided, which amounted to >90% in 2020, there is a situation of insufficient coverage of water services by customer payments and a threat to the sustainability of water services. The level of customer payments for the Uzhhorod Water Supply and Sewerage Production Department is 92.4%, and for Chernivtsi Vodokanal - 93.1%, which corresponds to a high level. The condition of water supply and sewerage networks in the Danube basin is unsatisfactory, which affects water quality. The main source of investment in 2020, as in previous years, was depreciation in the amounts stipulated in the tariff structures. Funds were also raised at the expense of the profit provided for in the tariff structure of licensees. However, none of the companies provided for the use of profits to form a reserve fund (capital) for modernisation or for production investments, which should have been provided for in their business activities. According to the NEURC, "the amount of production investments from profits is determined in the amounts necessary for the gradual restoration of networks (improvement of the functioning of water and sewerage enterprises), and taking into account the needs to fulfil the financial obligations of licensees to international financial organisations". However, this level is extremely insufficient.

II. PAYBACK OF THE USE OF WATER RESOURCES IN THE *DANUBE* ***BASIN***

(based on public finance calculations)

1. *REVENUES FOR SPECIAL WATER USE*

In accordance with the principles of "user pays" and "polluter pays" The Tax Code of Ukraine establishes a fee for special water use:

A. Rent for water abstraction for different types of water users.
B. Environmental tax on discharges into water bodies.

In addition, there is a fee for the use of water bodies for aquaculture purposes:

C. Rent for water bodies.
D. Payment for special use of water bioresources.

A. Rent for special water use

The state (general and special funds combined) and local (general fund) budgets received a total of UAH 42.645 million from business entities in the Danube basin by administrative region in 2018, UAH 41.221 million in 2019, and UAH 39.624 million in 2020. The maximum rent revenues to the budgets in the Danube basin were observed in 2018. In 2019-2020, there is a downward trend in rent revenues. The Tisza, Prut, and Siret sub-basins are among the lowest in Ukraine in terms of rent revenues for special water use.

Table 28. Dynamics of rent revenues for special water use to the state and local budgets in the Danube basin, UAH million[17],[18]

Year/ region/ sub-basin	Tisza sub-basin		Prut and Siret sub-basins				Lower Danube sub-basin		Together	
	Transcarpathian region		Ivano-Frankivsk region		Chernivtsi region		Odesa region			
	state budget	local budgets	state budget	local budgets	state budget	local budgets	state budget	local budgets	state budget	local budgets
2018	8,640	7,077	5,000	4,091	7,940	6,497	3,4	-	**24,98**	**17,665**
2019	8,223	6,745	5,224	4,275	7,455	6,099	3,2	-	**24,102**	**17,119**
2020	9,011	7,378	4,032	3,299	7,086	5,798	3,02	-	**23,149**	**16,475**

[17] KKDB 13020000 "Rent for special water use"
[18] Source: Local budget revenue reports, state budget revenue reports

Б. Environmental tax on discharges of pollutants into water bodies

In the Danube basin, in 2018-2020, the state budget and the special fund of local budgets received a total of UAH 20.966 million in tax revenues for pollutant discharges directly into water bodies. More than half of these funds (55%) are collected by local budgets in accordance with the budget allocation (Table 29). Since 2019, there has been a downward trend in the total amount of environmental tax revenues from discharges of pollutants into water bodies to both the state and local budgets.

Table 29: Dynamics of environmental tax revenues from discharges into water bodies to the state and local budgets in the Danube basin, UAH million[19]

Year/ region/ sub-basin	Tisza sub-basin		Prut and Siret sub-basins				Lower Danube sub-basin		Together	
	Transcarpathian region		Ivano-Frankivsk region		Chernivtsi region		Odesa region			
	state budget	local budgets	state budget	local budgets	state budget	local budgets	state budget	local budgets	state budget	local budgets
2018	0,549	0,671	0,423	0,518	0,288	0,352	4,24	-	**5,5**	**1,541**
2019	0,949	1,160	0,336	0,411	0,348	0,425	3,79	-	**5,423**	**1,996**
2020	0,769	0,940	0,340	0,416	0,365	0,446	3,23	-	**4,704**	**1,802**

C. Payment for the lease of water bodies

The weighted average rent is unified for all water bodies and is constantly increasing. Its dynamics is as follows:

- in the Tisza sub-basin in 2017 - UAH 46,339 thousand, 2018 - UAH 46,668 thousand, 2019 - UAH 67,436 thousand and 2020 - UAH 71,021 thousand;
- in the Prut and Siret sub-basins in 2017 - 156.9 UAH/ha, in 2018-2020 - 162.7 UAH/ha;
- in the Lower Danube sub-basin in 2017 - 156.9 UAH/ha, in 2018-2020 - 162.7 UAH/ha.

The local budgets of the Tisza, Prut and Siret sub-basins are estimated to have received rent for water bodies (parts thereof) in the amount of UAH 194.75-179.67 thousand in 2017-2020. While in the Tisza sub-basin there is a steady trend towards a gradual increase in water body rent (compared to 2017, local budget revenues from water body rent (parts thereof) in 2020 increased by almost 35%), in the Prut and Siret sub-basins there is a downward trend in water body rent (by almost 40% compared to 2017).

According to estimates, local budgets in the Lower Danube sub-basin received rent for water bodies (parts thereof) in the amount of UAH 18.2-214.6 thousand in 2019-2020, including 2019 - UAH 18.2 thousand, 2020 - UAH 214.6 thousand. The dynamics of rent revenues for water bodies to the budgets of the sub-basin regions is positive.

According to the State Tax Service of Ukraine, in total, local budgets of all levels in Ukraine received UAH 10-10.4 million in rent for water bodies in 2017-2018, UAH 13.5 million in 2019, and UAH 14 million in 2020. Revenues from rents for water bodies (or parts thereof) to local budgets in the Danube basin are shown in Table 30.

Table 30. Dynamics of rent revenues to local budgets in the Danube basin, UAH[20]

Region/year	2017	2018	2019	2020
Transcarpathian	46393,29	46668,84	67436,08	71021,0
Ivano-Frankivsk	38497,7	55248,9	51027,4	32261,3
Chernivetska	109861,3	93786,8	84309,1	76393,3
Odesa	no information available		18200,0	214600,0

[19] KCDB 19010200 "Revenues from discharges of pollutants directly into water bodies"

[20] KKDB 22130000 "Rent for water bodies (parts thereof) provided for use on a lease basis by regional, district and local councils"

Together	**194752,29**	**195704,54**	**220972,58**	**394275,6**

D. Payment for special use of fish and other aquatic bioresources

The fee for the use of fish and other aquatic bioresources is levied in accordance with the Resolution of the Cabinet of Ministers of Ukraine.[21]

According to the report on local budgets from fees for the special use of fish and other aquatic bioresources (*KKDB 13070200 "Fees for the special use of fish and other aquatic resources"),* no fees for the special use of fish and other aquatic resources were collected in the Tisza sub-basin in 2017-2020.

In the Prut and Siret sub-basins, no payments for the special use of fish and other water resources were collected in 2017-2019. In 2020, only Ivano-Frankivsk region (with a 35% share in the sub-basin) received UAH 8.1 thousand.

In the Lower Danube sub-basin, according to the report on local budgets, the fee for the special use of aquatic bioresources amounted to UAH 70.02 thousand in 2018, UAH 184.59 thousand in 2019, and UAH 1574.5 thousand in 2020.

Table 31. Dynamics of revenues from fees for the special use of water bioresources to local budgets in the Danube basin, thousand UAH

Region/year	2017	2018	2019	2020
Transcarpathian	-	-	-	-
Ivano-Frankivsk	-	-	-	8,1
Chernivetska	-	-	-	-
Odesa	-	70,02	184,59	1574,5
Together	**-**	**70,02**	**184,59**	**1582,6**

2. EXPENDITURE ON WATER RESOURCES IN THE DANUBE BASIN

A. Capital and current expenditures from the state and local budgets for environmental programmes in the field of water resources protection

According to state statistical reports, capital investments and current expenditures are allocated to nine environmental areas, including those directly related to the reproduction and protection of water resources:

- waste water treatment;
- protection and rehabilitation of soil, groundwater and surface water.

The share of the former is more significant than the latter, accounting for about half of all expenditures out of the total amount of capital and current expenditures in all areas. These two areas are funded from the state (including the State Environmental Protection Fund (SEPF)) and local budgets (including local SEPF funds), own funds, and other sources of financing.

Information on capital and current expenditures in 2018-2020 is provided in the state statistical reports. The dynamics of capital and current investments in the Prut and Siret sub-basins and the Lower Danube sub-basins in 2018-2020 is shown in Table 32.

Table 32. Dynamics of capital and current investments in the sub-basins of the Prut and Siret and the Lower Danube, thousand UAH

[21] Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Charging Fees for the Special Use of Water Bioresources and the Amount of Fees for Their Use" of 12 February 2020, No. 125

Area.	2018			2019			2020		
	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water
Ivano-Frankivsk	308718,6	121475,8	33015,8	308718,6	121475,8	33015,8	299001,9	100832,2	71907,7
Chernivetska	123272,9	62401,3	7384,7	123272,9	62401,3	7384,7	196513,2	89997,7	59956,8
Odesa	88024,1	27550,8	209,7	88024,1	27550,8	209,7	176299	30635,2	6223
Together	**520015,6**	**211427,9**	**40610,2**	**520015,6**	**211427,9**	**40610,2**	**671814,1**	**221465,1**	**138087,6**
% of programmes from the total		**40,7**	**7,8**		**40,7**	**7,8**		**33**	**20,6**
A total of 2 water protection programmes		**252038,1**			**252038,1**			**359552,7**	

A total of UAH 369.112 million was spent in the Danube basin in 2020. In 2020, there was an increase in capital and current expenditures due to capital investments in the area of "protection and rehabilitation of soil, groundwater and surface water". These expenditures are allocated for flood protection and bank protection measures, given the increased risk and periodic destructive effects of floods and floods in the basin.

B. State budget expenditures for the maintenance of water infrastructure under the management of the State Agency of Water Resources

In the Danube basin, water infrastructure maintenance activities are carried out by organisations under the management of the State Agency of Ukraine for Water Resources - the Tisza River Basin Water Resources Administration, the Prut and Siret River Basin Water Resources Administration, the Dniester River Basin Water Resources Administration (in terms of activities within Ivano-Frankivsk Oblast), and the Black Sea and Lower Danube River Basin Water Resources Administration.

UAH 104624.2 thousand was allocated for the maintenance of the water management complex in Zakarpattia region, including:

- under the programme 2707050 "Operation of the State Water Management Complex and Water Resources Management" - UAH 70938.5 thousand, of which UAH 65805.1 thousand from the general fund and UAH 5133.4 thousand from the special fund;
- under the programme KPKV 2707070 "Protection from harmful effects of waters of rural settlements and agricultural lands, including in the Tisa River basin in Zakarpattia oblast" (Environmental protection measures) - UAH 20388.9 thousand;
- under the programme KPKV 2707700 "Protection from harmful effects of waters of rural settlements and agricultural lands, including in the Tisa River basin in the Transcarpathian region" - (Reserve Fund of the State Budget) - UAH 13296.8 thousand.

In addition to state funding, in 2020, the Tisza RBMU managed to attract funds from local budgets, business entities, and international grants aimed at developing the water sector and environmental rehabilitation of the Tisza sub-basin:

- implementation of the "Regional Target Programme for the Development of Water Management and Environmental Rehabilitation of the Tisa River Basin in the Transcarpathian Region for 2013-2021" in accordance with the order of the Head of the Transcarpathian Regional State Administration No. 155 dated 19.03.2020 - UAH 10745.1 thousand;
- implementation of international projects in the water sector - UAH 24173.8 thousand.

The total amount of expenses for 2020 is UAH 139543.10 thousand.

Expenditures for the operation of water infrastructure in the Prut and Siret sub-basins are carried out under the comprehensive programme "Operation of the State Water Management Complex and Water Resources Management" and amounted to UAH 36804.5 thousand in 2020 (UAH 23321.08 thousand for the Prut and Siret sub-basins and UAH 13483.42 thousand for the Dniester sub-basin).

In the Lower Danube sub-basin, expenditures for the operation of water infrastructure are carried out under the comprehensive programme "Operation of the State Water Management Complex and Water Resources Management" and amount to UAH 10,086.4 thousand in 2020.

DETERMINING THE PAYBACK OF WATER RESOURCES USE IN THE DANUBE BASIN

If the payback ratio of water resources use, calculated using the formula "Revenues / Expenses * 100":

- is more than 100%, this means that all costs are reimbursed by paying tax and non-tax revenues for services to budgets of all levels or by tariffs; budget revenues, if used for their intended purpose, can be used for water resources restoration; enterprises receive profits that can be used for production development - production investments, formation of a reserve fund (capital), etc. (part of which will be used to pay income tax);
- If the indicator is less than 100%, this indicates a threat to the sustainability of the service, as the costs of budgets or enterprises are not covered by the revenues received. The calculated return on water resources use is 7.4%, which means that costs are higher than tax revenues for water services (Table 33).

Table 33. Balance of revenues and capital expenditures in 2020

SOURCES.	amount, thousand UAH	EXPENSES	amount, thousand UAH
Rent for special water use (state and local budgets)	39627,789	Capital investments in water resources restoration and protection	369111,626
Environmental tax on discharges into water bodies (state and local budgets)	6508,117	Expenditures from the state budget for the operation of the state water management complex	277434
Rent for water bodies (parts thereof) provided for use on a lease basis (local budgets)	394,321		
Payment for aquatic bio-resources	1582,7		
TOGETHER	**48112,927**	**TOGETHER**	**646545,626**
ROI	**7,4%**		

This level of payback indicates a critical situation in terms of covering the costs of water services. Revenues are significantly lower than expenditures from the state and local budgets. The calculated level of cost recovery indicates that tax mechanisms for recovering the use of water resources in the Danube basin do not ensure the sustainability of service provision.

6.4.2 Water tariffs

Tariffs for centralised water supply and sewerage

According to the institutional structure in Ukraine, the NEURC and local governments set the following types of tariffs for centralised water supply and sewerage services:

1. tariff for centralised supply (cold water) and sewerage (cold and hot water combined) (calculated by water utilities, approved by the NEURC for its own licensees, local governments for other local licensees) and centralised water supply (hot water) (calculated by Teploenergo enterprises, approved by the NEURC for its own licensees, local governments for other local licensees);

2. tariff for centralised supply (cold water, hot water separately) and sewerage (cold and hot water) using in-building systems.

The NEURC licenses the activities of water supply companies (water utilities) if these companies serve more than 100,000 people, the volume of water supply is more than 300,000 m^3 , the volume of water disposal is more than 200,000 m^3 .

When setting tariffs, the NEURC is guided by the principle of balancing the interests of consumers, business entities and the state: it limits the planned costs of licensees to an economically justified level that should ensure self-sufficiency of their activities, provided that they are managed efficiently and use resources economically, while at the same time providing for the necessary investments for the safe and sustainable operation of water and sewerage systems.

As of the beginning of 2021, tariffs for centralised water supply and sewerage were set by the NEURC in the Danube basin for 2 licensees (1 in the Tisza sub-basin, 1 in the Prut and Siret sub-basin), which have tariffs for other water utilities (water and wastewater companies) (Table 34). There are no NEURC licensees in the Lower Danube sub-basin.

Table 34. Tariffs for centralised water supply and wastewater disposal of the NEURC licensees providing services in the Danube basin[22]

Name of the company	Tariffs set by the NEURC, UAH/m³/ Cost price, UAH/m³/ Reimbursement, %.			
	Water supply		Drainage	
	for consumers who are business entities in the field of water supply and sanitation (water utilities)	for consumers who are not business entities in the field of CWS (households, budgetary organisations, others)	for consumers who are business entities in the field of water supply and sanitation (water utilities)	for consumers who are not business entities in the field of CWS (households, budgetary organisations, others)
Transcarpathian region				
Municipal enterprise Production Department of Water Supply and Sewerage of Uzhhorod"	8,23	21,13/ 20,6173/ **102,5**	7,89	11,23/ 10,9839/ **102,2**
Chernivtsi region				
MUNICIPAL ENTERPRISE "CHERNIVTSIVODOKANAL"	4,65	12,18/ 11,86/ **102,7**	-	7,21/ 7,1/ **101,5**

The main items in the structure of the NEURC licensees' cost of services in 2020 continue to be labour costs (including social benefits) and electricity purchase. Less significant cost components are depreciation, repair costs, reagents and fuels and lubricants, as well as taxes and fees, including the fee for special use of water (rent), and subsoil use fees for fresh groundwater extraction.

The NEURC is included in the tariff structure of licensees:

-for centralised water supply: labour costs (45-57%); electricity (26-35%), etc;
-Wastewater disposal: labour costs (55-63%); electricity costs (20-30%), etc.

Water supply and wastewater services in the Danube basin are provided by enterprises licensed by local authorities - these are communal enterprises of district, city, town and village councils and even some village councils. Local governments have set tariffs for centralised water supply and sewerage for 48 companies in the Danube basin. The tariffs are different for different categories of users - for households, budgetary organisations and commercial organisations. In general, local tariffs are higher than those of the NEURC licensees. Another peculiarity is that, as a rule, the tariff for wastewater disposal, which includes wastewater treatment, is higher than the tariff for water supply.

The total tariffs for all licensees of the Danube basin local governments are as follows (including VAT):

22 According to the NEURC, tariffs as of 01.01.2021

-for centralised water supply services: the minimum is 5.80 UAH/m³ (for the population of Nepolokovetske Kommunkhoz), the maximum is 45.06 UAH/m³ (for budgetary and other organisations of Sniatynske Vodokanal);
-for centralised sewerage services: minimum - 2.21 UAH/m³ (for the population of Solotvyno Water), maximum - 38.00 UAH/m³ (for budgetary and other organisations of Kitsman City Council).

The cost of water for industrial enterprises

The cost of water is actually paid by industrial enterprises in the form of a mandatory payment for special water use - rent. The object of taxation for rent for special water use is the actual volume of water used by water users. In the case of surface water use, the rental rate depends on the needs of the use, the place and region of consumption, and the actual volume of water used. No rent is paid if the volume of consumption is less than 5 m³/day and the water user does not have its own water intake facilities. The rate of rent for special use of surface water in the Danube River basin is the lowest in Ukraine. In the case of groundwater use, the rates of rent for special water use are set by the Tax Code of Ukraine and are differentiated by region. The rates for the use of groundwater are among the highest in Ukraine. The rates of rent for special use of surface and groundwater in the Danube basin are set out in Table 35.

Table 35. Rental rates for special water use in the Danube basin[23]

River basin area	Rent rate, UAH per 100 cubic metres
For the use of surface water	
Danube River Basin Region	29,96
Name of the region	**Rent rate, UAH per 100 cubic metres**
For the use of groundwater	
Transcarpathian	69,95
Ivano-Frankivsk:	166,51
Chernivetska	116,56
Odesa	116,56
Other rates for special water use	
For the needs of hydropower	UAH 12.95 per 10 thousand m³ , passed through the turbines of hydroelectric power plants
For water transport needs from all rivers except the Danube	UAH 0.1938 per 1 tonne-day of operation
for self-propelled and non-self-propelled freight fleets in operation	UAH 0.2219 per 1 tonne-day of operation
for the passenger fleet in operation	0.0246 UAH per 1 place-day of operation
For the needs of fish farming	UAH 67.97 per 10 thousand m³ of surface water; UAH 81.71 per 10 thousand cubic metres of groundwater
For water used exclusively in beverages	UAH 63.22 per 1 m³ of surface water; UAH 73.73 per 1 m³ of groundwater
For mine, quarry and drainage water	14.64 UAH per 100 m³ of water

Housing and communal enterprises apply a coefficient of 0.3 to rent rates in terms of water volumes of technological standards for the use of drinking water determined in accordance with the legislation on drinking water, drinking water supply and sewerage.

Fees for water pollution are collected in the form of fines and environmental tax for discharges of pollutants into water bodies. The tax rates for discharges of pollutants into water bodies are presented in Table 36.

Table 36. Environmental tax rates for discharges of certain pollutants into water bodies[24]

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23 Tax Code of Ukraine, Article 255
24 Tax Code of Ukraine, Article 245

Name of the pollutant	Tax rate, UAH per 1 tonne
Ammonium nitrogen	12883,84
Organic substances (based on biochemical oxygen demand (BOD)5	5156,8
Suspended solids	369,52
Petroleum products	75792,4
Nitrates	1108,56
Nitrites	63278,16
Sulphates	369,52
Phosphates	10297,44
Chlorides	369,52

Cost of water supply services for irrigation

The state-owned operators of the irrigation water supply market are water management organisations of the State Agency of Water Resources.

The cost of such services is formed on the basis of a unified approach, which is defined by the order of the State Agency of Ukraine for Water Resources and is determined on the basis of economically justified costs directly related to their provision. The costs include direct labour costs, direct material costs and other direct costs, general and administrative expenses, including renewal and modernisation of fixed assets used in the amount of 10% of direct costs. These costs are differentiated according to technological characteristics.

The principle of pricing this service is not intended to generate profit, as the state in the risky farming zone has committed itself to subsidising agricultural production. The service of water supply for irrigation is a kind of subsidy to agribusiness in the form of reducing the cost of irrigation through state maintenance (operation) of irrigation systems and service personnel.

The peculiarity of cost formation is that the calculation of the cost of this service includes the costs of water supply that are not covered by budget financing (including electricity, salaries, capital expenditures).

The cost of the service does not include the cost of water as a resource, as water management organisations are not primary water users.

The cost of water supply for irrigation as of 2020 varied from 1.08 to 3.51 UAH/m³ (Table 37).

Table 37. Cost of water supply for irrigation in the Danube basin (Lower Danube sub-basin), 2018-2020, UAH/m³ (excluding VAT)

Area.	The cost of everything			Including the cost of	
	2018	2019	2020	electricity	own services
Odesa	**0,23-2,48**	**0,64-3,51**	**0,87-2,81**	**0,35-1,85**	**0,52-0,96**
Bolgrad district	1,29-2,48	1,71-3,51	0,87-2,81	0,42-1,85	0,45-0,96
Reni district	1,25-2,19	2,02-2,86	1,54-2,63	0,58-1,67	0,96-0,96
Izmail district	0,23-1,45	1,08-1,84	1,08-2,14	0,47-1,43	0,61-0,71
Kiliya district	0,58-1,22	0,64-1,86	0,87-0,95	0,35-0,42	0,52-0,53
Artsyz district	0,77-1,18	1,59-2,5	1,38-1,51	0,7-0,83	0,68-0,68

Funds received for the provision of paid services are transferred to a special fund of the State Budget of Ukraine and used in accordance with the budget of the water management organisation approved by the State Agency of Ukraine for Water Resources.

7 A REVIEW OF THE IMPLEMENTATION OF PROGRAMMES OR ACTIVITIES, INCLUDING HOW THE OBJECTIVES HAVE BEEN ACHIEVED

This section provides an overview of the implementation of environmental protection measures within the Danube basin, which were funded by national targeted programmes, the State Environmental Protection Fund, relevant regional and local programmes or funds, the State Regional Development Fund, state investment projects, international technical assistance projects, and regional and local infrastructure projects.

Among the numerous national environmental programmes developed in Ukraine, we will first analyse the implementation of the Dnipro Programme measures. Clause 4 of the CMU Resolution No. 336 of 18 May 2017 "On Approval of the Procedure for Developing RBMPs" states that the development of the first RBMPs for each RBF is carried out during the period of implementation of the Dnipro Programme. In accordance with clause 11 of the said Procedure, the measures to develop the first RBMPs for each RBRD are financed from the state budget, which is provided for by the same Dnipro Programme within the expenditures envisaged by the State Budget of Ukraine for the respective year, as well as from other sources. The implementation of this Programme is important both in the context of the preparation of the RBMP and the implementation of the RBP to achieve the strategic environmental objective for the Danube RBM MEA.

The Dnipro Programme aims to define the main directions of state policy in the field of water management, conservation and restoration of water resources, implementation of an integrated water resources management system based on the basin principle, restoration of the role of reclaimed land in the food and resource supply of the state, optimisation of water consumption, prevention and elimination of the consequences of harmful water impact.

The main objectives of the Dnipro Programme are:

- harmonisation of Ukrainian legislation with international standards and improvement of the regulatory framework for innovation and investment development of the water sector; (*partially implemented)*;
- Implementation of an effective, justified and balanced mechanism for the use, protection and reproduction of water resources, ensuring sustainable development of the state water monitoring system in accordance with international standards (*achieved)*;
- Implementation of the integrated water resources management system based on the basin principle, development and implementation of river basin management plans, application of the economic model of targeted financing of activities in river basins, establishment of river basin councils, as well as enhancement of the role of existing and creation of new basin water resource management agencies (*partially implemented)*;
- Improving the technological level of water use, introducing low-water and waterless technologies, developing more rational water use standards, construction, reconstruction and modernisation of water supply and sewage systems (*partially completed)*;
- bank protection and regulation of river channels, construction and reconstruction of hydraulic structures, protective dams, polders, flood control reservoirs, clearing of river channels, arrangement of water protection zones and coastal protection strips, development of schemes for comprehensive flood protection of territories from the harmful effects of water, improvement of methods and technical devices for hydrometeorological observations, flood forecasting (*partially completed*);
- Ensuring the development of land reclamation and improvement of the ecological condition of irrigated and drained lands, in particular, restoration of the water management and reclamation complex, reconstruction and modernisation of reclamation systems and their facilities, engineering infrastructure of reclamation systems with the creation of integrated technological complexes, introduction of new methods of irrigation and land drainage, application of water and energy-saving environmentally safe irrigation and water regulation regimes (*not fulfilled)*.

The creation of a single Dnipro Water Management Programme was intended to consolidate state and local funds for the purpose of achieving its objectives and goals. The estimated amount of its funding was UAH 46478.46 million, including UAH 21029.03 million from the state budget, UAH 9294.2 million from the local budget, and UAH 16155.2 million from other sources not prohibited by law (total dollar equivalent of USD

6.193 billion (as of 01.01.12), USD 688 million annually, 0.4% of Ukraine's gross domestic product (GDP)). The amount of funding for the Dnipro Programme was determined annually when the draft State Budget Law of Ukraine for the respective year was prepared, taking into account the real possibilities of the state budget, and each year less and less funds were allocated for it. Since the start of the Dnipro Programme's activities, as of 1 January 2019, 26% of the envisaged need has been allocated from budgets of all levels and other sources, and as of 1 January 2020, 17% of the envisaged need, which has led to a significant failure to complete its tasks and activities on time.

The main implementer of the Dnipro Programme was the State Agency of Water Resources (hereinafter referred to as SAWR). State funds were allocated mainly for the costs of consumption of the water sector, labour remuneration, utilities, the share of which was financed from the state budget, for example, in 2020: from the general fund - 93.5% (UAH 2092158.5 thousand), from the special fund - 81.1% (UAH 2261343.4 thousand). In 2020, total state budget expenditures to finance the Dnipro Programme amounted to UAH 5022671.0 thousand. The lion's share of all funds is used for the operation of the state water management complex and water resources management - UAH 4561352.5 thousand (90.8%).

In the context of the Danube basin, all these generalisations and conclusions on the implementation and financing of the Programme are approximated to the relevant regional water management units. Measures to maintain water infrastructure in the Danube basin are carried out by water management organisations under the management of the TWA within the respective regions of the basin: Tisza BWR (Zakarpattia oblast), Prut and Siret BWR (Chernivtsi and Ivano-Frankivsk oblasts) and Black Sea and Lower Danube BWR (Odesa oblast). Expenditures for the operation of water infrastructure are made under the budget programme "Operation of the State Water Management Complex and Water Resources Management" for each separate division of the SAC, based on the administrative-territorial principle rather than the basin principle, except for the Zakarpattia Oblast, where the Tisa River sub-basin is entirely located within one administrative region. This is the only oblast in Ukraine where its administrative boundaries coincide with the boundaries of the river basin.

The issue of extending the Programme was resolved by reviewing the amount of funding for the measures and agreeing on their volumes at the central and regional levels. As of 8 June 2021, the Accounting Chamber of Ukraine conducted an audit of the effectiveness of the implementation of the Dnipro Programme activities for the period up to 2021. The purpose of the audit was to identify existing problems with the implementation of the Dnipro Programme and to confirm or deny the need to extend the National Target Programme for the Development of Water Management and Environmental Rehabilitation of the Dnipro River Basin until 2024.

No less important and necessary was the National Target Programme "Drinking Water of Ukraine for 2011-2020" approved by the Law of Ukraine No. 2455-IV dated 03.03.2005 (hereinafter - the Drinking Water Programme). Its main goal was to ensure the rights of citizens to an adequate standard of living and environmental safety guaranteed by the Constitution of Ukraine by providing drinking water in the required volumes and in accordance with the established standards. In order to achieve this, the Drinking Water Programme was intended to ensure the implementation of the state policy on the development and reconstruction of centralised water supply and sewerage systems; protection of drinking water sources; bringing the quality of drinking water in line with the requirements of regulatory acts; regulatory support in the field of drinking water supply and sewerage; development and implementation of research and development using the latest materials, technologies, equipment and devices.

The estimated amount of funding for the Drinking Water Programme was UAH 9,471.7 million (in 2010 prices), of which UAH 3,004.3 million was allocated from the state budget and UAH 6,467.4 million from other sources. Due to the lack of adequate funding over the 10 years of the Drinking Water Programme in Ukraine, there have been no significant positive changes in the provision of drinking water in the required volumes and of the appropriate quality. As of 01.01.2020, about 1% of cities, more than 10% of towns and almost 70% of villages in Ukraine (8.934 million people) were not provided with centralised drinking water supply. Almost 1 in 4 citizens of the country is not provided with centralised water supply. The problem of using imported water covers at least 9 regions of the country and directly affects at least 268,000 people living in 824 settlements. According to global standards, Ukraine is classified as a low-water country in terms of water quantity and quality. Ukraine ranks 37th among 40 European countries in terms of drinking water quality. In terms of water per capita, Ukraine ranks 125th in the global ranking. At the same time, the National Target Programme "Drinking Water of Ukraine" is not being implemented or financed at all. The last time the Programme was funded was in 2018, when UAH 200 million was allocated from the State Budget of Ukraine, while only water and sewerage companies in Ukraine submitted projects totalling UAH 1.3 billion. Such activity of the companies is caused by their unsatisfactory financial and economic condition, as well as the inability of local governments to provide the necessary support for the renewal of fixed assets from local budgets. Procedures for obtaining grants and loans from international financial institutions are quite lengthy and involve significant risks, so obtaining state funds for the implementation of an infrastructure project was a desirable goal for each water utility. During 2019-2020, the Drinking Water Programme was not funded, and in 2020, it ended altogether.

In 2019, in order to continue supporting water supply and wastewater treatment companies, the Ministry of Regional Development developed and submitted to the central executive authorities and specialised associations a draft law "On Amendments to the Law of Ukraine "On the National Target Programme "Drinking Water of Ukraine" for 2011-2020", which provided for the extension of the Programme for another 5 years. Interagency approval, coordination, and consultations with the Ministry of Finance lasted for 2 years. The Resolution of the Verkhovna Rada of Ukraine of 5 November 2020 No. 980-IX provides for the possibility and expediency of increasing/foreseeing expenditures and providing loans from the general fund of the draft state budget for 2021 under the budget programme "Implementation of the National Target Programme "Drinking Water of Ukraine" for the Ministry of Communities and Territories Development of Ukraine (instead of MinRegion) (clause 2.17.68.).

As part of the Decree of the President of Ukraine No. 357 dated 13 August 2021, the decision of the National Security and Defence Council of Ukraine (NSDC) dated 30 July 2021 "On the State of Water Resources of Ukraine" was put into effect, and the Law of Ukraine "On the National Targeted Social Programme "Drinking Water of Ukraine" for 2022-2026" was adopted on 15 February 2022. The purpose of this Programme is to ensure the rights of citizens to an adequate standard of living and environmental safety guaranteed by the Constitution of Ukraine by providing high-quality drinking water in the required volumes and in accordance with the established drinking water quality standards, ensuring the development and reconstruction of centralised water supply and centralised sewerage systems in Ukrainian settlements. A total of UAH 28,588.6 million is to be allocated for the implementation of the Programme, including UAH 16940.3 million from the state budget and UAH 11639.3 million from other sources. The Law of Ukraine "On the State Budget of Ukraine for 2022" provided for funding of the "National Targeted Social Programme "Drinking Water of Ukraine" for 2022-2026" in the amount of UAH 1.0 billion. In accordance with the second paragraph of subparagraph 22 of Section VI "Final and Transitional Provisions" of the Budget Code of Ukraine, the CMU Resolution No. 245 "On Allocation of Funds to the Reserve Fund of the State Budget" dated 10.03.2022 reduced expenditures and lending to the general fund of the state budget, including the budget programme "Implementation of the National Target Social Programme "Drinking Water of Ukraine" for 2022-2026" (CPCELC 2751570).

In the context of the preparation and implementation of the RBMP, in particular, Section 3, it is very important to have information on the implementation of the National Programme for the Development of Nature Reserves for the period up to 2020, approved by the Cabinet of Ministers of Ukraine on 08.02.2006 No. 70-r (hereinafter referred to as the NRF Programme). According to the data on the registration of protected areas and objects submitted by the local executive authorities responsible for the implementation of the state policy in the field of environmental protection (hereinafter referred to as the National Environmental Protection Agency), as of 01.01.2020, the Ukrainian PAs include 8,512 territories and objects with a total area of 4.418 million hectares within the territory of Ukraine (actual area 4.085 million hectares) and 40,2500.0 hectares within the Black Sea. The ratio of the actual area of the NRF to the area of the state (the "protected area indicator") is 6.77%.

The NRF is managed by the Ministry of Ecology and is funded through the state budget programme KPKVK 2701160 "Conservation of protected areas". In 2020, UAH 403734.6 thousand (general fund) and UAH 25644.9 thousand (special fund) were used for measures to conserve and expand the PAs, totalling UAH 429581.5 thousand. In general, the performance indicators under this budget programme were met.

Underfunding of the State Target Programme for the Development of Land Relations in Ukraine for the period up to 2020, approved by the Cabinet of Ministers of Ukraine on 17.06.2009 No. 743-p (the "Land Programme"), has resulted in excessive ploughing of agricultural land, which leads to a violation of the ecologically balanced ratio of agricultural, nature reserve and other environmental, health, recreational, historical, cultural, forestry, water fund lands, and an increase in the area of degraded, low-productive, and technogenically contaminated land. As of 1 January 2021, more than 500,000 hectares of degraded, underutilised and technologically contaminated land are subject to conservation, 143,000 hectares of disturbed land need reclamation, and 294,000 hectares of underutilised land need improvement.

The government has established a separate Ministry for Development of Economy, Trade and Agriculture of Ukraine (Ministry of Economy, CMU Resolution No. 838 of 19.09.2019), which will implement the State Target Programme for the Development of Land Relations and National Geospatial Data Infrastructure in Ukraine for the period up to 2030 (Land Programme, CMU Order of 13.04.2021).

Budgetary environmental funds are one of the most important sources of financing environmental protection activities. Currently, Ukraine has a three-tier system of environmental funds, consisting of the State

Environmental Protection Fund (SEPF), regional and local (city, town and village) environmental protection funds. At the regional level, the regional and local environmental funds are a significant source of funding for environmental protection measures. Environmental funds are used for targeted financing of environmental protection measures in accordance with the List of activities that are considered to be environmental protection measures approved by the Cabinet of Ministers of Ukraine on 17.09.1996 No. 1147. In accordance with the Law of Ukraine "On Environmental Protection" dated 25.06.1991 No. 1264-XII (as amended on 18.12.2019), financing of environmental protection measures, including water resources protection, is carried out at the expense of the State Budget of Ukraine, local budgets, funds of enterprises, institutions and organisations, environmental funds, voluntary contributions and other funds.

According to the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Regulation on the State Environmental Protection Fund" of 7.05.1998 No. 634 (as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 1065 of 4.12.2019), the State Environmental Protection Fund became part of the State Budget of Ukraine. All environmental funds go to the consolidated budget, and environmental protection measures are financed on a residual basis or on the principle of urgent need, when a critical, emergency environmental situation has already occurred. In fact, the entirety of the environmental tax collected is dissipated within the general and special funds of the state and local budgets. According to the Ministry of Finance, in 2018, environmental tax revenues amounted to UAH 2779.6 million, which significantly exceeds the budget expenditures of UAH 361.1 million for targeted environmental protection measures, which has signs of inefficient and misuse of environmental tax and is a violation of the current legislation.

According to 2018 data, the share of environmental revenues (rent, environmental tax, special permits, fines) in the state budget was over UAH 52 billion, of which UAH 4.6 billion was allocated to support the activities of the relevant central government agencies and environmental control, and only UAH 4.2 billion, or only 8% of environmental funds, was allocated to implement environmental protection measures. This also includes the allocation of funds for the national budget programmes Dnipro and Drinking Water, the actual funding status of which is presented above. The distribution of environmental funds among agencies and entities is as follows: the State Agency of Water Resources (38%), local budgets (24%), SAUEZM (22%), the Ministry of Ecology (now the Ministry of Environment) (9%), the State Environmental Inspectorate (4%), and the State Service of Geology and Mineral Resources (2%) received the most.

The State Budget for 2020 allocated UAH 496.356 million to finance environmental protection measures. It is clear that such expenditures cannot play a significant role in solving environmental problems, including addressing the issue of water pollution and depletion, and even more so in fulfilling the obligations assumed by Ukraine to the international community in the field of environmental protection and, in particular, the preparation of the RBMP to achieve "good" environmental status of the Danube River basin. For comparison, on average, EU countries spend 0.8% of their GDP on environmental protection. For example, in Poland, the average annual funding for environmental programmes is EUR 1-1.3 billion. Half of these funds are covered by national funding, and the other half by attracting international funding. The implementation of Ukraine's international commitments in the field of environmental protection is impossible without financial support for the environmental modernisation of business entities themselves, which need to bring their operations in line with high European standards. There is already a positive example of this in the Danube basin.

During 2020-2021, the Tisza RBMU implemented the planned activities under the following grant contracts funded by the European Neighbourhood Instrument within the framework of the Hungary-Slovakia-Romania-Ukraine Cross-border Cooperation Programme 2014-2020.

The project "Strengthening cross-border security through joint measures aimed at preventing floods and inland water flooding in the Tisza and Tur rivers" (*Grant Contract No. HUSKROUA/1701/LIP/003 dated 13.08.2019*). Since the beginning of the Project implementation, international technical assistance funds in the amount of UAH 41198.0 thousand have been attracted, including for the works on the project "Reconstruction of the left bank dam of the Tisa River in the area of Tekovo - Hetynia village, Vynohradiv district, Transcarpathian region".

Project "Establishment of a transboundary water quality monitoring network in the Upper Tisa basin with further development and modernisation of the joint Hungarian-Ukrainian hydrographic telemetry system" (*Grant contract No. HUSKROUA/1901/6.1/0016 dated 30.04.2021*). Since the beginning of the Project implementation, international technical assistance funds in the amount of UAH 774.12 thousand have been attracted. The funds were used to develop a detailed design of the construction project "Reconstruction and expansion of the existing network of hydrometric observation facilities on rivers and other water bodies (AIS-Tysa 2.0)".

The project "Joint measures for the prevention of natural disasters in the transboundary basin of the Uzh River" (*Grant contract No. HUSKROUA/1702/8.1/0005 dated 29.08.2019*). Since the beginning of its implementation, international technical assistance funds in the amount of UAH 9590.3 thousand have been attracted, including UAH 786.8 thousand for the purchase of a Doppler flow velocity profiler, tender procedures for the development of flood zones and risks for the Uzh River basin and the city of Uzhhorod, and the development of a feasibility study for the construction of a regulatory structure on the Uzh River within the city of Uzhhorod.

The State Ecological Inspectorate in Zakarpattia region, together with the government administration of Szabolcs-Szótmar-Bereg region (Hungary), EUROPOLIS Agency and the Transylvanian Carpathians Association (Romania), is implementing the project "Environmental Assessment of the Upper Tisza River Basin with the aim of developing a monitoring network and developing an Action Plan for the Protection of Natural Values", which is being implemented under the HUSKROUA ENI CBC Cross-border Cooperation Programme 2014-2020. The total cost of the project is EUR 504943.06, of which EUR 454454.14 are EU funds. The project pursues the overall goal of protecting natural ecosystems and water quality in the cross-border Ukrainian-Hungarian-Romanian area of the upper Tisza River basin.

Instead, public investment projects in Ukraine once again proved to be ineffective and extremely dependent on state funding. In 2019-2020, the State Fund for Regional Development (hereinafter referred to as the SFRD) was much better funded, with funds allocated for specific investment projects in the regions, although the share of environmental projects, in particular, water supply and sewerage construction/reconstruction projects, was negligible. The SFRD was established in 2012 with the aim of increasing the competitiveness of regions by unlocking their own potential. The SFRD is the main instrument of the state for financing social, economic, infrastructure, cultural and sports projects in the country.

With regard to the review of funding for regional local programmes and the implementation of environmental measures, it can be stated that only in all 4 Danube sub-basins (Tisza, Prut, Siret and Lower Danube) and, in particular, in each of the 4 administrative regions that are part of the sub-basins (Zakarpattia, Ivano-Frankivsk, Chernivtsi and Odesa), targeted regional programmes were developed and approved by the sessions of the regional councils in accordance with the national target programmes. For Zakarpattia oblast, where the Tisa sub-basin is entirely located within the oblast, the allocated environmental funds were used to address the main water and environmental problems (hereinafter referred to as "WEPs") of the Tisa RBD. For the other 3 oblasts, where the Danube sub-basins partially occupy the territory, the funds were distributed among other river basins within the administrative territories of the oblasts. This distribution of allocations in each administrative region was different and was not determined by the needs of a particular river basin, but rather by local, municipal administrative-territorial needs, in a haphazard manner, without taking into account the basin principle of management decision-making.

Traditionally, each oblast has developed its own environmental development programme, adding the specifics of the region. While the administrative-territorial regions of the Tisza, Prut and Siret sub-basins focused on protection against harmful effects of water (flood protection), restoration of the hydrological regime of rivers, preservation and expansion of protected areas, and increase in forest cover, Odesa region of the Lower Danube sub-basin gave priority in its environmental targeted programmes to the development of the agro-industrial complex, provision of water resources for irrigation, development of water transport and protection of land resources in the region. Each oblast had its own specifics in terms of programme titles, deadlines and implementation stages. Some regional councils made changes to the regional programmes in advance, both in terms of their duration and sources of funding, while others left everything unchanged. Despite the specifics, the names of the regional target programmes, and the changes made, there was little funding from both the state and local budgets to implement the programmes' activities. Some state programmes had not been funded for years, and the burden of addressing urgent environmental and socio-economic problems in the sub-basins fell on local regional programmes.

Since both national and regional programmes are funded on an administrative-territorial basis rather than on a basin basis, in the context of the review of the implementation of programmes or measures, including the ways to achieve the set objectives, the Danube RBM suggests that their funding at the regional level is practically very different in terms of both the amount of investment and the number of projects implemented. Almost all regional programmes lack consistency and systematic funding for environmental protection measures. The determining element, the prerequisite for financing a particular environmental infrastructure project, is not comprehensive (integrated) water resources management within a sub-basin, nor is it the GWMP, the MWMP or the MWMP, but rather a certain "lobbying", "small-townism", party and electoral interests of regional elected officials. It is also worth noting the initiative of local communities and their financial capacity, when funds are allocated from the oblast budget only if there is co-financing from the local budget of the TC.

Of course, given the economic situation in the country, the state budget is not able to finance significant expenditures on water management and reclamation, housing and communal services, or environmental protection, so at present and in the near future, to address the problems that were addressed by the regional programmes, some new administrative units (ATCs) have begun to focus on their own investments, to seek internal reserves of enterprises and funds in the regional, district and amalgamated territorial community budgets, to attract international technical assistance. And the first document to help local CBCs lay the foundation for planning their future actions with the involvement of international technical assistance should be a regulatory document, a "roadmap" - the first RBMP with a complete list of programmes (plans) for the Danube River Basin region, their content and problems to be solved in 2025-2030.

A detailed overview of the implementation of environmental protection measures by Danube sub-basins, which were funded by existing national targeted programmes, the State Environmental Protection Fund, relevant regional and local programmes or funds, the State Regional Development Fund, state investment projects, international technical assistance projects, regional and local infrastructure projects, etc. is provided in Chapters 7 of the Danube River Sub-basin RBMPs and relevant Annexes 12 (M5.3.1), (M5.3.2, M5.3.3), (M5.3.4).

8 A COMPLETE LIST OF PROGRAMMES (PLANS) FOR THE DANUBE RIVER BASIN REGION, THEIR CONTENT AND THE PROBLEMS TO BE SOLVED

The Action Programme (hereinafter referred to as the AP) was developed in accordance with the requirements of the "Methodological Recommendations for Setting Environmental Objectives, Developing an Action Programme and Performing a Cost-Effectiveness Analysis of the River Basin Management Plan Action Programme" (hereinafter referred to as the Methodological Recommendations), approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources of 12 July 2023. The RMP was developed by the Tisza RBMU within the Zakarpattia Oblast (Tisza sub-basin), the Prut and Siret RBMU within the Ivano-Frankivsk and Chernivtsi Oblasts (Prut and Siret sub-basins) and the Black Sea and Lower Danube RBMU within the Odesa Oblast (Lower Danube sub-basin) in accordance with the Methodological Recommendations and the Procedure for Developing RBMPs in cooperation with local executive authorities, local self-government bodies, non-governmental organisations (NGOs), scientific and educational institutions (SEIs) and other stakeholders, taking into account proposals and decisions of the basin councils of the said sub-basins.

The development of the RMP took into account the measures implemented or planned in the national RBMPs of the neighbouring sub-basin countries (Romania, Hungary, Slovakia, Republic of Moldova) and the chemical state of the transboundary WBMs according to the monitoring data for 2022-2023. The RWP is developed for a period of 6 years, starting with the first cycle of the 2025-2030 plan. The start of the measure implementation should be no later than the third year from the beginning of the cycle (no later than 1 January 2028). During the implementation, it is allowed to make additions and changes to the approved programme. In total, 294 main and 18 additional measures are proposed for the programme. A full list of measures by sub-basin and their content is provided in the relevant Annexes 13 (M5.3.1), (M5.3.2, M5.3.3), (M5.3.4) of the Danube River Sub-basin RBMPs.

8.1 Surface water

For surface waters, the RMP includes the following key measures:

- measures aimed at reducing organic pollution (diffuse and point sources);
- measures aimed at reducing pollution by nutrients (diffuse and point sources);
- measures aimed at reducing pollution by hazardous substances (diffuse and point sources);
- measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology;
- measures aimed at reducing the impact of planned infrastructure projects on water conditions.

In addition to these measures, the RBP also includes other measures aimed at addressing other key water and environmental issues in the Danube RBM, identified in view of the specifics and transboundary nature of the basin.

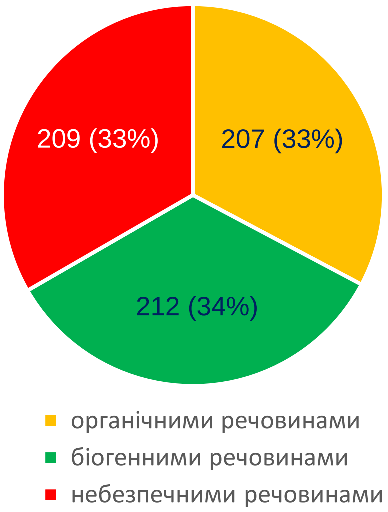
8.1.1 Measures to reduce pollution by organic matter, nutrients and hazardous substances (diffuse and point sources)

Anthropogenic loads and their impacts on the state of the IWM include pollution with organic, biogenic and hazardous substances from the main sources of pollution - sewage treatment plants of agglomerations (point pollution) and deterioration/damage/absence of drainage systems (diffuse pollution). The same measure for the construction/reconstruction/modernisation of WWTPs and sewerage networks (hereinafter referred to as "Sewerage Networks") of the agglomeration, including stormwater networks (melt and rainwater), combines the reduction of pollution of the MSW with organic, nutrient and hazardous substances from point and diffuse sources. Anthropogenic loads and their impacts on the state of the IWM allow establishing reasonable correlations between them and developing a software to achieve environmental goals.

The proposed measures aimed at reducing pollution of the Danube basin's IWW fall into three groups:

- measures aimed at reducing organic pollution (diffuse and point sources) - 207 measures;
- measures aimed at reducing pollution by nutrients (diffuse and point sources) - 212 measures;

- measures aimed at reducing pollution by hazardous substances (diffuse and point sources) - 209 measures.



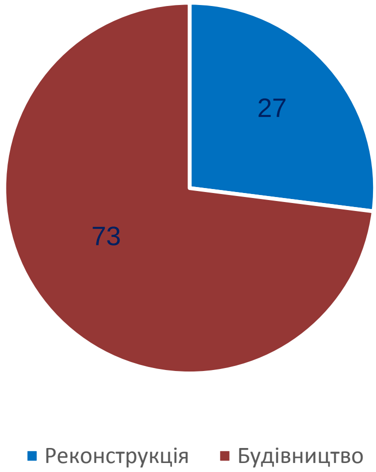


Figure 33. Percentage of measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources and the method of their implementation (reconstruction or construction of CWS and CM), %.

In order to reduce pollution by organic, biogenic and hazardous substances (point and diffuse sources), the following measure is planned to be implemented: "Establishment of wastewater treatment and solid waste disposal facilities in the Danube seaports of five territorial communities in Izmail district, Odesa region" (No. 3 in the list of measures for the Lower Danube sub-basin). This measure is a pilot project that is planned to be implemented in the TG to achieve/maintain the "good" status of the Lower Danube MSF.

Measures aimed at reducing pollution of the IWR by nutrients (diffuse sources) also include: "Establishment of water protection zones (WPZs) and coastal protection strips (CPZs)" in each administrative-territorial region of the Danube basin. It is planned to indicate the boundaries of SPZs and CZs in land management and urban planning documentation, to enter information on the boundaries of SPZs and CZs into the State Land Cadastre (hereinafter referred to as the "SLC"), to restrict land use, and to mark them with information signs. This measure covers all the Danube basins.

In addition, the measures aimed at reducing pollution of the IWR by nutrients (diffuse sources) also include the measure: "Assessment, monitoring of changes in the state of water intake and implementation of works on the restoration of water intakes of the Polyanske forestry, Polyanske territorial community, Mukachevo district, Zakarpattia region" (No. 71 from the list of measures of the Tisa sub-basin). The measure is a local pilot project that is planned to be implemented in the entire Tisza sub-basin to preserve and protect the "good" condition of the MES in the forest fund (the forest covers more than 50% of the territory of Zakarpattia Oblast), flood prevention, erosion control and fire protection measures.

Measures aimed at reducing pollution by hazardous substances (diffuse sources) include the measure: "Construction of a waste processing plant in the Polyanska territorial community, Mukachevo district, Zakarpattia region" (measure No. 98 of the list of measures in the Tisza sub-basin). The plant's capacity will allow processing newly generated solid waste that will be collected in the region, as well as raw materials from existing old landfills that need to be remediated. The event will cover three districts of the region (16 DHs) and more than 40 MSW in the upper reaches of the Latorytsia, Uzh, Borzhava and Rika rivers.

Measures aimed at reducing pollution by hazardous substances (diffuse sources) include the measure: "Rehabilitation of the territory of the former oil storage facility and prevention of oil pollution in the border area of Reni TG, Izmail district, Odesa region" (No. 2 in the list of measures for the Lower Danube sub-basin). The project envisages a set of measures to prevent oil pollution of the Danube River bank, with an estimated area of 0.35 hectares and a volume of 6.5 thousand cubic metres of contaminated soil.

In accordance with the requirements of the Law of Ukraine "On Wastewater Disposal and Treatment" dated 12 January 2023 No. 2887-IX, in order to ensure high-quality centralised wastewater disposal while reducing the impact of return (wastewater) on the MSP, it is planned to build/reconstruct WWTPs and KMs for 201 settlements (36%) in the Danube basin with a population equivalent of 2,000 or more. The proposed measures to reduce pollution by organic, biogenic and hazardous substances and their implementation in terms of new construction or reconstruction/modernisation indicate the following: 31 POTWs and CWs need reconstruction/modernisation, including 15 with tertiary (proper) wastewater treatment with removal of nitrogen and phosphorus compounds. Construction of new WWTPs and KPs is planned in 99 TS, mostly in sub-basins: Tisza (31), Prut and Siret (66).

There is a clear trend towards the intention to aggregate (combine) the SWS and CWS of settlements into separate agglomerations (treatment clusters) with single sewage treatment facilities around cities, in particular, district centres in the Tisza, Prut and Siret sub-basins. The issue of forming such an association, a conglomerate with a single CWS and CWM complex, is already being implemented in Polyanska TG (Tisza sub-basin), where a single network of wastewater collection and treatment is being built from the community and all sanatorium and resort complexes within the community.

Among the measures aimed at reducing pollution by organic, biogenic and hazardous substances (diffuse and point sources): 121 measures are classified as IAPs that are "at risk" of failing to achieve environmental objectives, and 50 measures are classified as IAPs that are "possibly at risk" of failing to achieve environmental objectives. With regard to business entities (production enterprises in the automotive, chemical and food industries, and livestock), the proposed measures fall into different categories of risk of failure to achieve environmental targets for IAPs. The share of the proposed measures aimed at reducing pollution by organic, biogenic and hazardous substances from point sources of pollution, depending on the risk assessment, is shown in Figure 34.

Figure 34. Distribution of measures aimed at reducing pollution by organic, biogenic and hazardous substances, depending on the risk assessment of IWR, %.

All the proposed measures aimed at reducing pollution by organic, nutrient and hazardous substances are related to the category "rivers" and have a single objective: to achieve/maintain "good" ecological status of the MNRB. One measure relates to the category of "lakes" with the objective of achieving/maintaining "good" ecological status of the MNR (UA_M5.3.4_0018, Lake Cahul, Lower Danube sub-basin). 22 measures to achieve/maintain "good" ecological status are classified as MSIPs: 1 in the Tisza sub-basin (UA_M5.3.1_0204, Stary Botar River) and 21 in the Prut and Siret sub-basins. Two measures in the Tisza sub-basin are classified as SSSIs (UA_M5.3.1_0285, Kodach Canal; UA_M5.3.1_0348, Vysokoberezhny Canal).

8.1.2 Measures aimed at improving/restoring the hydrological regime and morphological indicators

The number of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology in the Danube basin is 73. Almost all of them are aimed at mitigating/reducing the negative impact of channel regulation works planned as part of the implementation of the "Flood Risk Management Plan for Certain Areas within the Danube River Basin Region for 2023-2030", approved on 8 October 2022 by CMU Resolution No. 895-r (hereinafter referred to as the Danube Flood Risk Management Plan). In developing the measures, it was taken into account that the environmental objectives for the IWMS are to maintain the "good" status of 11 IWMS and to achieve "good" status for 50 IWMS where channel regulation works are planned in the Tisza, Prut and Siret sub-basins. Appropriate measures to improve hydromorphological indicators to achieve "good" potential have been developed for 11 IZMVs in the Lower Danube sub-basin. Measures aimed at improving/restoring the hydrological regime and morphological indicators in the event of impaired free flow of rivers, hydraulic connectivity between river channels and their floodplains, hydrological changes, and modification of river morphology, depending on the risk assessment, are presented in Figure 35.

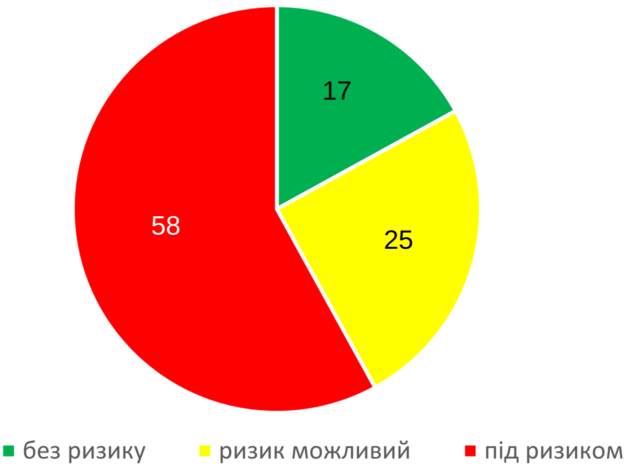


Figure 35. Distribution of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology, depending on the assessment of IWR risks, %.

8.1.3 Measures to reduce the negative impact of infrastructure projects

The RP includes two measures aimed at reducing (mitigating) the negative impact on the hydrological regime and morphological indicators of the MWR of infrastructure projects in the Tisza sub-basin:

- "Implementation of measures to mitigate the infrastructure project: "Bridge over the Tisa River on the Teplytsia - Sighetu Marmatiei section", Ukraine-Romania border, NW 298-299, Bila Tserkva village, Solotvyno territorial community, Tyachiv district, Transcarpathian region" (No. 9 in the list of Tisa sub-basin activities);
- "Implementation of measures to mitigate the infrastructure project: "Construction of a road bridge over the Teresva River on the national road of national importance H-09 "Mukachevo-Rakhiv-Bohorodychany-Ivano-Frankivsk-Rohatyn-Bibarka-Lviv", between the villages of Bedevlya and Teresva, Bedevlyanska and Teresvyanska territorial communities, Tyachiv district, Transcarpathian region" (No. 24 of the list of Tisa sub-basin activities).

These measures are aimed at stabilising/restoring the hydrological regime and morphological indicators in the event of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology. Both MEAs are assessed as being at "risk" of failing to achieve environmental objectives In the Prut and Siret sub-basins and the Lower Danube, there are no measures to mitigate the negative impact of infrastructure projects.

8.1.4 Measures aimed at reducing pollution and improving/restoring hydrological regime and morphological indicators on transboundary IBAs

The PA includes measures aimed at reducing pollution of transboundary IWRs in the Danube basin through the reconstruction/construction of Sewage Treatment Plants and KM agglomerations:

- Rakhiv, Velyky Bychkiv, Solotvyno, Teresva, Tyachiv, Vynohradiv, Pyiterfolvo, Vylok, Chop, Mukachevo, Uzhhorod, Storozhnytsia (Tisa River sub-basin);
- Chernivtsi, Novoselytsia, Marshyntsi, Mamalyha, Vanczykivka, Tarasivtsi, Podvirne, Zelena, Podvirivka, Lukachivka, Vashkivtsi (Prut River sub-basin);
- Storozhynets, Ropcha, Cherepkivtsi, Petrychanka, Turyatka (Siret River sub-basin).

The Programme also provides for certain measures to improve/restore the hydrological regime and morphological indicators (mitigation of channel regulation works on the Tisza River, Ukrainian-Romanian border).

These measures are planned to be implemented in 2025-2030 on the transboundary LBAs of the sub-basins, which will have a potential impact on the neighbouring countries of the Danube basin, in particular,

Romania:

- UA_M5.3.1_0007, UA_M5.3.1_0008 (Tisza River), UA_M5.3.2_0007 (Prut River), UA_M5.3.3_0005 , UA_M5.3.3_0006 (Siret River);

Hungary:
- UA_M5.3.1_00011, UA_M5.3.1_0012, UA_M5.3.1_0014 (Tisa River), UA_M5.3.1_0204 (IZMV, Staryi Batar River);

Slovakia:
- UA_M5.3.1_0300 (Latorytsia River), UA_M5.3.1_0433 (Uzh River);

Republic of Moldova:
- UA_M5.3.2_0231 (IWRM, Patzapule River), UA_M5.3.2_0233, (Zelena River), UA_M5.3.2_0235, (Medvedka River), UA_M5.3.2_0239 (Viliya River), UA_M5.3.2_0242 (IWRM, Lopatynka River).

The number of events at cross-border MoSs by Danube basin country is shown in Figure 36.

Figure 36. Number of events at cross-border IBOs with neighbouring Danube basin countries

8.2 Groundwater

For groundwater, the RMP includes the following key measures:

- measures aimed at reducing pollution (diffuse and point sources);
- measures aimed at preventing groundwater depletion;
- measures aimed at reducing the impact of planned infrastructure projects on water conditions.

To achieve/maintain a good quantitative and qualitative state of the IWZs, the following two measures should be implemented first of all: "Establishing the boundaries of sanitary protection zones for groundwater intakes used for centralised water supply, medical and recreational needs, indicating them in land management documentation, urban planning documentation at the local and regional level, entering information on relevant restrictions on land use into the State Land Cadastre and marking these boundaries on the ground with information signs" and "Mandatory equipment of all water intake wells with water regulating and controlling devices. These measures cover all the Danube basin MSPs and will be implemented at the expense of water users and local TGs.

8.3 Other events

Other measures include the following additional measures: legislative, administrative, fiscal, research, educational, aimed at introducing new technologies, environmental and communication, design, and others.

Additional activities include awareness-raising activities for groundwater and surface water, in particular, awareness-raising activities on the protection, conservation and restoration of water resources in all the TSs of the Danube basin. It is planned to hold annual Wetlands Day (2 February), International Water Day (22 March), and Danube Day/eco-events: "Tisa is the Danube's younger sister", Prut/Siret Day (29 June), and Clean Shores Day (third Saturday of September). It is also planned to clean up and restore river sources, as well as to conduct outreach and educational activities with local community groups, NGOs, NPOs, schoolchildren and youth in the field of solid waste management. Implementation of local measures by local executive authorities to conserve, protect and restore water resources.

Additional activities include such research activities as "Economic and environmental certification of water users in the Lower Danube sub-basin on the basis of digitalisation 16 TG Bilhorod-Dnistrovskyi rayon, Bolhradskyi rayon, Izmailskyi rayon, Odesa oblast", "Development of the Strategy for the greening of water management activities in the context of sustainable development of the Lower Danube sub-basin" 16 TG Bilhorod-Dnistrovskyi rayon, Bolhradskyi rayon, Izmailskyi rayon, Odesa oblast", "Modernisation of the hydrological infrastructure management system and hydrological monitoring of water management systems "Kyslytskyi arm of the Stepovyi arm - floodplain of the Stepovyi arm - Lake China" Safianivska TG, Izmail district, Odesa region", "Modernisation of the hydrological infrastructure management system and hydrological monitoring of the water management systems "Safiany - Katlabukh" Safianivska TG, Izmail district, Odesa region", "Modernisation of the hydrological infrastructure management system and hydrological monitoring of the Kyslytskyi Rukav - Staronekrasivski Plains - Lung Lakes", Izmail TG, Izmail district, Odesa region, and "Modelling of water and salt balance and water quality in the Danube Lake Katlabukh, Safianivka TG, Izmail district, Odesa region". Five activities are planned for the Lower Danube, aimed at improving hydromorphological characteristics and creating wastewater treatment facilities.

For groundwater, an additional measure is also "Inventory, rehabilitation of observation wells and monitoring of groundwater in the Tisa River sub-basin". The previous inventory of wells in the Tisza sub-basin was carried out in 2006, when 31 wells were found to be in working condition (23 groundwater, 2 interstitial water, 6 at the reference sites for studying operational reserves), and in 2018 only 19 groundwater wells remained. Since 2018, groundwater monitoring has not been carried out in the entire Danube basin, and the condition of water intake facilities is unknown. An inventory is needed to resume monitoring observations and assess the need to drill additional observation wells.

8.4 Overall assessment of the effectiveness of the proposed measures for the LIP

The RP includes measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources, measures to improve/restore the hydrological regime and morphological indicators in case of disturbance of free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology, and other additional measures aimed at achieving or maintaining the "good" status/potential of the MES. Some measures have an impact on several GWEs. The largest share of measures is aimed at reducing pollution of IWRs (68%). The overall structure of the PAs in terms of proposed measures for surface waters in the Danube basin is presented in Figure 37.

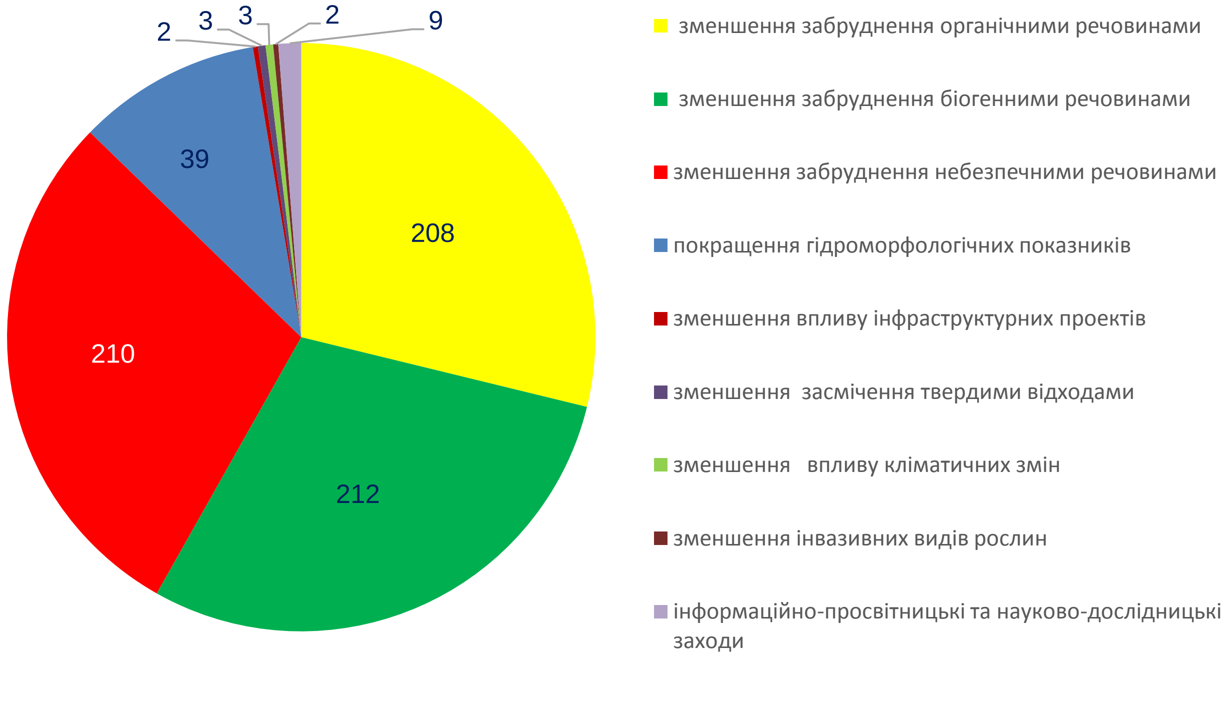


Figure 37. Main and additional measures for the Danube River Basin MEAs, number of measures

The overwhelming majority of measures relate to communities/settlements with a population of 2.0 to 10.0 thousand. There are 234 (79%) of such measures, for communities with a population of 10 to 100.0 thousand - only 51 (18%) - these are practically measures in administrative, rayon centres: Mukachevo, Berehove, Khust, Tyachiv, Rakhiv (Tisa sub-basin); Kolomyia, Yaremche, Vashkivtsi, Storozhynets, Krasnoilsk, Nyzhniy Verbizh, Stopchativ, Miliyeve, Chornohuzy, Slobidka, Velykyi Kuchuriv (Prut and Siret sub-basins); Reni, Kiliya, Izmail (Lower Danube sub-basin). There are only 9 (3%) measures for agglomerations with PE over 100.0 thousand, and these are measures for the TG cities: Uzhhorod and Chernivtsi. This social specificity of the measures is due to the fact that the vast majority of residents of the western regions of Ukraine, in the Tisza, Prut and Siret sub-basins, live in rural areas.

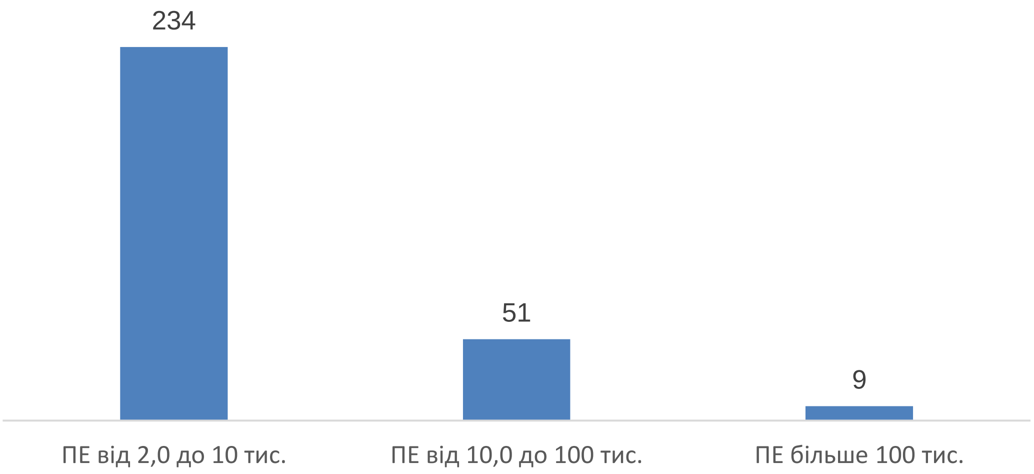


Figure 38. Number of measures depending on PE in the Danube basin

In accordance with the RBMP Development Procedure, the measures envisaged in the RBMP will be financed from the state and local budgets, as well as other sources not prohibited by law. These measures shall be financed from the state budget within the limits of expenditures envisaged by the State Budget of Ukraine for the respective year.

The total cost of all the proposed measures for the period 2025-2030 is UAH 19684.37 million, per TS (154) - UAH 127.82 million (UAH 21.303 million per year), per inhabitant of the Danube basin (3.532 million people, data for 2020) - UAH 5573.2 (UAH 928.9 per year). The most costly measures are those related to the reconstruction/modernisation of the CWS and CM. For example, to implement such measures in the cities of: Uzhhorod and Mukachevo require up to UAH 2363.2 million, Kolomyia and Chernivtsi - up to UAH 170.54 million, and Izmail - up to UAH 1269.8 million.

According to the cost-effectiveness analysis (CEA), no measures with a very high level of efficiency were identified among the proposed measures in the Danube basin.

There are 7 measures in the high performance group. In the Tisa sub-basin (4 measures): "Reconstruction of Sewage Treatment Facilities and Networks in Uzhhorod, Uzhhorod TG, Uzhhorod District, Zakarpattia Oblast", "Reconstruction of Sewage Treatment Facilities and Networks in Mukachevo, Mukachevo TG, Mukachevo District, Zakarpattia Oblast", "Reconstruction of Sewage Treatment Facilities and Sewerage Network in Berehove, Berehove TG, Berehove district, Zakarpattia region", "Reconstruction of sewage treatment facilities and sewerage network in Khust, Khust TG, Khust district, Zakarpattia region", with a total cost of UAH 3407.0 million (34% of the cost of all measures in the sub-basin), one of them with a very high cost, more than UAH 1 billion. There are 2 measures in the Prut and Siret sub-basins: "Reconstruction of sewage treatment facilities and sewage networks in Kolomyia, Kolomyia TG, Kolomyia rayon, Ivano-Frankivsk oblast" and "Completion of reconstruction of sewage treatment facilities in Chernivtsi, Chernivtsi TG, Chernivtsi rayon, Chernivtsi oblast", with a total cost of UAH 170.54 million (2.4% of the cost of all measures in the sub-basin). In the Lower Danube sub-basin, there is 1 measure with a total cost of UAH 1269.8 million (48% of the total cost of all measures in the sub-basin), namely "Reconstruction of sewage treatment facilities in Izmail, Izmail TG, Izmail district, Odesa region".

The total cost of the measures is UAH 4,847.34 million (25%), with a social impact of 667.4 thousand people. The measures are aimed at reducing pollution with organic, nutrient and hazardous substances in the Danube basin's IWR (GWP 1-3). All the objects of the measures belong to the sector of very high water use pressure - the housing and utilities sector.

The group with an average level of efficiency includes 197 measures with a total cost of UAH 11263.60 million (57%). The measures are mainly aimed at addressing GWEPs 1-4 and GWEP 10 - reducing pollution by organic, nutrient and hazardous substances, hydromorphological changes, and clogging of water bodies with solid waste in small towns and villages in the basin. The social impact is 1494.17 thousand people. 194 of the sites where the measures were implemented belong to the sector of very high water use pressure - the housing and utilities sector. This group is the largest in terms of the number of measures.

The group with low efficiency includes 60 measures with a total cost of UAH 3011.71 million (15%). These are mainly measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their flood-plains, hydrological changes, modification of river morphology (HUC 4), as well as HUC 5, and HUC 9-11. Social effect - 690.49 thousand people.

The group with a very low level of effectiveness includes 30 measures with a total cost of UAH 555.302 million (3%) aimed at improving hydromorphological indicators (GWEP 4). The implementation of these measures will achieve a social effect for 104.5 thousand people. The economic sector's pressure on water resources is minimal and corresponds to the lowest score.

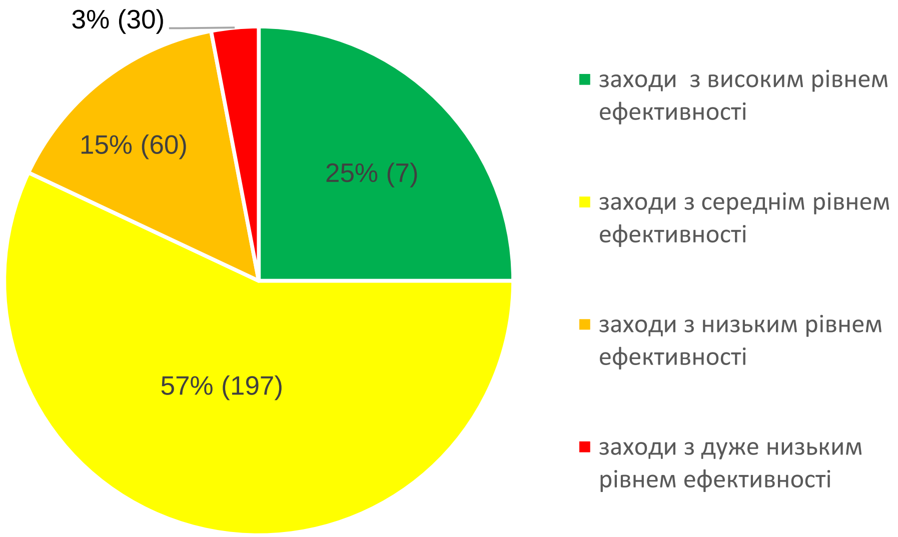


Figure 39. Distribution of measures with different levels of efficiency by total cost of measures

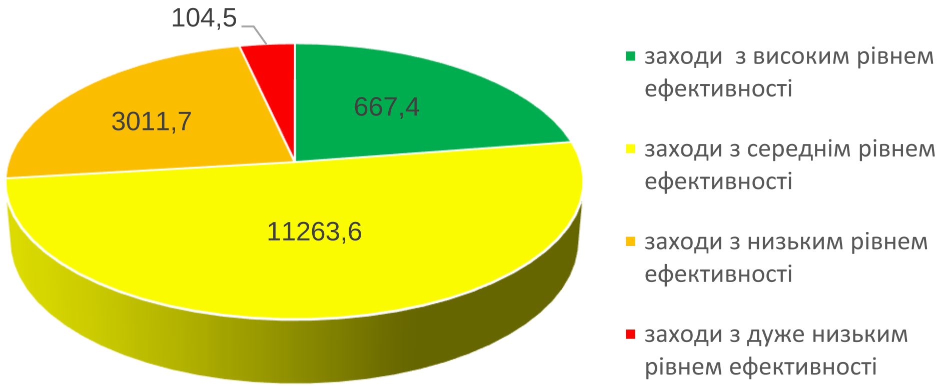


Figure 40. Distribution of measures with different levels of effectiveness by social component, thousand people

A detailed LCA of the measures is provided in Annex 14.

9 REPORT ON PUBLIC INFORMATION AND PUBLIC DISCUSSION OF THE DRAFT RIVER BASIN MANAGEMENT PLAN

The Danube River basin area is located within four regions of Ukraine (Zakarpattia, Ivano-Frankivsk, Chernivtsi and Odesa regions). The Tisza sub-basin is located entirely within Zakarpattia Oblast, the Prut and Siret sub-basins are located in Ivano-Frankivsk and Chernivtsi Oblasts, and the Lower Danube sub-basin is located in Odesa Oblast. Accordingly, the Danube River Basin Management Plan includes river sub-basin management plans (RBMPs) for the Tisza, Prut and Siret rivers and the Lower Danube. The Tisza River Basin Water Resources Management Authority, the Prut and Siret River Basin Water Resources Management Authority, and the Black Sea and Lower Danube River Basin Water Resources Management Authority have been designated as responsible for the preparation of the draft RBMPs.

During 2022-2023, the basin authorities held consultations with the public in Zakarpattia, Ivano-Frankivsk, Chernivtsi, and Odesa oblasts on the main water and environmental problems of the Tisza, Prut, and Siret sub-basins and the lower Danube, developed a full list of programmes (plans) for the sub-basins, their content and problems to be solved, and prepared draft RBMPs for 2025-2030.

In order to prepare the Danube RBMP in a timely manner, implement the "Schedule for the Development of the Draft Danube River Basin Management Plan" approved by the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 313 of 27 November 2020, and the Orders of the State Agency of Water Resources of Ukraine No. 44 "On Approval of the Action Plan" of 16 May 2022 and No. 1105 "On Development of Draft River Basin Management Plans" of 18 December 2020, the basin water resource management departments held working meetings with the regional military administrations of the Danube River Basin. Based on the results of the working meetings, instructions were prepared for the district military administrations and executive bodies of local councils to submit proposals to the RMP aimed at addressing the GWEP of river sub-basins (pollution by organic, nutrient and hazardous substances, hydromorphological changes, uncontrolled water use, and littering) for the appropriate response of state and local authorities.

In order to ensure the preparation of the RAPs for the development of the 2025-2030 RBMPs, the basin water resource departments held meetings with the heads and representatives of territorial communities and water utilities, and prepared and sent letters to business entities providing water supply and sewerage services (water utilities), industrial enterprises, agricultural enterprises, hotel, tourist and sanatorium complexes of the region that discharge waste water into surface water bodies (SWBs) of sub-basins, to submit their proposals to the RWP aimed at addressing the GWE of river sub-basins.

Working Groups for the development of RBMPs were established at the meetings of the basin councils, which included representatives of stakeholders (central and local executive authorities, local governments, basin water management authorities, water users, enterprises, institutions, organisations, and public associations).

The working groups processed all proposals aimed at addressing the GWEPs of river sub-basins, summarised them and presented the RBMPs for the period 2025-2030 at meetings of the relevant basin councils.

In accordance with the Law of Ukraine "On Strategic Environmental Assessment" dated 20.03.2018 No. 2354-VIII, river basin (sub-basin) management plans are subject to strategic environmental assessment (SEA) prior to their approval.

In accordance with Article 2 of the Law of Ukraine "On Strategic Environmental Assessment", an SEA is mandatory for projects of the PPA that meet two criteria at the same time: related to agriculture, forestry, fisheries, energy, industry, transport, waste management, water resources, environmental protection, telecommunications, tourism, urban planning or land management (scheme) and the implementation of which will involve the implementation of activities (or contain activities and objects) for which the legislation

The SEA allows to focus on a comprehensive analysis of the possible environmental impact of planned activities, which makes it possible to reasonably assess strategic documents in terms of environmental and public health impact, to coordinate them with each other and to use the results of this analysis to prevent or mitigate environmental consequences in the strategic planning process.

The SEA helps to increase the overall transparency of strategic decision-making and enables the opinions and suggestions of key stakeholders to be taken into account at an early stage of planning and development of the LDP.

The SEA provides for clear procedures for consultations and communication between key government agencies, business and civil society representatives, which contributes to more informed and balanced decision-making.

The section will be supplemented after public consultations in 2024 and the completion of the SEA procedure.

10 LIST OF COMPETENT STATE AUTHORITIES RESPONSIBLE FOR IMPLEMENTING THE RIVER BASIN MANAGEMENT PLAN

According to part two of Article 13 of the Water Code of Ukraine, the Cabinet of Ministers of Ukraine, the Council of Ministers of the Autonomous Republic of Crimea, village, town and city councils and their executive bodies, district and regional councils, executive authorities and other state bodies are responsible for public administration in the field of water use and protection and water resources restoration in accordance with the legislation of Ukraine.

The executive authorities in the field of water use and protection and water resources reproduction are the Ministry of Ecology, the State Water Agency, the State Geological Survey, the State Ecological Inspectorate and other bodies in accordance with the law.

Table 38. Central executive authorities in the field of water use and protection and water resources restoration

Name of the body (full and abridged)	Legal address	Official website
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	35, Metropolitan Vasyl Lypkivsky Street, Kyiv, 03035; tel.: (044) 206-31-00, (044) 206-31-15; fax: (044) 206-31-07; e-mail: info@mepr.gov.ua	www.mepr.gov.ua
State Agency of Water Resources of Ukraine (SAWR)	8 Velyka Vasylkivska St., Kyiv, 01024; tel./fax: (044) 235-31-92; tel. (044) 235-61-46; e-mail: dar@davr.gov.ua	www.davr.gov.ua
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	16, Anton Tsedik Street, Kyiv, 03057; tel: (044) 536-13-18; e-mail: office@geo.gov.ua	www.geo.gov.ua
State Environmental Inspectorate of Ukraine (SEI)	3, building 2, Novopecherskyi lane, Kyiv, 01042 tel./fax +38 (044) 521-20-40, tel: (044) 521-20-38; e-mail: info@dei.gov.ua	www.dei.gov.ua

Table 39. Key regulatory acts that define the powers of central executive authorities in the field of water use and protection and water resources restoration

Name of the body (full and abridged)	Legal act	Link on the official web portal of the Verkhovna Rada of Ukraine
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Articles 15 and 15[1]	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the Ministry of Environmental Protection and Natural Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 25 June 2020, No. 614 (Official Gazette of Ukraine, 2020, No. 59, p. 32, Article 1853)	https://zakon.rada.gov.ua/laws/show/614-2020-%D0%BF#Text

Name of the body (full and abridged)	Legal act	Link on the official web portal of the Verkhovna Rada of Ukraine
State Agency of Water Resources of Ukraine (SAWR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 16	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Agency of Water Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 20 August 2014, No. 393 (Official Gazette of Ukraine, 2014, No. 71, p. 34, Article 1995)	https://zakon.rada.gov.ua/laws/show/393-2014-%D0%BF#Text
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 17	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulations on the State Service of Geology and Subsoil of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 30 December 2015 No. 1174 (Official Gazette of Ukraine, 2016, No. 3, p. 284, Article 192)	https://zakon.rada.gov.ua/laws/show/1174-2015-%D0%BF#Text
State Environmental Inspectorate of Ukraine (SEI)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 15[2]	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Environmental Inspectorate of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 19 April 2017 No. 275 (Official Gazette of Ukraine, 2017, No. 36, p. 73, Article 1131)	https://zakon.rada.gov.ua/laws/show/275-2017-%D0%BF#Text
	Regulation on Territorial and Interregional Territorial Bodies of the State Environmental Inspectorate, approved by the Order of the Ministry of Energy and Environmental Protection of Ukraine dated 07 April 2020 No. 230, registered with the Ministry of Justice of Ukraine on 16 April 2020 under No. 350/34633 (Official Gazette of Ukraine, 2020, No. 33, p. 25, Article 1116)	https://zakon.rada.gov.ua/laws/show/z0350-20#Text

In order to ensure the implementation of the state policy in the field of management, use and reproduction of surface water resources within the Tisza River Sub-basin Area (hereinafter - the TISZA), to direct and coordinate the activities of organisations under the management of the State Agency of Water Resources of Ukraine on the management, use and reproduction of surface water resources within the Tisza River

Sub-basin Area, as well as to ensure the implementation of the state policy in the field of water management within the Transcarpathian region, the State Agency of Water Resources of Ukraine established the Basin Department

In order to ensure the implementation of the state policy in the field of management, use and reproduction of surface water resources within the Prut and Siret river sub-basins, to direct and coordinate the activities of organisations under the management of the State Agency of Ukraine for Water Resources on management, use and reproduction of surface water resources within the Prut and Siret river sub-basins, as well as to ensure the implementation of the state policy in the field of water management within the Chernivtsi region, the State Agency of Ukraine for Water Resources established the Basin Management Department.

In order to ensure the implementation of the state policy in the field of management, use and reproduction of surface water resources within the Lower Danube River Sub-basin, to direct and coordinate the activities of organisations under the management of the State Agency of Water Resources of Ukraine on the management, use and reproduction of surface water resources within the Lower Danube River Sub-basin, as well as to ensure the implementation of the state policy in the field of water management within Odesa region, the State Agency of Water Resources of Ukraine created the

Table 40. Representatives of the central executive authority in the field of water use and protection and water resources restoration in the Danube River Basin

Name of the body (full and abridged)	Legal address	Tel./fax	Email.	Website.
Basin water management Tisza River (Tisza Boulevard)	5 Slavyanskaya Embankment, м. Uzhhorod, 88018	(0312) 64-61-91	office@buvrtysa.gov.ua	buvrtysa.gov.ua
Basin water resources management of the Prut and Siret rivers (BOVR of the Prut and Siret)	58013, м. Chernivtsi, 194-b Heroiv Maidanu Street	(0372) 51-14-56	dpbuvr@gmail.com	dpbuvr.gov.ua
The Black Sea and Lower Danube River Basin Water Management Authority (Black Sea and Lower Danube Rivers)	13, Ivan and Yurii Lypiv Str., Odesa, 65078	(048)766-91-02	buvr_odesa@oouvr.gov.ua	www.oouvr.gov.ua

(Source: https://davr.gov.ua/vodogospodarskiorganizacii)

The names of sub-basins and water management areas (WMAs) within river basin districts (RBDs) and sub-basins (SBWAs) are given in the Annex to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 25 dated 26 January 2017 "On the Allocation of Sub-Basins and Water Management Areas within Established River Basin Districts", registered with the Ministry of Justice of Ukraine on 14 February 2017 under No. 208/30076 (https://zakon.rada.gov.ua/laws/show/z0208-17#Text).

The boundaries of the RRB, RRSB and IOP were approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 dated 03 March 2017, registered with the Ministry of Justice of Ukraine on 29 March 2017 under No. 421/30289 (https://zakon.rada.gov.ua/laws/show/z0421-17#Text).

The Tisza RBMU is a budgetary non-profit organisation that is managed by the State Water Agency. The Regulation on the Tisza RBMU was approved by the Order of the State Agency of Water Resources of Ukraine No. 83 dated 12 July 2023 (https://buvrtysa.gov.ua/newsite/?page_id=56).

The Prut and Siret RBMU is a budgetary non-profit organisation that belongs to the management of the State Agency of Ukraine for Water Resources. The Regulation on the Prut and Siret River Basin Water Resources Management was approved by the Order of the State Agency of Ukraine for Water Resources dated 30 December 2020 No. 1159 (https://dpbuvr.gov.ua/polozhennia-pro-upravlinnia-2/).

The Black Sea and Lower Danube River Basin Authority is a budgetary non-profit organisation that is managed by the State Agency of Ukraine for Water Resources. The Regulation on the Black Sea and Lower Danube Rivers Basin Management Organisation was approved by the Order of the State Agency of Water Resources of Ukraine No. 80 dated 06.07.2023 (https://oouvr.gov.ua/pro-buvr/poloshenya/).

The purpose of the Tisza River Basin Council is to develop proposals and ensure coordination of interests of enterprises, institutions and organisations in the field of water use and protection and water resources restoration within the Tisza RBF, to promote integrated water resources management within the Tisza RBF, to ensure coordination of interests and coordination of actions of stakeholders in water resources management within the Tisza RBF, to promote cooperation between central and local executive authorities, local self-government bodies, enterprises, institutions, organisations, international organisations, and the public. The Tisza River Basin Council is an advisory body of the State Agency of Ukraine for Water Resources within the Tisza River RBM. The Regulation on the Tisza River BR was approved by the Order of the State Agency of Water Resources of Ukraine No. 887 dated 26 November 2018 (https://buvr-tysa.gov.ua/newsite/wp-content/uploads/2018/08/polojennya.pdf).

To develop proposals and ensure coordination of interests of enterprises, institutions and organisations in the field of water use and protection and water resources restoration within the Prut and Siret sub-basins, to promote integrated water resources management within the Prut and Siret sub-basins, to ensure coordination of interests and coordination of actions of stakeholders in water resources management within the Prut and Siret sub-basins, to facilitate cooperation between central and local executive authorities, local authorities and municipalities. The Prut and Siret Basin Council is an advisory body of the State Agency of Ukraine for Water Resources within the Prut and Siret sub-basins. The Regulation on the Prut and Siret Basin Council was approved by the Order of the State Agency of Water Resources of Ukraine No. 947 dated 18 December 2018 (https://davr.gov.ua/polozhennya-pro-basejnovu-radu-prutu-ta-siretu).

The Lower Danube Basin Council is a consultative and advisory body of the State Agency for Water Resources Management of the Lower Danube Sub-basin in order to develop proposals and ensure coordination of interests of enterprises, institutions and organisations in the field of water use and protection and water resources restoration within the Lower Danube Sub-basin area, to promote integrated water resources management within the Lower Danube Sub-basin area, to ensure coordination of interests and coordination of actions of stakeholders in water resources management within the Lower Danube Sub-basin area, to facilitate cooperation between central and local executive authorities, bodies The Lower Danube Basin Council is an advisory body to the State Agency of Water Resources of Ukraine within the Lower Danube Sub-basin area. The Regulation on the Lower Danube Basin Council was approved by the Order of the State Agency of Water Resources of Ukraine No. 972 dated 22.12.2018 (https://oouvr.gov.ua/baseynova-rada-nushnogo-dynayu/yst-docs/).

According to the List approved by Resolution of the Cabinet of Ministers of Ukraine No. 1371 dated 13 September 2002 (as amended by Resolution of the Cabinet of Ministers of Ukraine No. 1276 dated 30 November 2011) (https://zakon.rada.gov.ua/laws/show/1371-2002-%D0%BF#n38), the Ministry of Environment and/or the State Agency of Water Resources of Ukraine are responsible for fulfilling international obligations in the field of water protection arising from Ukraine's membership in international organisations or in accordance with international treaties concluded by Ukraine.

In addition, pursuant to Article 9 of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (https://zakon.rada.gov.ua/laws/show/801-14#Text), the Government of Ukraine has concluded bilateral agreements on the protection of border/boundary waters, the responsibility for which lies with the State Agency of Water Resources:

- Agreement between the Government of Ukraine and the Government of the Republic of Hungary on Water Management on Boundary Waters of 11 November 1997 (https://zakon.rada.gov.ua/laws/show/348_001-97#Text);

- Agreement between the Government of Ukraine and the Government of the Slovak Republic on Water Management on Boundary Waters of 14 June 1994 (https://zakon.rada.gov.ua/laws/show/703_061#Text);

- Agreement between the Government of Ukraine and the Government of Romania on Cooperation in the Field of Water Management on Boundary Waters of 30 September 1997 (https://zakon.rada.gov.ua/laws/ show/642_059#Text);

- Agreement between the Government of Ukraine and the Government of the Republic of Moldova on the Joint Use and Protection of Boundary Waters of 23 November 1994 (https://zakon.rada.gov.ua/laws/show/498_051 #Text);

- The Commissioners of the Cabinet of Ministers of Ukraine for Cooperation on Boundary Waters and their deputies were appointed by the Resolution of the Cabinet of Ministers of Ukraine of 10 March 2017 No. 126 as amended {As amended by the Resolutions of the Cabinet of Ministers of Ukraine No. 489 of 05.06.2019 No. 45 of 13.01.2021 No. 1186 of 18.10.2022) (https://zakon.rada.gov.ua/laws/show/126-2017-%D0%BF#Text).

11 THE PROCEDURE FOR OBTAINING INFORMATION, INCLUDING PRIMARY INFORMATION, ON THE STATE OF SURFACE AND GROUNDWATER

In order to ensure proper organisation of access to public information, implementation of the Law of Ukraine "On Access to Public Information", Presidential Decree No. 547 of 05 May 2011 "Issues of Ensuring Access to Public Information by Executive Authorities", resolutions of the Cabinet of Ministers of Ukraine No. 583 of 25 May 2011 "Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the Secretariat of the Cabinet of Ministers of Ukraine, Central and Local Executive Authorities", No. 835 of 21 October 2015 "On Approval of the Regulation on

To regulate the procedure for access to public information, the State Agency of Ukraine for Water Resources adopted Order No. 163 dated 08.12.2023 "On Certain Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the State Agency of Ukraine for Water Resources".

In accordance with paragraphs 16-18 of the Procedure for State Water Monitoring, approved by Resolution of the Cabinet of Ministers of Ukraine No. 758 of 19 September 2018, the results of state water monitoring are:

- Primary information (observation data) provided by the subjects of state water monitoring;
- generalised data relating to a certain period of time or a certain territory;
- Assessment of the ecological and chemical state of surface water bodies, the ecological potential of artificial or significantly altered surface water bodies, the quantitative and chemical state of groundwater bodies, the ecological state of marine waters and identification of sources of negative impact on them;
- forecasts of water conditions and their changes;
- scientifically based recommendations necessary for making management decisions in the field of water use and protection and water resources reproduction.

Subjects of state water monitoring are obliged to store primary information (observation data) obtained as a result of state water monitoring for an indefinite period of time.

The information obtained and processed by the state water monitoring bodies is official.

Primary information (observation data), generalised data, assessment results, forecasts and recommendations resulting from the state water monitoring are provided free of charge:

- for surface waters (including coastal waters) - to the State Agency of Water Resources and the Ministry of Environment;
- for groundwater massifs - to the State Service of Geology and Subsoil of Ukraine and the Ministry of Ecology and Natural Resources, as well as to the State Agency of Water Resources in terms of generalised data, assessment results and forecasts;
- for marine waters - the Ministry of Environment.

The subjects of state water monitoring shall exchange information with each other on the data and results of state water monitoring on a free-of-charge basis.

The State Agency of Ukraine for Water Resources collects and publishes information on the state of surface waters in the public domain by maintaining the following information resources:

- Water Resources of Ukraine geoportal (http://geoportal.davr.gov.ua:81/);
- the web system "Monitoring and Environmental Assessment of Water Resources of Ukraine" (http://monitoring.davr.gov.ua/EcoWaterMon/GDKMap/Index).

Automatic data exchange has been set up between these information resources and the Ministry of Ecology's EcoThreat resource.

MANAGEMENT PLAN
RIVER SUB-BASIN
TICS
(2025-2030)

December 2023

1 GENERAL CHARACTERISTICS OF SURFACE AND GROUNDWATER IN THE **YEW SUB-BASIN**

1.1 Description of the river sub-basin

1.1.1 Hydrographic and water management zoning

The transboundary sub-basin of the Tisza River is located in four countries: Ukraine, Romania, Hungary and Slovakia.

The catchment area of the sub-basin rivers within Ukraine is 12777 km^2 . The river basin area covers 2.1% of Ukraine's territory.

The Tisza River sub-basin is entirely located within one region - Zakarpattia.

The hydrographic network of the sub-basin includes 165 rivers with a catchment area of more than 10 km^2 and 8 reservoirs (with a volume of more than 1 million m).[3]

According to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 3 March 2017 "On Approval of the Boundaries of River Basin Areas, Sub-basins and Water Management Areas", 3 water management areas were allocated in the Tisza sub-basin.

1.1.2 Climate.

Climate research is carried out at 9 meteorological stations and 7 meteorological posts.

The sub-basin has the highest duration of sunshine at 2010 hours per year. The mountainous areas experience fewer sunny days.

The largest annual radiation balance amounts are observed in the plain part of the basin (2000 - 2100 MJ/m^2), with increasing altitude the radiation balance values decrease and amount to 1500 - 1600 MJ/m^2 , at the level of the Polonynsky and Vodorozdilny ranges: Gorgany, Svydovets and Chornohora - 1250 - 1300 MJ/m^2 .

The general pattern of temperature variation in the sub-basin is as follows: the minimum occurs in January and the maximum in July. The average annual temperature reaches 9.3°C (Uzhhorod). An annual isotherm of 8.5°C separates the lowlands and the southern foothills from the colder mountainous areas. In terms of temperature conditions, the Rika River divides the mountainous area into two equal parts: western and eastern. The western part is warmer, with average annual temperatures ranging from 4.5 to 8.5°C. The eastern part is colder, with average annual temperatures ranging from 3.0 to 6.5°C. The annual amplitude of average monthly air temperatures is highest in the Khust depression (25.1°C) and the Zakarpattia lowland (23.7°C - Chop). The continental climate is most pronounced here.

In mountainous hollows, the continental climate is less pronounced. Winter on the plain is short, mild and unstable. It begins in mid-December. The weather in winter is cloudy, humid with fogs, temperatures around 0°C. In the mountains winter is more severe and begins in late November - early December. The average temperature in January in Uzhhorod is -2.9°C, with frosts down to -18°C. Average January temperatures are: -4.2°C (Solotvyno), -3.7°C (Khust), -8.9°C in the mountains. The warmest month in Zakarpattia is July. At this time, the average air temperature is: 25.9°C (Uzhhorod), 24.5°C (Khust), 11.5°C (Plymouth). The average daily temperature in July is between 15 and 25°C, with maximums reaching 37°C. In the mountains it is much lower, and in the valleys it is only 7-8°C.

The average long-term precipitation ranges from 870 mm (Velykyi Bereznyi - foothills) to 1600 mm (Plyai - midlands). On the windward slopes of the mountains, the amount of precipitation can reach 1100 - 1200 mm per year. The intra-annual distribution of precipitation in Zakarpattia has two peaks - in July and December. In winter, the amount of precipitation decreases.

Most precipitation falls during the warm season. Maximum precipitation in the mountains occurs in summer (60-80%). The amount of precipitation during the warm season varies from 1032 mm (Playa) to 425 mm (Chop). The amount of precipitation in the cold season is much lower and ranges from 618 mm (Playa) to 227 mm (Chop).

The maximum amount of precipitation is observed in the central part of the mountains and on the tops of mountain systems: Chornohora, Gorgany, in the meadows: Runa, Borzhava, Krasna and in the area of the Svydovets ridge.

Autumn is the driest season of the year. The least amount of precipitation during this period falls in the Transcarpathian lowlands. The greatest amount of precipitation (90 to 100 mm) during this period falls on the southwestern slopes, which is associated with the passage of southern cyclones.

1.1.3 Terrain

The sub-basin is located within two orographic regions. The majority of it is located in the mountains and foothills of the Carpathians, while the rest is in the Hungarian Plain (Transcarpathian Lowland).

The sub-basin is cut by three groups of ridges separated by longitudinal depressions. The main central group is the chain of the Polonyn Mountains, with the Gorgany Mountains to the north and the Vygorlat-Gutyn (volcanic) range to the south. In the extreme south-east, the Hutsul Alps stand out separately.

The Polonynsky Range extends to the eastern border of the Zakarpattia region, with a length of 180 km. The absolute height increases from northwest to southeast from 1400 m in the Runa valley to 2000 m in the Black Mountains, where the highest mountain in the Zakarpattia region and Ukraine, Hoverla, is located at 2061 m above sea level. The Polonynski Mountains are characterised by wide, flat peaks - polonyny: Runa, Borzhava, Svydovets and others.

The Gorgany are divided by the Mokryanka and Teresva rivers into Western and Eastern Gorgany. The Eastern Gorgany are higher than the Western ones: Boshtul (1698 m), Sivulya (1815 m).

There are several mountain groups in the Vyhorlat-Hutyn range. To the northwest of the Tisza River are the Vygorlat Mountains, with an average height of 800-1000 m. The highest peaks are Poprachnyi Verkh (1020 m) and Velykyi Dil (1081 m). To the north of the Tysa River are the Hutyn Mountains, 700-800 m high. The southern slopes of the Vygorlat-Gutyn Mountains are framed by a 30-40 km wide strip of foothills. The valleys of the tributaries of the Latorytsia and Borzhava rivers divide the foothills into separate escarpments with wide flat peaks.

The Polonyn Mountains are separated from the Gorgan Mountains by the Central Carpathian Depression and from the Vygorlat-Gutyn Mountains by the Internal Carpathian Depression. The Central Carpathian Depression stretches from southeast to northwest. This depression along its entire length up to the Yasynska Basin is a strip of low mountains 700 - 800 m high. The Intra-Carpathian depression is divided into three hollows: Perechyn, Svalyava and Khust depressions.

The Transcarpathian lowland, which occupies about 35% of the Tisza RBR, is a plain with some manes and hills. In the vicinity of the city of Berehove, there are mountains formed by volcanic rocks.

1.1.4 Geology

The Ukrainian part of the sub-basin is located within the young (alpine) folded structure of the Carpathians and covers the central part of the Ukrainian segment of the folded Carpathians with the adjacent Transcarpathian internal trough. These two main longitudinal segments are separated by a central suture zone (the Zakarpattia or otherwise Peripenian deep fault zone).

The geological structure of the territory is made up of two structural layers. The lower structural floor forms the foundation of the Transcarpathian Trough and the Folded Carpathians. The basement of the trough contains intensively deposited sedimentary, volcanogenic and metamorphic formations of the Paleozoic and Mesozoic-Cenozoic periods. The folded Carpathians are formed by carbonate-terigenous and terrigenous Mesozoic-Cenozoic formations that comprise several structural and facies zones. They are intensively dislocated and form a package of covering structures.

Internal Carpathians: Transcarpathian Internal Trough, Vygorlat-Hutyn Ridge and Berehove Uplift and "buried" volcanoes (rhyolites, andesites, basalts, their tuffs and tuff rocks).

Peninsular zone of rocks: The Pennine zone (limestone, mudstone, sandstone with gravels and conglomerates).

Marmarosh rocks area: Monastyretsky and Vezhansky covers (conglomerates, marls, sandstones, mudstones with gravels, limestones, siltstones).

Marmarosh massif: Dilove and Bilopotocky rocks (gneisses, shales of various compositions, quartzites, marbles and marbled limestones, limestones and dolomites, granite porphyries, granitogneisses, amphibolites, gabbro, tuffs, phyllites, mudstones, siltstones, sandstones, tuffs, coal, conglomerates).

External Carpathians: Magur and Rakhiv rocks (flysch, massive sandstones with limestones in places), Kamianopotocky rocks and Krosnenska zone (sandstones, limestones, mudstones, spilites, diabases and their tuffs in places), Porkulets, Dukliany, Chornohora and Skibovy rocks (flysch, mudstones, marls, sandstones, siltstones).

The sediments of the upper structural floor fill the Zakarpattia Internal Trough. These are Neogene-Quaternary sedimentary, volcanogenic and volcanomictic, sometimes coal-bearing molassic formations that lie mostly subhorizontally and form a cover complex. The general cover-scaly structure of the Carpathians (with masses moving from southwest to northeast) is complicated by a series of regional and local longitudinal and transverse faults, the largest of which determined the facies distribution of sediments, development of salt-dipyrite structures and block tectonics, and thus largely control the development of modern morphostructures and geological and hydrogeological conditions of groundwater massifs (hereinafter - GWM) formation.

1.1.5 Hydrogeologists me

The Ukrainian Carpathians are a complex hydrodynamic system, where the Carpathian and Transcarpathian groundwater basins are distinguished by geostructural features and conditions of groundwater formation, accumulation and circulation.

The Carpathian groundwater basin covers the mountainous folded structure of the Carpathians. The water-bearing rocks are almost exclusively terrigenous flysch rocks of the Cretaceous and Paleogene, crumpled into numerous folds, often faulted, overturned and complicated by thrusts. The Carpathian Basin is characterised by low flooding due to the predominantly clayey composition of the flysch rocks and intense denudation processes that make it difficult to form exogenous fracture zones, which are the main places of groundwater accumulation and movement. This leads to the absence of consistent aquifers in the area and in the section. Groundwater circulation occurs in local zones of exogenous fracturing of bedrock (weathering zone) and in zones of tectonic fracturing. Groundwater in the weathered zone is non-pressure, fresh. The waters of the tectonic fracture zones are pressurised, often mineralised.

The groundwater in the Carpathian Basin is fed by precipitation and discharged through a hydrographic network. In the mountainous part, the main source of water supply for most small settlements is aquifers in alluvial formations of river valleys, deluvial and proluvial sediments, and in the zone of exogenous fracturing of bedrock. Water intakes are mostly autonomous from springs and wells.

The Zakarpattia groundwater basin covers the territory of the Zakarpattia Internal Trough. The main source of fresh groundwater is the alluvial aquifer, which is widespread, holds significant groundwater reserves and is used to supply the population with drinking water. The aquifer is free-flowing. Alluvial groundwater generally meets state sanitary standards in terms of its chemical and organoleptic characteristics, but in areas of slow water exchange, the content of naturally occurring iron and manganese exceeds the maximum permissible levels. The aquifer is not sufficiently protected from surface sources of pollution due to the low thickness of the covering water-resistant sediments, and with the growth of anthropogenic load, the risks of groundwater quality deterioration increase. The aquifer is recharged mainly through infiltration of precipitation. The main discharge of groundwater flow is into the Tisa River and its tributaries, as well as through evaporation and artificial water extraction. Groundwater of the alluvial aquifer is of the greatest practical importance in the region, widely used for centralised water supply of all major settlements and some industrial and agricultural enterprises.

Significant reserves of fresh groundwater are accumulated in the volcanic complex of the Vygorlat-Gutynsky Ridge. Fractured, cavernous and porous tuffs, andesites, andesite-basalts, volcaniclastic conglomerates and breccias are water-bearing. The upper zone of intense weathering fracturing is associated with fractured groundwater, which is characterised by good drinking quality. The waters of the tectonic fracture zones are under pressure, often have elevated temperature and mineralisation, and a specific chemical composition. As a rule, they are enriched with orthosilicic acid ions. Waters infiltrating through highly permeable and highly porous tuffs can be additionally enriched with Ca^{2+} , Mg^{2+} ions (source - reactions of silicate hydrolysis), sulfate ions and soluble heavy metal complexes (source - reactions of sulfide oxidation and hydration, which are always present in volcanic bedrock). The intensity of changes in water composition depends on the presence of additional anthropogenic factors.

The aquifer is fed by precipitation and surface water. The aquifer complex is discharged into the hydrographic network and the alluvial sediment aquifer. The Vygorlat-Gutynskyi Ridge aquifer is exploited by group water intakes for centralised domestic water supply to some settlements and is often used by individual wells to supply water to industrial and agricultural facilities and households. The mineral waters of the complex are used in balneology and for industrial bottling.

Groundwater in deep aquifers is confined to layers and interlayers of sands, sandstones, conglomerates, tuffs and tuffites that occur among substantially clayey strata. The distribution of groundwater is localised, with waterlogged zones of tectonic fractures containing highly mineralised, heat-generating water. Sanatoriums and swimming pools of health and recreation centres operate on the basis of mineral thermal energy waters.

1.1.6 Soil and

Due to a certain lithological heterogeneity of the bedrock, altitudinal differentiation of the relief, climatic conditions and the tiered vegetation cover, the sub-basin has a significant diversity and specificity of soil cover.

The sub-basin is dominated by sod-podzolic soils in the lowlands, brown mountain-forest and meadow-forest soils in the mountains, and meadow and meadow gley soils on the floodplain terraces.

Within the mountainous part of the territory, the vertical differentiation of soils is clearly visible. In the highland tier, mountain-meadow-brown soils are common at altitudes of 1100-1200 m; in the non-forested areas - meadows - sod-brown soils are common.

The gentler mountain slopes are covered with loamy brown earth-podzolic soils. On gentle slopes and in river valleys, meadow-brown loam soils are formed.

The Transcarpathian lowland is covered with soddy- podzolic gley and gley or brown gley soils.

In the valleys of the Borzhava and Irshava rivers, bog-gley and meadow-gley soils prevail. In the upper reaches of the rivers: Uzh, Latorytsia, Rika, light brown forest soils were formed, and in the upper reaches of the rivers: Borzhava, Tereblya, Teresva, Chorna and Bila Tysa - brown mountain-forest soils. The dominant soil type in the lower reaches of the Uzh, Latorytsia and Borzhava rivers is soddy- podzolic clayey soils.

1.1.7 Vegetation

The Ukrainian Carpathians belong to the Central European province of the broadleaf forest region. The land area of the Transcarpathian forest fund is 57.5% of the basin (as of *01.01.2023)*. The dendrological composition includes 10 coniferous and more than 150 deciduous tree and shrub species. The area of the Ukrainian Carpathians covered by forests is 41% spruce and 35% beech. Other species cover smaller areas: oak - 9%, spruce - 5%, hornbeam - 4%. Other species such as birch, maple, ash, and alder cover 6% of the forested area.

There are altitudinal zones of vegetation: foothill oak, lowland beech, upper mountain spruce, subalpine shrub and meadow, and alpine.

The foothill zone, which rises to 400-500 (700) m, is dominated by oak forests, spruce-beech forests and derivative hornbeam forests, beech forests, birch forests, smoky forests, aspen-willow forests. The lowland belt on different slopes rises from 500 - 700 m to 1000 - 1200 m and 1350 - 1450 m, and is dominated by tall-stemmed beech, spruce-beech, hornbeam-beech and oak-beech forests. Pure spruce forests occupy the upper parts of the slopes of Chornohora, the Rakhiv Mountains, and the Gorgan Mountains. In the subalpine zone at altitudes of 1200 - 1500 m, 1650 - 1850 m, there are thickets of mountain pine, juniper shrubs, green alder, East Carpathian rhododendron, cereals and herbaceous meadows. The alpine zone includes herbaceous and shrubby communities above 1800-1850 m; they are fragmented.

1.1.8 The animal world

The total number of fauna species in the region is over 30 thousand. Both invertebrates and vertebrates are common on the territory of the Tisa RBR. Invertebrates include representatives of more than 20 types of organisms, most of which are protozoa. There are about 400 species of vertebrates, 80 species of mammals, 287 species of birds, including 197 breeding birds, 10 species of reptiles, 16 amphibians, 60 fish, and 100 molluscs. The most common species in Zakarpattia are: mole, fox, wolf, hare, squirrel, ermine, forest marten, wild boar, roe deer, red deer. Rare species include the Danube salmon, sterlet, eagle owl, golden eagle, alpine curlew, lynx, and otter.

Endangered species include the red-winged sparrow, hairy owl, big and small horseshoe bats, Bechstein's, pond, Natterer's, tricoloured and other bats. The number of species of fauna listed in the Red Data Book of Ukraine (the "Red Data Book") increased: grouse, forest cat, black stork and brown bear. The nesting bird fauna includes new species such as the crested and white-eyed ducks. The population of the spotted salamander is stable. A relict fish species, the Kramer umber, has been preserved in the lowland areas in the system of reclamation canals.

1.1.9 Hydrological regime

The hydrological regime of the sub-basin's rivers is monitored using 50 automated measuring stations (hereinafter referred to as AIS Tisa), 30 of which are hydrometeorological, 13 meteorological, 4 monitoring pumping stations, 2 monitoring gateways, and 50 hydrological posts (Transcarpathian Hydrometeorological Centre). The average duration of observations for all hydrological characteristics is more than 50 years. Water flows are measured at 19 hydrological stations.

The surface runoff of the Tisza RBR in Ukraine is formed by the Black and White Tisza, the right tributaries are the Teresva, Tereblya, Rika, Borzhava rivers, which flow directly into the Tisza River, and the Uzh and Latorytsya rivers, which flow into the Laborets and Bodrog rivers in the Slovak Republic, and the latter into the Tisza River in Hungary. Transit surface runoff comes from Romania: the left tributaries of the Viseu, Iza, Sapince and Hungary - the Tur River. In Slovakia, the right tributaries of the Uzh: Ulica and Ubl'a. In addition, surface water runoff from the Beregovo drainage (polder) system comes from Hungary.

A distinctive feature of the intra-annual distribution of runoff in the Upper Tisza basin is the decrease in winter runoff with altitude. Much of the solid precipitation is transferred to the spring or summer seasons. This explains the more intensive growth of runoff in the summer and autumn seasons. The largest share of spring runoff falls on April (18%) and May (17%), and in general, spring accounts for 40% of the annual runoff. The summer season accounts for 24% of the runoff, with the highest runoff in June (11%). Since meltwater is overlaid by rainfall floods, 66% of the annual runoff occurs in the spring and summer, while the autumn season accounts for only 19%. Winter is the season that accounts for the smallest share of the annual runoff - 15%. This season also has the lowest monthly runoff. However, the Borzhava, Latorytsia and Uzh rivers are characterised by a predominance of winter runoff over autumn runoff.

The intra-annual flow regime of the rivers in this sub-basin is characterised by floods occurring between March and August. In low water years, high floods are sometimes observed in autumn and even winter. Due to this complexity of the river flow regime, the definition of the boundaries of the seasons is rather arbitrary, as floods occurring throughout the year make it difficult to identify a boundary period.

Floods on the rivers of the sub-basin are formed by precipitation, which is frequent (165 - 175 days). However, floods begin to form when precipitation exceeds 20 mm per day. In the event of very intense downpours, during which more than 100 mm of precipitation falls, floods become catastrophic. Water levels in mountainous areas rise by 2-4 m, in foothill areas by 5-6 m, and in the Tisza River by 6.5-9.5 m. At the same time, floodwaters are rapidly discharged from mountain watercourses into river valleys, where significant flooding occurs - in a strip of 15-60 m wide in the mountainous area, 115-500 m wide in the foothill area, and in the plains the flood zone increases to 2500 m. Significant slopes of the terrain cause flash floods, during which water levels rise by 1.5-2.5 m in 3 to 4 hours.

An analysis of long-term data on precipitation and hydrological regime in the Tisza RBF shows that the highest water level rises and flows are typical of autumn and winter floods. The share of these floods is on average 20-30% of the number of floods formed during the year.

In addition to floods of mixed origin that occur in the cold season, there are warm-season floods (April - November) that occur as a result of sudden heavy rainfall or siege rains.

Minimum water flows are observed in both warm and cold seasons. The first minimum is recorded in September-October and is associated with a sharp decrease in precipitation, while the second is formed in January-February, when there is no surface runoff and groundwater reserves are depleted. In the mountainous rivers of the basin, stable summer low water is observed in 20% of cases, and stable winter low water in 40% of cases. The summer low water period begins in June and July and ends in early November. The average duration of the summer low water period is 100-160 days. The end of the winter low water period on the basin's rivers occurs in February - March. The average duration of the winter low water period is 45 to 80 days.

The minimum flow characteristics are the average monthly flow (30-day periods with the lowest flow) and the minimum average daily flow in summer, autumn and winter. The minimum average monthly flows of 95% availability are mainly calculated when designing hydroelectric power plants, reservoirs, and ponds, and the minimum average daily flows of 95% availability are used when designing water supply facilities for residential and industrial enterprises.

1.1.10 Specifics of the river basin

The specificity of the Ukrainian part of the Tisza RBD is that it is located exclusively within one administrative unit - the Zakarpattia Oblast. This fact has positive implications for river basin management.

The natural specificity of the sub-basin is that its Ukrainian part is located in the upper reaches of the sub-basin and it is here that the chemical composition of the water and most of the river flow is formed. Floods of varying intensity are common and occur with a recurrence of 3-6 times per year during all seasons.

Volcanogenic sediments within polymetallic deposits and ore occurrences in the Carpathians due to the high solubility of sulphate compounds of heavy metals (chromium, cadmium, copper, etc.) cause an increase in their concentrations in surface and groundwater.

The sub-basin contains mineral deposits, including lead and zinc (Muzhiyevo, Berehivske), mercury (Dubrynychi, Turya Bystra, Vyshkovo), and rock salt (Solotvyno, Tereblya). Enrichment of water with sulphate ions and heavy metal ions is also observed in places of sulphide (kolchedansky) mineralisation in the Marmarosh Rocks area and in the covers of the Marmarosh massif.

The groundwater of the Ukrainian part of the river sub-basin forms a single artesian basin that covers the territory of Hungary and, partially, Slovakia and Romania. The plain part of Transcarpathia is used for transit of groundwater outside Ukraine, while the Panonian Basin in Hungary is a regional discharge area.

Within the Tisa RBR, there are five wetlands of international importance (Ramsar sites), the Carpathian Biosphere Reserve and the Uzhansky National Nature Park, which have international status.

1.1.11 Typology of surface water bodies

The IWM typology was developed in accordance with the Methodology for Determining Surface Water Arrays (hereinafter - the Methodology) approved by the Order of the Ministry of Ecology and Natural Resources No. 4 dated 14 January 2019 to detail the hydrographic zoning of Ukraine, prepare a state water monitoring programme, and develop and evaluate the effectiveness of the RBMP implementation.

In the Tisza sub-basin, three categories of surface water bodies have been identified - rivers, artificial (hereinafter referred to as "ASCB") and significantly modified surface water bodies (hereinafter referred to as "SMSB").

The EU WFD system A was used for river typology and delineation (Table 41).

Table 41. Descriptors for rivers (system A)

Descriptors		
Catchment height, m	**Catchment area, km^2**	**Geological rocks**
• midlands: over 800 • lowlands: 500 - 800 • upland: 200 - 500 • lowland: < 200	• small: 10 - 100 • average: >100 - 1000 • Large: >1 000 - 10 000 • very large: > 10 000	• limestone • silicate • organic

The Tisza sub-basin is located within two ecoregions - the Hungarian Lowlands (number 11) and the Carpathians (number 10).

The rivers of the basin are classified as small (with a catchment area of less than 100 km^2), medium (100 to 1000 km^2), large (1000 to 10,000 km^2) and very large (over 10,000 km^2) rivers by catchment area.

According to the altitude of the catchment area, the rivers of the basin are located in the lowlands (less than 200 m), uplands (200-500 m), lowlands (500-800 m) and midlands (over 800 m).

The geological rocks of the RBD are represented by one type: silicate (Si).

Table 42. Types of IBAs in the "rivers" category

№	Type code	Type
1	UA_R_10_L_1_Si	a large river in the lowlands in silicate rocks
2	UA_R_10_L_2_Si	a large river on a hill in silicate rocks
3	UA_R_10_M_1_Si	medium-sized river in the lowlands in silicate rocks
4	UA_R_10_S_1_Si	a small river in the lowlands in silicate rocks
5	UA_R_10_S_2_Si	a small river on a hill in silicate rocks
6	UA_R_10_S_3_Si	a small river in the lowlands in silicate rocks
7	UA_R_10_S_4_Si	a small river in the middle mountains in silicate rocks

№	Type code	Type
8	UA_R_10_M_2_Si	medium-sized river on a hill in silicate rocks
9	UA_R_10_M_3_Si	medium-sized river in the lowlands in silicate rocks
10	UA_R_11_L_1_Si	a large river in the lowlands in silicate rocks
11	UA_R_11_M_1_Si	medium-sized river in the lowlands in silicate rocks
12	UA_R_11_S_1_Si	a small river in the lowlands in silicate rocks
13	UA_R_11_S_2_Si	a small river on a hill in silicate rocks
14	UA_R_11_XL_1_Si	a very large river in the lowlands in silicate rocks

1.1.12 Reference conditions

The assessment of the ecological state of the MPA is based on a comparison of biological indicators (benthic macroinvertebrates, macrophytes, phytobenthos, phytoplankton and fish) with reference conditions that characterise the state of the MPA, which has not been subjected to anthropogenic impact or is minimal.

Reference conditions are determined on the basis of data obtained from reference sites, by modelling (predictive models or retrospective forecasting methods that take into account historical, paleogeographic and other available data that provide a sufficient level of confidence in the values for reference conditions for each type of MPE) or by a combination of these methods or based on expert opinion.

In order to establish reference values for biological indicators based on data from reference sites, it is necessary to establish such sites for each type of MPA in all natural categories. The network should cover a sufficient number of sites to provide a sufficient level of confidence and to account for the variability of values for indicators that correspond to the different ecological status of the MPA type.

Key criteria for selecting reference sites:

- characterise the state of the MPA without anthropogenic impact or with minimal impact;
- There is no industry or intensive agriculture;
- concentrations of specific synthetic pollutants are zero or below the detection limits;
- no morphological changes;
- water abstraction and flow control cause only minor fluctuations in water levels and do not affect surface water quality;
- the vegetation of the coastal zone is appropriate for the type of MPA and geographical location;
- None Invasive species;
- fishing and aquaculture do not affect the functioning of the ecosystem.

In accordance with paragraph 2, clause VII. of the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14.01.2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Conditions of a Surface Water Body, as well as Assigning an Artificial [...]", type-specific reference conditions may also be determined on the basis of existing reference sites in other countries for the same type of MWB or by combining the procedures described above. Given that reference conditions for all types of MSPs are not currently defined in Ukraine, it was suggested to use the reference conditions established for the same or similar types in neighbouring EU countries, namely the Slovak Republic and Romania.

The methodology includes four hydrobiological indicators (benthic macroinvertebrates, phytoplankton, phytobenthos, macrophytes, macroalgae and eutrophication, respectively) for four natural categories of surface waters (rivers, lakes, transitional waters and coastal waters) that have been identified in Ukraine.

A draft order has been developed to approve environmental water quality standards for the MWR and to amend certain regulatory acts that set out reference conditions and type-specific classifications.

1.2 Defining arrays

1.2.2 Surface water

In the Tisza sub-basin, the MWC was determined on 165 rivers (according to the Water Resources of Ukraine geoportal of the State Agency of Water Resources of Ukraine).

A total of 481 MPAs have been identified within the sub-basin. The identified MPAs belong to the following categories of surface water:

- rivers;
- artificial (AIU) and significantly modified (SMM).

Category "rivers"
According to the Methodology, 400 MSPs were identified. The number of identified MSPs by descriptors and types is shown in Tables 43 and 44.

Table 43. Distribution of IBAs of the "rivers" category by descriptors

Descriptor	Indicator.	Number of MPVs
by eco-region	Hungarian lowlands (number 11)	34
	Carpathians (number 10)	366
by catchment area	small (S)	327
	average (M)	56
	large (L)	15
	very large (XL)	2
by the height of the catchment area	in the lowlands (1)	83
	on a hill (2)	131
	in the lowlands (3)	115
	in the midlands (4)	71
by geological type	in silicate rocks (Si)	400

Table 44. Distribution of IBAs of the "rivers" category by type

№	Type code	Type	Number of designated MPAs
1	UA_R_10_L_1_Si	a large river in the lowlands in silicate rocks	4
2	UA_R_10_L_2_Si	a large river on a hill in silicate rocks	5
3	UA_R_10_M_1_Si	medium-sized river in the lowlands in silicate rocks	12
4	UA_R_10_S_1_Si	a small river in the lowlands in silicate rocks	37
5	UA_R_10_S_2_Si	a small river on a hill in silicate rocks	96
6	UA_R_10_S_3_Si	a small river in the lowlands in silicate rocks	105
7	UA_R_10_S_4_Si	a small river in the middle mountains in silicate rocks	71
8	UA_R_10_M_2_Si	medium-sized river on a hill in silicate rocks	26
9	UA_R_10_M_3_Si	medium-sized river in the lowlands in silicate rocks	10
10	UA_R_11_L_1_Si	a large river in the lowlands in silicate rocks	6
11	UA_R_11_M_1_Si	medium-sized river in the lowlands in silicate rocks	8
12	UA_R_11_S_1_Si	a small river in the lowlands in silicate rocks	14
13	UA_R_11_S_2_Si	a small river on a hill in silicate rocks	4
14	UA_R_11_XL_1_Si	a very large river in the lowlands in silicate rocks	2

Category "significantly altered surface water bodies"

A total of 49 IWMS have been identified in the basin. The share of IZMVOs in the total number of MSPs in the sub-basin is 10%. Most of them (39 MSW) are classified as IWMS due to diversion.

9 IPPs are classified as MSMEs due to their overregulation.

1 MWR is classified as an IWRM due to a combination of regulation and channel straightening (Figure 41).

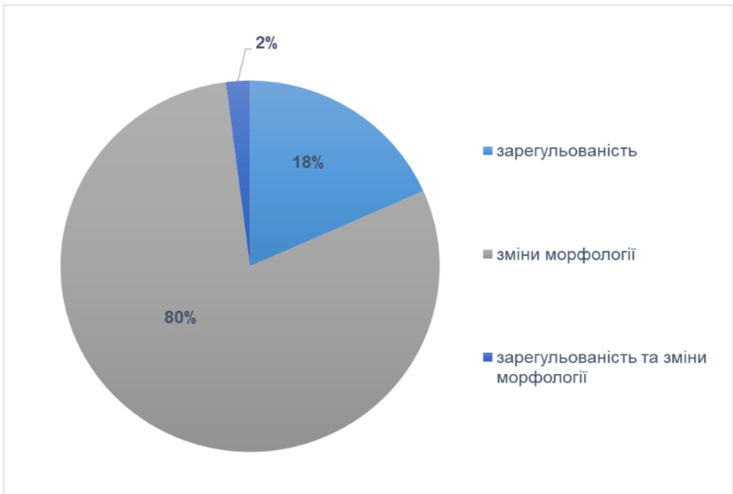


Figure 41. Distribution of IHMW by hydromorphological loads, %.

Category "artificial surface water bodies"

The sub-basin has 32 SSSIs, which are canals.

The percentage distribution of the identified WFDs in the Tisza sub-basin by category is shown in Figure 42.

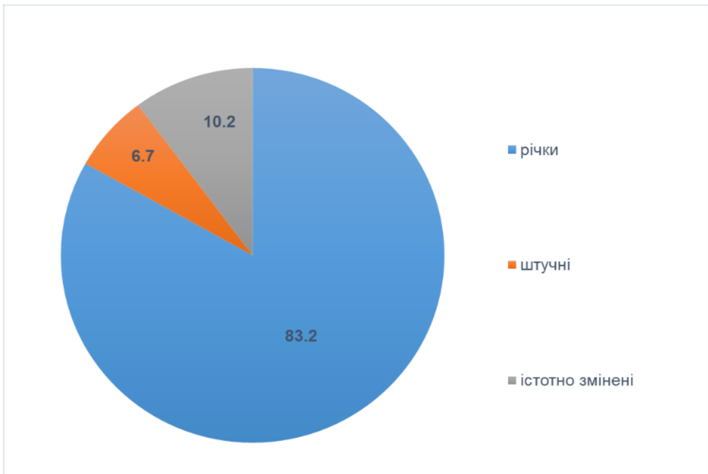


Figure 42. Breakdown of identified MSPs by category, %.

Each of the 481 MPAs identified in the sub-basin has been assigned a unique code that looks like this:

UA_ M5.3.1_YYYY , where

- UA - Ukraine;
- M5.3.1 is the code of the Tisza sub-basin (according to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 29 March 2017 "On Approval of the Boundaries of River Basin Areas, Sub-basins and Water Management Areas");
- YYYY *is the* unique number of the designated WFD in the sub-basin.

Each linear IBA (categories "rivers", "artificial or significantly modified IBA") has a length (km). The length of the IBAs ranges from 0.3 km (UA_M5.3.1_0453 - Lyuta River) to 67.3 km (UA_M5.3.1_0300 - Latorytsia River).

Figure 43 shows the distribution of the identified linear MWRs in the sub-basin by length.

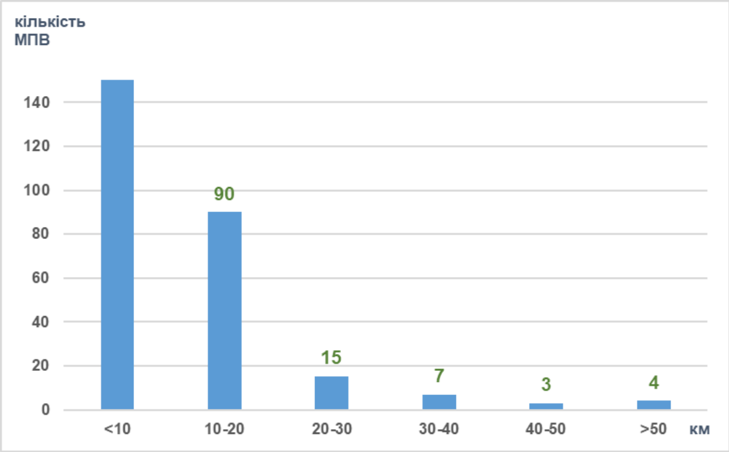


Figure 43. Distribution of the identified linear IPPs by length

Each polygonal MPA (of the "significantly altered MPA" category) has an area (km^2). The area of the MPAs ranges from 0.2 km^2 (UA_M5.3.1_0368 - Bobovyshchanske Reservoir) to 2.1 km^2 (UA_M5.3.1_0413 - Fornosh Reservoir).

Figure 44 shows the distribution of the identified polygonal WFDs in the sub-basin by area.

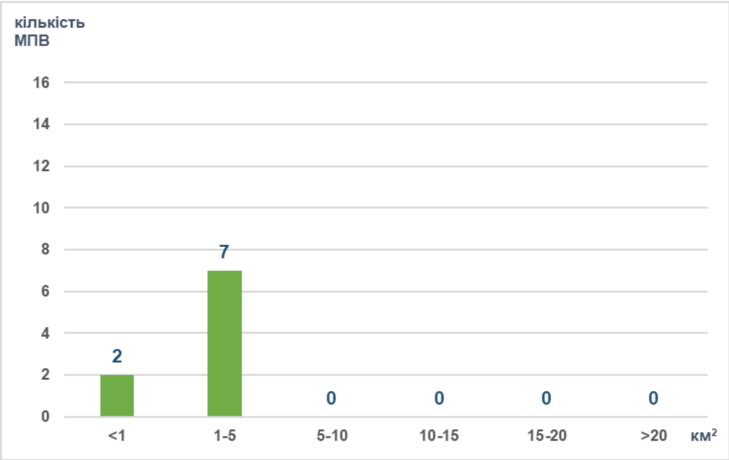


Figure 44. Distribution of identified polygonal MPAs by area

1.2.2 Groundwater and

The groundwater massifs were determined in accordance with the Methodology for Determining Surface and Groundwater Massifs (hereinafter referred to as the Methodology), approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 4 dated 14.01.2019.

In the process of identifying IBAs in the Tisza sub-basin, 7 groups of IBAs with a total area of 14713 km^2 (average area of 2101.9 km^2) were identified (Table 45). In total, 3 groups of non-pressure IBAs, 2 groups of pressure IBAs and 2 groups of pressure and non-pressure IBAs were identified in the sub-basin.

As a result of the definition of MWCS, MWCS codes have been developed, for example, UAM5300Q100, where:

- UA is a country;
- M5 is an international maritime system code;
- 3 - river basin, according to the Water Code;
- 0 - river sub-basin, according to the Water Code;
- 0Q - geological system (geological age of water-bearing rocks);
- 100 - the number of the MPZV.

Table 45. Tisza sub-basin MWR

№	Unified code of the IPPC	M&E groups	Geological index	Area of the MWP, km^2

1	UAM5310Q100	Group of MWPs in alluvial Upper Neopleistocene-Holocene sediments of floodplains and first floodplain terraces of rivers of the mountainous part and Solotvynska depression	aP +aH$_{III}$	1251,0
2	UAM5310Q200	A group of IPMs in weathering crust and other loose Holocene sediments of the mountain slopes of the sedimentary Carpathians	e, p, ed, dcH	7366,0
3	UAM5310Q300	MWP in lacustrine-alluvial middle-upper Neopleistocene-New Member sediments of the Minaya Formation	laPII-IIImn	1854,0
4	UAM5310Q400	MWP in lacustrine-alluvial Eopleistocene-Lower Neopleistocene sediments of the Chop Formation	laE+P$_{I}$ čp	1090,0
5	UAM5310Q500	MWP in alluvial Pliocene-Lower Neopleistocene sediments of the ninth and tenth overflank terraces (Kopanska terrace)	a N -E$^{9-10}_{2I}$	118,0
6	UAM5310N100	MWP in the Pliocene Ilnytsia Formation sediments	N$_{2}$ il	1307,0
7	UAM5310N200	A group of IPMs in volcanogenic Pliocene sediments of the Vygorlat-Gutynsky Ridge	N vg$_{2}$	1727,0

Group of MWPs in alluvial Upper Neopleistocene-Holocene sediments of floodplains and first floodplain terraces of rivers of the mountainous part and Solotvynska depression

The group of MWPs occurs in alluvial deposits of the same genesis in the floodplain and the first floodplain terrace of the middle reaches of the largest rivers of Transcarpathia: Tisa, Teresva, Tereblya, Rika, Borzhava, Latorytsya and Uzh, and sometimes in the alluvium of their lateral tributaries.

Morphologically, the floodplain and the first overflank terrace belong to the river valley bottoms. Accordingly, the configuration of the boundaries of the MPZV follows the linearly elongated perimeter of the valley floor.

The length of the MPZV from the upstream areas with absolute elevations of 583-1040 m to the outflow of the rivers to the plain is 53 to 100 km. The width of the massifs ranges from 0.5 km in the upper reaches of the rivers to 10-13 km in the lowlands. The approximate total area of the combined massif in the bottom of the Tisza, Teresva, Tereblya and Rika is approximately 751 km^2 , Borzhava - 157 km^2 , Latorytsia - 190 km^2 , Uzh - 153 km^2 .

In total, there are 4 distinct areas and in the context of the MZV with a total area of approximately 1251 km^2 .

The alluvial deposits of the floodplain and the first terrace above the floodplain form a single lithological stratum, often lying on a common basement. The terrace surface is 0.5-5.0 m above the floodplain.

The water-bearing alluvium of the valley bottoms is composed of coarsely rolled boulders, pebbles, gravel and various grains of sand as aggregate. The volume of aggregate reaches 20%. Clay loam material in the context of alluvium is insignificant and sometimes completely absent. A layer of loam with an admixture of boulders and pebbles, 0.5 to 2 m thick, often lies in the roof of terraces. This layer of low-permeability rocks can shield the MPZV from episodic contamination with a small amount of pollutant. These overlying loams are ineffective for protection against long-term contamination. The thickness of the MPZV ranges from several metres to 14-16 metres. Cretaceous and Paleogene sandstones, mudstones, siltstones underlie the basement in the Flysch Carpathians, and tuffs, andesites and dacites in the volcanogenic Carpathians.

The MPZV is fed by infiltration of river water into the floodplain. In low water, when river levels are low, alluvial water is discharged into river channels.

The predominant values of the water conductivity coefficient of the MPZV at the studied water intake sites are 800 -1100 m^2 /day. The filtration coefficient is 80 - 400 m/day, the equal conductivity is (6.6 - 9.5)*10^3 m^2 /day, and the water yield is 0.12 - 0.2. The hydraulic resistance of the channel sediments is about 40 m.

The depth of the natural alluvial water table ranges from 1-2 to 4-5.5 m, but in floods in some areas the water table is directly below the surface. The average amplitude of water level fluctuations is about 1.5 m.

During catastrophic floods, which occur with a frequency of once every 10 to 20 years, part of the area of the first floodplain terrace is completely inundated.

The chemical composition of alluvial waters is calcium bicarbonate. Mineralisation ranges from 0.12 to 0.32 g/dm^3 . In terms of macro- and micro-components, the water generally meets the standards of DSan-PiN2.2.4-171-10 "Hygienic requirements for drinking water intended for human consumption". In the vicinity of settlements, nitrogenous compounds and phosphates may be present in alluvial waters in excess of normal concentrations, which is associated with domestic pollution. Special environmental studies are required to determine the presence and intensity of pollution.

Alluvial waters from the bottom of river valleys are used by the local population to supply water to private households, public and industrial facilities, and cities.

For local water supply, water is extracted from wells up to 8 m deep and single wells of greater depth. For cities: Rakhiv, Perechyn, settlements: Velykyi Bychkiv and Velykyi Bereznyi, currently operating water intakes with operational reserves of 3 to 6 thousand m have been explored^3 /day. The depth of production wells at these water intakes is 6.0-32.0 m. The wells have fully penetrated the alluvial stratum and the bedrock cover to construct sumps. Experimental water intake wells flow rates are in the range of 65-1200 m^3 /day with a decrease in levels by 0.66-6.2 m. Significant variations in these indicators are associated with different well loading during the experiments and different thicknesses of water-bearing rocks.

The alluvial waters of the first floodplain terrace are also developed in conjunction with the waters of the volcanogenic Carpathian massif that lies below the alluvium at the Chynadiyivka (Mukachevo) and Rika (Khust) water intakes. The thickness of the watered alluvium is 10.0-23.0 m. Water-bearing andesites and tuffs have been uncovered by wells to a depth of 100 - 200 m.

Experimental water discharges at Chynadiyivka water intake ranged from 238 to 1043 m^3 /day with a water level drop of 1.4 to 3.8 m. The integral value of water permeability of the entire thickness of water-bearing rocks is 244-342 m^2 /day. Experimental discharges of the Rika water intake are in the range of 1380-2680 m^3 /day with a decrease in the level to 5.9 m.

The chemical composition of mixed waters of the massifs is calcium hydrocarbonate, sodium-calcium hydrocarbonate and magnesium-calcium hydrocarbonate. Mineralisation is 0.19-0.41 g/dm^3 .

A group of IPMs in weathering crust and other loose Holocene sediments of the mountain slopes of the sedimentary Carpathians

Most of the mountain slopes of the sedimentary (flysch) Carpathians have Holocene weathering crusts formed as a result of destructive changes (weathering) of the surface layer of Cretaceous-Paleogene bedrock under the influence of temperature fluctuations, chemical action of the atmosphere, water, as well as organic weathering under the influence of flora and vital activity of various groups of organisms (e, p, ed, dcH). The lithological composition of the sedimentary bedrock of the slopes is mainly represented by mudstones, siltstones and sandstones.

The massif is bounded in the north-east by the main watershed of the Carpathians, in the south-west by the contact with the Transcarpathian trough, in the east by the borders of Ukraine with Poland and Slovakia, and in the south by the border with Romania. At the bottom of the mountain river valleys, the massif is in contact with the modern alluvium of floodplains and the first floodplain terraces. The area of the massif is 7366 km^2 .

Among the weathering products of the surface layer of bedrock, the following types of debris are common by genesis: eluvium (weathering crust), colluvium, deluvium, and proluvium.

Groundwater in the loose sediments of mountain slopes has not been systematically studied and is not being studied. Only long-term monitoring of 5 springs in representative subdivisions is carried out. Their discharge ranges from 6.7-10.0 m^3 /day in low periods to 72.0-79.0 m^3 /day at maximum recharge. There were also occasional determinations of the flow rate and water quality of the 3 largest springs of Mizhhirya (now Khust) district for the purpose of their industrial bottling. The discharge of these springs is 200-300 m /day.^{3}

The water salinity of the studied springs ranges from 0.12 to 0.2 g/dm^3 . Chemical composition: magnesium-calcium hydrocarbonate, sodium-calcium sulphate-hydrocarbonate.

The groundwater of loose sediments is widely used by the local population to meet their domestic and drinking needs. Almost every private household has built traditional wells, usually 4-10 metres deep. Depending on the size of the households, the volume of water extracted from these wells is up to 5-7 m^3 /day. Sometimes household owners jointly exploit the nearest springs after capping them and laying water pipelines. Spring water is also used to provide centralised water supply to some of the existing sanatoriums, recreation centres, public and private institutions in the Carpathians. According to indirect estimates, about

350,000 people use groundwater from the loose sediments of the Carpathian mountain slopes, with a total volume of up to 100-150,000 m3^3 /day.

MWP in lacustrine-alluvial Middle-Upper Neopleistocene sediments of the Minaya Formation

The MWMF in lake-alluvial Middle-Upper Neopleistocene sediments of the Mynai Formation (LaPII-IIImn) is distributed in the Transcarpathian alluvial plain (lowland). The absolute surface elevation of the plain is 103-140 m.

In the west and south, the IEZ extends into the territory of neighbouring countries: Slovakia, Hungary and Romania. Accordingly, the state border of Ukraine is taken as a conditional boundary of the massif. In the northeast, the massif's boundary is mainly formed by the foothills of the Vygorlat-Gutyn volcanogenic range, while in the central part of the Zakarpattia lowland, the massif borders on the foothills of the Berehove hills and the Kopanska terrace. The total area of the massif is about 1854 km^2 .

The groundwater of the Mynai massif has been studied in detail to solve the problems of water supply for the local population and enterprises. Several hundred special wells, including production wells, have been drilled as a result of a range of hydrogeological works. There are also observation wells for regular monitoring of groundwater levels and quality.

Explored, with conditioned estimates of operational groundwater reserves, centralised water intakes for cities: Uzhhorod, Chop, Berehove, Vynohradiv and others. A predictive assessment of the massif's forecast groundwater resources has been made.

The massif is the first to emerge from the earth's surface. It consists of a thick layer of homogeneous waterlogged alluvial sand, gravel, pebble and boulder deposits. These sediments were accumulated on land and in lakes of the plain during the Middle-Upper Pleistocene. The mineralogical composition of the alluvium is identical to the rocks of the surrounding mountains, from which erosive debris was carried by water flows to the plain. From the surface, the massif is covered by a layer of water-resistant clays and loams of low thickness - up to 8-10 m. In the floodplains of the Tysa, Uzh, Latorytsia, Borzhava rivers that cross the plain, there are practically no surface water retaining structures. The small Holocene (modern) alluvial deposits of the river floodplains and the first floodplain terrace are hydraulically closely connected to the thick thickness of the Mynai alluvium. They form a single groundwater body.

In the north of the massif, along the border with Slovakia and partly Hungary near Chop, fine-grained sands (sometimes quicksand) with minor layers of medium-coarse sand fractions prevail. To the east, between the Latorytsia and Uzh rivers, the largely sandy section is gradually replaced by gravel and pebble with inclusions of boulders near Uzhhorod. The thickness of the northern fragment of the massif is 50-80 m.

The central part of the groundwater massif of the Mynai Formation is dominated by sand and gravel deposits interbedded with clays. In the vicinity of Batyovo, Gut, Gat, Koropets and other settlements, layers of waterlogged alluvium sometimes resemble riverbeds in shape and lithology. The riverbeds buried in the Pleistocene have a northeast orientation. Active water exchange between alluvial layers takes place through "hydraulic windows" in clay layers. The total thickness of the central part of the massif is mostly 40-70 m.

The southeastern flank of the massif between the towns of Berehove and Vynohradiv is characterised by the widespread occurrence of gravel and large fragmentary alluvium (pebbles and boulders). The largest areas of boulder and pebble alluvium with an admixture of gravel and sand occur in a wide strip on the right bank of the Tisa River near the settlements: Korolevo - Vynohradiv. Sandy deposits occur only on the left bank near the intersection of the three borders. The thickness of alluvium varies from 10-20 m at the foot of the Berehove hill to 100-120 m southwest of Vynohradiv.

The depth of the natural water table is generally 4-7 m. The amplitude of their fluctuations throughout the year depends on the volume of groundwater supply and discharge and is about 2.5 m.

The chemical composition of the alluvial waters of the Mynai is determined by the nature of their feeding, transit, discharge, as well as by flows from adjacent aquifers. The groundwater of the Maine massif is predominantly calcium bicarbonate with an admixture of chlorides, sulphates, sodium and magnesium. Sometimes the content of chlorides and sodium exceeds 20 mg-eq/dm^3 . Sulphates are present in groundwater over almost the entire area of the massif. This is due to the economic use of the land, as well as the presence of sulphide rocks in the lower deep horizons.

The total water salinity is 0.35-0.6 g/dm^3 . In the river floodplains, groundwater salinity is somewhat lower - 0.22-0.3 g/dm^3 . In terms of macro- and micro-components, the water of the Minaj complies with the standards of Sanitary and Epidemiological Norms 2.2.4-171-10 "Hygienic requirements for drinking water intended for human consumption", with the exception of iron and manganese in most areas. The maximum concentrations of these trace elements were recorded in the border area between the settlements of Chop-Vylok. At the municipal water intakes of the towns: Berehove and Chop, the content of manganese is 3-5 mg/dm^3 , and of ferrous iron - up to 10-20 mg/dm^3 . Before these waters are used for domestic drinking purposes, they are centrally treated by aeration and then filtered through a zeolite sorbent.

The groundwater of the Mynai massif is widely used by the local population to meet household and drinking water and other needs. The total volume of water production from wells and domestic wells reaches 100 thousand m^3 /day, which is about 10% of the total amount of operational reserves and forecasted groundwater resources of the Mynai massif.

The production wells' flow rate at their maximum load can reach from 0.5 to 3-4 thousand m^3 /day and more in the areas with the highest water availability.

The groundwater massif of the Mynai Formation is formally considered to be conditionally protected from surface sources of pollution due to the presence of water-resistant clays with a thickness of more than 3 metres in the roof. The protection of the massif increases from east to west, where the clay layer is thicker and less eroded by water flows. In the last century, when drainage canals were laid to drain waterlogged land, the insulating functions of water-resistant rocks were partially disrupted, which negatively affects the ecological state of the massif. In addition, almost all of its area is subject to significant anthropogenic pressure. The land is intensively used in agricultural production with the use of mineral fertilisers, pesticides and herbicides. There are household waste dumps near almost every settlement. There are no facilities for their processing and disposal. Only cities have centralised systems for the disposal, treatment and discharge of domestic wastewater. In general, this gradually leads to a systemic deterioration of the ecological state of groundwater.

In the most vulnerable (representative) areas, it is advisable to establish comprehensive environmental monitoring.

MWP in lacustrine-alluvial Eopleistocene-Lower Neopleistocene sediments of the Chop Formation

The groundwater massif in the lake-alluvial Eopleistocene-Lower Neopleistocene sediments of the Chop Formation (LaE+PIčp) is distributed on the territory of the Transcarpathian alluvial plain. The absolute surface elevation of the plain is 103-140 m. The total area of the massif is about 1090 km^2 .

The massif is the second from the earth's surface. It lies beneath a 20-40 m thick marking layer of water-resistant clay, which hydraulically isolates the Chop massif from the waterlogged alluvium of the Minaya River.

The lithological composition of alluvial water-bearing rocks of the Chop massif is predominantly sandy. The sands occur in the form of lenses and layers, sometimes with inclusion of pebbles and gravel. Waterlogged rocks are often interlayered with clays and loams. Due to the presence of "hydraulic windows" of sand in the clays, there is vertical filtration throughout the thickness of the waterlogged alluvium of the Chop massif. The approximate depth interval of the roof of the massif is 30-117 m, and the depth of the basement is 46-303 m. The thickness of the massif from east to west increases from several meters to 240-400 m in the area of Chop town, villages: Solovka and Svoboda.

The waters of the Chop massif are pressurised. The pressure is determined from the roof to the natural piezometric level, the depth of which is 2.7-5.8 m, which is slightly higher than the low water level of the Danube.

The filtration parameters of the Chop permeable strata are almost two orders of magnitude lower than those of the Minai alluvium. Water permeability is 3-35 m^2 /day, filtration coefficient is 1-5 m/day.

Well flow rate during short-term pilot pumping ranges from 80 m^3 /day to 260 m^3 /day at 4-44 m water levels.

The chemical composition of the water is calcium bicarbonate. Mineralisation is mainly 0.5-0.8 g/dm^3 . Sometimes, in the foot of the massif, above areas with tectonic faults in the underlying Neogene sediments, water mineralisation can reach 1.0 g/dm^3 . Its composition is dominated by chlorine ion, which is explained by the inflow of chloride water into the Chop alluvium through faults from deep aquifers. The content of ferrous iron (10-40 mg/dm^3) in the Chop Formation's IPW is substandard for drinking water without deironing.

No assessment of the forecasted groundwater resources of the Chop massif has been carried out. According to indirect data, they may amount to 50-80 thousand m /day.^{3}

MWP in alluvial Pliocene-Lower Neopleistocene sediments of the ninth and tenth overflank terraces

The MWM in the alluvial Pliocene-Lower Neopleistocene deposits of the ninth and tenth floodplain terraces (a N -E$^{9-10}{}_{21}$) is distributed within the so-called "Kopanska" accumulative terrace in the Borzhava and Tisa rivers, near the village of the same name. The absolute elevation of the terrace surface is 174-307 m.

The total area of the massif is about 118 km^2 . The section is composed of well-crushed pebbles (up to boulders), red-brown loams, lenses of sands and clays with a total thickness of 52-137 m.

The thickness of aquifers in gravelly-sandy, sandy, sandy-pebbly and boulder-pebbly deposits of high terraces ranges from 5-10 to 50-80 m. The depth of groundwater levels ranges from 1 m to 47 m.

The flow rate of the springs is mainly within 1-10 m^3 /day, sometimes more, and that of the wells is 1-432 m^3 /day at a depression of 4.8 to 18 m. Three sources are monitored. The flow rate of these sources is in the range of 4.3-7.5 m^3 /day. Under conditions of enhanced feeding, their flow rate reaches 30 m /day.[3]

The chemical composition of the water is calcium-sodium chloride, sodium bicarbonate-chloride and magnesium-calcium-sodium with a salinity of 0.14-0.6 g/dm^3 .

Groundwater in alluvial deposits of high floodplain terraces is in most cases naturally conditionally protected, which is ensured by the presence of a 5-10 m thick water-resistant clay and loam cover in the upper part of the deluvial-proluvial cover and a significant (up to 50-70 m) aeration zone.

The water is fed by the infiltration of precipitation.

The aquifer is exploited by individual wells and boreholes to supply water to small industrial and agricultural facilities and households.

Group of MWPs in the Ilnytsia Formation sediments Pliocene

The group of IPM in the Pliocene Ilnytsia Formation (N_2 il) is developed in large areas of the Zakarpattia Trough under Quaternary alluvial strata. In the northeast of its distribution, the MPV borders the slopes of the Vygorlat-Gutyn volcanic ridge with narrow near-surface strips and partially overlaps them.

Water-bearing rocks are interbedded with sands, siltstones, tuffs, conglomerates and tuffs. Often, water-resistant clays lie between these rock complexes. Due to the presence of water-resistant clays, the massifs have local heads relative to the general roof of their occurrence.

The thickness of the massifs in the western part of their distribution is 100-519 m, and in the eastern part 200-590 m.

Approximate values of filtration coefficient are 3 - 70 m/day and sometimes more. Water salinity in the upper parts of the massif section is 0.4 - 0.8 g/dm^3 . The chemical composition of the water is predominantly calcium-sodium chloride-hydrogen carbonate. At the foot of the massifs and in the zone of tectonic faults, water mineralisation can reach 1.0-1.5 g/dm^3 . Its chemical composition is dominated by chlorides. All these parameters need to be clarified.

The groundwater of the IAP in the Pliocene Ilnytsia Formation is practically not used for centralised water supply.

A group of IPMs in volcanogenic Pliocene sediments of the Vygorlat-Gutynsky Ridge

The Vygorlat-Gutyn volcanogenic ridge occupies the area between the Transcarpathian alluvial plain and the Carpathian flysch. The ridge continues into Romania and Slovakia. Accordingly, the borders of these countries are taken as the conditional boundaries of the IPM groups developed in the volcanics of the ridge.

The total area of the arrays is 1727 km^2 .

The water-bearing rocks of the massifs are fractured andesites, andesite-basalts, darites, andesite-dacites and tuffs. Vertical and horizontal zonation is observed everywhere in the water content of volcanic sediments, which is associated with varying degrees of fracturing throughout the section.

In general, two "floors" can be traced in the section of fractured waterlogged volcanics. The "upper floor" (modern weathering crust) of intense fracturing and weathering with a thickness of 20-70 m is associated with pore and fracture and fracture-forming groundwater. There are many springs in the area, which contribute to part of the surface runoff in the area. The flow rates of the springs range from 4.3 to 346 m^3 /day. Well flow rates are up to 350-430 m^3 /day at water levels of up to 16 m. The composition of the "upper floor" groundwater is sodium-calcium bicarbonate with a mineralisation of 0.04 to 0.4 g/dm^3 . Sometimes they contain excessive concentrations of silicon.

The groundwater of the "lower floor" is confined to tectonic fracture zones. They were discovered by wells at depths of 140-300 m. The thickness of the watered zones is from 3-5 m to 20 m. The waters are pressure. Piezometric levels are installed at depths ranging from 9-70 m to 6 m above the ground surface. Well flow rates are 150-560 m /day.[3]

The waters of tectonic fracture zones at considerable depths often have elevated temperature and mineralisation, and a specific chemical composition. As a rule, they are enriched with silicon oxides. In a number of areas of the region, they are used as mineral resources. In this regard, the average depth of drinking (fresh) water is 200 metres. These data need to be clarified.

Volcanites are characterised by significant anisotropy in water permeability. As a rule, the water permeability of the bulk of rocks is an order of magnitude lower than that in tectonic fault zones. Its approximate value is from 5 - 20 m^2 /day to 200 - 250 m^2 /day, respectively. The estimated value of filtration coefficients is from 1 - 3 m/day to 10 - 30 m/day.

The Gutynskoye MPV is fed by precipitation and surface water. Groundwater is discharged into the hydrographic network and alluvial deposits of the river bottom. Significant elevation of the recharge areas on the mountain slopes above the discharge areas provides for rather high heads.

The groundwater of the volcanogenic rocks of the Vygorlat-Gutynsky Ridge is considered to be unprotected from vertical filtration of surface pollution.

Huta waters are used in conjunction with alluvial waters for the centralised domestic water supply of the cities of Mukachevo and Khust and are often developed in separate individual wells to supply water to industrial and agricultural facilities and households. Mineral waters from deeper horizons are used in balneology and for industrial bottling.

Fresh groundwater in the Hutyn massifs is characterised by good drinking quality and significant resources, but due to its difficult accessibility, it is not of widespread practical importance.

2 MAJOR ANTHROPOGENIC IMPACTS ON THE QUANTITATIVE AND QUALITATIVE STATE OF SURFACE AND GROUNDWATER, INCLUDING POINT AND DIFFUSE SOURCES

2.1 Surface water

The Tisza River sub-basin is located within one region - Zakarpattia. The socio-economic structure of the sub-basin creates preconditions for the formation of anthropogenic pressure that affects surface water ecosystems.

The main factors of anthropogenic pressure on the sub-basin's MPAs include:

- **Population (municipal return (waste) water).** According to the administrative-territorial division, the sub-basin includes 6 administrative districts (there were 13 before July 2020), 11 cities, 19 towns, 578 villages and 64 TGs, with a population of about 1.25 million people, and a population density of about 97.5 people/km^2 . The population is dominated by rural residents - 63%, urban population - 37%.
- **Enterprises in various sectors of the economy.** The main industrial production sectors include: processing industry, mining and quarrying, chemical and petrochemical industry, food industry, and mechanical engineering. The largest consumers of water are the mining industry (0.276 million m^3), chemical industry (1.044 million m^3) and food industry (0.067 million m^3). The discharge of polluted return (waste) water from industrial water users amounts to 0.466 million m^3 (17.7% of the total discharge), of which 0.255 million m^3 and 0.211 million m^3 are normatively clean.
- **Agriculture.** Agriculture is one of the leading sectors of the sub-basin economy and is characterised by a high level of development. The structure of water withdrawals for agricultural purposes is dominated by fisheries - 92.7% (10.3 million m^3) of the total withdrawals in this category.
- **Hydromorphological changes.** Transverse hydraulic structures on small and medium-sized rivers in the sub-basin make it impossible for water, sediments and aquatic life to pass freely, and change the transit mode of rivers to an accumulation one.

The characterisation of anthropogenic load and its impact was carried out on the basis of chemical, physicochemical and hydromorphological parameters that reflect the conditions of existence of the biotic component of aquatic ecosystems. Changes in these parameters under conditions of significant anthropogenic pressure may lead to the risk of not achieving the "good" ecological status of the MNR.

The assessment of the anthropogenic load on the MWR was carried out in accordance with the "Methodological Recommendations for the Analysis of the Main Anthropogenic Loads and Their Impact on the Surface Water Status" (hereinafter - the Methodology), which were approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources on 20 April 2023, Minutes No. 2.

The methodological basis of the assessment was the DPSIR model developed by the European Environment Agency (EEA)[25] and adapted to the conditions of Ukraine. The determination of anthropogenic pressure was based on a sequential analysis of Drivers/Activities → Pressures → State → Impact → Response (Figure 45).

[25] CIS Guidance #3 Pressure and Impact Analysis, EU, 2003

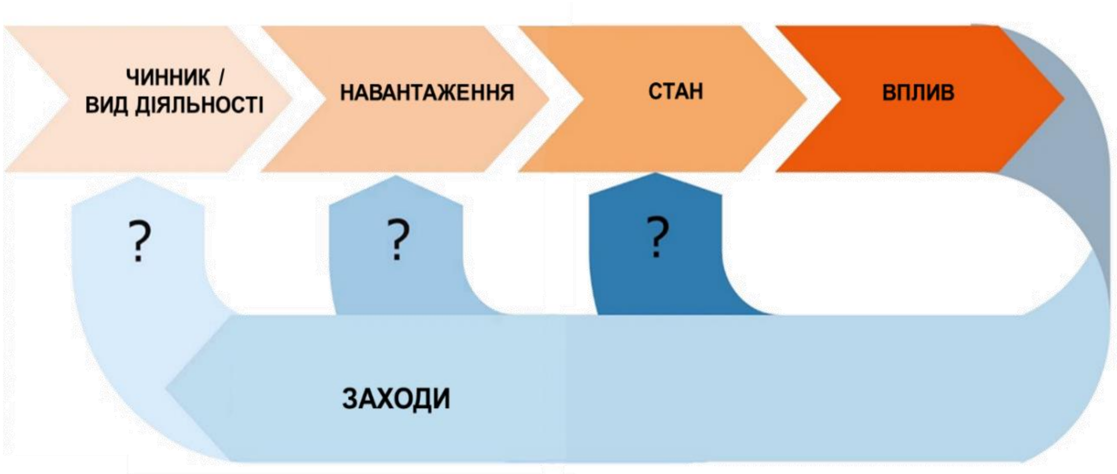


Figure 45. Conceptual model of the DPSIR

Assessing the risk of not achieving "good" environmental status

The analysis of anthropogenic load and related impacts is aimed at determining the probability of compliance/non-compliance of a water body with the objectives of environmental quality of the water environment.

The distribution of MWRs in the Tisza RBF by category: natural MWRs, artificial MWRs and significantly modified MWRs is shown in Figure 46.

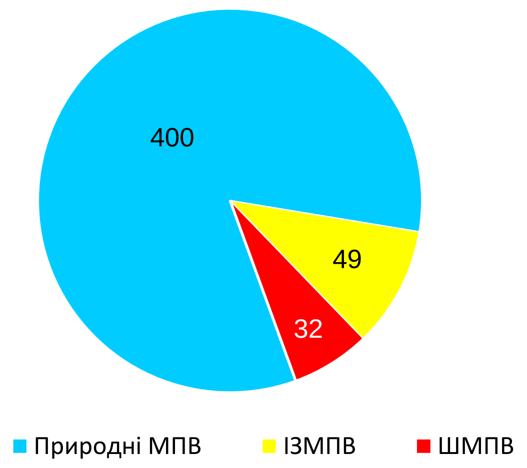


Figure 46. Distribution of IWPs in the Tisza sub-basin by category, number

Among the 481 identified IBAs in the Tisza sub-basin, natural IBAs clearly prevail, accounting for 83%, with IZMVB and SHMVB accounting for 10% and 7% respectively.

Assessment of the risk of failure to achieve environmental goals from point sources of pollution

Based on the results of the assessment of anthropogenic loads from point sources of pollution and their impact on the MES of the Tisza sub-basin, the risk of not achieving a "good" ecological status/potential was determined (Fig. 47) for

- 325 MPV - "no risk";
- 76 MPV - "possibly at risk";
- 80 MPV - "at risk".

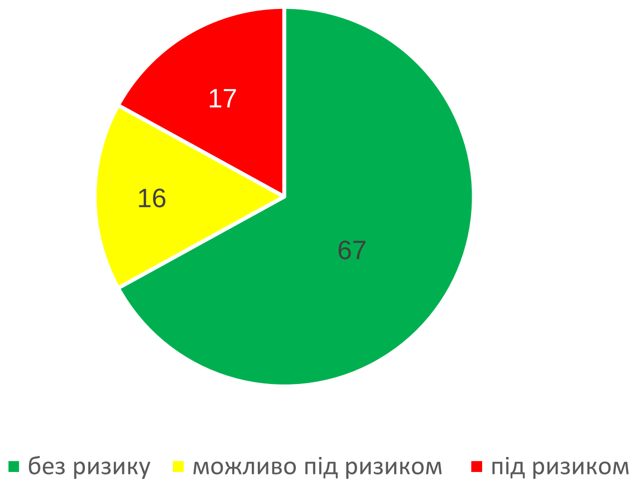


Figure 47. Risk assessment of failure to achieve "good" ecological status/potential based on the results of the assessment of anthropogenic loadings from point sources, %.

Assessment of the risk of failure to achieve environmental goals from diffuse sources of pollution

Based on the results of the assessment of anthropogenic loads from diffuse sources of pollution and their impact on the sub-basin's MES, the risk of failure to achieve "good" ecological status/potential was determined (Fig. 48) for

- 336 MPV - "no risk";
- 100 MPV - "possibly at risk";
- 45 MPV - "at risk".

Figure 48. Assessment of the risk of not achieving "good" environmental status/potential based on the results of the assessment of anthropogenic loads from diffuse sources, %.

Assessing the risk of not achieving environmental goals: hydromorphological changes

Based on the results of the assessment of hydromorphological changes,[26] was established:

- 400 MPV - "no risk";
- 49 MPV - "at risk".

[26] The risk of failure to achieve environmental objectives based on hydromorphological changes was not assessed for the SSSI

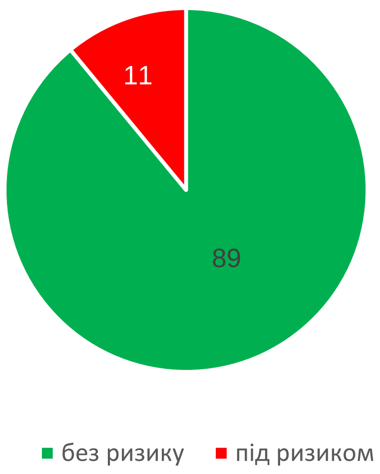


Figure 49. Assessment of the risk of not achieving "good" environmental status/potential Based on the results of anthropogenic load assessment: hydromorphological changes, %.

Generalised risk assessment of failure to achieve 'good' environmental status/potential

The risk of not achieving a "good" environmental status/potential has been assessed as follows:

- 214 MPV - "no risk";
- Possible at risk - "possibly at risk";
- 156 IPPs are "at risk".

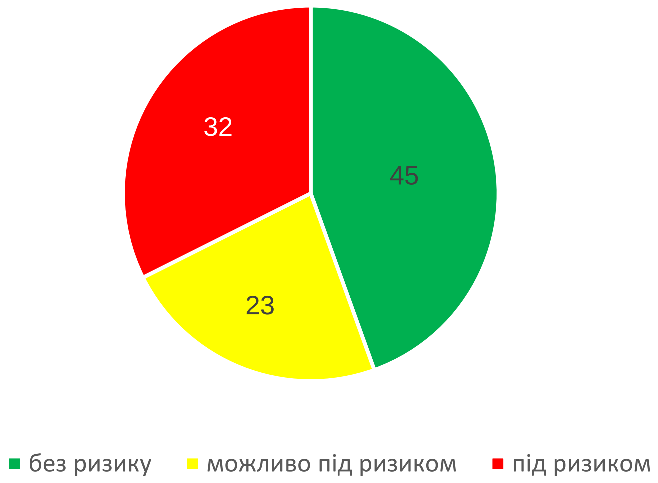


Figure 50. Generalised risk assessment of failure to achieve "good" environmental status/potential of MNR, %.

Impact of military operations on the state of surface water bodies

No cases of military operations impact have been recorded in the Tisza sub-basin.

2.1.1 Organic pollution

The main reason for organic pollution is the insufficient degree of wastewater treatment or the absence of sewerage networks (hereinafter referred to as "Sewerage Networks") and sewage treatment plants (hereinafter referred to as "STPs"). Organic pollution can lead to significant changes in the oxygen balance of surface waters and, as a result, to changes in the species composition of aquatic life or even their death. The supply of organic substances with wastewater is assessed by indirect indicators of BOD and COD.

Diffuse sources

Organic pollution from diffuse sources is mainly caused by rural households that are not connected to the Wastewater Treatment Plant. The wastewater of such individual households is disposed of by accumulation in lagoons, from which wastewater is filtered into the nearest groundwater horizons.

The load from the rural population was assessed using the calculation method. For this purpose, we used the coefficients of organic matter intake due to the vital activity of 1 person. In European countries, the generation of load from the population is calculated using the following indicators: BOD_5 - 60 g/day/person, COD - 110 g/day/person.

During a calendar year, the total organic matter (BOD, COD) discharge to the MEWs from distributed sources of pollution is significantly higher than from point sources. The reason for this is the low level of connection of the population to the POTWs.

In the region's rural settlements, small towns and some cities, wastewater is discharged into sumps and pits, from where pollutants easily enter groundwater and are transported to surface water.

The key role in organic pollution of the sub-basin from diffuse sources is played by the following rivers: the lower reaches of the Tisa (Berehovo district), the Latorytsia (Mukachevo and Uzhhorod districts), and the Borzhava (Khust district, Berehovo district (from the village of Velyki Komyaty to the mouth)). The Irshava River suffers the most from diffuse organic pollution, from the villages of Siltse and Zarichchia to its confluence with the Borzhava River.

Point sources

In total, there are 608 settlements in the sub-basin, including 19 settlements with a population[27] > 2000 (Figure 51). Among them, the city of Uzhhorod has a PE > 100,000. Large agglomerations also include the city of Mukachevo with a PE > 84,000 is also a large agglomeration. In total, there are 7 cities in the range of 10,000 - 100,000. The remaining 12 settlements fall into the category of 2000 - 10,000 PE.

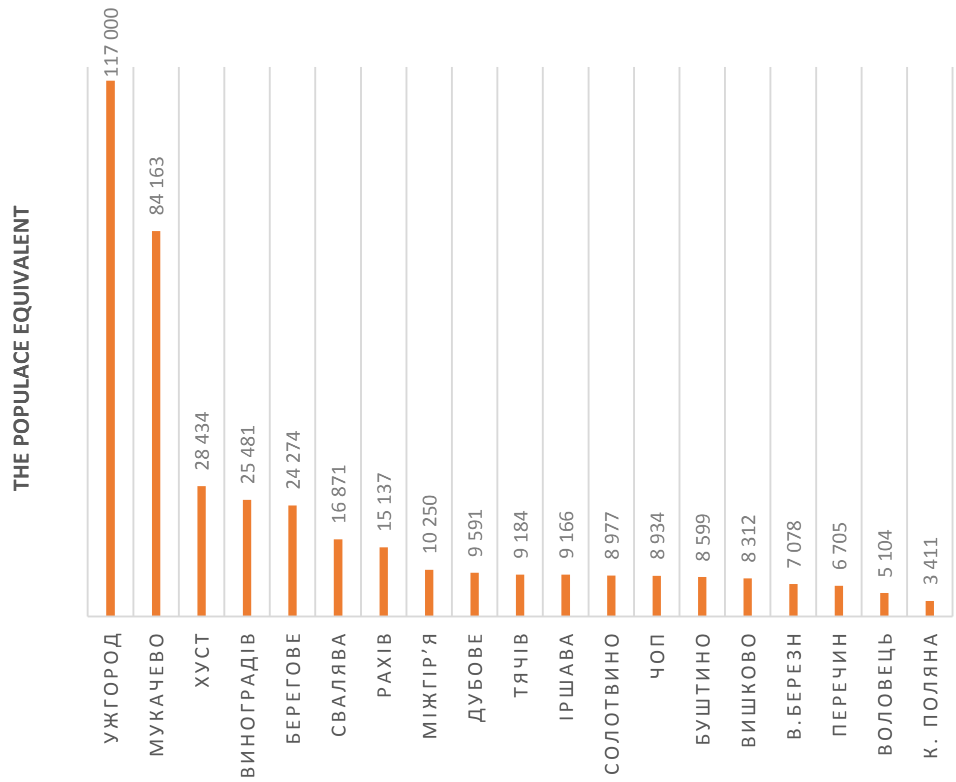


Figure 51. Settlements in the Ukrainian part of the Tisza sub-basin with PE > 2000

In 2020/2019, the total volume of waste water discharged into surface water bodies of the sub-basin was as follows: industry - 0.466/0.364 million m^3 , agriculture - 6.232/7.137 million m^3 , housing and communal services - 30.060/31.22 million m^3 , other (forestry, transport) - 1.376/0.389 million m^3 . A diagram of the distribution of discharges by economic sectors is shown in Figure 52.

27 Population equivalent (PE) is a numerical indicator of the load of wastewater with biodegradable organic substances with a five-day biochemical oxygen consumption of 60 grams of oxygen per person per day

Figure 52. Diagram of discharges by economic sectors, million m3[3] (%), 2020

Since the anthropogenic load was assessed based on 2020 data, we present below the data on the total volumes of organic matter discharges to the sub-basin in 2019-2020.

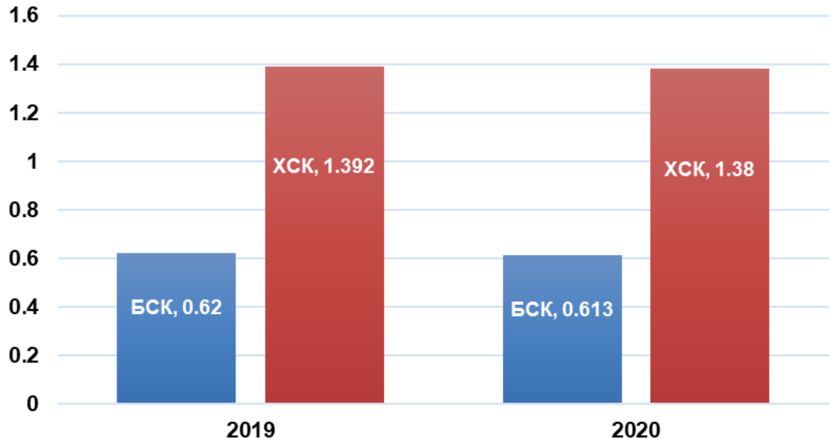


Figure 53. Organic matter discharges, thousand tonnes (2019-2020)

The figure above shows a gradual decrease in the volume of organic matter discharged into surface waters, but the impact of organic pollution remains quite significant. Thus, in 2019, BOD was 0.62 thousand tonnes per year, in 2020 - 0.61 thousand tonnes per year, and COD was 1.39 thousand tonnes per year in 2019 and 1.38 thousand tonnes per year in 2020.

Organic pollution from municipal services

Surface water pollution in the sub-basin is caused by point sources, which are utility companies (93% of the total discharges). Wastewater is discharged by 39 utilities providing water supply and sewerage services (production departments of housing and communal services), where the wastewater is pre-treated before being discharged into the sub-basin's river network.

Most of the agglomerations are connected to WWTPs. For agglomerations not connected to the CWS, wastewater is collected in individual septic tanks or cesspools, which are not treated and may be one of the potential sources of pollution of both surface water and groundwater aquifers in the sub-basin (Figure 54).

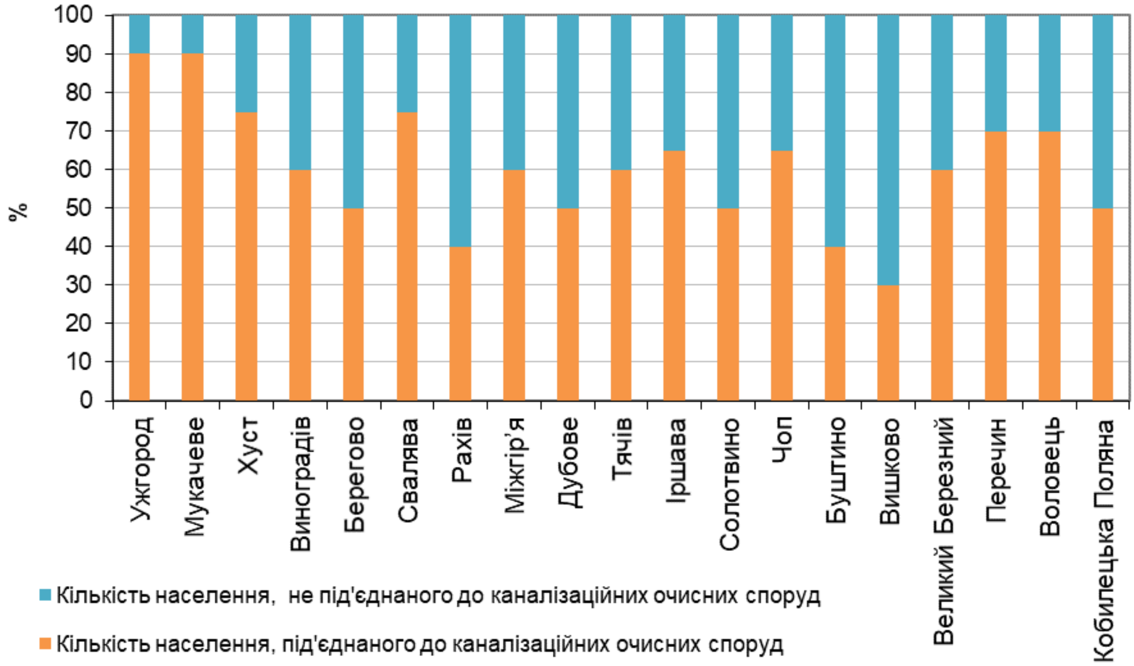


Figure 54. The degree of connection of the population of the cities of the Tisza River sub-basin to the OSS, as of 01.01.2021

The highest proportion of the population connected to the OSS is observed in agglomerations with a population of more than 20,000, at 90%. In smaller agglomerations, this figure varies between 30 and 75%.

Table 46. Amount of organic pollutants discharged to the Tisza sub-basin by agglomerations with PE>2000, 2020 data

Settlement, PE	ODS discharges (according to BSC),5 t O /year2	ODS discharges (by COD), t O /year2
Uzhhorod, 117000	282,2	958,9
Mukachevo, 84163	109,5	278,2
Khust, 28434	8,9	18,6
Vinogradov, 25481	9,9	18.1
Beregove, 24274	9,2	21.9
Svalyava, 16871	3,3	3.6
Rakhiv, 15137	3,7	7.4
Mizhhirya, 10250	1,8	3.9
Dubove, 9591	0,7	3,4
Tyachiv, 9184	3,8	12.6
Irshava, 9166	2,6	4.8
Solotvyno, 8977	1,3	2,2
Chop, 8934	3,5	5.6
Vyshkovo, 8312	0,7	4,0
Velykyi Bereznyi, 7078	1,9	2.6
Perechyn, 6705	4,1	8.1
Volovets, 5104	1,0	2.0
Kobyletskaya Polyana, 3411	1,2	0,5
TOGETHER	**449,3**	**1356,4**

The results obtained showed that the dominant share of organic pollution is determined by the 2 largest cities: Uzhhorod and Mukachevo, whose wastewater contributes 84% of the OD (according to BOD_5) and 88% of the OD (according to COD).

The degree of wastewater treatment at CWSs varies significantly (Fig. 55).

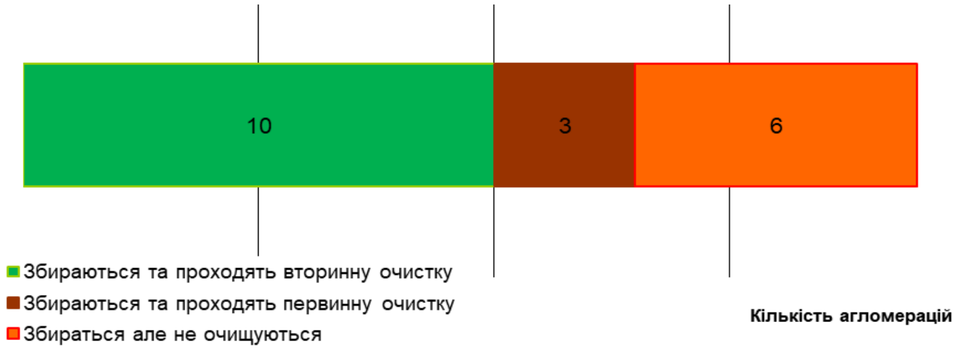


Figure 55. Degree of wastewater treatment in urban agglomerations in the Tisza River sub-basin, 2020

Slightly more than half of the WWTPs perform secondary biological treatment, mechanical wastewater treatment is provided for 3 cities (16%), and the remaining 32% have only collector systems and their wastewater is not treated at all. The latter include the city of Tyachiv, the villages of Mizhhirya, Dubove, Bushtyno, Vyshkovo and Kobyletska Polyana. The treatment facilities of these settlements were destroyed by the floods of 1998 and 2001 and have not been restored to date.

Wastewater treatment plants in most cities are in an extremely dilapidated state, having been built in Soviet times. Over the past 30 years, urban development has led to an increase in the amount of wastewater that is several times higher than the design capacity of the WWTPs, resulting in a significant amount of insufficiently treated or untreated wastewater entering the Tisza River sub-basin.

In 2020, the total volume of discharges was 38.134 million m^3 , of which 0.273 million m^3 and insufficiently treated wastewater - 3.259 million m^3 , normatively clean without treatment - 7.073 million m^3 and normatively treated - 27.529 million m^3 (Fig. 56).

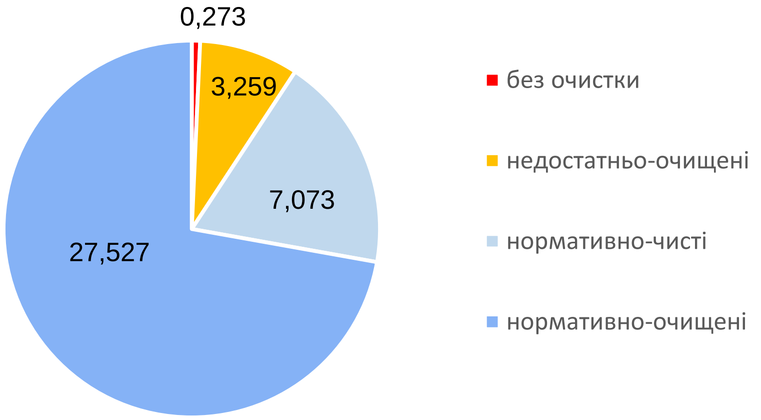


Figure 56. Wastewater disposal volumes, million m3^3 , 2020

Organic pollution of the Tisza sub-basin from industry and other facilities (water users)

According to the state statistical reporting on water use, the total number of water users discharging wastewater into the surface water bodies of the Tisa River sub-basin in 2020/2019 was 122/145 business entities, of which industrial enterprises (industry) - 25/35, agriculture - 12/11; housing and communal services of the region - 18/18, and others.

Organic pollution from industrial wastewater is insignificant. In 2020/2019, they discharged a total of 0.002/0.001 thousand tonnes of organic matter (BOD) and 0.005/0.003 thousand tonnes (COD). The bulk of the pollution of the IWW with organic substances is formed by the return (wastewater) of housing and communal enterprises, mainly the water utilities of the cities of Uzhhorod and Mukachevo.

2.1.2 Pollution by nutrients

The flow of nutrients into the surface waters of the sub-basin is the driving force behind eutrophication, which leads to an increase in primary production and accumulation of organic matter. The enrichment of water with nutrients that stimulate the development of autotrophic aquatic organisms, resulting in an undesirable imbalance of organisms in the aquatic environment and a decrease in water quality.

Phosphorus and nitrogen compounds play a dominant role among biogenic substances, and in some cases, ferrous may have an impact. Of the first two, phosphorus plays a greater role, while nitrogen is much less likely to limit the development of autotrophic organisms, due to the ability of many bacteria and cyanobacteria to fix it.

Nutrients can come from both point and diffuse sources. The main sources are untreated wastewater from municipal and industrial facilities. The widespread use of phosphorus-containing detergents and washing powders with insufficient treatment of waste water increases nutrient pollution. The efficiency of phosphorus removal from wastewater at most WWTPs does not exceed 18%, and due to outdated technological equipment, the efficiency of phosphorus removal does not even reach the design values.

Nutrients enter the sub-basin from point sources (agglomerations, industry, agriculture) and diffuse sources (surface runoff, precipitation). Diffuse sources are partly of natural and anthropogenic origin (mainly agriculture).

Diffuse sources

Diffuse sources are defined as the washing away of substances from the surface of the catchment and the soil layer of the soaking zone. This type of pollution is the most difficult to assess, as it cannot be directly measured, but must be estimated through probable pathways. Diffuse runoff can be caused by both natural factors (precipitation, geological structure and soil composition) and anthropogenic factors, which in this case act as indirect factors (degree of ploughing, crop yields). Diffuse pollution from the territory of former timber and chemical industry enterprises (Perechyn, Velyky Bychkiv and Svalyava timber and chemical plants) and solid household waste disposal sites is a particular danger in the Tisza sub-basin.

Point sources

The main pollutants of surface waters with biogenic substances, as well as organic ones, are:

- agglomeration;
- industry.

Table 47. Amount of nutrients discharged to the Tisza River sub-basin by agglomerations with PE>2000, 2020

Settlement, PE	Dumps N_{3ar} , t/year	Discounts P_{3ar} , t/year
Uzhhorod, 117000	77,9	17,22
Mukachevo, 84163	23,56	1,4
Khust, 28434	0,04	1,0
Vinogradov, 25481	0	0
Beregove, 24274	4,037	0,5
Svalyava, 16871	0	0
Rakhiv, 15137	1,4	0
Mizhhirya, 10250	0,5	0,1
Dubove, 9591	0,6	0,1
Tyachiv, 9184	0	0
Irshava, 9166	0	0,1
Solotvyno, 8977	0,1	0,1
Chop, 8934	0	0
Vyshkovo, 8312	0,1	0,1
Velykyi Bereznyi, 7078	0	0
Perechyn, 6705	0	0,1
Volovets, 5104	0,3	0,1
Kobyletskaya Polyana, 3411	0,1	0,1
TOGETHER	**108,7**	**21,02**

The results obtained showed that the dominant share of nutrient pollution is determined by the 2 largest cities in the region: Uzhhorod and Mukachevo, whose wastewater discharges 91% of total nitrogen and 93% of total phosphorus. At the same time, nitrogen comes mainly in the form of nitrate compounds, and phosphorus - in the form of phosphates.

Pollution from industrial wastewater is negligible.

The main share of pollution is formed by the return (waste) water of healthcare facilities, mainly sanatoriums in Zakarpattia. The composition of the return (waste) water of these institutions is similar to that of municipal enterprises and is represented mainly by nitrogen and phosphorus compounds. In most cases, sanatoriums, in addition to health improvement functions, also perform the role of public utilities in the settlements where they are located.

2.1.3 Pollution by hazardous substances

Hazardous substances are represented by priority pollutants subject to control in accordance with the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45 dated 06.02.2017 "On Approval of the List of Pollutants for Determining the Chemical State of Surface and Groundwater Massifs and the Ecological Potential of an Artificial or Significantly Modified Surface Water Massif" (hereinafter - the Order) and the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14.01.2019 No. 5 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial or Significantly Modified Surface Water Body to One of the Classes of Ecological Potential of an Artificial or Significantly Modified Surface Water Body".

The available information on the discharge of priority pollutants in the Tisza sub-basin is currently quite limited. According to the state water use accounting, reporting on water use in the form No. 2TP-water farm (annual), approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 78 of 16.03.2015, for the period 2016-2021, no business entity in the Tisza sub-basin indicated information on the presence of pollutants in the discharge of return (waste) water included in the list of priority pollutants by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45.

Monitoring of the content of priority and other hazardous substances in surface waters and bottom sediments of the Tisza River sub-basin and its tributaries, conducted as part of the Europaid/114957/C/SV/UA project "Bug, Latorytsia and Uzh River Basin Management" (2002-2005), showed that organic substances, including priority substances such as pesticides, pharmaceuticals, and heavy metals (cadmium, lead), are present in the water and bottom sediments.

The monitoring results showed that the concentration of diphthalates (2-ethylhexyl) (a widely used plasticiser), naphthalene, cadmium and lead exceeded the environmental quality standard for priority substances in water for both the Tisza River and its tributaries. In addition, elevated concentrations of polyaromatic hydrocarbons, which are indicators of petroleum products, were found in each of the surface water samples collected in the Tisza sub-basin.

According to the Resolution of the Cabinet of Ministers of Ukraine dated 19.09.2018 No. 758 "On Approval of the Procedure for State Water Monitoring", the Tisza BWR laboratory took monthly water samples during 2019-2020 to determine chemical and physicochemical parameters at 30 (2019), 45 (2020) monitoring points of surface water massifs.) observation points of surface water massifs, from which water is abstracted to meet the drinking and household needs of the population of Zakarpattia region in the volume of more than 100 m^3 /day; massifs that are at risk based on anthropogenic impacts on the qualitative and quantitative state and massifs of surface waters in transboundary areas identified in accordance with interstate agreements on water management in border waters between the Government of Ukraine and the Governments of the Republic of Hungary and the Slovak Republic.

Water samples from surface water massifs were transferred to the water monitoring laboratory of the Western Region of the Dniester BWR in compliance with the requirements of regulatory documents (DSTU ISO 6468-2002, DSTU ISO 10301:2004, DSTU ISO 5667-1:2009, DSTU ISO 5667-2:2009, DSTU ISO 5667-6:2009) for measurements of priority pollutants approved by the relevant Order.

Based on the results of the monitoring of priority pollutants in the Tisza River sub-basin, 26 hazardous specific pollutants (22 synthetic pollutants and 4 non-synthetic pollutants (heavy metals: cadmium, nickel, mercury, zinc) were identified. The list of hazardous substances is presented in Table 48.

Table 48. Specific pollutants (synthetic pollutants) for the Tisza sub-basin

Chemical registration number	Indicators for determining the environmental status of the MPE	Average annual concentration, μg/dm³	Maximum concentration, μg/dm³
62-53-3	Aniline, μg/dm³	1,5	16,0
98-10-2	Benzenesulfonamide, μg/dm³	100,0	n.a.
95-16-9	Benzothiazole, μg/dm³	2,0	n.a.
92-52-4	Biphenyl, μg/dm³	1,0	3,6
80-05-7	Bisphenol A, μg/dm³	10,0	460,0

Chemical registration number	Indicators for determining the environmental status of the MPE	Average annual concentration, µg/dm³	Maximum concentration, µg/dm³
1702-17-6	Clopyralid, µg/dm³	70,0	300,0
13684-56-5	Desmedipham, µg/dm³	1,0	15,0
84-74-2	Dibutyl phthalate, µg/dm³	10,0	48,0
122-39-4	Diphenylamine, µg/dm³	1,6	31,0
26225-79-6	Etgofumesate, µg/dm³	6,4	50,0
85-01-8	Phenanthrene, µg/dm³	0,38	2,0
50-00-0	Formaldehyde, µg/dm³	5,0	50,0
1071-83-6	Glyphosate, µg/dm³	15,0	n.a.
74-90-8	Cyanides, µg/dm³	5,0	n.a.
94-74-6	MCPA, µg/dm³	1,6	15,0
128-37-0	4-methyl-2,6-di-tert butylphenol, µg/dm³	1,4	17,0
1336-36-3	Polychlorinated biphenyls and their derivatives, µg/dm³	0,01	n.a.
40487-42-1	Pendimethalin, µg/dm³	0,3	2,0
79-00-5	1,1,2-trichloroethane, µg/dm³	300,0	n.a.
108-88-3	Toluene, µg/dm³	100,0	n.a.
100-42-5	Vinylbenzene (styrene), µg/dm³	0,63	60,0
1330-20-7	Xylene (isomers), µg/dm³	10,0	n.a.

The preliminary assessment of synthetic and non-synthetic specific substances will be based on the assessment of compliance with the relevant environmental quality standards and expressed as an annual average and as a maximum permissible concentration. Failure to comply with an environmental quality standard will be established if the arithmetic mean of the measured concentrations is higher than the value of the relevant environmental quality standard. When assessing the values of non-synthetic specific substances, background concentrations of heavy metals for each MPA in the Tisza sub-basin should be taken into account.

Control over the content of hazardous pollutants in the discharges of waste water from business entities mainly consists of determining the content of only the parameters stipulated in the draft maximum permissible discharges of water users (mainly pollution with organic and nutrients). The actual presence of hazardous substances, volumes and values need to be additionally verified, confirmed by research monitoring data and screening results of samples of wastewater (return) water discharged into the MEW of the Tisza sub-basin.

Sources of hazardous pollutants in the Tisza sub-basin may include industrial sources, including machine building, the forestry and chemical industry, mining facilities, livestock and food production, industrial and municipal waste.

2.1.4 Accidental pollution and impact of contaminated areas (landfills, sites, zones, etc.)

There is little "hazardous" industrial activity in the Tisza sub-basin, but there are potential sources of accidental pollution both through wastewater discharges and runoff from sites where industrial waste is stored.

The mechanism for preventing and minimising the risk of accidental pollution is established in the EU member states through the implementation of the Seveso-III Directive (Directive 2012/18/EU), the Industrial Waste from Mining Directive (2006/21/EC)10 and the Industrial Emissions Directive-IED (2010/75/EU)11 and for non-EU countries through the implementation of the recommendations of the UNECE Convention on the Transboundary Effects of Industrial Accidents.

At the Tisza River sub-basin level, a list of potential accident risk sites has been developed, which includes operating industrial facilities with a high risk of accidental pollution due to the nature of chemicals stored or used at industrial facilities, contaminated sites, including landfills and dumps located in flood zones. This register includes facilities that pose risks of accidental pollution, primarily CWS, sites where industrial waste is stored, sludge ponds and tailing pits.

Recent studies in the Tisza River sub-basin have revealed an excess of synthetic substances: pesticides, pharmaceuticals and substances used in perfumery, heavy metals: zinc and copper, cadmium and nickel, which confirms a significant anthropogenic load on the Tisza's MPA.

The Ministry of Environmental Protection and Natural Resources of Ukraine has launched an electronic service that also contains the Register of Waste Disposal Sites and the List of Facilities that are the largest polluters of the environment in terms of discharging pollutants into water bodies.

The register of business entities with risks of accidental pollution of the Tisza River sub-basin as of 01.01.2023 is presented in Table 49.

Table 49. Register of facilities in the Tisza River sub-basin that are at risk of accidental pollution

№	Object name
1	Municipal enterprise "Vodokanal Uzhhorod", Uzhhorod
2	Municipal enterprise "Miskvodokanal" of the Mukachevo City Council, Mukachevo
3	Limited Liability Company "Vodokanal Karpatviz", Beregovo
4	Municipal enterprise of the Chop City Council "Vodokanal of Chop. Chop", Chop city
5	"Khust Production Department of Water Supply and Sewerage, Khust
6	Vodokanal municipal enterprise of the Tyachiv City Council, Tyachiv
7	Municipal enterprise of Volovets Village Council "Vodokanalservice", Volovets village
8	"Vynohradiv Production Department of Water Supply and Sewerage, Vynohradiv
9	Communal Service, Velykyi Bereznyi village
10	Mizhhirya Village Council's communal enterprise Mizhhirya VUZHKH, Mizhhirya village
11	Rakhiv municipal enterprise Rakhivteplo, Rakhiv
12	Solotvyno Municipal Utility Company, Solotvyno village
13	Kommunalnyk, Perechyn, Ukraine

According to the register of waste disposal sites (hereinafter referred to as WDS), there are 62 certified WDS in the Zakarpattia Oblast:

59 - solid waste disposal sites;
2 - wood waste (sawdust);
1 - waste of artificial fur.

Most of the existing landfills have exhausted their capacity, being 80-85% full, and the life of the landfills in Vynogradiv has expired. Vynogradiv has reached the end of its service life. Due to its mountainous nature, high population density, proximity to 4 EU countries, a single water basin of the Tisa River, and protected areas, a number of settlements in the region are deprived of the opportunity to choose land plots for landfills. This applies to the cities: Rakhiv, Tyachiv, Vynohradiv, Berehove, Perechyn, Velykyi Bereznyi, and rural settlements in mountainous areas. Centralised collection and disposal of solid waste in the region is carried out by 36 specialised enterprises, the largest of which are: ABE Uzhhorod, ABE Vynohradiv, ABE Mukachevo and Bereg Vertical. These entities collect municipal solid waste from 199 settlements in the region. In total, centralised solid waste collection in the region is organised in 491 settlements, which is 80.75% of the total number (608) of settlements in the region. Household waste is also collected from households and business entities independently by enterprises and organisations, some private structures and specialised communal services under village councils. There are no household waste disposal facilities.

Separate collection of solid waste (glass, plastic, waste paper and scrap metal) has been introduced in the cities of Uzhhorod, Perechyn, Irshava, Rakhiv, Svaliava, V. Bychkiv and 23 territorial communities (187 settlements in total). Resource-intensive components of solid waste are transferred to specialised enterprises (52 business entities in the region). The collected waste is mostly transferred for disposal outside the region. According to the Main Department of Statistics, there are 1 hazardous waste disposal facility, 24 waste incineration facilities for energy production, 5 waste incineration facilities for thermal processing, and 35 other waste disposal facilities (other than incineration) in the region.

Wood waste is disposed of by briquetting and burning in boilers as an additional energy resource. Production facilities for processing and utilisation of wood waste have been established at the following largest woodworking enterprises in the region: Karpaty LLC (Rakhiv district), Maple LLC (Khust district), Inter-Kashtan (Mukachevo), Synevyr UTOG, Elit Wood LLC (Uzhhorod), etc. New technologies for sawdust processing are introduced at the expense of the companies' own funds and investments.

Production facilities for recycling PET containers and other polymeric waste (plants, presses, crushers) are operated by the following companies: ME "Vody Khustshchyny", PE "Brenner" (Khust), ME "Vtorma", LLC "Karpaty LTD" (Mukachevo), PE "Plastor" (Berehovo district), Recycling Station "Proektna, 3", LLC "Eco

Karpaty Plus" (Uzhhorod). Worn-out tyres are disposed of by PE Breza O. O. (Uzhhorod district).Technological equipment for hazardous waste disposal is available at New Ecosvit LLC (Uzhhorod, location: Uzhhorod district, Kinchesh village).

In order to maximise the use of resource-rich waste components, the region is creating appropriate conditions for attracting investors to build waste processing plants, introduce alternative fuel technologies, establish a system for collecting, sorting and recycling solid waste, and reduce the number of waste disposal sites.

The construction of a plant for sorting and mechanical processing of solid household waste with a capacity of 20-30 thousand tonnes per year is underway in Yanoshi village, Berehove district, which will enable the company to process 100% of the total amount of solid waste generated in the district. Negotiations are also underway with foreign investors on the construction of a plant for the storage, sorting, and disposal of solid waste (without the right to incinerate) in Tyachiv. In Uzhhorod district, there are intentions to build a solid waste processing facility on the territory of Serednyanska territorial community of Uzhhorod district outside the settlements, which will help solve the problem of solid waste in the area. A waste processing plant is planned to be built on the territory of Polyanske village council. The main goal and objective of the plant is to collect total solid waste from 16 mountainous communities in Zakarpattia Oblast. There are also land plots available for the construction of the waste processing facility in Mukachevo, Krylova Street, and on the territory of the Irshava city community, outside the village of Dubrivka. Waste sorting stations are planned to be installed on the territories of Dragivska and Kolochava TG in Khust district and Yasinyanska TG in Rakhiv district.

According to the Regional Waste Management Plan for Zakarpattia Oblast, the region was divided into 5 clusters. Scenarios for each cluster were developed based on an analysis of the amount of waste generated, existing infrastructure, logistics, and the region's specifics. As a result, 5 options were proposed: the first is when 100% of solid waste is disposed of at landfills. According to experts, this option has a significant disadvantage - landfills are harmful to the environment and people and are poorly aligned with the goal of waste management reform. The second option is when 100% of solid waste is incinerated at special plants to generate electricity. Options 3, 4 and 5 involve mechanical and biological waste treatment (MBT), differing only in the type of operations performed with the organic fraction - biological drying, anaerobic digestion or composting. Each of these three options involves the production of dry fuel from waste. The cheapest option is landfilling (€114.4 million), and the most expensive is incineration (€350.6 million). Two options are the most attractive: MBW with anaerobic digestion and MBW with composting of the organic fraction. Investment costs for these options are estimated at €128.3 and €108.6 million. The choice of options will be determined by the communities.

There is no storage of unsuitable and banned pesticides and pesticide chemicals in Zakarpattia Oblast. However, according to the Mukachevo District State Administration, there are 41 reinforced concrete containers in 8 settlements of the Mukachevo district that contain chemical plant protection products. In the places where these containers are stored, there are pungent smells of unknown substances, which negatively affects the health of residents of these settlements and poses a danger to the environment. In addition, 225 tonnes of pesticide-contaminated soil is stored in Rokosovo village, Khust district, which, according to the Ukrainian Research Institute of Environmental Problems (Kharkiv), is toxic waste of I and II classes of hazard to public health and requires urgent removal outside the region. In order to resolve the issue of pesticide-contaminated soil clean-up, the Department submitted proposals to the draft National Waste Management Plan with specific measures, one of which is the removal of pesticide-contaminated soil stored in the village of Rokosovo, Khust district.

Thus, given the current situation, addressing the problem of solid waste management should be included in the programme of measures to achieve good environmental status of the MNE.

2.1.5 Hydromorphological changes

Hydromorphological changes are one of the main water-environmental problems (WEPs) that impede the achievement of environmental objectives set and enshrined in the RBMP. Hydromorphological changes, as a result of economic activity, affect the conditions of existence of aquatic communities. The presence of hydromorphological changes in MPAs leads to the deterioration of the ecological status of many MPAs.

Hydromorphological changes are divided into types:

- disruption of the continuity of water flow and habitats - longitudinal disruption of the continuity of rivers and habitats (transverse artificial structures in the river channel, interruption of water flow, disruption of the free flow of rivers, movement of sediments, migration of fish and other aquatic life);
- disruption of the hydraulic connection between river channels and their floodplains;
- hydrological changes (water abstraction, hydropicking/ fluctuations in water levels of artificial origin);

- Morphological changes (modification of the morphology of the riverbed, banks, and adjacent parts of the floodplain, e.g. straightening).

Hydromorphological changes, namely, changes or disturbances in the anthropogenic morphology of the riverbed, banks, floodplain of the Tisza sub-basin, as well as its hydrological regime, are one of the main water and environmental problems (a significant pressure).

The main factors (impact factors or activities) that lead to hydromorphological changes include hydropower, flood protection, land development (urbanisation) and agricultural activities.

Disruption of the hydraulic connection between river channels and floodplains. The hydraulic connection between the riverbed and the floodplain plays an important role in the functioning of aquatic ecosystems, providing water for important habitats for fish and aquatic life, and has a positive impact on the condition of surface and groundwater.

The assessment of this type of hydromorphological changes is included in the hydromorphological protocol for assessing the MWP used by the SES in the course of state monitoring of surface waters (indicators No. 10: "Interaction between the channel and the floodplain: 10a - Possibility of floodplain inundation, 10b - Limiting factor for the development of horizontal deformations of the channel").

Disruption of the free flow of rivers. Dams and other artificial structures located in riverbeds were built primarily to accumulate water, with its subsequent use for irrigation, water supply to the population and industry. The accumulation of water in ponds and reservoirs upstream of dams also provides flood protection for areas downstream.

Dams, weirs and other structures that cross the riverbed from one bank to the other disrupt the free flow of the river and restrict the migration of fish and other living organisms. The criterion for classifying a structure as one that disrupts flow and migration is a structure height of more than 0.3 m for rivers dominated by carp fish and 0.8 m for rivers dominated by salmonid species.

Morphological changes. The main factors that negatively affect the natural morphology of the sub-basin's river channels, their banks and floodplains are urbanisation, flood protection and agriculture. As a result of these activities, rivers in certain areas are straightened, dredged, banks are reinforced, the floodplain adjacent to the channel is ploughed up, and its natural vegetation is changed.

In sub-basin 40, the river morphology has been modified (straightening). Reduced variability in channel depth and width, disturbance of the natural balance of erosion and accumulation, narrowing of the inter-dam space and restriction of free meandering lead to an impoverishment of the composition and reduction in the number of biological indicators, such as fish, benthic invertebrates, higher aquatic vegetation, and phytoplankton.

In the Tisza sub-basin, 481 MPVs have been identified. Based on data on existing cross structures in the channel, water intake locations and level fluctuations, as well as using satellite imagery, topographic and cadastral maps, one third of the identified MWBs - 49 MWBs (10% of all identified MWBs) - were identified as IZMWBs and 30 (6% of all identified MWBs) MWBs were identified as SHMWBs. Of these:

- 9 IWRs are classified as significantly altered due to disruption of the free flow of rivers (overregulation);
- 39 MWP - due to modification of river morphology (straightening of river channels);
- 1 MPV - due to a combination of overregulation and directionality;
- 30 IWCs - artificial IWCs (canals) (Fig. 57, Table 50).

Table 50. Hydromorphological changes in the Tisza River sub-basin

№	Hydromorphological changes	Load	Number of IPMOs	% of the total number of MPAs
1	disruption of the continuity of water and media flow	regulation (water accumulation)	9	1.9
2	morphological changes	straightening	39	8.1
3	disruption of the continuity of water and media flow and morphological changes	regulation (water accumulation) and directivity	1	0.2
4	artificially created IAPs	channels	30	6.2

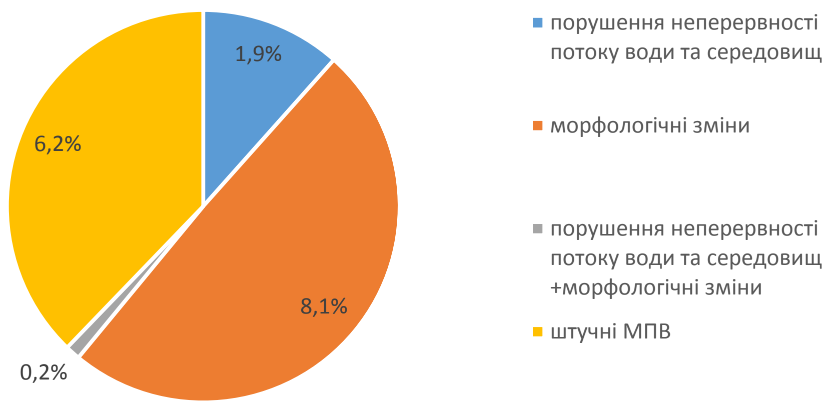


Figure 57. Distribution of IHMW by types of hydromorphological loads

All of these INDCs should be considered as those where there is a risk of not achieving "good" environmental potential.

The criteria for assessing the failure to achieve "good" environmental potential are as follows:

- disruption of the continuity of water flow and environments (transverse artificial structures in the riverbed, disruption of the continuity of water flow and sediment movement and migration of fish and other aquatic life);
- water withdrawals (small and medium-sized rivers - water withdrawals exceeding 75% of the supply; large and very large rivers - water withdrawals exceeding 90% of the supply);
- water accumulation (ponds with a ponding area of more than 1 km or several ponds with a ponding area of less than 1 km, but their total length is more than 30% of the length of the MPA, as well as reservoirs with a volume of more than 1 million m);[3]
- fluctuations in the water level below the dam (water level fluctuations exceeding 0.5 m per day for most of the year);
- disturbance of natural morphological characteristics of rivers (hydromorphological class below the third according to the monitoring results, or straightening of more than 70% of the length of the main river channel in the absence of monitoring data).

Based on the analysis of the main water and ecological problems associated with hydromorphological loads in the sub-basin, it can be concluded that 49 MPAs, defined as IWMPAs, require restoration (revitalisation) of hydromorphological changes.

2.2 Groundwater

2.2.1 Pollution

Rural urbanisation prevails in the Zakarpattia region. There are no large urban agglomerations or large industrial facilities related to the extraction and processing of significant amounts of natural resources. Largest cities by population: Uzhhorod and Mukachevo.

In the context of rural urbanisation, the anthropogenic load on the MHW is associated with agricultural activities of the population. Within the Zakarpattia Plain, intensive farming and horticulture with intensive use of fertilisers, pesticides and herbicides prevails. Cattle are raised mainly in stationary conditions.

The mountains are dominated by pasture farming and forestry.

Among the hydrotechnical types on the plain, amelioration and, to some extent, fisheries are very common.

Research carried out in the early 1990s to study the elements of the groundwater regime showed that land reclamation measures disrupt the natural hydraulic and hydrochemical connection between aquifers and contribute to the deterioration of groundwater and surface water quality.

When the main drainage channels were laid, the surface layer of low-permeability rocks was completely or partially destroyed, which led to a deterioration in the protection of the MPZV throughout the plain. Negative processes of groundwater quality deterioration are observed during flood filling of the canals and in the post-flood filtration period. Within the reclamation systems, the intensity of surface and groundwater pollution due to agricultural production (mineral and organic fertilisers, pesticides, etc.) is increasing. The filtration of flood water enriched with oxygen from canals leads to an increase in oxidised iron in the water and its accumulation in soils. In addition, during the flood period, an increase in groundwater mineralisation and soil salinity was observed in a number of areas.

At present, a significant part of the reclamation network is out of order - the canals are silted up, overgrown with various vegetation, and the locks are out of order.

The mining and industrial type of anthropogenic load is very common in the development of the MES in the region. It includes water intakes of fresh, mineral and thermal groundwater, open and underground mining, and oil and gas exploration sites.

An important place among the types and objects of technogenic (anthropogenic) load that negatively affects the MEW is occupied by domestic pollution due to the lack of centralised sewage systems with treatment and discharge of domestic wastewater in rural areas and partially in cities. Some rural households have absorption tanks. There are solid waste dumps near almost every settlement. There is no industrial-scale sorting and recycling of this waste.

A detailed assessment of the current state of the anthropogenic load on the MWR is required.

2.2.2 Volumes/inventories

Estimated groundwater resources (EGWR) are the volumes of groundwater estimated on the basis of geological surveys that characterise the potential for their extraction from the subsoil in the relevant territory. In the Zakarpattia region, the PEDs amount to 1081.60 thousand m^3 /day, and their distribution over the territory is uneven, which is explained by the difference in geological, structural and physical geographical conditions. The exploration of forecasted groundwater resources in Ukraine is insignificant - 26%, for the Zakarpattia region this figure is 32%. It is necessary to conduct a detailed assessment of the current state of anthropogenic pressure on the MPZV.

Out of the total number of EORs, 344.10 thousand m3 of exploitable groundwater reserves have been explored and approved^3 /day. Operational groundwater reserves are calculated on the basis of geological study of groundwater that can be extracted from the subsoil by rational technical and economic indicators of water intake in a given extraction mode, provided that the quality characteristics of groundwater meet the requirements of their intended use and the permissible degree of environmental impact during the estimated period of water use.

The development of projected groundwater resources is most intensive in densely populated areas of the region with high economic potential. Most groundwater is abstracted in areas with high population density and developed industry. The exploitable mineral water resources amount to about 10.0 thousand m^3 /day and belong to 20 types of mineral water. In 2020, the volume of mineral water use did not exceed 10-15% of the total resource. Mineral waters are used for balneology and industrial bottling. The resources of thermal power waters, which are also therapeutic, amount to about 50.0 thousand m /day. ^{3}

According to the statistical reporting of 2TP-Vodkhoz (annual), the share of groundwater abstraction from natural objects was 19.415 (49%) in 2020, which indicates a high degree of groundwater use (compared to surface water) in Zakarpattia region. The water supply of Zakarpattia region is largely dependent on groundwater.

Table 51. Extraction of drinking and industrial groundwater and its use in the Zakarpattia region

Year	Production, million m3 /year^3	Usage, million m /year^3					Groundwater discharge without use, million m3 /year^3
		Total	Household and drinking water	Production and technical	Agricultural	Irrigation	
2020	19,415	10,690	8,230	2,352	0,029	0,083	0,167

State accounting of groundwater extraction and use from explored, preliminary explored deposits and subsoil areas with unevaluated reserves within the Zakarpattia region is carried out. Groundwater extraction is subject to mandatory accounting based on the statistical reporting data of 2TP-water farm (annual) of the State Agency of Ukraine for Water Resources.

The region's current water supply is based on a network of centralised and dispersed water intakes and a dense network of individual production wells located in large settlements and rural areas.

The State Research and Production Enterprise Geoinform of Ukraine annually analyses the groundwater regime under natural and disturbed conditions of its formation. The regime observation network of the state groundwater monitoring consists of a number of observation points that are studied in the area of water intake impact: Uzhhorod "Mynai" and Khust "Rika".

2.3 Other significant anthropogenic impacts

2.3.1 Climate change

One of the main manifestations of regional climate change against the backdrop of global warming is a significant increase in air temperature, changes in the thermal regime and precipitation patterns, an increase in the number of dangerous meteorological phenomena and extreme weather conditions, and the damage they cause to various sectors of the economy and the population. These trends are typical for Ukraine in general and the Tisza River sub-basin in particular. The greatest changes have been observed over the past thirty years, which have been the warmest for the period of instrumental weather observations. The rise in air temperature is observed not only near the Earth's surface but also in the lower troposphere, accompanied by an increase in tropospheric moisture content, and causes an increase in atmospheric instability and convection intensity. These changes have led to an increase in the frequency and intensity of convective weather phenomena: thunderstorms, showers, hail, squalls, and an increase in the maximum intensity of precipitation and its storm component.

Representative concentration trajectories (RCPs) of greenhouse gases have different trajectories of emissions and concentrations in the atmosphere, emissions of pollutants, and specifics of land use in the 21st century (in particular, changes in the area of forested areas) and their corresponding consequences. Two RTC scenarios were selected for this study: The "soft" scenario of GHG emission reduction scenario 2.6, which, in accordance with the Paris Agreement, provides for a reduction in greenhouse gas emissions, and the "hard" scenario of GHG emission reduction scenario 8.5, which does not take into account any adaptation or mitigation measures. All scenarios demonstrate a steady increase in average annual temperature throughout the 21st century in all regions. By the end of the century, the average annual temperature averaged across regions under different scenarios is expected to increase by 2-5°C. Global greenhouse gas emissions scenarios (Sources: USGCRP/GlobalChange.gov, UHMI 2014) The study calculated simulated changes in the average annual river flow (flow rate) of the RBD of Ukraine for two future periods (2041-2070 and 2071-2100) under GWP 2.6 and GWP 8.5 scenarios

The projections for the Tisza sub-basin show an increase in water flows during the winter months in both future periods from 4% to 42% under RTC 2.6 and from 9% to 42% under RTC 8.5. In June, river flows will increase slightly (by 5%), while in other months they will decrease from 4% to 17% in both periods under RTC 2.6. If the "hard" scenario under RTC 8.5 is realised, flows in the period from April to November will decrease in the range of 7% to 21% in the middle of the century and 17% to 35% at the end of the current century.

The water-heat balance of river basins is highly sensitive to climate change. Rising air temperatures and changes in precipitation patterns affect not only the hydrological regime of rivers, but also the overall water resources. Climate change is increasing the frequency of floods and droughts, which makes agriculture, energy, transport and the social sector vulnerable, as they depend on water resources.

In the period 2041-2070, the average annual runoff is expected to fluctuate. The flow of the rivers in the Tisza basin during this period will be within the long-term norm. The deviation will be only 0.7 to 4.0%. However, the intra-annual distribution of runoff may change significantly. It will be characterised by a significant increase in water flow in the rivers of the sub-basin during the winter months in both future periods from 4% to 42% under RCP 2.6 and from 9% to 42% under RCP 8.5. Special studies to assess the impact of climate change on flood risk conducted on rivers in the Carpathian region have shown a significant increase in the intensity of catastrophic floods in the Tisza sub-basin at the end of this century (2071-2100) compared to the control period (1981-2010), ranging from 4.5% to 62%. The increase in water flow in the rivers of the Carpathian region will manifest itself in the formation of catastrophic floods on mountain rivers and may lead to significant economic losses in all sectors of the economy and in the territorial communities of the Zakarpattia region.

2.3.2 Pollution of water bodies with solid waste, including plastic

The clogging of river channels and floodplains with municipal solid waste (MSW) is one of the main water and environmental problems specific to the Ukrainian part of the Tisza sub-basin. The reason for this is the lack of an effective mechanism and infrastructure for the collection, processing and disposal of household waste in Zakarpattia.

Approximately 80% of the population is covered by waste collection and disposal services, mainly residents of cities and urban-type settlements. The low percentage of service provision is explained by the underdeveloped infrastructure (lack of containers, specialised equipment, etc.), as well as the low density of the rural population and difficult access to some settlements. Moreover, the higher up the mountains, the lower the percentage of the population receiving waste collection services. As a result, spontaneous landfills are common.

Typically, paper, cardboard and wood are disposed of by households (incinerated). Glass and construction waste do not cause chemical pollution of water. It is plastic (polymeric) waste that poses the greatest threat to the environment and water resources in particular. It includes packaging, plastic containers, household products, etc. The decomposition of plastic waste releases toxic substances. Such garbage harms aquatic fauna, which leads to biodiversity degradation and thus negatively affects the state of MPAs. In addition, the aesthetic value of the floodplain is lost, which negatively affects the tourist attractiveness of the region, which positions itself as one of the most visited by tourists.

The pollution of the rivers of the Tisza sub-basin by municipal waste is a major concern for neighbouring countries. In particular, since 2020, there have been more than 50 cases of municipal waste pollution on Hungarian territory during floods. First of all, these are PET bottles, the number of which in the Tisza during floods is 50-100 bottles per minute, sometimes this figure reaches 300 bottles per minute. In 2021, surveys were carried out on the watercourses of Transcarpathia to identify unauthorised landfills on floodplains and blockages, and 32 unauthorised landfills and 23 garbage jams were found.

Given the current situation, addressing the problem of solid waste management should be included in the programme of measures to achieve good environmental status of the Tisza sub-basin.

2.3.3 Invasive species

Invasions of alien species outside their original habitats are global in nature, and their naturalisation and further spread can cause irreversible environmental disasters and undesirable economic and social consequences. Today, biological invasions are considered to be "biological pollution", the effect of which can significantly exceed the effects of chemical pollution of watercourses.

Unlike most pollutants of anthropogenic origin, which are usually destroyed in natural ecosystems during self-purification processes and whose content is subject to effective human control, alien organisms that have successfully established themselves can multiply and spread in the environment, causing biological interference, destroying native species, and disrupting the structure of biotic communities, often with unpredictable and irreversible consequences.

The introduction of alien species can contribute to the deterioration of water quality and the spread of parasites and diseases, including those dangerous to humans. The economic losses from the introduction of some invasive alien species can in some cases amount to hundreds of millions of dollars per year. This makes biological pollution particularly dangerous and determines the specifics of control measures. Such measures should be mainly preventive in nature (Decision VI/23 COP6 of the Convention on Biological Diversity, The Hague, 2002). At the same time, it is not possible to effectively control the flow of invasions due to the lack of a biodiversity monitoring system, so this problem is becoming very important in terms of ensuring the environmental safety of the Tisza sub-basin.

The unique biodiversity of the rivers in the Tisza sub-basin, with many endemic and rare species that are highly sensitive to external influences, clearly requires protection from invasive alien species from other basins. Given the direct connection of the Tisza with the Danube, where a large number of invasive species have already naturalised, and the presence of historical and current bifurcation processes caused by abnormal floods, the Tisza River and its tributaries are highly vulnerable to biological pollution.

3 ZONES (TERRITORIES) TO BE PROTECTED AND THEIR MAPPING

3.1 Emerald Network facilities

The Emerald Network is an ecological network consisting of special areas for the conservation of biological diversity created (designated) in accordance with the Convention on the Conservation of Wild Flora and Fauna and Natural Habitats in Europe (Bern Convention). Its goal is to ensure the long-term survival of species and habitats listed in the Bern Convention that require special protection.

On 30 November 2018, six countries: Belarus, Georgia, the Republic of Moldova, Norway, Switzerland and Ukraine have officially approved the lists of Emerald Network sites on their territories. The full list of Ukraine's Emerald Network includes 271 sites[28] , and the network covers about 8% of Ukraine's territory.

There are 12 Emerald Network sites in the Tisza sub-basin, covering approximately 16% (2027.94 km^2) of the sub-basin area.

By category (Fig. 58), the sub-basin's Emerald Network facilities are divided into:

- reserve - 1;
- Biosphere Reserve - 1;
- national nature park - 5;
- regional landscape park - 5.

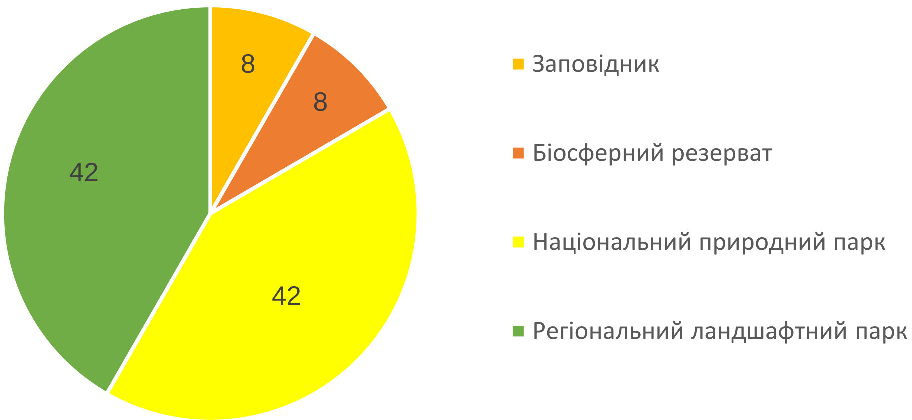


Figure 58. Breakdown of Emerald Network facilities by category, %.

None of the facilities has a management and development plan in place.

3.2 Sanitary protection zones

Sanitary protection zones include the areas where water intakes for drinking water supply are located. According to the Resolution of the Cabinet of Ministers of Ukraine on the Legal Regime of Sanitary Protection Zones of Water Bodies No. 2024 of 18 December 1998, these zones are classified as the so-called first zone (strict regime) of compliance with the use regime. The Resolution provides for a number of permitted and prohibited activities within drinking water intakes.

Member States should identify in each RBI:

- WSPs/MPPs that are used to collect water intended for human consumption, provide an average of more than 10 m³ of water per day or supply water to more than 50 people;

28 UPDATED LIST OF OFFICIALLY ADOPTED EMERALD SITES (NOVEMBER 2018) Document prepared by the Directorate of Democratic Participation and Marc Roekaerts (EUREKO) **https://rm.coe.int/updated-list-of-officially-adopted-emerald-sites-november-2018-/16808f184d**

- MREs/MRPs intended for future use for the same purpose.

State accounting of water use in Ukraine, which is carried out through the submission of reports on water use in the form No. 2TP-vodhosp (annual), provides for reporting only by those water users who withdraw water from surface and groundwater bodies in the amount of 5.0 m³/day or more (the diagram in Figure 59 is based on 2020 data, when only water users who withdrew water in the amount of 10.0 m³/day reported[3]).

There are 64 water intakes in the Tisza sub-basin that withdraw more than 10.0 m³/day. Of these, 52 (81%) are groundwater intakes and 12 (19%) are surface water intakes.

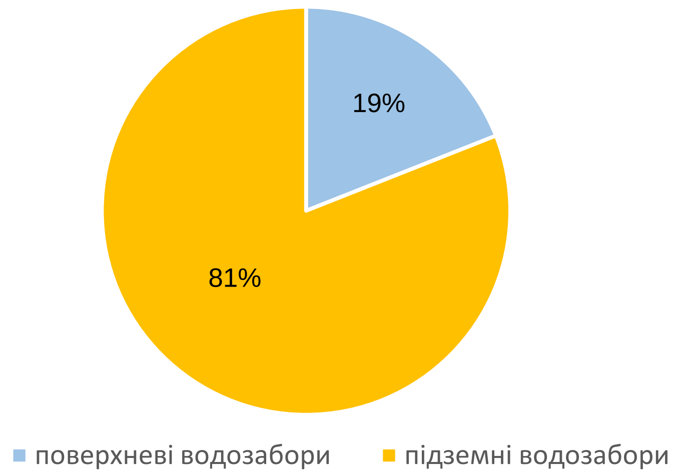


Figure 59. Water intakes in the Tisza sub-basin, %.

The State Agency of Water Resources of Ukraine is responsible for maintaining state water accounting.

3.3 Protection zones for valuable aquatic bioresources

Areas designated for the protection of economically important aquatic species or areas for the protection of valuable aquatic bioresources include those areas where such aquatic resources of significant economic value are found or cultivated.

Depending on the specifics of the protection zone for valuable aquatic bioresources, the monitoring programme may include additional indicators or sampling frequency.

According to the Resolution of the Cabinet of Ministers of Ukraine No. 1209 "On Approval of Tariffs for Calculating the Amount of Compensation for Damage Caused by Illegal Harvesting (Collection) or Destruction of Valuable Aquatic Bioresources" dated 21 November 2011 (as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 1039 dated 6 October 2021), the list of valuable bioresources includes both rare and common fish species throughout Ukraine.

At the same time, according to Article 1 of the Law of Ukraine "On Fisheries, Commercial Fishing and Protection of Aquatic Bioresources", a fishery water body (or part thereof) is a water body (or part thereof) that is used or may be used for fisheries purposes.

Thus, taking into account the above, as well as the lack of an appropriate legislative and regulatory framework, the protection zones for valuable bioresources in Ukraine have not been defined.

3.4 Surface/ground water bodies used for recreational, medical, spa and health purposes, as well as water intended for bathing

Recreation zones (hereinafter referred to as RZ) of water bodies are land plots with adjacent water space intended for organised recreation of the population on the coastal protection zones (hereinafter referred to as CPZ) of water bodies. Places of mass recreation are determined by local governments in accordance with the powers vested in them every year before the start of the summer swimming season. Water protection zones (WPZ) are established along rivers, around lakes, reservoirs and other water bodies, within which land plots are allocated for SPZs.

It is prohibited on the territory of the PZ and in the PZU:

- storage and use of pesticides and fertilisers;

- construction of cemeteries, summer camps for livestock, manure storage facilities, cattle cemeteries, waste dumps, filtration fields, liquid and solid waste storage facilities, etc;
- discharge of untreated wastewater;
- construction of any structures (except for hydrotechnical, hydrometric and linear structures), including recreation centres, summer cottages, garages and car parks;
- Washing and maintenance of vehicles and equipment.

Requirements for the placement and organisation of water bodies:

- to organise the WR of water bodies, their owners or lessees are obliged to agree on the operation of the beach with the State Service of Ukraine for Food Safety and Consumer Protection before the start of each swimming season;
- The storage facility should be located outside the sanitary protection zones of industrial enterprises. The storage facility should be located at the maximum possible distance (at least 500 m) from sluices, hydroelectric power plants, wastewater discharge sites, stables, livestock watering places and other sources of pollution;
- beaches should not be located within the first zone of the sanitary protection belt of drinking water sources.

Environmental goals for the railway:

- The water quality of reservoirs and rivers used in the SR must meet the requirements of sanitary legislation;
- the composition and properties of water in the area of recreational water use must meet the requirements for physical, chemical and sanitary-microbiological indicators.

Requirements for water monitoring in the RS:

- water sampling for departmental control in water bodies should be carried out annually by local self-government bodies at least 2 times before the start of the swimming season (at a distance of 1 km upstream from the swimming area on watercourses and at a distance of 0.1-1.0 km in both directions from it on water bodies, as well as within the swimming area);
- during the swimming season, such water sampling shall be carried out at least twice a month at at least two points selected in accordance with the nature, length and intensity of use of swimming areas.

Pursuant to CMU Resolution No. 264 of 06.03.2002 "On Approval of the Procedure for Registration of Places of Mass Recreation on Water Bodies", local executive authorities and territorial fishery protection authorities are required to identify on maps and schemes land plots and water areas suitable for the organisation of beaches, boat rental facilities, water attractions, as well as places for water sports and places for amateur and sport fishing in winter.

Approved copies of the map schemes shall be submitted to the emergency rescue services serving water bodies in their area of responsibility and to the regional coordination emergency rescue centres of the State Specialised Emergency Rescue Service on Water Bodies of the State Emergency Service of Ukraine (hereinafter referred to as the SES).

Information on places of mass recreation is submitted annually by 1 April by local governments, and information on places of recreational and sport fishing is submitted on 10 February and 30 October by territorial fish protection authorities to regional coordination emergency rescue centres of the SES.

According to the SES of Ukraine in Zakarpattia Oblast, as of August 2023, there are three (3) officially designated recreation and leisure sites in the Tisa sub-basin (Annex 5 (M5.3.1)).

3.5 Areas vulnerable to (accumulation of) nitrate

Areas sensitive to nutrient pollution are those MPAs identified in accordance with Directive 91/271/EEC on the treatment of urban wastewater. Areas vulnerable to (accumulation of) nitrates are those areas identified as being at risk from agricultural nitrate pollution (in accordance with the Nitrate Directive).

Ukraine has approved a methodology for determining nitrate vulnerable zones (Order of the Ministry of Ecology No. 244 dated 15.04.2021), as required by the EU Nitrate Directive. The methodological approach relies heavily on a large amount of high-resolution spatial and temporal data, mainly surface and groundwater monitoring data, but it also uses statistical data such as livestock numbers, fertiliser application and nitrogen surplus calculations to identify these zones. All of this information is needed to identify nitrate vulnerable zones, and it needs to be of high quality and with a sufficient level of confidence. At the moment, the existing monitoring network for MNV in its continuity and spatial coverage is not sufficient to apply the developed method, and MNV monitoring is not carried out at all.

Based on statistical data and expert assessment of the situation with nutrient pollution of the Ukrainian IPW:

- the highest percentage of ploughed land in the world (53.9%, 2021 data), and the agricultural land ploughed rate is 78.2%;
- There is a lack of sufficient representative and reliable information on the content of nutrients in surface and groundwater;
- Eutrophication of water bodies is a common phenomenon in all RBMs;
- the initial level of implementation of the Nitrate Directive.

Taking into account the above, it is proposed to define the entire territory of Ukraine as a nitrate vulnerable zone for the period 2025-2030. This meets the requirements of the EU WFD, which provides for the "protection of seas and coastal waters" and the prevention of deterioration of MPAs and MEAs (it is more appropriate to classify more MPAs as vulnerable than to change their status from "good" to "poor"). This "whole country" approach is also used in many EU countries. Areas vulnerable to nitrate accumulation can be refined or defined in subsequent river basin management plan cycles based on improved, more accurate information.

This approach makes it possible to extend the main measures to the entire territory of the country and plan more specific measures for surface and groundwater bodies where there is a risk of not achieving environmental objectives due to the impact of agriculture based on confirmed data.

During the period 2025-2030, the focus should be on improving the monitoring network (both groundwater and surface water) and the database to ensure a more detailed approach to zone designation and monitoring and thus achieve full compliance with the EU WFD during the 2nd cycle of the river basin management plan (2031-2036).

3.6 Vulnerable and less vulnerable areas identified in accordance with the criteria approved by the Ministry of Environment

In accordance with the Law of Ukraine "On Wastewater Disposal and Treatment" dated 12 January 2023 No. 2887-IX (the "Law"), the vulnerable zone is the MPA and inland sea waters that are affected by wastewater discharge and where eutrophication is observed or may be eutrophic if no preventive measures are taken.

Pursuant to Article 12 of the Law, the MPA is defined as a vulnerable zone, and inland sea waters are defined as a less vulnerable zone by a decision of a local self-government body upon submission of the State Agency of Ukraine for Water Resources, in accordance with the Criteria for determining vulnerable and less vulnerable zones (hereinafter - the Criteria), approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 6 dated 14.01.2019, registered with the Ministry of Justice of Ukraine on 5 February 2019 under No. 126/33097.

The State Agency of Ukraine for Water Resources has prepared and sent submissions to local authorities. The process of making relevant decisions by the competent authorities is ongoing.

4 MAPPING OF THE MONITORING SYSTEM, RESULTS OF MONITORING PROGRAMMES IMPLEMENTED FOR SURFACE WATER (ECOLOGICAL AND CHEMICAL), GROUNDWATER (CHEMICAL AND QUANTITATIVE), AREAS (TERRITORIES) SUBJECT TO PROTECTION

4.1 Surface water

Surface water monitoring is carried out in accordance with the Procedure for State Water Monitoring approved by the Cabinet of Ministers of Ukraine on 19 September 2018, No. 758. The Ministry of Ecology, the State Agency of Water Resources and the State Emergency Service are the subjects of state water monitoring.

Every year, starting from 2020, surface water monitoring programmes are approved by the relevant orders of the Ministry of Ecology (Order No. 410 of 31.12.2020 "On Approval of State Water Monitoring Programmes", Order No. 3 of 05.01.2022 "On Approval of the State Water Monitoring Programme", Order No. 27 of 17.01.2023 "On Approval of the State Water Monitoring Programme").

4.1.1 Monitoring system

In the Tisza sub-basin, monitoring is carried out at 45 monitoring sites at 41 GWPs (Annex 6 (M5.3.1)), including:

- 10 at cross-border IUI designated in accordance with intergovernmental cooperation agreements;
- at the IWPs from which water is abstracted to meet the drinking and household needs of the population - 4;
- to determine reference conditions and at Emerald Network facilities - 2.

4.1.2 Hydromorphological assessment/condition

The hydromorphological condition is assessed in accordance with the Methodology approved by the Order of the Ukrainian State Geological Survey No. 23 of 19.02.2019, in five classes.

Hydromorphological monitoring was carried out at 31 MPVs (Annex 7 (M5.3.1)). According to the monitoring results: 8 WBMs belong to the first class, 23 WBMs - to the second class (Fig. 60).

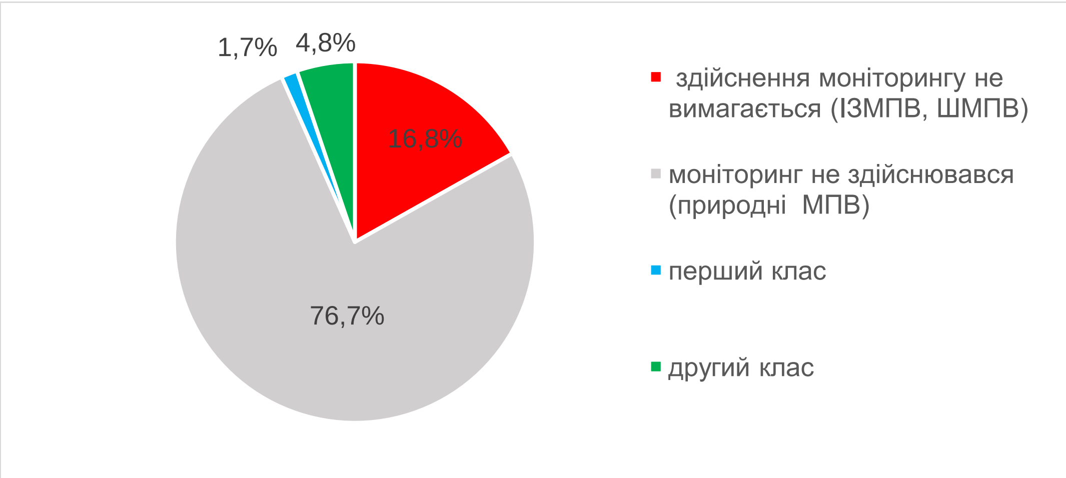


Figure 60. Hydromorphological state of the MWP

4.1.3 Assessment of the chemical state

The assessment of the chemical state of the MSW is based on the determination of the concentrations of priority substances specified in Directive 2008/105/EC, taking into account Directive 2013/39/EU250, which sets the maximum permissible concentrations. In Ukraine, the Order of the Ministry of Ecology and Natural Resources of 6 February 2017 No. 45, registered with the Ministry of Justice of Ukraine on 20 February 2017 under No. 235/30103, defines a list of indicators for which environmental quality standards are set in Annex 8 of the Order of the Ministry of Ecology and Natural Resources of 14.01.2019 No. 5 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Conditions of a Surface Water Body, as well as Assigning an Artificial or Significantly Modified Surface Water Body to One of the Classes of Ecological Potential of an Artificial or Significantly Modified Surface Water Body".

Directive 2009/90/EC (Article 5) sets out technical requirements/criteria for the processing of monitoring data that were taken into account in the assessment of the chemical state of the WTG:

- if the measured value was below the quantification limit;
- when summarising the results of individual isomers or mixtures (e.g. polycyclic aromatic hydrocarbons, cyclodiene pesticides, DDT), in the case of values measured below the LOQ, zero "0" should be used to calculate the average concentrations.

In addition, Article 4 of Directive 2009/90/EC stipulates that the methods for measuring the content of indicators must meet the minimum criteria: have a measurement uncertainty value below 50% (k=2) and a quantification limit equal to or below 30% of the relevant EQOE.

Valuation reliability

The reliability of the chemical state assessment was performed using the criteria for establishing the reliability of the correct determination of the environmental and chemical states of the MSW specified in Annex 11 of the Order of the Ministry of Ecology and Natural Resources of 14.01.2019 No. 5.

According to the established criteria, a three-stage scheme was used to assess the reliability of the correct determination of the chemical state of the MPV:

- a high level of assessment reliability means that most of the requirements have been met, namely: measurement data are available for all indicators defined by the Order of the Ministry of Ecology and Natural Resources of 6 February 2017 No. 45 "List of Pollutants for Determining the Chemical State of Surface and Groundwater Massifs and the Ecological Potential of Artificial or Significantly Modified Surface Water Massifs" (hereinafter referred to as the List), which meet the requirements of the Monitoring Procedure (all relevant requirements for the list of indicators, methods and frequency have been met); aggregation of MPEs demonstrates reliable res
- the medium level of reliability of the assessment of the state of the IAP is established in the absence of sufficient monitoring data, frequency and measurement of all indicators identified in the List;
- low reliability of the assessment of the state of IWM means that the assessment of the state of IWM was based on risk assessment, transfer of monitoring data through aggregation of IWM according to certain criteria.

To assess the chemical state of the MWR, statistically processed data of measurements of pollutant content in surface waters conducted at 50 monitoring sites were used, namely, the average and maximum values (Annex 7 (M5.3.1)).

Background concentrations for non-synthetic substances (mercury, lead, cadmium, nickel) were not taken into account when assessing the chemical state of the MPW.

The compliance of the EQA measurement results with the established annual average and maximum permissible concentrations is considered to be in line with the requirements established for the good chemical condition of the Waste Water Treatment Plant.

For MPEs where monitoring was not carried out, the chemical state was assessed by interpolating (transferring) the assessment results from MPEs where monitoring was carried out, according to the aggregation of MPEs.

The following parameters were not measured: brominated diphenyl ethers (esters), chloralkanes, C $_{,10-13}$ di(2-ethylhexyl)-phthalate, diuron, isoproturon, pentachlorophenol, tributyltin compounds (tributyltin cation), perfluorooctane sulfonate and its derivatives (PFOS), dioxins and dioxin-like compounds, hexabromocyclododecane (HBCDD) (Annex 7 (M5.3.1)).

For the indicators fluoranthene, hexachlorobenzene, hexachlorobutadiene, mercury and its compounds, dicofol, heptachlor and heptachloroepoxide, for which the recommended object of control is biota, due to the lack of technical capabilities and measurement methods, concentrations were determined only in surface water samples.

The chemical state was assessed on the basis of monitoring data obtained as part of the diagnostic and operational monitoring of the IWPs in 2022, for 47 IWPs (Annex 8 (M5.3.1)).

The results of the assessment of the chemical state of the MPW based on monitoring data (Table 52):

- chemical condition is "good": 7 linear MPEs (2% of the total number of linear MPEs), by MPE length it is 89.7 km (2% of the total length of linear MPEs); 1 polygonal MPE (12% of the number of polygonal MPEs), by MPE area it is 1.43 km^2 (14% of the area of polygonal MPEs);
- chemical status of "failure to achieve good": 35 linear MPEs (7% of the total number of linear MPEs), by MPE length this amounts to 692.29 km (18% of the total length of linear MPEs); 4 polygonal MPEs (44% of the total number of polygonal MPEs), by MPE area this amounts to 5.79 km^2 (54% of the total area of polygonal MPEs).

Table 52. Chemical state of the WIPP for the period 2020-2022 (according to monitoring data)

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	total area of the MWP, km^2
"good"	7	89,7	1	1,43
"failure to achieve the good"	35	692,29	4	5,79

The following substances have been found to exceed the MAC$_{MAX}$ - maximum permissible concentration and/or MAC$_{CP}$ - average annual concentration:

- cadmium (for 1 MPV);
- nickel (for 1 MPV);
- fluoranthene (for 12 MPV);
- benzo(*a*)pyrene (for 34 MPV);
- benzo(*b*)fluoranthene (for 6 MPV);
- benzo(*k*)fluoranthene (for 5 MPV);
- benzo(*g,h,i)* perylene (for 10 MPV);
- Cypermethrin (for 3 MPVs);
- dicofol (for 2 MPVs);
- dichlorvos (for 1 MPV) .

Based on interpolation of the monitoring results according to the aggregation of IAPs (low level of reliability of the IAPs assessment) (Table 53), the following was established:

- chemical condition is "good": 71 linear WWTPs (15% of the total number of linear WWTPs), with a length of 347.94 km (9% of the total length of linear WWTPs);
- chemical state of "failure to achieve good": 162 linear MPEs (34% of the total number of linear MPEs), by MPE length this amounts to 1360.96 km (36% of the total length of linear MPEs); 4 MPEs (44% of the number of polygonal MPEs), by MPE area this amounts to 3.35 km^2 (32% of the area of polygonal MPEs).

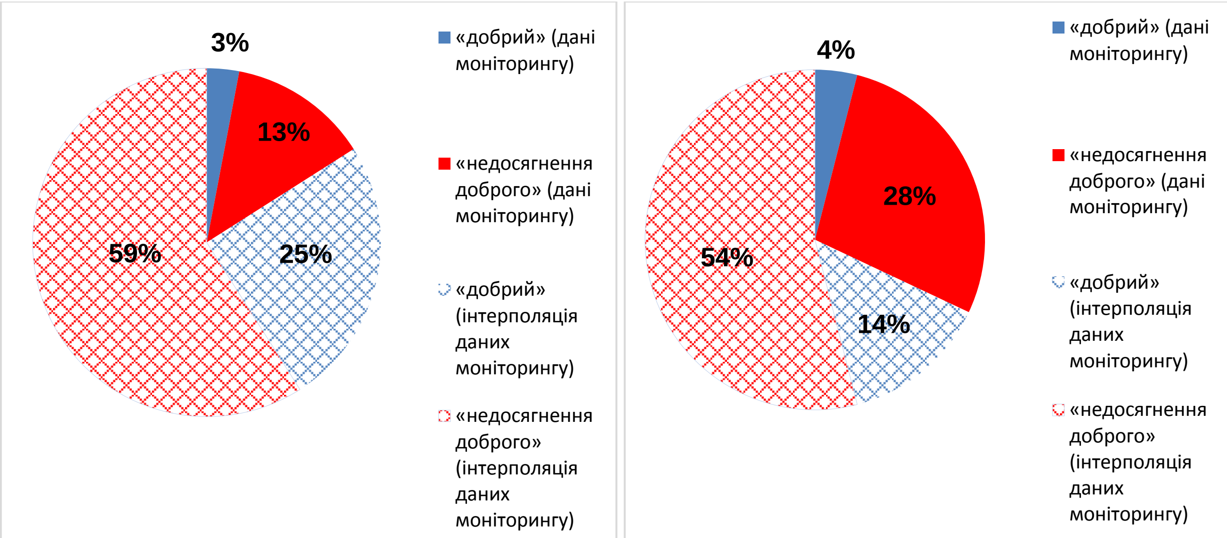
Table 53. Chemical state of the WRF based on interpolation of monitoring data

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	is the total area of the MPA, km^2
"good"	71	347,94	0	0
"failure to achieve the good"	162	1360,96	4	3,35

The assessment of the chemical state of the WBF for the period 2020-2022 (monitoring data and interpolation of monitoring data) is presented in Table 54, Annex 9 (M5.3.1) and Figures 61 - 62.

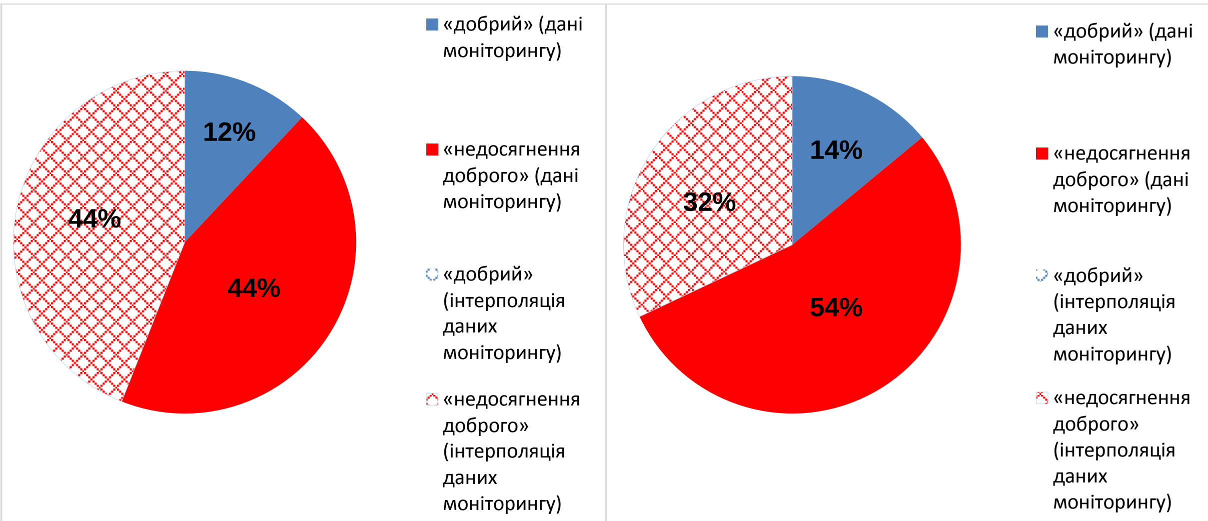
Table 54. Assessment of the chemical state of the WRF for the period 2020-2022 (monitoring data and interpolation of monitoring data)

Chemical state	number of linear MPVs	total length of linear IPPs, km	number of polygonal MPAs	is the total area of polygonal MPAs, km^2
"good"	78	437,64	1	1,43
"failure to achieve the good"	197	2053,25	8	9,14



a) by the number of MPAs *b) by the length of the IPA*

Figure 61. Assessment of the chemical state of linear MPVs (monitoring data and interpolation of monitoring data)



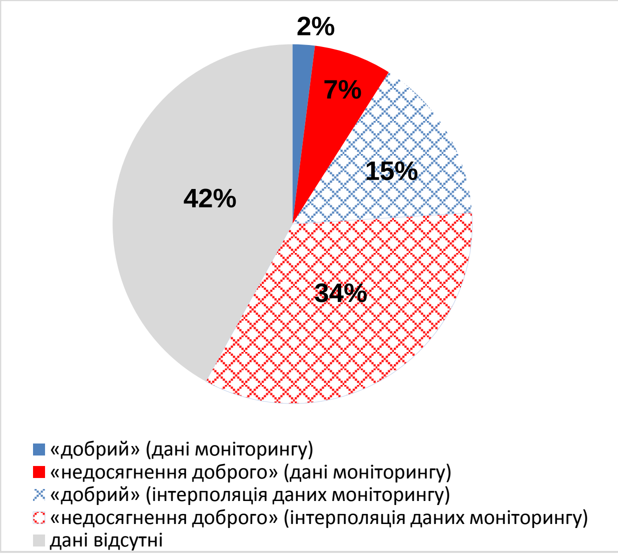
a) by the number of MPAs *b) by the area of the IPA*

Figure 62. Assessment of the chemical state of polygonal landfill sites (monitoring data and interpolation of monitoring data)

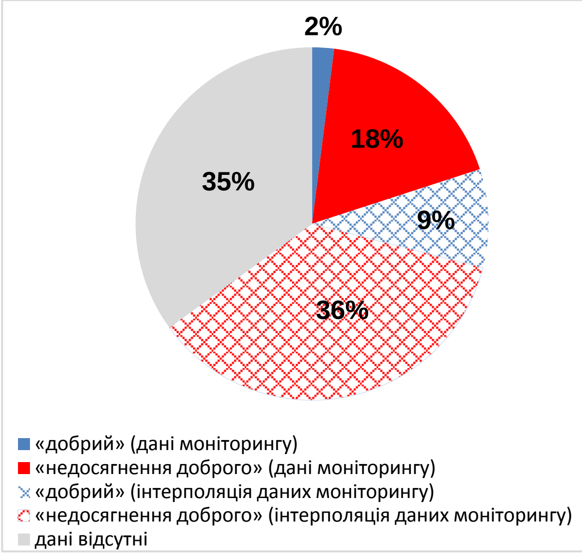
For 47 MPVs, the reliability of the assessment of the correct chemical state determination corresponds to the average level of reliability.

237 MPUs were assessed with a low level of reliability based on the transfer of results obtained under the surface water quality monitoring programme to MPUs where no monitoring was carried out, according to the aggregation of MPUs.
Taking into account the interpolation of monitoring data, the chemical state was assessed for 275 linear MPAs, , which is 2490.89 km in length, and 9 polygonal MPAs, which is 10.57 km in area^2 .

Summarised assessments of the chemical state of linear MPAs and polygonal MPAs in the Tisa River sub-basin are presented in Figures 63 and 64.

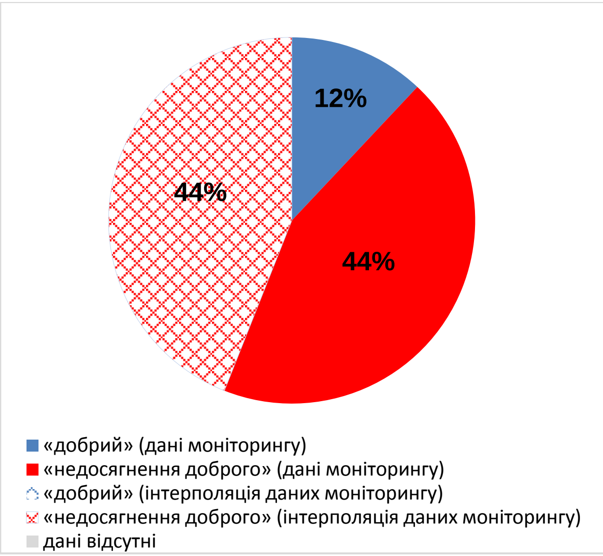


a) by the number of MPAs



b) by the length of the IPA

Figure 63. Total assessment of the chemical state of linear MPAs in the Tisza sub-basin



a) by the number of MPAs

b) by the area of the IPA

Figure 64. Total assessment of the chemical state of polygonal WFDs in the Tisa River sub-basin

4.1.4 Environmental assessment

As of the end of 2023, the environmental status of any of the MPFs had not been determined.

In 2022, biological indicators were monitored at 41 WFOs (Annex 7 (M5.3.1)):

- phytoplankton;
- microphytobenthos;
- vascular plants;
- bottom macroinvertebrates.

No fish monitoring was carried out.
The assessment of the status of the MPA by biological indicators (except fish) is presented in Figure 65.

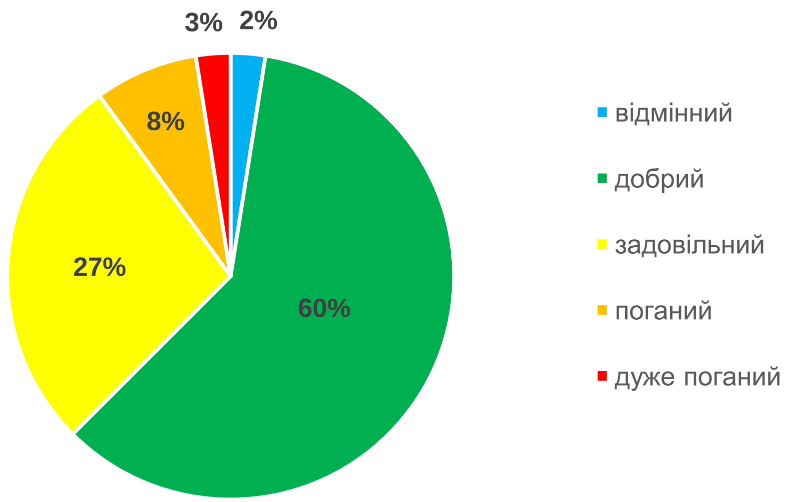


Figure 65. Evaluation of MWP by biological indicators

4.1.5 Assessment of environmental potential

As of the end of 2023, no assessment of the environmental potential of substantially altered and artificial MPAs had been carried out.

4.2 Groundwater

4.2.1 Monitoring system

The inventory of wells in the Tisza sub-basin was carried out in 2006, when it was established that 31 wells were in working condition (23 - groundwater, 2 - interstitial water, 6 - at the reference sites for studying operational reserves), in 2018 only 19 groundwater wells remained. Since 2018, groundwater monitoring has not been carried out, and the condition of water intake facilities is unknown.

4.2.2 Chemical assessment/risk assessment

As of the end of 2023, no environmental assessment/risk assessment of the Mine site has been carried out.

4.2.3 Estimation of groundwater volumes/reserves

As of the end of 2023, no assessment of groundwater volumes/reserves was made.

5 A LIST OF ENVIRONMENTAL OBJECTIVES FOR SURFACE WATERS, GROUNDWATER AND PROTECTED AREAS (TERRITORIES) AND DEADLINES FOR THEIR ACHIEVEMENT (IF NECESSARY, JUSTIFICATION FOR SETTING LESS STRINGENT OBJECTIVES AND/OR POSTPONEMENT OF THEIR ACHIEVEMENT)

Environmental targets for surface water, groundwater and protected areas (territories) are set separately.

Surface water:

- Preventing the deterioration of all MPEs;
- Achieving/maintaining "good" ecological and chemical status of all natural MPAs (rivers, lakes, transitional and coastal waters);
- achievement/maintenance of "good" ecological potential and chemical state of significantly altered and artificial MPAs;
- gradual reduction to the complete absence of hazardous substances.

Groundwater:

- preventing the deterioration of all MSW;
- Achieving/maintaining a "good" quantitative and chemical condition of all MSW;
- preventing and limiting groundwater pollution.

Areas (territories) to be protected:

Achieving standards and targets as required by applicable law for:
- Emerald Network facilities;
- sanitary protection zones;
- protection zones for valuable aquatic bioresources;
- surface/ground water bodies used for recreational, medical, resort and health purposes, as well as water intended for bathing;
- areas vulnerable to (accumulation of) nitrates;
- vulnerable and less vulnerable areas identified in accordance with the criteria approved by the Ministry of Environment.

In cases where several objectives are set for a particular MEA or MEAs, the most stringent ones should be applied, while all other objectives should also be met.

In some cases, the deadline for achieving environmental targets or the target itself may be postponed as an exception.

It is allowed to postpone the date of achievement of the target for a period of 6 years (until 2036), but not longer than 12 years (until the end of 2042) from the end of the implementation of the first cycle of the RBMP (2030).

An exemption applied to a particular MPA or MNR should not create a risk of not achieving the environmental objectives of the upstream (for MPAs) or downstream (for MNRs) and adjacent (for MNRs) massif or massifs.

The exceptions include:

- **Achieving less stringent targets or postponing the date of their achievement** due to technical reasons (e.g. lack of a technical solution, technical impracticality or impracticability), disproportionately high cost or the existing natural state of the water body that does not allow for its improvement in a timely manner (e.g. inert groundwater to be restored). The presence or absence of disproportionality is determined by the results of an economic assessment of costs and benefits;

- **Temporary deterioration of the state (goals) as a result of an unforeseen force majeure of** natural origin (e.g. extreme flood, drought) or anthropogenic (accident);
- **New physical modifications of the** MPA **as a result of new infrastructure projects** aimed at economic development (e.g., a road or railway, a hydroelectric power station). In other words, hydromorphological changes to the MPA are allowed (up to the point of classifying it as "significantly altered"), but any water pollution from point or diffuse sources is not allowed. New physical modifications of a water body are allowed when the benefits to society outweigh the environmental ones, and there is no other option to avoid these modifications for technical and/or financial reasons.

5.1 Environmental objectives for surface water

Based on the results of the assessment of anthropogenic pressure on the MPA of the Tisza sub-basin:

- 214 MNEs are "at no risk" of not achieving "good" environmental status/potential, 111 MNEs are "possibly at risk", and 156 MNEs are "at risk";
- 445 MPEs are "without risk" of not achieving "good" chemical condition, and 36 MPEs are "at risk".

By 2030, 233 MNPs will achieve "good" environmental status/potential, of which 214 MNPs are currently "without risk" (they need to maintain this status), 19 MNPs are 5% of MNPs that are "at risk" or "possibly at risk" of not achieving environmental objectives based on the results of the anthropogenic load assessment and will achieve environmental objectives through the implementation of PA measures.

The remaining 'at risk' or 'possibly at risk' MPSs in the basin (248 MPSs) could achieve 'good' ecological status/potential by 2036 or 2042, subject to the implementation of remedial measures.

By 2030, 445 MPAs will have achieved "good" chemical status, these are those that are currently "without risk" (they need to maintain this status), 36 MPAs, which are "at risk" according to the results of an assessment of anthropogenic load, will achieve environmental goals no earlier than 2036 or 2042, provided that environmental protection measures are implemented.

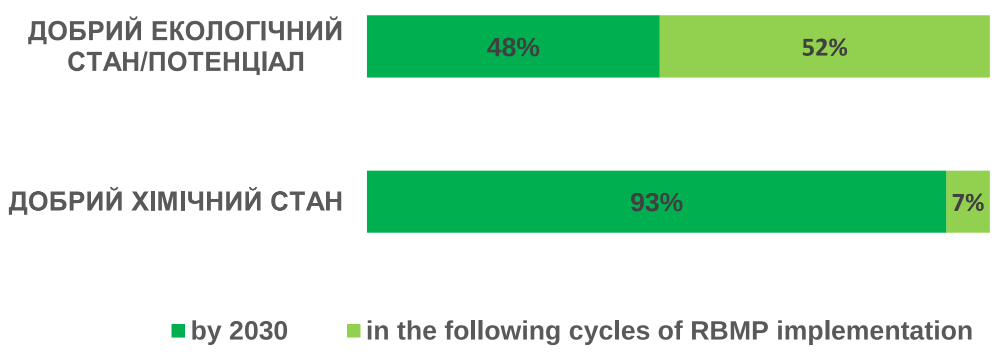


Figure 66. Timeframe for achieving environmental targets for MWPs, %.

Annex 10 (M5.3.1) contains the environmental targets of the MIP, the timeframe for achieving them, reasons for postponement and setting less stringent targets.

5.2 Environmental objectives for groundwater

Environmental targets are set for each MPZ, both in terms of their quantitative and qualitative (chemical) status. According to the WFD, the main objective is to achieve "good" groundwater status.
Additional targets for each individual IWR are defined depending on the existing quantitative and qualitative state of IWR, their use or potential use for water supply to the population, anthropogenic pressure and possible impact on surface ecosystems.

The main criterion for the "good" quantitative state of the MHW should be the absence of groundwater depletion. Depletion is considered to be the state of aquifers in which, under the influence of artificial drainage, the decline in groundwater levels has reached such indicators that exclude the possibility of further use of the horizon to meet the needs of society using traditional technical means.

The assessment of the depletion of ASBMs is based on information on the level regime, data on groundwater extraction volumes and their comparison with resources and approved operational reserves. In addition, for non-pressure ASFs, the criterion of "good" condition is the appropriate condition of the associated surface water bodies and the absence of negative impact on surface ecosystems, primarily vegetation suppression.

The criteria for the "good" quality (chemical) state of the MPW are the natural background content of chemical elements and compounds, as well as the standards set for drinking water by the State Sanitary Norms and Rules "Hygienic Requirements for Drinking Water Intended for Human Consumption" (hereinafter - SanPiN 2.2.4-171-10).

Quantitative state of non-pressure MPPs

The environmental objective is to avoid groundwater depletion and not to deteriorate its quantitative state. Given the extremely limited monitoring data, it can be concluded that given the insignificant volumes of water extraction from non-pressure IGSFs by private water consumers, negative trends in the quantitative state are not expected.

Qualitative (chemical) state of non-pressure water treatment plants

The majority of non-pressure WWTPs are used by the rural population to meet their drinking needs, therefore, to assess the quality state, it is necessary to use the standards of Sanitary and Epidemiological Norms 2.2.4-171-10, except for those elements and compounds whose content exceeds the normative level in the natural state. For such components, the values of natural backgrounds should be used.

The environmental objective is compliance with Sanitary and Epidemiological Norms 2.2.4-171-10 and no deterioration of the quality state. It is worth noting that the stability of the quality state is relative, the content of macro- and micro-components in the water of non-pressure WTGs is subject to significant fluctuations in space and time, so it is necessary to have information on the intervals of changes in the content and to refine it in the course of monitoring. Unfortunately, groundwater monitoring in the Tisza sub-basin has not been carried out in recent years.

Quantitative state of pressure vessels

Environmental objective - avoidance of groundwater depletion and no deterioration of the quantitative state. The lack of data on the results of level measurements at operational water intakes does not allow drawing conclusions/analysis of the trend in groundwater extraction, depletion and deterioration of the quantitative state of the pressure groundwater bodies.

Qualitative (chemical) state of pressure vessels

The environmental objective is to ensure that the content of elements and compounds complies with Sanitary and Epidemiological Norms 2.2.4-171-10, except for those components whose elevated content in groundwater is of natural origin. These are components whose natural background content is close to the maximum permissible concentrations. An additional environmental objective is to avoid deterioration of the quality of the injection groundwater, and conclusions on trends in chemical composition should be based on reliable monitoring data, since the content of components in water is subject to natural fluctuations, which is especially typical for those groundwater bodies that are located closer to the surface. Therefore, for each MPZV, it is necessary to have information on the interval of fluctuations in the content of components of the chemical composition of water. Such data is currently not available.

In addition, for operational water intakes, changes in water quality are determined by comparing current indicators with those at the time of approval of reserves.

Given the current state of groundwater use and problems with water supply in low-lying areas of Zakarpattia Oblast, an additional goal is to determine and maintain an optimal balance of surface and groundwater use for drinking water supply in accordance with Article 6 of the Law of Ukraine "On Drinking Water, Drinking Water Supply and Sanitation".

The primary objective is to resume groundwater monitoring in the Tisza sub-basin, which has been virtually suspended in recent years. In the absence of groundwater monitoring, it is unlikely that all of these objectives will be achieved. The unsatisfactory state of groundwater monitoring over the past decades, and, accordingly, insufficient information on the current state of the MMP, allows us to define environmental objectives only in the most general form. In the course of monitoring, the environmental objectives for each MPZ should be specified.

Appendix 10 (M5.3.1) (Table 2) lists the environmental targets of the Mine Action Plan and its groups, the timeframe for achieving them, reasons for postponement and setting less stringent targets.

Taking into account the current situation with groundwater monitoring and a realistic forecast of the timeframe for the possible start of MMP implementation, the achievement of these environmental objectives for MMPs should be expected only in the 2nd RBMP cycle, not earlier than 2042. "Good" quantitative status and "good" chemical status can be achieved by all 7 groups of MES in the Tisza sub-basin (3 non-pressure, 2 pressure and 2 pressure/non-pressure) only if the proposed measures for both surface and groundwater are implemented (Fig. 67).

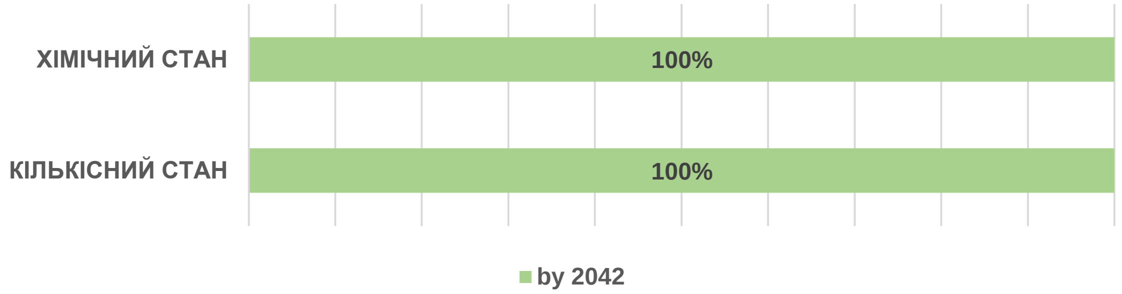


Figure 67. Timeline for achieving environmental targets for MMPPs, %.

6 ECONOMIC ANALYSIS OF WATER USE

6.1 Economic development of the sub-basin

In Ukraine, the Tisza River sub-basin is entirely located within one administrative region - Zakarpattia. The Zakarpattia region is small in area and population, but has a favourable economic and geographical location in the heart of Europe, situated in the west of Ukraine and bordering EU member states Poland, Slovakia, Hungary and Romania.

Among the regions of Ukraine, it ranks 24th in terms of territory and 19th in terms of population (according to 2013 statistics). According to the administrative-territorial division, it includes 6 rayons, 11 cities, 19 towns, 578 villages and 64 united territorial communities.

The territory of Zakarpattia is densely populated, with a population density of 97.5 people/km^2 , which ranks 6th among all regions of Ukraine. The population of the region is 1.25 million people (as of 1 January 2021) and accounts for 2.9% of the population of Ukraine. The population is dominated by rural residents (63%), while the urban population is 37%.

Analysis of the Tisza River sub-basin's GRP

The gross regional product (GRP) is a summary indicator that characterises the level of economic and social development of a region and is measured by the total value of goods and services produced for final use. In 2019, the GRP of the Tisza sub-basin was UAH 61.3 million (data for 2020 has not been published). The dynamics of this indicator over the entire study period of 2015-2019 shows an upward trend with different rates in different periods. The highest growth rates were observed in 2017-2018 (at the level of 3-4%), while in 2019 these rates decreased (to the level of 1%).

Table 55. Dynamics of the gross regional product (GRP) of the Tisza sub-basin in 2015-2019[29]

Indicators.	2015	2016	2017	2018	2019
GRP in actual prices, UAH million	28952	32390	43043	52445	61335
Share of GRP in the Tisza sub-basin in the total GDP of Ukraine, %.	1,5	1,4	1,4	1,5	1,5
GRP growth rate in the Tisza sub-basin to the previous year, %.	93,5	97,3	103,1	104,0	101,5

The GRP within the sub-basin in actual prices in 2019 per capita was UAH 48.9 thousand, which is lower than the total GRP in Ukraine (as of 2019, the GRP per capita was UAH 94.7 thousand).

Analysis of the Tisza River sub-basin

The main component of the gross regional product is gross value added (GVA). As of 2019, the sub-basin's GVA amounted to UAH 53337 million in actual prices (data for 2020 have not been published) in actual prices, and has a share of 1.6% in the total GVA of Ukraine (Table 56).

Table 56. GVA by economic sector in the sub-basin, 2019

Sectors of the economy	AIRBORNE FORCES, million UAH	Share in Ukraine's airborne troops, %.	Share in the basin's GVA, %.
Agriculture, forestry and fisheries	7403	2,1	13,9
Mining and quarrying	335	0,2	0,6
Processing industry	4828	1,2	9,0
Supply of electricity, gas, steam and air conditioning	1657	1,4	3,1
Water supply, sewerage, waste management	172	1,2	0,3
Construction	1790	1,7	3,4
Transport, warehousing, postal and courier services	5738	2,2	10,8
Water-dependent economic activities	21923	0,7	41,1

[29] Calculated based on data from the State Statistics Service of Ukraine http://www.ukrstat.gov.ua/

Sectors of the economy	AIRBORNE FORCES, million UAH	Share in Ukraine's airborne troops, %.	Share in the basin's GVA, %.
Other economic activities	31414	0,9	58,9
Total in the Tisza sub-basin	53337	1,6	100

The structure of airborne troops is uneven and is distributed as follows (Figure 68).

Figure 68. The structure of the Tisza sub-basin WFD, 2019

Agriculture, forestry and fisheries account for the largest share in the total GRP of the sub-basin - UAH 7403 million or 13.9%, which corresponds to 2.1% of the total GRP of Ukraine. Among the water-dependent sectors of the economy, transport, warehousing, postal and courier activities have a fairly high share in the overall structure of the sub-basin's GRP, accounting for UAH 5,738 million or 10.8%, and their share in the total GRP of Ukraine is 2.2%. The share of the processing industry in the sub-basin's GRP is also quite high, namely 9.0%, which in absolute terms amounts to UAH 4,828 million, and in total GRP of Ukraine - 1.2%. Other, non-water-dependent economic activities account for UAH 31414 million, which corresponds to 58.9% of the sub-basin's GRP and 0.9% of Ukraine's GRP.

The dynamics of the GVA of water-dependent economic activities in the sub-basin during 2015-2019 decreased from 57.8% in 2015 to 55.6% in 2019 of the sub-basin's GVA and shows a gradual downward trend. The decline in the total value of the GVA of water-dependent sectors was due to a decrease in the GVA of agriculture, forestry and fisheries, as well as the processing industry over the past 5 years. The remaining water-dependent sectors of the economy show fluctuations in GVA, with transport showing a slight increase in its share of GVA from 4.6% in 2015 to 7.0% in 2019. In turn, the growth of the total GVA of the Tisza sub-basin is driven by other, non-water-dependent sectors of the economy.

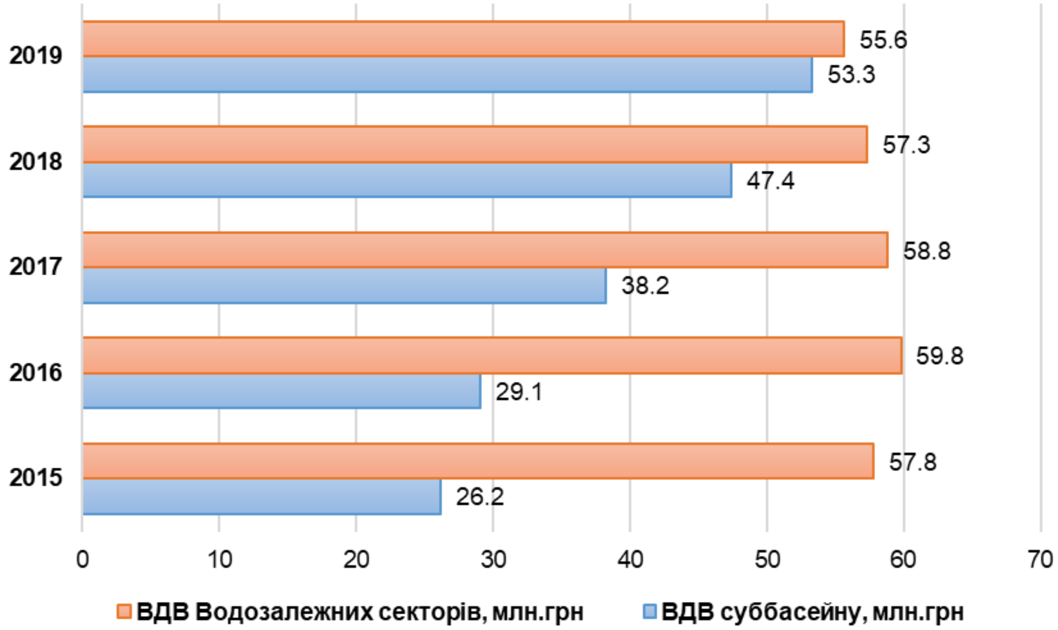


Figure 69. Dynamics of the share of GVA of water-dependent economic activities in the total GVA of the sub-basin, 2015-2019, UAH million

6.2 Characteristics of modern water use

The sub-basin is well provided with water resources. According to the international classification, the Zakarpattia region is classified as a medium-supplied region with 6.19 thousand m^3 of water per capita. The main sources of water supply are surface water and groundwater from the hydrogeological province of the folded Carpathian region.

The total resources of surface runoff in an average water year are 13300 million m^3 , in a low-water year - 7290 million m^3 . In addition to the surface waters of the sub-basin's rivers, they include 9 reservoirs (total capacity 40.55 million m^3), 645 ponds (total capacity 22.6397 million m^3) and 44 lakes, the largest of which is Lake Synevyr, with a volume of 1.75 million m^3 .

Forecasted groundwater resources of drinking quality are 399 million m^3 /year, and the level of approved reserves is 124 million m^3 /year. At the same time, as of 2020, about 27.6 million m^3 /year are used, meaning that the region has significant potential for the development of drinking water supply.

The sub-basin's water consumption is insignificant. In 2020, a total of 46.632 million m^3 of water was abstracted from natural sources, which is almost 8% of the total abstraction in the Danube basin and 0.5% of the total abstraction in Ukraine. Ratio of water use by source of water withdrawal: 58.4% from surface water and 41.6% from groundwater (Figure 70).

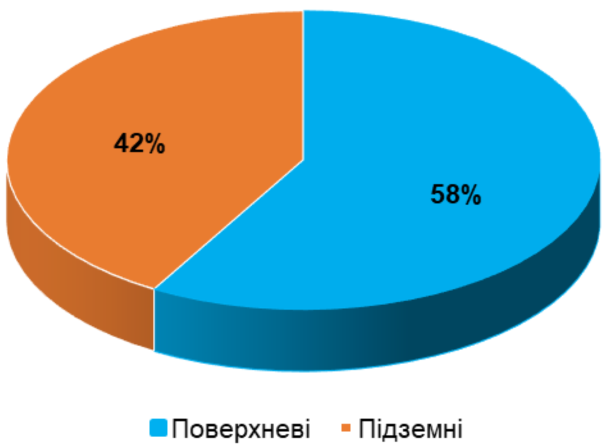


Figure 70. Sources of water intake in the sub-basin, 2020

The peculiarity of the region's economic development is the absence of production and technological complexes that require significant volumes of water, which leads to a characteristic distribution of water use with the dominance of the municipal sector. The relative share of the latter in water intake in 2020 was 47%

or 21.9 million m³ (Fig. 71). The second largest water user is agriculture - 23.8% (11.1 million m³), while industry in the sub-basin accounts for only 3% (1.4 million m³). Other sectors of the economy use 26.2% of the abstracted water for their own needs, including transport - less than 1% (0.1 million m).³

Figure 71. Structure of water withdrawals in the Tisza sub-basin, million m3³ for 2020

The main water users within the sub-basin are the following economic sectors: industry, housing and communal services, agriculture and transport.

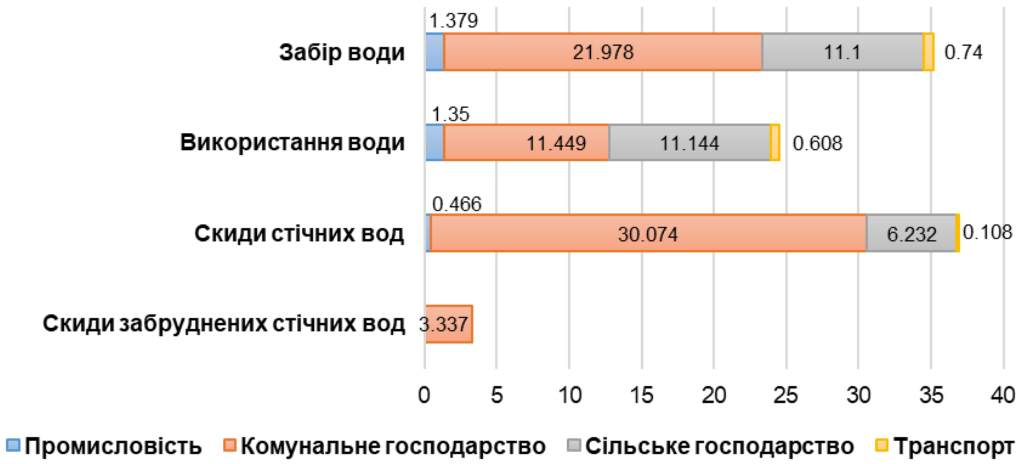


Figure 72. Characteristics of water use in the Tisza sub-basin, 2020

The volume of water use in the sub-basin is 27.6 million m³ . A detailed description of the sub-basin's water use by economic sectors is presented in Annex 11.1 (M5.3.1).

As for the structure of wastewater discharge, more than 78% of wastewater is discharged into surface water bodies by housing and communal services, 16% by agriculture and 1.2% by industrial water users.

Wastewater treated to standard standards at wastewater treatment plants accounts for 72.2%, 18.5% is standard clean without treatment and 9.3% is polluted wastewater. Almost 95% of contaminated wastewater comes from water users in the housing and utilities sector. Information on wastewater discharges to water bodies by categories of discharged water is provided in Annex 11.2 (M5.3.1).

To assess the socio-economic importance of water for economic sectors, the ranking of water users by 5 indicators was used:

- GVA generated by the industry is an economic indicator of the sector's weight in the sub-basin economy;
- the volume of water withdrawn by the industry;
- water intensity of the industry compared to other industries;
- The industry's dependence on water quality;
- pollution of water bodies by the industry's waste water.

Table 57. Water intensity of the sub-basin's economic sectors

Industry sector	Water intake million m³	AIRBORNE FORCES, million UAH	Water intensity of airborne troops, m³ /1000 UAH
Industry	1,379	5163	0,26

Housing and utilities	21,978	172	127,7
Agriculture	11,10	7403	1,49
Transport	0,740	5738	0,13
Total for the sub-basin	46,6	18476	2,52

Table 58. Socio-economic weight of the main water users in the sub-basin

Sectors of the economy	Scope of airborne forces creation	Water intake by the industry	Water intensity of the industry	Dependence on water quality	Waste water contamination
Energy	moderate	low	moderate	low	moderate
Trade	high	low	low	low	low
Chemical industry	moderate	moderate	low	low	low
Mechanical engineering and metalworking	moderate	low	low	low	low
Food industry	low	low	moderate	high	low
Housing and utilities	low	high	high	high	high
Fisheries	high	high	moderate	moderate	low
Irrigation	high	moderate	moderate	moderate	low
Other types of agriculture (including livestock and crop production)	high	moderate	moderate	moderate	low
Transport	high	moderate	low	low	low
Recreation and healthcare	moderate	low	moderate	high	moderate

Based on the results of the assessment of dependence on the five criteria above, the economic sectors were divided into 5 groups according to their socio-economic importance in the sub-basin.

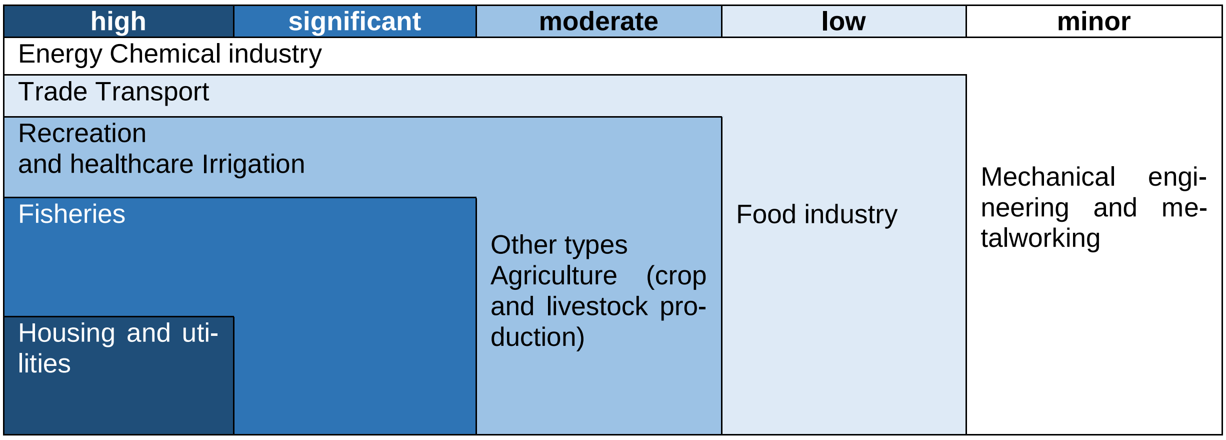


Figure 73. Socio-economic importance of the sub-basin's economic sectors

Group 1 "Full dependence" includes water users that are highly dependent on 4 indicators - water quality, high water intensity, significant pressure on water resources and low volumes of GWP, such as housing and communal services. Water in this sector is a key factor for their operations.

Group 2 "Multiple dependence" includes those with high dependence on at least two indicators, such as fisheries.

Group 3 "Specific dependence" includes those with high dependence on one of the indicators - recreation and healthcare, irrigation and other types of agriculture.

Group 4 "Moderate dependence" includes those with moderate dependence on at least 1 indicator, such as the food industry, trade and transport.

Group 5 "Water dependence without water use" includes economic sectors that use water without abstraction from natural water bodies, generate low volumes of GWP and are not significant polluters. This group includes the chemical industry, energy, machine building and metal processing.

According to the assessment of socio-economic importance, the housing and utilities sector is completely dependent on water resources and is the most water-intensive sector of the economy (127.7 m^3 /1000 UAH).

Over the period 2017-2020, there is a trend towards a significant decrease in water withdrawals, mainly due to a reduction in industrial and agricultural use.

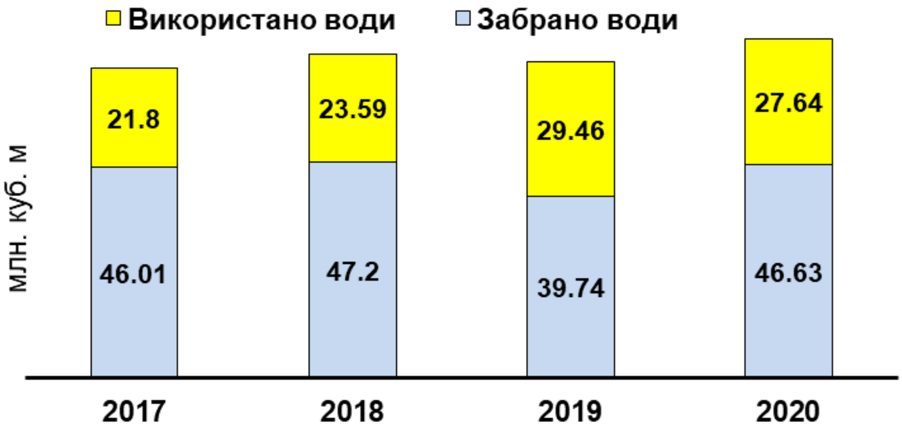


Figure 74. Dynamics of water intake and consumption in 2017-2020

The permit for special water use includes setting limits for water intake, water use and pollutant discharge. The established limits for water use in the sub-basin are 1.3-2.7 times higher than the actual water withdrawal (Figure 75).

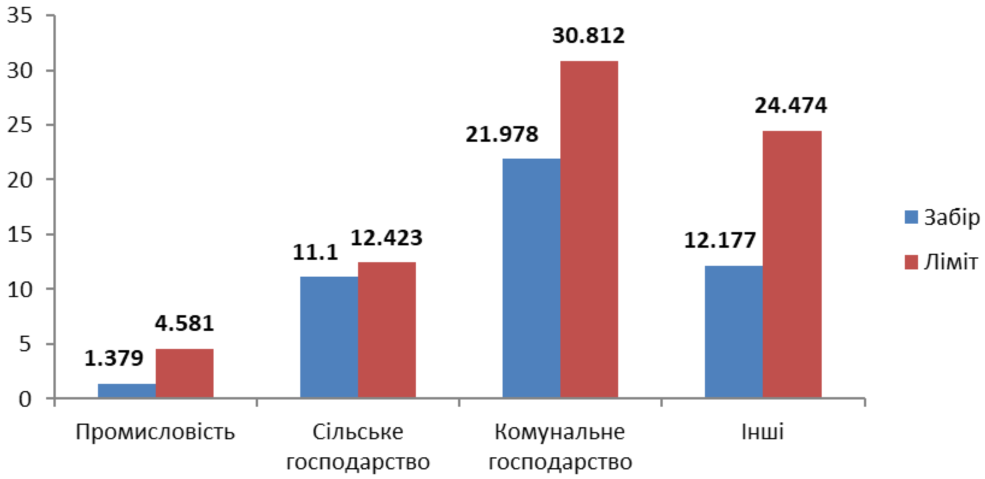


Figure 75. Ratio of actual water withdrawals to water use limits by water users in Zakarpattia Oblast in 2020

6.2.1 Municipal water use

As of 1 January 2021, 39 companies operate in the field of centralised water supply and/or centralised wastewater disposal, of which 38 are licensed by the regional state administration and one utility company, the Uzhhorod Water Supply and Sewerage Production Department, is a licensee of the NEURC.

The water supply system of the region, which is serviced by the enterprises of the industry, includes 48 water intake facilities, 159 water pumping stations (WPS) of the first lift with a capacity of 194,054 thousand m^3 of water per day, 37 WPS of the second lift with a capacity of 141,418 thousand m of water per day. m^3 of water per day, 13 water treatment plants (WTPs) with a capacity of 78.80 thousand m^3 of water per day, 66 clean drinking water reservoirs (CDWR), 191 artesian wells, 1002.6 km of water supply networks, of which 302.84 km or 30.2% are dilapidated and in poor condition. Tap water is used by 37.5% of the region's population from water supply systems of different subordination. Of the 901,574 people living in towns and villages, 48.5 per cent and 14.6 per cent use tap water, respectively. The share of the population living in cities and using centralised water supply systems is 85.4%.

The peculiarities of the sub-basin's orographic structure have led to the fact that groundwater sources provide water supply to the plains, while in the mountainous areas only surface water is available for water consumption. A part of the population and the majority of facilities in rural areas are supplied with water from decentralised water sources (wells, capstans, individual wells). All cities and urban-type settlements in the Tisza sub-basin are provided with centralised water supply. Water is abstracted in the region from surface (58.4%) and underground (41.6%) sources.

In 2020, residential and municipal water users abstracted 47% of the sub-basin's total water withdrawal (21.9 million $m3^3$). The largest water users in the housing and communal sector are the Utility Company "Vodokanal of Uzhhorod" (USREOU 03344556) - 8.749 million m^3 , Mukachevvodokanal (03344556) -

8.978 million m^3 , Vynogradiv VUZHKG (03344332) - 1.003 million m^3 , Svalyava RKPVV (13587366) - 0.705 million m^3 , Khust VUVKG (00432283) - 0.740 million m^3 .

Water is supplied from surface sources in Svaliava (4 water intakes), partially in Uzhhorod (right bank part, 1 water intake), Mizhhirya (2), Velykyi Bereznyi (partially, 1) and Volovets (1). In other settlements, water is supplied from underground sources using artesian wells, the water in which generally meets regulatory requirements.

The main problematic issues of water supply in the Tisza sub-basin include:

- quality of drinking water;

As of 1 January 2021, only 32% of the water supplied is treated, with only the water utilities of Uzhhorod, Berehove, Svaliava, Volovets and Mizhhiria having water treatment facilities;

- uneven coverage of the population with water supply;

Only 7 cities and 9 urban-type settlements receive round-the-clock water supply services. Other settlements are supplied with water according to a schedule;

- high losses.

Water losses in water pipelines are caused by a number of factors, the main ones being: consumer losses - losses of water sold, defined as the difference between the volume of water actually sold to consumers and its rational estimated demand; technological losses - losses of water in the process of its extraction, preparation and transportation to consumers.

Technological losses are determined by technologically sound procedures for water extraction, lifting and transportation, as well as unproductive leaks due to depressurisation of water supply networks.

The housing and communal sector is the main polluter of the sub-basin, as it discharges 78.8% of the return (wastewater) in 2020 (30.074 million m).[3]

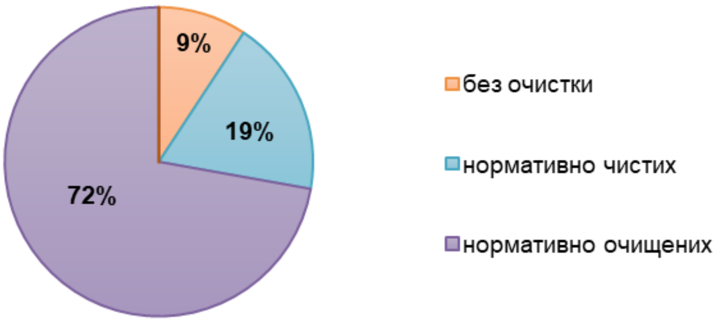


Figure 76. Dynamics of wastewater discharges of different treatment levels in the Tisza sub-basin, 2020

The functioning of the domestic water supply system is directly related to the need for water disposal. The main problems of water disposal in the sub-basin include:

– insufficient coverage of the population, the degree of sewerage coverage in settlements is lower compared to centralised water supply and averages 60.5%. Residents of cities and rural areas not covered by the sewerage network discharge untreated wastewater directly into water bodies or into underground septic tanks, from which the water is filtered into deeper horizons;

– discharges of untreated or insufficiently treated wastewater; discharges of wastewater from municipal enterprises enter the surface waters of the Tisa River sub-basin.

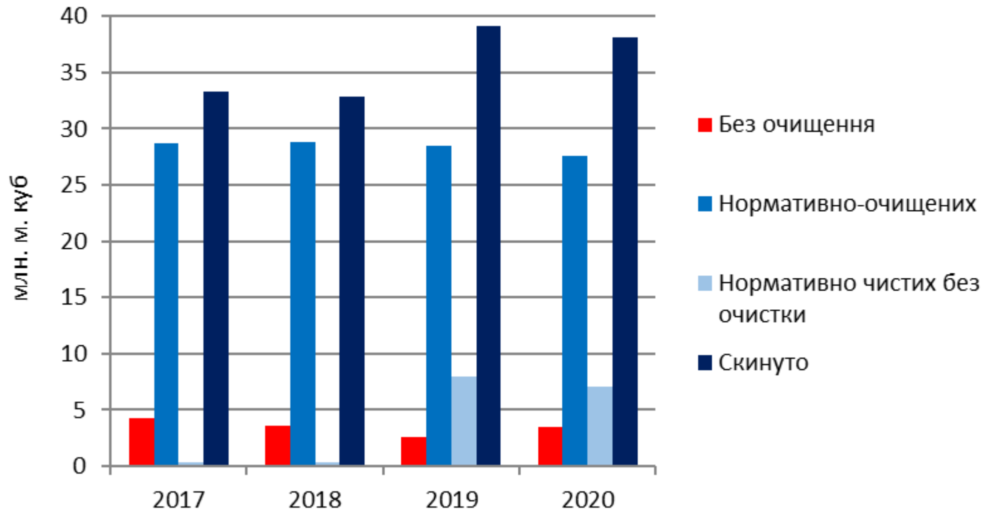


Figure 77. Dynamics of wastewater discharges of different treatment levels 2017 - 2020

Among all urban agglomerations, the cities of Uzhhorod and Mukachevo play a dominant role in the formation of wastewater, discharging 71% and 18% of the total amount of wastewater, respectively. The degree of wastewater treatment in the settlements varies significantly. Only half of them are equipped with second-stage wastewater treatment plants, which provide for biological treatment of wastewater (Volovets, Irshava, Svaliava, Mukachevo, Uzhhorod).

At the same time, in many of these settlements, treatment efficiency is low due to overloading of treatment facilities and non-compliance with industrial wastewater discharge conditions. As a result, part of the wastewater does not undergo regulatory treatment and enters surface waters as insufficiently treated water. The most difficult situation with wastewater treatment is in the towns of Mizhhirya, Vyshkovo, Dubove, Bushtyno, Kobyletska Polyana and Tyachiv. As a result of the floods of 1998-2001, the treatment facilities of these settlements were destroyed and have not yet been restored, and the agglomerations' wastewater is discharged without treatment into the surface water bodies of the Tisa sub-basin. The functioning sewerage network is in an unsatisfactory technical condition, with about 32% of sewerage networks in disrepair, and the share of dilapidated and emergency sewerage networks reaching >16% (104.6 km). In general, almost 20% of sewerage networks in the Tisza sub-basin require urgent replacement.

6.2.2 Industrial water use (by major water users)

In 2020, water abstraction by industrial water users amounted to 3% in the sub-basin (1.379 million m^3). The needs of water users in the industrial sector are met mainly from groundwater bodies - 63% (0.870 million m^3) and surface water bodies - 37% (0.509 million m^3). According to the state water accounting data, industrial water use in the sub-basin is carried out by water users in the processing industry - 76.5% (1.005 million m^3) and the mining industry - 23.5% (0.324 million m^3). The main industrial water users in the sub-basin are the following enterprises: Perechyn Timber and Chemical Plant ALC *(00274105)* - 0.502 million m^3 , Fischer-Mukachevo LLC *(22073637)* - 0.120 million m^3 , Khust Quarry PJSC *(05467613)* - 0.108 million m^3 , Svalyava Mineral Waters ALC *(00371512)* - 0.092 million m^3 , Flextronics LLC *(32221224)* - 0.040 million m^3 .

In the sub-basin, 94 industrial facilities are supplied with water according to the 2TP-Vodkhoz (annual) reports. The largest consumers of water are the mining (0.276 million m^3), chemical (1.044 million m^3) and food industries (0.067 million m^3). The discharge of polluted wastewater by industrial water users is 0.466 million m^3 (17.7% of the total discharge), of which 0.255 million m^3 and 0.211 million m^3 are normatively clean.

An analysis of trends in industrial water use in the Tisza sub-basin shows that it has been significantly reduced over the past 20 years. There are two reasons for this. Firstly, the economy of Zakarpattia Oblast, as well as the country as a whole, has undergone significant restructuring, which has resulted in a significant reduction in industrial production. Secondly, economic factors encourage companies to introduce waterless technologies, switch to water recycling or modern technologies for water saving.

6.2.3 Water use in agriculture

In agriculture, water resources are used mainly for water supply for fish farming, forestry, livestock and crop production. [3]As noted above, agriculture ranks second in the region after municipal water supply in terms of water abstraction, with 11.10/11.62 million m3 of water abstracted in 2020/2019. The agricultural water supply needs in the Tisza River sub-basin are met from surface sources, mainly from the Black Mochar reclamation system (98.6% (10.9 million m^3) and only 1.4% (0.159 million m^3) from groundwater sources. The structure of water abstraction for agricultural purposes is dominated by fisheries - 92.7% (10.3 million m^3) of the total abstraction in this category. Fish farming is a secondary water user of reclamation systems and is cultivated in the reservoirs of the Chornyi Mochar system (Transcarpathian Fish Factory ALC).

Over the past 10 years, the area of land subject to irrigation has been increasing, and the volume of water withdrawn has been increasing accordingly, in 2019/2020 it was 0.683/0.736 million m^3 . The introduction of modern technologies, namely drip irrigation (Konik Farm, Blue Berry LLC, Zavydivske LLC, etc.) is gradually being cultivated by individual and farms in the lowland areas of the region.

Water was used the most:

- Transcarpathian Fish Factory ALC (00476636) - 8.770 million tonnes^3 ;
- UTMR Vinogradiv district organisation (25440668) - 0.957 million m^3 ;
- Konik Farm (22075725) - 0.515 million m^3 ;
- F.F. Isayovich (2524506179) - 0.211 million m^3 ;
- Klyachanovsky Pond (33379188) - 0.167 million m^3 .

In 2020, agricultural water users discharged 6.232 million m3 of waste water into surface water bodies^3 , which is 16.3% of the total water discharge in the sub-basin. Agriculture does not exert significant pressure on the water resources of the Tisza sub-basin due to the almost absence of polluted water discharges from water users in this sector. The bulk of the wastewater - 6.228 million m^3 (99.9%) - discharged by agricultural water users is normatively clean water without treatment.

6.2.4 Water use in transport

Water use in transport involves the use of water resources, both surface and groundwater, for various types of transport, including water and land transport. According to the list of inland waterways, there are no navigable sections within the Tisza sub-basin. Water use in transport in the sub-basin is carried out for the needs of land and pipeline transport. Water users in the transport sector withdrew 0.740 million m^3 of water (1.6% of the total water withdrawal).

The largest water users in the industry:

- Lviv Territorial Administration (41149437) - 0.712 million m^3 ;
- Gas Transmission System Operator LLC (00153133) - 0.018 million m^3 ;
- JSC Uzhhorod ATP - 12107 (03114017) - 0.005 million m^3 .

Water users in the transport sector discharged 0.108 million m^3 of waste water into surface water bodies, of which 0.053 million m^3 was normatively clean and 0.055 million m^3 was normatively treated.

6.2.5 Other types of water use

Other types of water use carry out significant water withdrawals in the amount of 12.177 million m^3 of water, which is 26.2% of the total water withdrawals in the sub-basin. The needs of water users are mostly met from surface water - 10.420 million m^3 . Zakarpattia region is one of the regions with significant medical and tourism potential. Therefore, among other sectors of the economy, healthcare, catering, and trade can be distinguished, which use surface water sources. In 2020, other types of water users discharged 1.362 million m^3 of wastewater into surface water bodies, of which 0.195 million m^3 was polluted wastewater. Other types of water use do not exert significant pressure on the state of surface waters, as they account for only 3.5% of the total wastewater in the sub-basin.

6.3 Forecast of water demand by major economic sectors

The forecast of water demand in the sub-basin as a whole and by major economic sectors is made for the period of the RBMP (until 2030) under three scenarios: realistic, optimistic and pessimistic.

The basis for the forecast is the total water withdrawals within the sub-basin for the period 2015-2019, their total volume and by economic sector. The water withdrawal forecast is based on the GDP of Ukraine for the same period and its forecast value for the short, medium and long term.

The forecast of water intake for the short term - for 2021 - is based on the European Bank for Reconstruction and Development's GDP Forecast for Ukraine for 2021[30] , which shows a decrease of 5.5%. For the medium-term period - 2021-2023 - the forecast is based on the "Forecast of Economic and Social Development

30 Anthony Williams. EBRD revises down economic forecasts amid continuing coronavirus uncertainty. European Bank for Reconstruction and Development. URL: https://www.ebrd.com/news/2021/ebrd-revises-down-economic-forecasts-amid-continuing-coronavirus-uncertainty.html.

of Ukraine for 2021-2023 of the Ministry of Economy, Trade and Agriculture of Ukraine"[31] , which envisages GDP growth of 4.6% in 2021, 4.3% in 2022 and 4.7% in 2023.

The long-term forecast period - 2024-2030 - was calculated on the basis of analytical materials from USDA, World Bank, IMF, IHS, Oxford Economic Forecasting ,[32][33] , which forecasts Ukraine's GDP growth by 3.4% annually.

Ukraine's GDP forecast indicates a resumption of the positive trend in economic development after the significant losses in 2019-2020 caused by the COVID-19 pandemic, showing rapid growth in 2021-2023 with gradual stabilisation in the subsequent period.

The method used to forecast water withdrawals for the period 2020-2030 was to calculate the projected exponential growth based on the available data, i.e. returning the value of y for a sequence of new values of x given the existing values of x and y.

Preliminary expert forecasts of changes in water use trends in the world show that water intake is gradually increasing in the housing and utilities sector ,[34][35] , due to quarantine restrictions, as well as hygiene and sanitation protocols and innovations. At the same time, Ukraine has seen an overall drop in the industrial production index - October 2019/October 2020 (95.5%)[36] , which also affects water consumption by industry. The downward trend in economic development is also characteristic of agriculture. For example, the agricultural production index in January-October 2019 to January-October 2020 was 85.8%[37] . However, the trends described above are not inherent in all regions, which will be reflected in the forecast.

The main factors affecting the volume of water use in the Tisza sub-basin:

- the spread of the COVID-19 pandemic and the introduction of restrictive measures;
- economic development - agriculture in low-lying areas;
- natural and geographical: borders with EU countries.

The scientific substantiation of the interdependence between the indicators of water abstraction in the Tisza sub-basin and Ukraine's GDP is proved by applying the Pearson linear correlation coefficient (correlation coefficient), which allowed to identify the regularity of dependence. Thus, the degree of dependence between Ukraine's GDP and water withdrawals by transport and agriculture is quite high, slightly lower in industry, while housing and communal services have a rather low degree of dependence.

Analysis of Figure 78 shows an increase in water use in the Tisza sub-basin in 2021, and this trend continues until 2022. In the period 2023-2030, there is a gradual increase in water withdrawal within 3%.

31 Forecast of economic and social development of Ukraine for 2021-2023. Ministry for Development of Economy, Trade and Agriculture of Ukraine. URL: https://www.me.gov.ua/Documents/Detail?lang=uk-UA&id=98c3a695-56bb-42ba-b651-60ce1f899654&title=PrognozEkonomichnogoISotsialnogoRozvitkuUkrainiNa2021-2023-Roki.

32 Forecast of global economic development until 2030. Ukrainian Institute for the Future. URL: https://strategy.uifuture.org/prognoz-rozvitku-sv%D1%96tovoi-ekonom%D1%96ki-do-2030e.html.

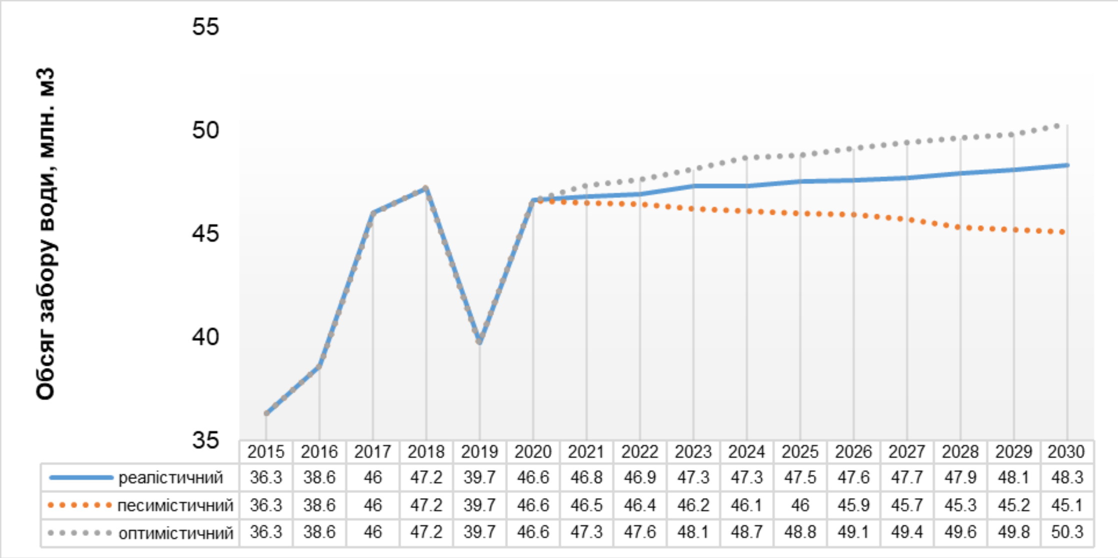
33 International Macroeconomic Data Set. United States Department of Agriculture. URL: https://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx.

34 Cooley H. (July 6, 2020). How the Coronavirus Pandemic is Affecting Water Demand. The Pacific Institute. URL: https://pacinst.org/how-the-coronavirus-pandemic-is-affecting-water-demand/

35 (15 Jul 2020) Helping to forecast water demand during Covid-19. WIRED GOV. URL: https://www.wired-gov.net/wg/home.nsf/nav/home?open&id=BDEX-6ZFKSD

36 Industrial production in January-October 2020. Express release. State Statistics Service of Ukraine. URL: http://www.ukrstat.gov.ua/express/expr2020/11/143.pdf.

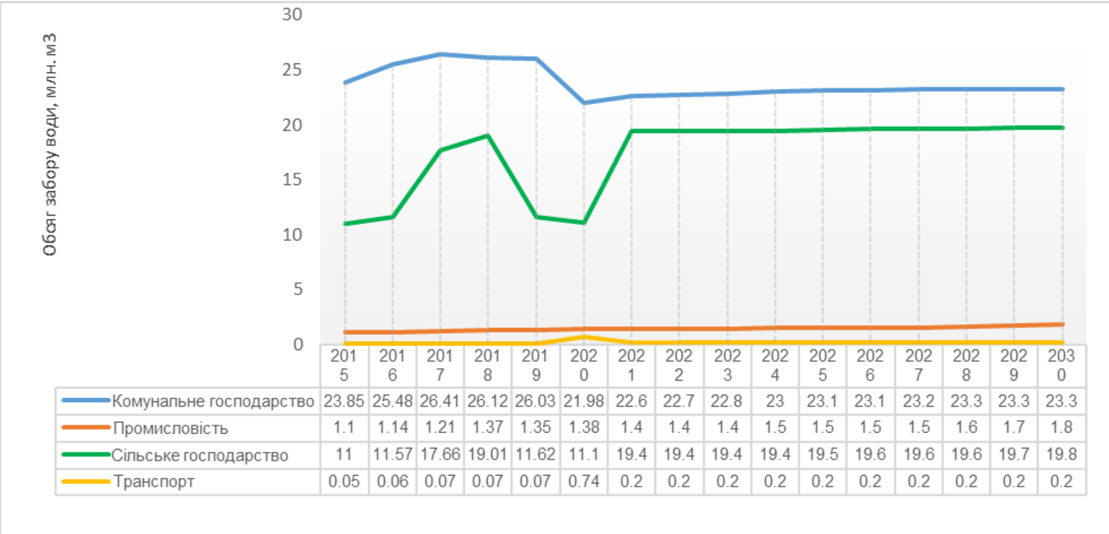
37 Agricultural production index in January-October 2020. Express release. State Statistics Service of Ukraine. URL: http://www.ukrstat.gov.ua/express/expr2020/11/140.pdf.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
реалістичний	36.3	38.6	46	47.2	39.7	46.6	46.8	46.9	47.3	47.3	47.5	47.6	47.7	47.9	48.1	48.3
песимістичний	36.3	38.6	46	47.2	39.7	46.6	46.5	46.4	46.2	46.1	46	45.9	45.7	45.3	45.2	45.1
оптимістичний	36.3	38.6	46	47.2	39.7	46.6	47.3	47.6	48.1	48.7	48.8	49.1	49.4	49.6	49.8	50.3

Figure 78. Forecast of water abstraction in the Tisza sub-basin until 2030

The results of forecasting water withdrawals in the sub-basin by 2030 by economic sector are shown in Figure 79.



	201 5	201 6	201 7	201 8	201 9	202 0	202 1	202 2	202 3	202 4	202 5	202 6	202 7	202 8	202 9	203 0
Комунальне господарство	23.85	25.48	26.41	26.12	26.03	21.98	22.6	22.7	22.8	23	23.1	23.1	23.2	23.3	23.3	23.3
Промисловість	1.1	1.14	1.21	1.37	1.35	1.38	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.7	1.8
Сільське господарство	11	11.57	17.66	19.01	11.62	11.1	19.4	19.4	19.4	19.4	19.5	19.6	19.6	19.6	19.7	19.8
Транспорт	0.05	0.06	0.07	0.07	0.07	0.74	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Figure 79. Forecast of water abstraction by economic sector in the Tisza sub-basin until 2030.

In 2021-2021, a slight increase in water abstraction for the needs of the housing and communal sector is projected, which was influenced by quarantine restrictions and hygiene and sanitary innovations due to the impact of the COVID-19 pandemic. Starting from 2023, water abstraction by the housing and communal services sector is projected to stabilise, which will be typical for the sub-basin by the end of the forecast period with a gradual slight increase of 2%.

The sub-basin's industry is also expected to grow slightly. In the short-term period of 2021-2023, water withdrawals are forecast to stabilise at 1.4 million m^3 /year, while from 2024 to 2030, a gradual increase to 1.8 million m^3 /year is possible. The increase in water abstraction can be attributed to the growing industrial production index in some water management areas (WMAs) of the sub-basin, in particular the Uzh River WMA (Uzhhorod) and the Latorytsia River WMA (Mukachevo), due to the investment component, the creation and development of enterprises with foreign investments in woodworking and electrical automation, and the automotive industry.

The forecast of water withdrawals for agricultural needs in the sub-basin tends to increase. Thus, in 2020, water use in this sector was 11.1 million m^3 /year, but already in 2021, significant growth and recovery of the sector is projected, followed by stabilisation of the projected indicators. The projected increase in water abstraction by 2030 can be explained by the expected increase in the agricultural production index in the region due to the restoration/creation of significant areas of agricultural crops, in particular the cultivation of traditional perennial crops for the sub-basin (grapes, pome and stone fruits), as well as the intensive development of fish farming (trout farms).

No significant increase in water withdrawals by transport sector water users is forecast.

6.4 Tools of economic control

6.4.1 Payback of water resources use

The payback of water resources use is a comparison of funds received from the use of water resources to funds spent on the provision of water services. The characteristics of water services and water use in the Tisza sub-basin are presented in accordance with the institutional structure of water services regulation:

I. Centralised water supply and sewerage services.
II. Special water use by economic sectors - payments and fees are paid to the budgets of all levels (rent, environmental tax for discharges into water bodies in Ukraine, lease of water bodies).

I. PAYBACK OF CENTRALISED WATER SUPPLY AND SEWERAGE SERVICES

In the sub-basin, centralised water supply and sewerage services are provided by licensees of the National Energy and Utilities Regulatory Commission and organisations licensed by local governments.

Table 59. Register of natural monopolies in the spheres of heat supply, centralised water supply and centralised sewerage [38]

№	Name of the natural monopoly entity in the field of centralised water supply and centralised sewerage	EDRPOU code	Location of the entity
1	MUNICIPAL ENTERPRISE "PRODUCTION DEPARTMENT OF WATER SUPPLY AND SEWERAGE SYSTEM OF UZHHOROD" (NERC licensee)	03344326	1 MYTNA ST., UZHHOROD 88000
2	MUKACHEVO MUNICIPAL UTILITY COMPANY "MUKACHEVVODOKANAL"	03344556	103V DUKHNOVYCHA OLEXANDRA STR. MUKACHEVO 89600
3	KHUST PRODUCTION DEPARTMENT OF WATER SUPPLY AND SEWERAGE SERVICES	00432283	94 MARKUSHA ST., KHUST 90400
4	VYNOGRADIV PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES	03344332	6 KOMMUNALNAYA ST., VINOGRADOV, 90300
5	WATER SUPPLY UTILITY COMPANY OF IRSHAVA DISTRICT COUNCIL	31432129	IRSHAVA, SHAVCHENKO LANE. 3/A 90100
6	SVALYAVA WATER SUPPLY AND SEWERAGE UTILITY COMPANY	13587366	28 NABEREZHNA ST., SVALYAVA 89300
7	RAKHIV MUNICIPAL ENTERPRISE "RAKHIVTEPLO"	36428735	43, SHEVCHENKO STR., RAKHIV 90600
8	MUNICIPAL ENTERPRISE "KOMMUNALNYK"	30920038	76 UZHHORODSKA ST., PERECHYN 89200
9	MUNICIPAL ENTERPRISE "VOLOVETS VILLAGE WATER SUPPLY SERVICE"	38035925	CITY. VOLOVETS, 24 SHEVCHENKA STR. 89100
10	MUNICIPAL ENTERPRISE OF MIZHHIRYA VILLAGE COUNCIL "MIZHHIRYA PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES"	03344473	TOWN AND VILLAGE. MIZHHIRYA, 72 "A" NEZALEZHNOSTI ST. 90000
11	COMMUNAL ENTERPRISE "KOMMUNALSERVICE" OF VELYKYI BEREZNYI VILLAGE COUNCIL	36917235	TOWN AND VILLAGE. VELYKYI BEREZNYI, 12 SHEVCHENKA ST. 89000
12	PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES "SOLOTVYNO"	38856617	TYACHIV DISTRICT, ST. SOLOTVYNO, CHETATE ST., 49 90575
13	MUNICIPAL ENTERPRISE "PRODUCTION DEPARTMENT OF HOUSING AND COMMUNAL SERVICES"	22115583	KHUST DISTRICT, VILLAGE. VYSHKOVO, GORNYAKIV STR. 11 90454
14	ROYAL BOROUGH COUNCIL'S COMMUNAL SERVICES	25437904	BEREHOVE DISTRICT, URBAN-TYPE SETTLEMENT KOROLEVO, 50 TSENTRALNA ST., 90332
15	MUNICIPAL ENTERPRISE "HOUSING AND COMMUNAL SERVICES ASSOCIATION	37520283	BEREGOVO DISTRICT, VELYKA BAKTA VILLAGE, AV. 10A SVOBODY AVE. 90252

[38] According to the NEURC, as of 31.10.21

№	Name of the natural monopoly entity in the field of centralised water supply and centralised sewerage	EDRPOU code	Location of the entity
	"GRAND" OF VELYKOBAKTYANSKY VILLAGE COUNCIL		
16	ROZIVKA STATE UTILITY COMPANY	31081247	ROZIVKA VILLAGE, 36 KONTSIVSKA STR. 89424
17	STATE UTILITY COMPANY "KOMMUNALNAYA SLUZHBA"	32401573	UZHHOROD DISTRICT, STOROZHNYTSIA VILLAGE, 4 SHEVCHENKA STR. 89421
18	STATE MUNICIPAL ENTERPRISE "KOMMUNALNOYE KHOZYA"	32532687	UZHHOROD DISTRICT, KAMIANYTSIA VILLAGE, UZHANSKA STR. 105 89411
19	HOUSING AND MAINTENANCE DEPARTMENT OF THE CITY OF MUKACHEVO	08439994	1A BEREHIVSKA OBOZNAYA STR., MUKACHEVO 89600
20	INDUSTRIAL HOUSING AND COMMUNAL ENTERPRISE	31880143	RAKHIV DISTRICT, URBAN-TYPE SETTLEMENT KOBYLETSKA POLIANA, PAVLYUKA STR. 175 90620
21	MUNICIPAL ENTERPRISE "VERYATSKE HOUSING AND COMMUNAL SERVICE" OF VERYATSKE VILLAGE COUNCIL	37713196	BEREHOVE DISTRICT, VERIATSIA VILLAGE, MIRA STR. 1 90336
22	MUNICIPAL ENTERPRISE "MALOKOPANSKA HOUSING AND COMMUNAL SERVICE" OF MALOKOPAN VILLAGE COUNCIL	38068966	BEREHOVE DISTRICT, MALA KOPANYA VILLAGE, 51 TSENTRALNA STR. 90331
23	SUBSIDIARY COMPANY "SANATORIUM POLYANA" CJSC HEALTHCARE FACILITIES "UKRPROFOZDOROVNYTSIA"	02649880	SVALYAVA DISTRICT, POLIANA VILLAGE, DUKHNOVYCHA STR. 104 89313
24	SUBSIDIARY ENTERPRISE "SHAYAN SANATORIUM" CJSC HEALTHCARE FACILITIES "UKRPROFOZDOROVNYTSIA"	02647183	KHUST DISTRICT, SHAYAN VILLAGE 90457
25	SUBSIDIARY SANATORIUM "SUNNY ZAKARPATTYA"	02649977	MUKACHEVO DISTRICT, POLYANA VILLAGE, 1A KURORTNA STR. 89313
26	LIMITED LIABILITY COMPANY "SANATORIUM COMPLEX "DERENIVSKA KUPIL"	01597841	UZHHOROD DISTRICT, NIZHNE SOLOTVYNO VILLAGE 89442
27	PRIVATE ENTERPRISE "EXPRESS-IR"	22088774	KHUST DISTRICT, BILKY VILLAGE, BOHDAN KHMELNYTSKY STR. 72 90132
28	PUBLIC JOINT STOCK COMPANY "UZHGOROD MOTOR TRANSPORT ENTERPRISE 12107"	03114017	2 RADISHCHEVA ST., UZHHOROD, 88015
29	NATIONAL CENTRE FOR SPACE CONTROL AND TESTING. WESTERN CENTRE FOR RADIO SURVEILLANCE	24507442	MUKACHEVO, KOSMONAVTOV STR, B/N 89600
30	MUNICIPAL ENTERPRISE "VYSHKOVO"	39061757	KHUST DISTRICT, URBAN-TYPE SETTLEMENT VYSHKOVO, CENTRAL SQUARE, 1 90454
31	MUNICIPAL ENTERPRISE "GEOLOG"	39795658	10 GEOLOGISTS AVENUE, BEREGOVO, 90201
32	MUNICIPAL ENTERPRISE OF CHOP CITY COUNCIL "VODOKANAL CHOP"	40361703	43 HOLOVNA ST., CHOP, 89502
33	LIMITED LIABILITY COMPANY "VODOKANAL KARPATVIZ"	35056062	BEREGOVO, B. KHMELNYTSKOGO STR. 99 90202
34	MUNICIPAL ENTERPRISE "MISKVODOKANAL" OF MUKACHEVO CITY COUNCIL	41536514	MUKACHEVO, DUKHNOVYCHA SQ. DUKHNOVYCHA SQ. 2 89600
35	MUNICIPAL ENTERPRISE "BUSHTINOSERVICE"	41255966	TYACHIV DISTRICT, URBAN-TYPE SETTLEMENT BUSHTYNO, 6 TRAVNEVA STR. 90556
36	LIMITED LIABILITY COMPANY "KARPAT-OIL"	41368427	378 TSENTRALNA ST., MUKACHEVO DISTRICT, 378 89655
37	MUNICIPAL ENTERPRISE "DOBROBUT" OF ONOKIVSKE VILLAGE COUNCIL	44073371	UZHHOROD DISTRICT, ONOKIVTSI VILLAGE, 59 HOLOVNA STR. 89412
38	MUNICIPAL ENTERPRISE "DUBIVSKE" OF THE DUBIV VILLAGE COUNCIL OF TYACHIV DISTRICT	43994905	TYACHIV DISTRICT, URBAN-TYPE SETTLEMENT DUBOVE, PODOLSKOGO STR. 46 90531
39	MUNICIPAL ENTERPRISE "VODOKANAL" OF TYACHIV CITY COUNCIL	44391553	56 KOSHUTA ST., TYACHIV, 90500

The largest revenues are received by water and sewerage companies. According to estimates, water and sewerage companies - NEURC licensees in the sub-basin (1 licensee, only 1% of the Ukrainian market[39]) received about UAH 255 million in 2020.[40] (including VAT).

The payback period for water supply and sewerage services, calculated as the ratio of the tariff to the cost price in the sub-basin, is more than 100%. Due to the insufficient level of customer payments for the services provided, which amounted to 92.4% in 2020 (by 90.1% for water supply and 94.8% for sewerage), a situation arises where water services are not sufficiently covered by customer payments and the sustainability of water services is threatened. The level of consumer payments at the Uzhhorod Water Supply and Sewerage Production Department is 92.4%, which corresponds to a high level. The condition of water supply and sewerage networks in the Tisza sub-basin is unsatisfactory, which affects water quality. The main source of investment in 2020 in the Tisza sub-basin, as in previous years, was depreciation in the amounts provided for in the tariff structures. Funds were also raised at the expense of profits provided for in the tariff structure of licensees. However, none of the companies provided for the use of profits to form a reserve fund (capital) for modernisation or for production investments, which should have been provided for in their business activities. According to the NEURC, "the amount of production investments from profits is determined in the amounts necessary for the gradual restoration of networks (improvement of the functioning of water and sewerage enterprises), and taking into account the needs to fulfil the financial obligations of licensees to international financial organisations". However, this level is extremely insufficient.

II. PAYBACK OF THE USE OF WATER RESOURCES IN THE YEW SUB-BASIN

(based on public finance calculations)

1. ***REVENUES FOR SPECIAL WATER USE***

In accordance with the principles of "user pays" and "polluter pays" The Tax Code of Ukraine establishes a fee for special water use:

А. Rent for water intake for different types of water users.
Б. Environmental tax on discharges into water bodies.

In addition, there is a fee for the use of water bodies for aquaculture purposes:

В. Rent for water bodies.
Г. Payment for special use of aquatic bioresources.

A. Rent for special water use

The state (general and special funds combined) and local (general fund) budgets received a total of UAH 14.256 million from business entities in the sub-basin by administrative district in 2017, UAH 15.716 million in 2018, UAH 14.967 million in 2019, and UAH 16.388 million in 2020. A decrease in rent revenues to the budgets in the Tisza sub-basin was observed in 2019. In 2020, there is an upward trend in rent revenues. The sub-basin is one of the lowest in Ukraine in terms of rent revenues for special water use.

Table 60. Dynamics of rent revenues for special water use to the state and local budgets in the Tisza sub-basin, UAH[41],[42]

Year/region/sub-basin	Transcarpathian region, Tisza sub-basin		
	State budget	Local budgets	Together
2017	7 132 728,27	7 124 069,06	14 256 797,33
2018	8 639 667,87	7 076 950,43	15 716 618,30
2019	8 222 569,18	6 744 543,25	14 967 112,43
2020	9 010 797,18	7 378 191,72	16 388 988,90

Б. Environmental tax on discharges of pollutants into water bodies

In the sub-basin, in 2017-2020, the state budget and the special fund of local budgets received a total of UAH 6,645 million in tax revenues for pollutant discharges directly into water bodies. More than half of these funds (55%) are collected by local budgets in accordance with the budget allocation (Table 61). Since

[39] NEURC data in the water supply and sewerage sector

[40] Hereinafter, calculations were made on the basis of available statistics in Ukraine

[41] KKDB 13020000 "Rent for special water use"

[42] Source: Local budget revenue reports, state budget revenue reports

2019, there has been a downward trend in the total amount of environmental tax revenues from discharges of pollutants into water bodies to both the state and local budgets.

Table 61. Dynamics of environmental tax revenues from discharges into water bodies to the state and local budgets in the Tisza sub-basin, *UAH 43*

Year/region/sub-basin	Transcarpathian region, Tisza sub-basin		
	State budget	Local budgets	Together
2017	321 407,29	1 285 628,62	1 607 035,91
2018	549 355,90	671 436,48	1 220 792,38
2019	949 036,01	1 159 934,34	2 108 970,35
2020	768 741,80	939 574,81	1 708 316,61

C. Payment for the lease of water bodies

The weighted average rent is unified for all water bodies in the Tisza sub-basin and is increasing every year. Its dynamics is as follows: in 2017 - UAH 46,339 thousand, in 2018 - UAH 46,668 thousand, in 2019 - UAH 67,436 thousand and in 2020 - UAH 71,021 thousand.

According to estimates, the local budgets of the sub-basin received rent for water bodies (their parts) in 2017-2020 in the amount of UAH 231.5 thousand, or less than 1% of the national figure. The sub-basin shows a steady trend towards a gradual increase in water body rental fees. Thus, compared to 2017, local budget revenues from rent for water bodies (or parts thereof) in 2020 increased by almost 35%. However, this is one of the smallest revenues in Ukraine. According to the State Tax Service of Ukraine, local budgets of all levels in Ukraine received a total of UAH 10 million for the lease of water bodies in 2017-2018, UAH 13.5 million in 2019 and UAH 14 million in 2020. Revenues from rent for water bodies (or parts thereof) to local budgets in the sub-basin are presented in Table 62.

Table 62. Dynamics of rent revenues to local budgets in the sub-basin, UAH[44]

Year / region / sub-basin	2017	2018	2019	2020
Transcarpathian region, Tisza sub-basin	46 393,29	46 668,84	67 436,08	71 021,00

D. Payment for special use of fish and other aquatic bioresources

The fee for the use of fish and other aquatic bioresources is levied in accordance with the Resolution of the Cabinet of Ministers of Ukraine.[45] According to the report on local budgets from fees for the special use of fish and other aquatic bioresources (*KKDB 13070200 "Fees for the special use of fish and other aquatic resources"),* no fees for the special use of fish and other aquatic resources were collected in the Tisza sub-basin in 2017-2020.

2. EXPENDITURES ON WATER RESOURCES IN THE YEW SUB-BASIN

A. Capital and current expenditures from the state and local budgets for environmental programmes in the field of water resources protection

According to state statistical reports, capital investments and current expenditures are allocated to nine environmental areas, including those directly related to the reproduction and protection of water resources:

- waste water treatment;
- protection and rehabilitation of soil, groundwater and surface water.

The share of the first direction is more significant than the second; together, they account for about half of all expenditures from the total amount of capital and current expenditures in all directions. These two areas are funded from the state (including the State Environmental Protection Fund (SEPF)) and local budgets (including local SEPF funds), own funds, and other sources of funding. In 2020, UAH 9558.926 thousand was allocated to the Tisza sub-basin (UAH 5451.4 thousand from the regional ONPS fund and UAH 4107.526 from local ONPS funds).

In 2018 and 2019, the information on capital and current expenditures was provided in the state statistical reports. In 2020, there was an increase in capital and current expenditures due to capital investments in the area of "protection and rehabilitation of soil, groundwater and surface water". These expenditures are

43 KCDB 19010200 "Revenues from discharges of pollutants directly into water bodies"

44 CCBC 22130000 "Rent for water bodies (parts thereof) provided for use on a lease basis by regional, district and local councils"

45 Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Charging Fees for the Special Use of Aquatic Bioresources and the Amount of Fees for Their Use" of 12 February 2020, No. 125

allocated to flood protection and bank protection measures, given the increased risk and periodic destructive effects of floods and floods in the sub-basin.

Б. State budget expenditures for the maintenance of water infrastructure under the management of the State Agency of Ukraine for Water Resources

In the sub-basin, water infrastructure maintenance activities are carried out by an organisation under the management of the State Agency of Ukraine for Water Resources - the Tisza River Basin Water Resources Management. UAH 104624.2 thousand was allocated for the maintenance of the water management complex in Transcarpathian region, including:

- under the programme 2707050 "Operation of the State Water Management Complex and Water Resources Management" - UAH 70938.5 thousand, of which UAH 65805.1 thousand from the general fund and UAH 5133.4 thousand from the special fund;
- under the programme KPKV 2707070 "Protection against harmful effects of waters of rural settlements and agricultural lands, including in the Tisa River basin in Zakarpattia oblast" (Environmental protection measures) - UAH 20388.9 thousand;
- under the programme KPKV 2707700 "Protection from harmful effects of waters of rural settlements and agricultural lands, including in the Tisa River basin in the Transcarpathian region" - (Reserve Fund of the State Budget) - UAH 13296.8 thousand.

In addition to state funding, in 2020, the Tisza RBMU managed to attract funds from local budgets, business entities, and international grants aimed at developing the water sector and environmental rehabilitation of the Tisza sub-basin:

- implementation of the "Regional Target Programme for the Development of Water Management and Environmental Rehabilitation of the Tisa River Basin in the Transcarpathian Region for 2013-2021" in accordance with the order of the Head of the Transcarpathian Regional State Administration No. 155 dated 19.03.2020 - UAH 10745.1 thousand;
- implementation of international projects in the water sector - UAH 24173.8 thousand.

DETERMINING THE PAYBACK OF WATER RESOURCES USE IN THE YEW SUB-BASIN

If the payback ratio of water resources use, calculated using the formula "Revenues / Expenses * 100":

- is more than 100%, this means that all costs are reimbursed by paying tax and non-tax revenues for services to budgets of all levels or by tariffs; budget revenues, if used for their intended purpose, can be used for water resources restoration; enterprises receive profits that can be used for production development - production investments, formation of a reserve fund (capital), etc. (part of which will be used to pay income tax);
- If the indicator is less than 100%, this indicates a threat to the sustainability of the service, as the costs of budgets or enterprises are not covered by the revenues received. The calculated return on water resources use is 12.2%, which means that costs are higher than tax revenues for water services (Table 63).

Table 63. Balance of revenues and capital expenditures in 2020

SOURCES.	amount, UAH	EXPENSES	amount, thousand UAH
Rent for special water use (state and local budgets)	16 388 988,90	Capital investments in water resources restoration and protection	9558,926
Environmental tax on discharges into water bodies (state and local budgets)	1 708 316,61	Expenditures from the state budget for the operation of the state water management complex	139543,100
Rent for water bodies (parts thereof) provided for use on a lease basis (local budgets)	71 021,00		
Payment for aquatic bio-resources	0		
TOGETHER	**18 168 326,51**	**TOGETHER**	**149102,026**
ROI	**12,2%**		

This level of payback indicates a critical situation in terms of covering the costs of water services. Revenues are significantly lower than expenditures from the state and local budgets. The main share of expenditures is made up of funds from the state and local budgets allocated for measures in the area of "Protection and rehabilitation of soil, groundwater and surface water" (flood protection measures). The calculated level of cost coverage indicates that tax mechanisms in the area of recouping the use of water resources in the Tisza sub-basin do not ensure the sustainability of service provision.

6.4.2 Water tariffs

Tariffs for centralised water supply and sewerage

According to the institutional structure in Ukraine, the NEURC and local governments set the following types of tariffs for centralised water supply and sewerage services:

1. tariff for centralised water supply (cold water) and sewerage (cold and hot water together) (calculated by water utilities, approved by the NEURC for its own licensees, local governments for other local licensees) and centralised water supply (hot water) (calculated by Teploenergo enterprises, approved by the NEURC for its own licensees, local governments for other local licensees);
2. tariff for centralised supply (cold water, hot water separately) and sewerage (cold and hot water) using in-building systems.

The NEURC licenses the activities of water supply companies (water utilities) if these companies serve more than 100,000 people, the volume of water supply is more than 300,000 m³, and the volume of water disposal is more than 200,000 m³.

When setting tariffs, the NEURC is guided by the principle of balancing the interests of consumers, business entities and the state: it limits the planned costs of licensees to an economically justified level that should ensure self-sufficiency of their activities, provided that they are managed efficiently and use resources economically, while at the same time providing for the necessary investments for the safe and sustainable operation of water and sewerage systems.

As of 1 January 2021, tariffs for centralised water supply and sewerage were set by the NEURC in the sub-basin for 1 licensee that has tariffs for other water utilities (business entities in the field of water and wastewater) - Table 64.

Table 64. Tariffs for centralised water supply and wastewater disposal of the NEURC licensees providing services in the Tisza sub-basin[46]

Name of the company	Tariffs set by the NEURC, UAH/m³/prime cost, UAH/m³/reimbursement, %.			
	Water supply		Drainage	
	for consumers who are business entities in the field of water supply and sanitation (water utilities)	for consumers who are not business entities in the field of CWS (households, budgetary organisations, others)	for consumers who are business entities in the field of water supply and sanitation (water utilities)	for consumers who are not business entities in the field of CWS (households, budgetary organisations, others)
Municipal enterprise Production Department of Water Supply and Sewerage of Uzhhorod"	8,23	21,13 / 20,6173 /102,5	7,89	11,23 / 10,9839 /102,2

In 2020, the main items in the structure of the NEURC licensee's cost of services continue to be labour costs (including social benefits) and electricity purchase. Less significant cost components are depreciation,

[46] According to the NEURC, tariffs as of 01.01.2021

repair costs, reagents and fuel and lubricants, as well as taxes and fees, including the fee for special use of water (rent), and subsoil use fees for fresh groundwater extraction. In the structure of the weighted average tariffs for centralised water supply and sewerage, the main share is made up of labour costs (56% and 58% in 2020-2021, respectively) and electricity (29% and 25%, respectively).

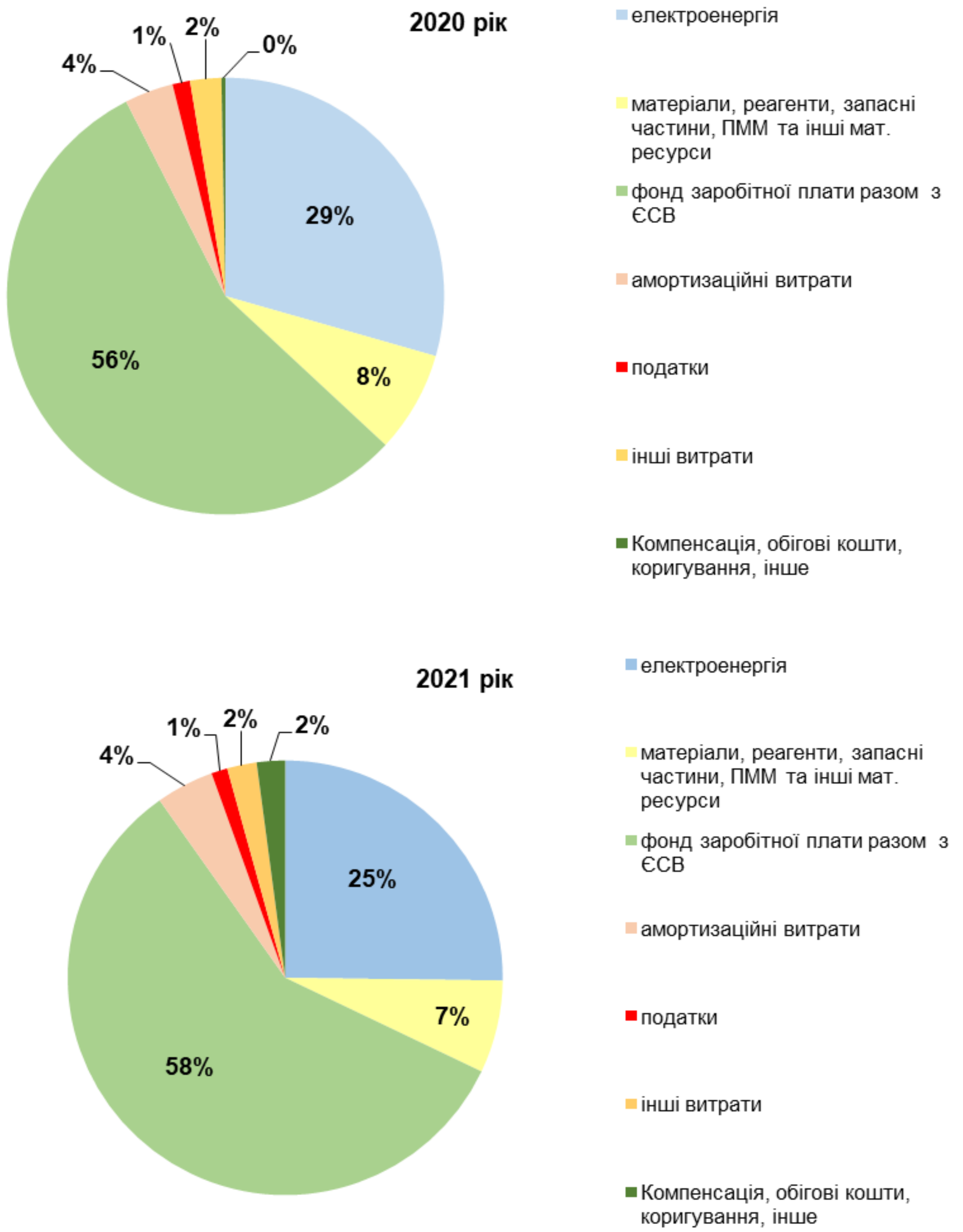


Figure 80. The structure of weighted average tariffs for centralised water supply and sewerage for 2020 and 2021 for the Municipal Enterprise "Production Department of Water Supply and Sewerage of Uzhhorod"

Water supply and wastewater services in the Tisza sub-basin are provided by enterprises licensed by local authorities - these are communal enterprises of district, city, town and village councils and even individual village councils. The tariffs differ for different categories of users: households, budgetary organisations and commercial organisations.

The cost of water for industrial enterprises

The cost of water is actually paid by industrial enterprises in the form of a mandatory payment for special water use - rent. The object of taxation for rent for special water use is the actual volume of water used by water users. In the case of surface water use, the rental rate depends on the needs of the use, the place and region of consumption, and the actual volume of water used. No rent is paid if the volume of consumption is less than 5 m³ per day and the water user does not have its own water intake facilities. Rental rates in the Tisza sub-basin are among the lowest in Ukraine. In the case of groundwater use, rent rates for special water use are set by the Tax Code of Ukraine and are differentiated by region. In the Tisza sub-basin, the rates are shown in Table 65. The rates for groundwater use are among the highest in Ukraine.

Table 65. Rental rates for special water use as of 1 January 2021[47]

Zakarpattia region, Tisza River sub-basin, including tributaries of all orders	Rent rate, UAH per 100 cubic metres
Surface water	26,17
Groundwater	61,09
Other rates for special water use	
For the needs of hydropower	12.95 per 10 thousand m^3
For the needs of water transport on all rivers - for self-propelled and non-self-propelled freight fleets; - for the passenger fleet in operation.	0.2219 per tonne per day of operation; 0.0215 for 1st place per day of operation
For the needs of fish farming	67.97 per 10 thousand m^3 of surface water; 81.71 per 10 thousand m^3 groundwater
For water used exclusively in beverages	63.22 per 1 m^3 of surface water; 73.73 per 1 m^3 groundwater
For mine, quarry and drainage water	14.64 for 100 m^3

Housing and communal enterprises apply a coefficient of 0.3 to rent rates in terms of water volumes of technological standards for the use of drinking water determined in accordance with the legislation on drinking water, drinking water supply and sewerage.

Charges for pollution of water bodies are received in the form of fines and environmental tax for discharges of pollutants into water bodies. The environmental tax is increased annually, with the last increase in environmental tax rates occurring in 2019: the rates for discharges increased by more than 2.2 times in accordance with the Tax Code of Ukraine. The tax rates for discharges of pollutants into water bodies are presented in Table 66.

Table 66. Environmental tax rates for discharges of certain pollutants into water bodies[48]

Name of the pollutant	Tax rate, UAH per 1 tonne
Ammonium nitrogen	1610,48
Organic substances (based on biochemical oxygen demand (BOD_5)	644,6
Suspended solids	46,19
Petroleum products	9474,05
Nitrates	138,57
Nitrites	7909,77
Sulphates	46,19
Phosphates	1287,18
Chlorides	46,19

In June 2021, the Verkhovna Rada of Ukraine (the "VRU") submitted Draft Law No. 5600 "On Amendments to the Tax Code of Ukraine and Certain Legislative Acts of Ukraine on Ensuring the Balance of Budget Revenues", which provided for changes in rent payment rates. On 13 October 2021, this draft law passed the second reading in the Verkhovna Rada. On 30 November 2021, the draft law was adopted by the Parliament and comes into force on 1 January 2022.

Table 67. Rent rates for special water use from 01 January 2022[49]

Zakarpattia region, Tisza River sub-basin, including tributaries of all orders	Rent rate, UAH per 100 cubic metres, ongoing / project
Surface water	26,17 / 29,96
Groundwater	61,09 / 69,95

[47] Tax Code of Ukraine, Article 255

[48] Article 245, Tax Code of Ukraine

[49] http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=72106

Other rates for special water use	
For the needs of hydropower	12.95 per 10 thousand m^3
For the needs of water transport on all rivers - for self-propelled and non-self-propelled freight fleets; - for the passenger fleet in operation.	0.2219 per tonne per day of operation; 0,0215 / 0,0246 for the 1st place per day of operation
For the needs of fish farming	67.97 per 10 thousand m^3 of surface water; 81.71 per 10 thousand m^3 groundwater
For water used exclusively in beverages	63.22 per 1 m^3 of surface water; 73.73 per 1 m^3 groundwater
For mine, quarry and drainage water	14.64 for 100 m^3

7 A REVIEW OF THE IMPLEMENTATION OF PROGRAMMES OR ACTIVITIES, INCLUDING HOW THE OBJECTIVES HAVE BEEN ACHIEVED

The document (Section 7 of the River Basin Management Plan (RBMP)) contains an overview of the implementation of environmental protection measures within the Tisza sub-basin, which were funded by national targeted programmes, the State Environmental Protection Fund, relevant regional and local programmes or funds, the State Regional Development Fund, state investment projects, international technical assistance projects, regional and local infrastructure projects, etc. (Annex 12 (M5.3.1)).

The National Target Programme for the Development of the Water Sector and Environmental Rehabilitation of the Dnipro River Basin for the Period up to 2021 (Dnipro Programme)

Clause 4 of the CMU Resolution No. 336 of 18 May 2017 "On Approval of the Procedure for Developing RBMPs" states that the first RBMPs for each RBM shall be developed during the period of implementation of the Dnipro Programme.

Funding for the development of the first RBMPs for each RBM is provided in accordance with paragraph 11 of the above Procedure at the expense of the state budget, as provided for in the Dnipro Programme within the expenditures envisaged by the State Budget of Ukraine for the relevant year, as well as other sources. Implementation of this programme is important both in the context of preparing the Tisza River RBMP and for implementing measures to achieve environmental objectives for the Tisza River RBM.

The Dnipro Programme aims to define the main directions of state policy in the field of water management, conservation and restoration of water resources, implementation of an integrated water resources management system based on the basin principle, restoration of the role of reclaimed land in the food and resource supply of the state, optimisation of water consumption, prevention and elimination of the consequences of harmful water impact.

The main objectives of the Dnipro Programme were as follows:

- harmonisation of Ukrainian legislation with international standards and improvement of the regulatory framework for innovation and investment development of the water sector - partially achieved;
- Implementation of an effective, justified and balanced mechanism for the use, protection and reproduction of water resources, ensuring sustainable development of the state water monitoring system in accordance with international standards - achieved;
- Implementation of the integrated water resources management system based on the basin principle, development and implementation of RBMPs, application of the economic model of targeted financing of activities in river basins, establishment of basin councils, and enhancement of the role of existing and creation of new basin water resource management agencies - partially achieved;
- Improving the technological level of water use, introducing low-water and waterless technologies, developing more rational water use standards, construction, reconstruction and modernisation of water supply and sewage systems - partially achieved;
- bank protection and regulation of river channels, construction and reconstruction of hydraulic structures, protective dams, polders, flood control reservoirs, clearing of river channels, improvement of water protection zones and coastal protection strips, development of schemes for comprehensive flood protection of territories from harmful effects of water, improvement of methods and technical devices for hydrometeorological observations and flood forecasting - partially completed;
- Ensuring the development of land reclamation and improvement of the ecological condition of irrigated and drained lands, including restoration of the water management and reclamation complex, reconstruction and modernisation of reclamation systems and their facilities, engineering infrastructure of reclamation systems with the creation of integrated technological complexes, introduction of new methods of irrigation and land drainage, application of water and energy-saving environmentally safe irrigation and water regulation regimes - not fulfilled.

The estimated amount of funding for the Dnipro Programme was UAH 46478.46 million, including UAH 21,029.03 million from the state budget, UAH 9,294.2 million from the local budget, and UAH 16,155.2

million from other sources not prohibited by law (in dollar terms, the equivalent of USD 6.193 billion (as of 01.01.12), or an average of USD 688 million annually, or 0.4% of Ukraine's gross domestic product (GDP)). The amount of funding for the Dnipro Programme was determined annually during the drafting of the State Budget Law for the respective year, taking into account the real possibilities of the state budget. Since the start of the Dnipro Programme's activities, as of 1 January 2019, 26% of the envisaged need has been allocated from budgets of all levels and other sources, and as of 1 January 2020, 17% of the envisaged need, which has led to a significant failure to complete its tasks and activities on time.

The main implementer of the Dnipro Programme is the SAI of Ukraine. If we analyse in detail the distribution of state budget expenditures by SAUEZM over the past 3 years, we can see the following trend. State funds are allocated mainly for the costs of consumption of the water sector, labour remuneration, utilities, the share of which is financed from the state budget, for example, in 2020: from the general fund - 93.5% (UAH 2,092,158.5 thousand), from the special fund - 81.1% (UAH 2,261,343.4 thousand). In 2020, total state budget expenditures to finance the Dnipro Programme amounted to UAH 5,022,671 thousand. The share of all funds used for the operation of the state water management complex and water resources management is UAH 4,561,352.5 thousand (90.8%).

The Tisza sub-basin water infrastructure is maintained by the Tisza River Basin Water Resources Authority, which is part of the SAI. Expenditures for the operation of water infrastructure are made within the framework of the comprehensive programme "Operation of the State Water Management Complex and Water Resources Management" for each separate division of the SAI.

The issue of extending the Dnipro Programme from 2022 to 2024 to the period of preparation of the RBMP has been resolved for the third year by reviewing the amount of funding for the measures and agreeing on their scope at the central and regional levels. Currently, the TWA has developed and submitted for interagency approval a draft Law of Ukraine "On Amendments to the National Target Programme for the Development of Water Management and Environmental Rehabilitation of the Dnipro River Basin for the Period up to 2021" to extend the Programme until 2024.

As of 8 June 2021, the Accounting Chamber of Ukraine conducted a regular audit of the effectiveness of the implementation of the Dnipro Programme activities for the period up to 2021. The purpose of the audit is to identify existing problems with the implementation of this Programme and to confirm or deny the need to extend its validity until 2024.

In 2021, the State Agency of Ukraine for Water Resources prepared a draft Law of Ukraine "On Amendments to the National Target Programme for the Development of Water Management and Environmental Rehabilitation of the Dnipro River Basin for the Period up to 2021" regarding the need to extend the National Target Programme for the Development of Water Management and Environmental Rehabilitation of the Dnipro River Basin for the Period up to 2024 until 2024. The Tisza RBMU, together with the Zakarpattia Oblast State Administration, submitted to SAWMA their proposals for amendments to this Programme in the area of "Integrated Flood Protection in the Tisza Basin" for a total amount of UAH 5779.8 million, of which UAH 5302.4 million are state budget funds, UAH 418.4 million are local budget funds and UAH 59.0 million are other funds.

National Target Programme "Drinking Water of Ukraine for 2011-2020" (Drinking Water Programme)

"The National Target Programme "Drinking Water of Ukraine for 2011-2020", approved by the Law of Ukraine No. 2455-IV dated 03.03.2005 (hereinafter referred to as the Drinking Water Programme). Its main goal was to ensure the rights of citizens to an adequate standard of living and environmental safety guaranteed by the Constitution of Ukraine by providing drinking water in the required volumes and in accordance with the established standards. The Drinking Water Programme was intended to ensure the implementation of the state policy on:

- development and reconstruction of centralised water supply and sewage systems;
- protection of drinking water sources;
- Bringing the quality of drinking water to the requirements of regulatory acts;
- regulatory and legal support in the field of drinking water supply and sewerage;
- development and implementation of research and development projects using the latest materials, technologies, equipment and devices.

The estimated amount of funding for the Drinking Water Programme was UAH 9,471.7 million (in 2010 prices), of which UAH 3,004.3 million was allocated from the state budget and UAH 6,467.4 million from other sources. Due to the lack of adequate funding over the 10 years of the Drinking Water Programme in Ukraine, there have been no significant positive changes in the provision of drinking water in the required volumes and of the appropriate quality.

As of 1 January 2020, about 1% of cities, more than 10% of urban-type settlements and almost 70% of villages in Ukraine (8.934 million people) were not provided with centralised drinking water supply. Almost

1 in 4 citizens of the country is not provided with centralised water supply. The problem of using imported water covers at least 9 regions of the country, and directly affects at least 268,000 people living in 824 settlements.

According to global standards for water quantity and quality, Ukraine is classified as a low-water country. Ukraine ranks 37th out of 40 European countries in terms of drinking water quality. And over the past 10 years, our performance has only been deteriorating. And in terms of water per capita, Ukraine is 125th in the global ranking. At the same time, the national target programme Drinking Water of Ukraine is not being implemented or financed at all. The last time the Drinking Water Programme was funded was in 2018, when UAH 200 million was allocated from the State Budget of Ukraine, with water and sewerage companies alone submitting projects totalling UAH 1.3 billion. Such activity of the companies is caused by their unsatisfactory financial and economic condition, as well as the inability of local governments to provide the necessary support for the renewal of fixed assets from local budgets.

In addition, it should be noted that the procedures for obtaining grants and loans from international financial institutions are quite lengthy and involve significant risks, so obtaining public funds for the implementation of a particular infrastructure project was a desirable goal for each water utility. In 2019-2020, the Drinking Water Programme was not funded and ended in 2020.

In order to continue supporting water supply and wastewater treatment companies, in 2019, MinRegion of Ukraine developed and submitted to the central executive authorities and specialised associations a draft law "On Amendments to the Law of Ukraine "On the National Target Programme "Drinking Water of Ukraine" for 2011-2020", which provided for the extension of the Programme for another 5 years.

Interagency approval, coordination, and consultations with the Ministry of Finance lasted for 2 years. The Resolution of the Verkhovna Rada of Ukraine No. 980-IX of 5 November 2020 provides for the possibility and expediency of increasing/foreseeing expenditures and providing loans from the general fund of the draft state budget for 2021 under the budget programme "Implementation of the National Target Programme "Drinking Water of Ukraine" for the Ministry of Communities and Territories Development of Ukraine (instead of MinRegion) (clause 2.17.68). The Drinking Water of Ukraine programme will be extended until 2026.

Thus, under the Decree of the President of Ukraine No. 357 of 13 August 2021, the decision of the National Security and Defence Council of Ukraine of 30 July 2021 "On the State of Water Resources of Ukraine" was put into effect, and the Law of Ukraine "On the National Targeted Social Programme "Drinking Water of Ukraine" for 2022-2026" was adopted on 15 February 2022.

The aim of this programme is to ensure the rights of citizens to an adequate standard of living and environmental safety guaranteed by the Constitution of Ukraine by providing quality drinking water in the required volumes and in accordance with the established drinking water quality standards, and to ensure the development and reconstruction of centralised water supply and centralised sewerage systems in Ukrainian settlements.

A total of UAH 28,588.6 million is to be allocated for the implementation of the Programme, including UAH 16,940.3 million from the state budget and UAH 11,639.3 million from other sources.

The Law of Ukraine "On the State Budget of Ukraine for 2022" provided for the funding of the "National Targeted Social Programme "Drinking Water of Ukraine" for 2022-2026" in the amount of UAH 1.0 billion. In accordance with the second paragraph of subparagraph 22 of Section VI "Final and Transitional Provisions" of the Budget Code of Ukraine, the Resolution of the Cabinet of Ministers of Ukraine No. 245 "On Allocation of Funds to the Reserve Fund of the State Budget" dated 10.03.2022, reduced expenditures and lending to the general fund of the state budget, including the budget programme "Implementation of the National Targeted Social Programme "Drinking Water of Ukraine" for 2022-2026" (CPCELC 2751570).

The State Target Programme for the Development of Land Relations in Ukraine for the period up to 2020

The programme was approved by the Cabinet of Ministers of Ukraine by its Resolution No. 743-r dated 17 June 2009.

The purpose of the Programme is to define and implement the main directions of state policy aimed at improving land relations and creating favourable conditions for sustainable development of land use in urban and rural areas, facilitating the solution of environmental and social problems in rural areas, developing highly efficient competitive agricultural production, and preserving the natural values of agricultural landscapes.

As a result of insufficient funding for the Programme, Ukraine is experiencing excessive ploughing of agricultural land, which leads to a disruption of the ecologically balanced ratio of agricultural, nature reserve and other environmental, health, recreational, historical, cultural, forestry, water fund lands, and an increase in the area of degraded, unproductive, and technologically polluted land (diffuse sources of pollution).

As of 1 January 2021, more than 500,000 hectares of degraded, underutilised and technologically contaminated land are subject to conservation, 143,000 hectares of disturbed land need reclamation, and 294,000 hectares of underutilised land need improvement.

A separate Ministry for Development of Economy, Trade and Agriculture of Ukraine has been established (Ministry of Economy, CMU Resolution No. 838 of 19.09.2019), which will implement the new State Target Programme for the Development of Land Relations and National Geospatial Data Infrastructure in Ukraine for the period up to 2030 (Land Programme, draft CMU Resolution of 13.04.2021).

The National Programme for the Development of Nature Reserves for the period up to 2020 (the NRF Programme)

One of the elements of the RBMP structure is Section 3 "Areas (territories) to be protected and their mapping: Emerald Network sites; sanitary protection zones; protection zones for valuable aquatic bioresources; surface/groundwater bodies used for recreational, medical, resort and health purposes, as well as bathing waters; zones vulnerable to (accumulation of) nitrates", vulnerable and less vulnerable zones identified in accordance with the criteria approved by the Ministry of Ecology, therefore, in the context of preparing and implementing the RBMP, it is very important to have information on the implementation of the "National Programme for the Development of Nature Reserves for the period up to 2020" approved by the Cabinet of Ministers of Ukraine on 8 February 2006. No. 70-r (hereinafter referred to as the NRF Programme).

Based on the results of the accounting of NRF territories and objects submitted by the executive authorities at the local level that ensure the implementation of the state policy in the field of environmental protection (hereinafter referred to as the "NRF"), as of 01.01.2020, the NRF of Ukraine comprises 8,512 territories and objects with a total area of 4.418 million hectares within the territory of Ukraine (actual area 4.085 million hectares) and 402,500.0 hectares within the Black Sea. The ratio of the actual area of the nature reserve fund to the area of the state (the "reserve indicator") is 6.77%.

The NRF is managed by the Ministry of Ecology and is funded through the state budget programme "Conservation of Protected Areas". According to the passport of this programme for 2021, UAH 589,326.7 thousand (state fund) and UAH 18,289.8 thousand (special fund) were used for measures to preserve and expand the protected areas, totalling UAH 607,616.5 thousand. In general, the performance indicators under this budget programme were met.

Regional Target Programme for the Development of Water Management and Environmental Rehabilitation of the Tisa River Basin in Zakarpattia Oblast for 2013-2021

"The Regional Target Programme for Water Management and Environmental Rehabilitation of the Tisa River Basin in Zakarpattia Oblast for 2013-2021 (hereinafter referred to as the Regional Programme) was developed pursuant to the Law of Ukraine No. 4836-VI of 24 May 2012 "On Approval of the National Target Programme for Water Management and Environmental Rehabilitation of the Dnipro River Basin for the Period up to 2021". The concept of this National Programme was approved by the Cabinet of Ministers of Ukraine in its Resolution No. 1029 of 3 September 2009. The issue of implementation in 2012 of the measures of the State and Regional Programmes for Comprehensive Flood Protection in the Tisa River Basin in Zakarpattia Oblast for 2006-2015 and the objectives of the Regional Target Programme for Water Management and Environmental Rehabilitation of the Tisa River Basin in Zakarpattia Oblast for 2013-2021 was separately considered by the Board of the Oblast State Administration.

The "Regional Target Programme for the Development of Water Management and Environmental Rehabilitation of the Tisa River Basin in Zakarpattia Oblast for 2013-2021" was approved by the Head of the Zakarpattia Oblast State Administration by Order No. 230 of 17 July 2013, and approved by the Regional Council session of 27 December 2013, No. 847. The initiator, developer and responsible executor of the Programme is the Tisa River Basin Water Resources Management Authority.

The purpose of the Programme **is to** define the main areas of activity in the field of water management, conservation and restoration of water resources, restoration of the role of reclaimed lands, optimisation of water consumption, prevention and elimination of the consequences of harmful effects of water with the help of:

- integrated water resources management systems based on the basin principle;
- bank protection and river channel regulation, construction and reconstruction of hydraulic structures, protective dams, polders, reservoirs, river channel clearance, and improvement of water protection zones and coastal protection strips;
- Improving the environmental condition of reclaimed land and introducing efficient use of it;

- Implementation of a reasonable and balanced mechanism for the use, protection and reproduction of water resources;
- Improving the technological level of water use, construction, reconstruction and modernisation of water supply and sewage systems.

Given the situation in the water sector and agriculture in Zakarpattia Oblast, in order to address the extremely acute water and environmental problems, increase the sustainability and efficiency of agricultural production, and reduce its dependence on adverse natural and climatic conditions by restoring the operation of reclaimed land, it was planned to introduce a mechanism for additional state support in these areas, as well as to use the available funds in local budgets more effectively.

The main spending units for the implementation of this Regional Programme were:

- The State Agency of Water Resources of Ukraine (SAWR);
- The State Agency of Land Resources of Ukraine (SLRU);
- The State Emergency Service of Ukraine (SES);
- Transcarpathian Regional State Administration (RSA);
- The Tisza River Basin Water Resources Management (TISZA);
- Local executive authorities.

The total funding requirement for the implementation of the Programme for the entire period of its validity was UAH 3911.8 million, including:

- measures to restore reclamation canals and hydraulic structures - UAH 45.0 million;
- reconstruction of drainage systems and reservoirs - UAH 34.3 million.

The first stage of the Regional Programme (2013 - 2016) was allocated UAH 1541.5 million, including:

- UAH 785.0 million at the expense of the state budget;
- UAH 73.0 million from local budgets;
- UAH 683.5 million at the expense of international projects.

UAH 2,370.3 million was allocated for the implementation of the Regional Programme's activities at the second stage (2017-2021), including:

- at the expense of the state budget - UAH 1,255.9 million;
- UAH 119.4 million from local budgets;
- UAH 995.0 million at the expense of international projects.

The Regional Programme provided for the following funding by area:

- Ensuring the development of land reclamation and improvement of the environmental condition of irrigated and drained lands - UAH 248.3 million;
- water resources management and operational activities - UAH 30.8 million;
- priority provision of centralised water supply to rural settlements - UAH 29.0 million.

A total of UAH 1,835.6 million was planned to be allocated for comprehensive flood protection in the Tisa River basin in Zakarpattia Oblast:

- UAH 1,780.3 million at the expense of the state budget;
- UAH 54.9 million from local budgets.

These funds were allocated for comprehensive flood protection in the Tisa River basin in Zakarpattia Oblast:

- to build and reconstruct dams, bank protection structures and regulate river channels in the amount of UAH 724.9 million;
- to build flood storage tanks in mountainous and lowland parts of rivers, polders and flood control reservoirs in the amount of UAH 840.6 million;
- to improve the regulatory framework and organisational structure of the water sector in the amount of UAH 165.7 million;
- to build and reconstruct landslide and mudflow protection structures in the amount of UAH 58.2 million;
- improve the flood monitoring and forecasting system in the amount of UAH 37.6 million.

Measures to increase fertility, protect soil and improve the environmental condition of agricultural land and settlements were envisaged in the Programme for the Protection and Improvement of Soil Fertility for 2005-2015.

Additional funds for the implementation of the Regional Programme were planned to be obtained:

- at the expense of funds allocated to support crop production and farming in adverse climatic conditions;
- by charging for the use of water resources;
- for funds from the preparation of land management projects;

- for funds received by the state budget in accordance with the Law of Ukraine "On Land Payment" and Article 209 of the Land Code of Ukraine;
- at the expense of the regional environmental protection fund in terms of supplementing the list of activities with measures to combat the harmful effects of water, measures to protect against flooding and flooding of territories, etc., in accordance with the list of activities related to environmental protection measures approved by the Resolution of the Cabinet of Ministers of Ukraine dated 17 September 1996 (as amended).

Environmental Protection Programme of Zakarpattia Oblast for 2019-2020

In order to solve environmental problems, ensure a balanced economic and social development of the territory, and efficient use of the region's natural resources, the Environmental Protection Programme for Zakarpattia Oblast for 2019-2020 was implemented in 2019-2020, approved by the decision of the Zakarpattia Oblast Council on 13.12.2018 No. 1335 (as amended).

In accordance with Article 43 of the Law of Ukraine "On Local Self-Government in Ukraine", the Laws of Ukraine "On Environmental Protection", "On Environmental Impact Assessment" and the Resolution of the Cabinet of Ministers of Ukraine of 17 September 1996 No. 1147 "On Approval of the List of Activities Related to Environmental Protection Measures" (as amended), the Transcarpathian Regional Council, by its decision of 20.12.2019 No. 1651, amended the "Environmental Protection Programme of the Transcarpathian Region for 2019-2020", approved by the decision of the Regional Council of 13

The total amount of financial resources required to implement the Programme is UAH 32389.7 thousand, including: UAH 23752.9 thousand - funds from the oblast budget. The measures envisaged by this Programme shall be financed at the expense and within the limits of expenditures of the regional budget, state, local budgets and own funds of enterprises, investment funds, international technical assistance and grants, other sources not prohibited by the current legislation.

The environmental protection measures were financed from the regional environmental protection fund of the regional budget, and no funds were allocated from the state budget.

Key measures that will improve the situation in the water sector, conservation, protection and restoration of water resources in the Tisza basin:

- construction of wastewater treatment facilities for the residential and municipal sector;
- Reconstruction of existing wastewater treatment facilities in the residential and municipal sector;
- construction of sewage facilities and networks;
- reconstruction of existing sewage facilities and networks.

The Programme developer is the Department of Ecology and Natural Resources of the Oblast State Administration; co-developers are rayon state administrations, municipal executive committees, departments of the Oblast State Administration; responsible executors are structural units of the Oblast State Administration, rayon state administrations, municipal executive committees, and territorial units of central executive authorities.

Unfortunately, this Programme was unable to fully address the problem of wastewater treatment and stop pollution of water bodies in the Tisza sub-basin, and did not have sufficient financial support for existing environmental programmes at the national, regional and local levels.

Environmental Protection Programme of Zakarpattia Oblast for 2021-2023

"The Environmental Protection Programme for Zakarpattia Oblast for 2021-2023 was approved by the order of the Zakarpattia Oblast State Administration dated 14 December 2020 No. 730 (as amended) and the decision of the Zakarpattia Oblast Council dated 17 December 2020 No. 66 (as amended). The draft decision of the Zakarpattia Regional Council was prepared in accordance with the Laws of Ukraine "On Environmental Protection", "On Environmental Impact Assessment", Resolution of the Cabinet of Ministers of Ukraine No. 1147 of 17 September 1996 "On Approval of the List of Activities Related to Environmental Protection Measures" (as amended), and is aimed at implementing the provisions of the Regional Development Strategy of Zakarpattia Oblast for 2021-2027.

"The Environmental Protection Programme of Zakarpattia Oblast for 2021-2023 (hereinafter referred to as the Programme) was developed by the Department of Ecology and Natural Resources of the Zakarpattia Oblast State Administration using proposals received from district state administrations, city councils and executive bodies of local councils (ATCs), sectoral departments of the Oblast State Administration, departments and organisations of central executive authorities.

The purpose of the Programme is to ensure the implementation of the environmental policy aimed at stabilising and improving the state of the environment in the region, which in turn will lead to a reduction in the negative impact on the environment and will be realised through the implementation of measures to prevent garbage from entering the rivers of the region; ensuring environmentally safe collection, transportation, storage, treatment, utilisation, disposal, neutralisation and burial of waste and hazardous chemicals, elimination of unauthorised

Total amount of financial resources required for the Programme implementation: UAH 19415.0 thousand in total, including the oblast budget funds - UAH 19415 thousand, funds from rayon, city (cities of oblast significance) budgets - not provided.

The programme participants are the Department of Ecology and Natural Resources of the Oblast State Administration, the Tisza River Basin Water Resources Management Authority (upon agreement), the Zakarpattia Oblast Hydrometeorology Centre (upon agreement), the State Environmental Inspectorate in Zakarpattia Oblast (upon agreement), structural units of the Oblast State Administration, District State Administration, executive bodies of local councils (ATCs), and territorial units of central executive authorities.

The main activities of the programme are:

- protection and rational use of land - construction, expansion and reconstruction of anti-erosion, hydraulic, anti-karst, bank protection, landslide, anti-landslide, avalanche and mudflow protection structures, as well as measures to protect against flooding and flooding aimed at preventing the development of hazardous geological processes, eliminating or reducing to an acceptable level their negative impact on territories and facilities (including preparation of design and estimate documentation) - UAH 9000.0 thousand;
- Rational use and storage of production and household waste - ensuring environmentally safe collection, transportation, storage, treatment, disposal, removal, neutralisation and burial of waste, including elimination of unauthorised, spontaneous landfills (including preparation of design and estimate documentation) - UAH 3000.0 thousand;
- Nuclear and radiation safety - UAH 900.0 thousand;
- scientific, educational, environmental information and propaganda, printing, environmental monitoring, support of public environmental organisations - UAH 6,515.0 thousand.

According to the information on the implementation of the Programme for 2021, out of 21 planned tasks, all environmental measures financed by the regional environmental protection fund in 2021 were completed. The total estimated cost of environmental protection measures in 2021 (according to the project) is UAH 2389 thousand, which is 36.2% (the projected amount of funding for the Programme for 2021 is UAH 6605 thousand). The amount of actual expenditures from the regional fund is UAH 2335 thousand and the amount of actual expenditures from other sources is UAH 54.0 thousand.

In addition, in 2021, 30 environmental protection measures were planned (4 measures with an extension of the implementation period to 2022), which were financed at the expense of the local environmental protection fund, of which 19 were completed, 6 were partially completed, 4 were under implementation, and 1 was pending approval. The total estimated cost (according to the project) is UAH 22,500.6 thousand, the amount of actual expenditures from the regional fund is UAH 225.6 thousand, and the amount of actual expenditures from other sources (local) is UAH 5,631.8 thousand.

Regional Programme "Drinking Water of Transcarpathia" for 2006-2020

In accordance with Article 43 of the Law of Ukraine "On Local Self-Government in Ukraine", pursuant to the Law of Ukraine of 20 October 2011 No. 3933-VI "On the National Target Programme "Drinking Water of Ukraine" for 2011-2020", the Transcarpathian Regional Council decided to approve the Regional Programme "Drinking Water of Transcarpathia" for 2006-2020 (as amended by the decision of the Transcarpathian Regional Council of 12 January 2006 No. 690) (as amended by the decision of the Transcarpathian Regional Council of 7 May 2019 No. 1093).

The Programme was aimed at implementing measures to comprehensively address the issue of improving the supply of drinking water of standard quality to the population of the region, increasing the reliability and efficiency of centralised water supply and sewage facilities, reconstructing the existing and building a new water supply and sewage network, improving the social and environmental situation, restoring, protecting and rationally using drinking water sources.

The initiator, developer and responsible executor of the Programme was the Housing and Communal Services Department of the Zakarpattia Oblast State Administration (the same department changed its name several times during the Programme implementation period).

Participants in the Programme included local executive authorities and local self-government bodies, as well as housing and communal services companies in the region.

Areas of activity of the Programme:

- protection of drinking water sources;
- bringing the quality of drinking water to the established standards.

The total amount of funding is UAH 753.6 million, including UAH 576.54 million and UAH 125.52 million from the state and local budgets, respectively, and UAH 51.54 million from other sources.

The National Target Programme "Drinking Water of Ukraine" for 2011-2020 is aimed at addressing the issue of providing the population, social institutions and other consumers with drinking water of appropriate quality, which has not been financed from the state budget in the last years of the Programme's implementation.

As of 1 January 2021, the water supply system of the region (Tisza sub-basin), which is serviced by the industry's enterprises, includes 48 water intake facilities, 159 first-lift water pumping stations with an installed production capacity of 194,054 thousand m^3 of water per day, 37 second-lift pumping stations with an installed production capacity of 141,418 thousand m of water per day. m^3 of water per day, 13 water treatment plants with an installed capacity of 78.80 thousand m^3 of water per day, 66 clean drinking water reservoirs, 191 artesian wells, 1002.6 km of water supply networks, of which 302.84 km, or 30.2%, are outdated and in poor condition.

Tap water from water pipelines of different subordination is used by 37.5% of the region's population. Of the 901,574 people living in towns and villages, 48.5 per cent and 14.6 per cent use tap water, respectively. The share of the population living in cities and using centralised water supply systems is 85.4 per cent. A part of the population and the majority of facilities in rural areas are supplied with water from decentralised water supply sources (wells, capstans, individual wells). All cities and urban-type settlements are provided with centralised water supply.

Water is abstracted in the region from surface (58.4%) and underground (41.6%) sources. Water is supplied from surface sources in Svaliava (4 water intakes), partially in Uzhhorod (1 water intake, right bank part), Mizhhirya (2), Velykyi Bereznyi (1) and Volovets (1). In other settlements, water is supplied from underground sources using artesian wells, the water in which generally meets regulatory requirements.

The industry operates 16 sewage treatment plants, 11 of which require urgent reconstruction. The design capacity is 43.852 million m^3 /year. There are 68 sewage pumping stations (SPS) in operation with a design capacity of 79.245 million m^3 /year, with an actual capacity of 43.4 million m^3 /year. The length of the main collectors and sewerage network is 681.8 km, of which 191.7 km or 28.1% is in an emergency condition.

Cities are 100% covered by centralised sewerage, urban-type settlements by 78.9%, and villages by 2.8% (Polyana, Gankovytsia). The annual volume of received and discharged wastewater is 30.295 million m^3 (as of 2020). The company provided wastewater services in the amount of 15.218 million m^{33} , including 7.958 million m^{33} (52.3%) to the population, 5.464 million m^{33} (35.9%) to commercial consumers, and the remaining 1.796 million m^{33} (11.8%) to budgetary institutions.

The activities carried out in the water supply and sewerage sector at the expense of local budgets and working capital of water supply companies (water utilities) were mainly aimed at maintaining water supply and sewerage networks and water management facilities (water intakes, NFS, WSS, SSS, and WSC) in working order.

Given that no funds were allocated from the state budget in 2019 under the budget programme "Drinking Water of Ukraine" for 2011-2020, local executive authorities and local self-government bodies took organisational measures to raise funds from other sources of funding.

The total amount of funds raised in 2019 to maintain the water and sewerage facilities in the region in working order and develop the industry was UAH 96.026 million, including UAH 40.910 million from the state budget, UAH 45.234 million from local budgets, UAH 8.910 million from the working capital of water supply companies, and UAH 0.972 million from other sources of funding.

Under the budget programme "Implementation of Environmental Protection Measures", the company attracted state budget funds in the amount of UAH 15.774 million to implement projects for the construction of new and reconstruction of existing sewerage networks in Khust. In 2019, at the expense of the State Fund for Regional Development, on the terms of co-financing from the city budget of Chop, the implementation of the project "Water intake at underground wells on Myr Street in Chop" (construction) continued, for which the state and city budget funds in the amount of UAH 5.213 million were used in the reporting year (construction of the facility is ongoing).

The Fund and co-financing from municipal budgets also financed the construction of a section of the water supply network in Chop (UAH 5.965 million) and the reconstruction of a part of the water supply and sewerage network in Rakhiv (UAH 10.234 million).

In recent years, local executive authorities and local self-government bodies have taken steps to implement project solutions aimed at providing the rural population with quality drinking water. The projects were built at the expense of the State Regional Development Fund and local budgets: "Water supply and sewage system in Barvinok village, Uzhhorod district" and "Water supply system in Chaslivtsi village, Uzhhorod district". At the expense of the subvention from the state budget to local budgets for the implementation of measures for the socio-economic development of certain territories, the projects "Reconstruction of the sewage system in Vyshkovo, Khust district" and "Reconstruction of the water supply system in Vynohradiv" were implemented.

In 2020, funds in the amount of UAH 68.222 million were allocated for these purposes, including: local budgets (ATCs) - UAH 53.347 million, working capital of water supply companies (water utilities) - UAH 13.405 million, and other sources of funding - UAH 0.759 million. The funds raised from the state and local budgets in the water and sewerage sector were mainly used for the construction of new and overhaul of existing water and sewerage networks, construction of new water intake facilities, construction of new and reconstruction of existing water pumping stations, purchase of special machinery and technological equipment.

According to the information provided, in 2021, the provision of settlements in the region was as follows: centralised water supply - all 11 cities, all 19 urban-type settlements, 191 villages (33%), centralised water supply was absent in 387 villages; centralised sewerage - all 11 cities, 15 urban-type settlements (78.9%), 16 villages (2.8%), centralised sewerage was absent in 4 urban-type settlements (Bushtyno, Kobyletska Polyana, Serednie, Dubove) and 562 villages.

Regional Development Strategy of Zakarpattia Oblast for the period 2021-2027

"The Regional Development Strategy of Zakarpattia Oblast for the period of 2021-2027 was approved by the decision of the Zakarpattia Oblast Council of 20.12.2019 No. 1630 (as amended by the decision of the Oblast Council of 01.10.2020 No. 1840).

The Regional Development Strategy of Zakarpattia Oblast is a tool for harmonising state, territorial and sectoral interests and plans. It is a generalised concept of action, a model for achieving goals that defines the priorities and main areas of activity of the region's economic sectors. The region needs a clear, consolidated and effective action plan to stimulate economic development, improve the welfare of the population and the quality of life. It will show the priority areas of Zakarpattia's development and guide the activities of state and local authorities in making important decisions for the region.

The purpose of this strategic document is to create conditions for sustainable development of the region and increase its competitiveness. The Regional Development Strategy is an important document that will contribute to the social and economic development of the region for the next seven years and will form the basis for the development of other programmes and projects for the balanced development of the entire region.

The strategy was developed and initiated by the Department of Economic Development and Trade of the Transcarpathian Regional State Administration.

Areas of work of the Zakarpattia Oblast Development Strategy for 2021-2027:

- SWOT analysis of regional development;
- smart specialisation;
- Spatial development of territories;
- development of education, science, healthcare and sports;
- ecology and environmental protection;
- Infrastructure development;
- economic development and investment activities;
- Human capital development ;
- realising the region's tourism and recreational potential;
- development of rural and problematic areas, including mountainous areas; preservation of cultural heritage.

In the context of water resources management in the Tisza sub-basin (Zakarpattia oblast), namely the implementation of the Tisza Sub-basin RBMP Action Programme, it will be important to implement Section 4 "Ecology and Environmental Protection" in 2025-2027." At the first stage of implementation of this Strategy (2021-2023), this section of the Programme has not been practically implemented due to a lack of funds from both the state and local budgets.

Cross-border cooperation development programme of the Zakarpattia Oblast for 2021-2027

In accordance with Articles 6, 17 and 39 of the Law of Ukraine "On Local State Administrations", the Law of Ukraine "On Cross-Border Cooperation", Resolution of the Cabinet of Ministers of Ukraine No. 153 of 15 February 2002 "On the Establishment of a Unified System for Attracting, Using and Monitoring International Technical Assistance", the "Transcarpathian Region Cross-Border Cooperation Development Programme for 2021-2027" was approved by the order of the Head of the Transcarpathian State Administration No. 705 of 03.12.2020.

The purpose of the Programme is to accelerate the socio-economic development of the Zakarpattia region by building good neighbourly relations with the EU member states and other foreign countries in the economic, social, scientific, technological, environmental, cultural and tourism sectors, implementing European integration measures at the regional level, co-financing projects implemented in the Zakarpattia region with the involvement of international technical assistance.

The Programme was developed by the Department of Foreign Economic Relations, Investments and Cross-Border Cooperation of the Transcarpathian Regional State Administration.

The Programme participants are structural subdivisions of the Regional State Administration: Department of Foreign Economic Relations, Investments and Cross-Border Cooperation; Department of Finance; Department of Culture; Department of Health; Department of Ecology and Natural Resources; Department of Infrastructure, Development and Maintenance of the Network of Public Roads of Local Importance and Housing and Communal Services; Department of Tourism and Resorts; Department of Urban Development and Architecture, other interested structural subdivisions

The Tisza River Basin Water Resources Authority and its structural units are also participants in the Programme: Tyachiv Interdistrict Water Management Authority (Romania), Vynogradiv, Berehove and Uzhhorod Municipal Water Management Authorities (Hungary), Uzhhorod Municipal Water Management Authority (Slovak Republic) and the State Environmental Inspectorate in Zakarpattia Oblast.

Main objectives and activities of the Programme:

- development of cross-border cooperation and strengthening its institutional support;
- deepening international and cross-border cooperation to support and promote cultural tourism and preserve historical and cultural heritage;
- deepening cross-border cooperation in education, healthcare and social protection;
- development of checkpoints and border infrastructure;
- development of the mountainous border areas of the Carpathians, implementation of the European Union Strategy for the Danube Region and the Danube Transnational Programme;
- attracting international technical assistance and implementing projects under the new financial instrument Neighbourhood, Development and International Cooperation (NDICI).

The Programme is financed from the regional budget, local budgets, international technical assistance and other sources not prohibited by law.

The amount of financing is UAH 53300.0 thousand, including:

Stage I - UAH 29,700.0 thousand, in terms of annual funding:
2021 - UAH 5,600.0 thousand;
2022 - UAH 8,120.0 thousand;
2023 - UAH 8090.0 thousand;
2024 - UAH 7,890.0 thousand;

Stage II - UAH 23,600.0 thousand, in terms of annual funding:
2025 - UAH 7,850.0 thousand;
2026 - UAH 7,850.0 thousand;
2027 - UAH 7,900.0 thousand.

The implementation of the Programme's activities and measures will contribute to the sustainable development of the region and increase its competitiveness. Unfortunately, in 2021, this Programme was funded only at the expense of international technical assistance.

Uzhhorod Environmental Protection Programme for 2018 - 2022

In accordance with paragraph 22 of part 1 of Article 26 of the Law of Ukraine "On Local Self-Government in Ukraine", the Law of Ukraine "On Improvement of Settlements" and the decision of the XIII session of the City Council of the VII convocation of 30 May 2017 No. 655 "On Approval of the Procedure for Development of City Target Programmes, Monitoring and Reporting on their Implementation", the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the List of Activities Related to Environmental Protection Measures" of 17.09.1996 No. 1147 as amended, the "Uzhhorod Environmental Protection Programme" was approved.

The initiator, developer and responsible executor of the Programme is the Department of Municipal Economy of Uzhhorod City Council.

The Programme participants are municipal enterprises of the city and business entities involved in the maintenance of the city.

The Programme implementation period is 2018-2020: Stage 1 - 2018 - 2020, Stage 2 - 2021 - 2022. The source of funding is the city budget and other sources (regional, state fund, investments, grants), the total amount of funding is UAH 8057.40 thousand.

The Programme aims to reduce emissions and discharges of pollutants into the environment, ensure safe management of industrial and household waste, preserve and restore biological diversity, create safe living conditions for people, ensure environmental safety, restore and create nature reserve areas, define protected areas, etc.

In particular, it is proposed to develop and implement greening projects for the city, create new green areas (parks, squares, etc.), provide for the preservation and expansion of green areas in the master plan of Uzhhorod; reconstruct the Bozdosh and Pidzamkovy parks; to ensure the removal of overgrown trees, shrubs and unwanted vegetation; to clear the Uzh riverbed of sediment; to certify lakes in the city area; to create a bank of illustrative and informational materials on environmental issues and their solutions in Uzhhorod, etc.

8 A COMPLETE LIST OF PROGRAMMES (PLANS) FOR THE TISZA RIVER SUB-BASIN AREA, THEIR CONTENT AND PROBLEMS TO BE SOLVED

The RBMP was developed in accordance with the requirements of the "Methodological Recommendations for Setting Environmental Objectives, Developing a Programme of Measures and Performing a Cost-Effectiveness Analysis of the River Basin Management Plan" (hereinafter referred to as the Methodological Recommendations), approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources on 12 July 2023. The software was developed by the Tisza RBMU in accordance with the Methodological Recommendations and the Procedure for the development of the RBMP together with local executive authorities, local self-government bodies, non-governmental organisations (NGOs), scientific and educational institutions (SEIs) and other stakeholders, taking into account the proposals and decisions of the Tisza River Basin Council.

The development of the RMP took into account the measures implemented or planned in the national RBMPs of the neighbouring countries of the Tisza sub-basin (Romania, Hungary, Slovakia) and the chemical state of the transboundary WBMs according to the monitoring data of 2022-2023. The RBP is developed for a period of 6 years, starting with the first cycle of the plan for 2025-2030. The start of the measure implementation should be no later than the third year from the beginning of the cycle (no later than 1 January 2028). During the implementation, it is allowed to make additions and changes to the approved programme. In total, 98 main and 4 additional measures are proposed for the Programme. A full list of measures in the Tisza river sub-basin and their content is provided in Annex 13 (M5.3.1).

8.1 Surface water

For surface waters, the RMP includes the following key measures:
- measures aimed at reducing organic pollution (diffuse and point sources);
- measures aimed at reducing pollution by nutrients (diffuse and point sources);
- measures aimed at reducing pollution by hazardous substances (diffuse and point sources);
- measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology;
- measures aimed at reducing the impact of planned infrastructure projects on water conditions.

In addition to these measures, the RAP includes other measures aimed at addressing other WUEIs of the Tisza RBM identified in view of the specifics and transboundary nature of the sub-basin.

8.1.1 Measures to reduce pollution by organic matter, nutrients and hazardous substances (diffuse and point sources)

Anthropogenic loads and their impacts on the state of the IWM include pollution with organic, biogenic and hazardous substances from the main sources of pollution - sewage treatment plants (STPs) of agglomerations (point pollution) and deterioration/damage/absence of drainage systems (diffuse pollution). The same measure for the construction/reconstruction/modernisation of the agglomeration's SSS and sewerage networks (hereinafter referred to as "S&S"), including stormwater networks (melt and rainwater), combines the reduction of pollution of the MSW with organic, nutrient and hazardous substances from point and diffuse sources. Anthropogenic loads and their impacts on the state of the IWM allow establishing reasonable correlations between them and developing a software to achieve environmental goals.

The proposed measures aimed at reducing pollution of the Tisza sub-basin's IWR fall into three groups:
- measures aimed at reducing organic pollution (diffuse and point sources) - 57 measures;
- measures aimed at reducing pollution by nutrients (diffuse and point sources) - 59 measures;
- measures aimed at reducing pollution by hazardous substances (diffuse and point sources) - 58 measures.

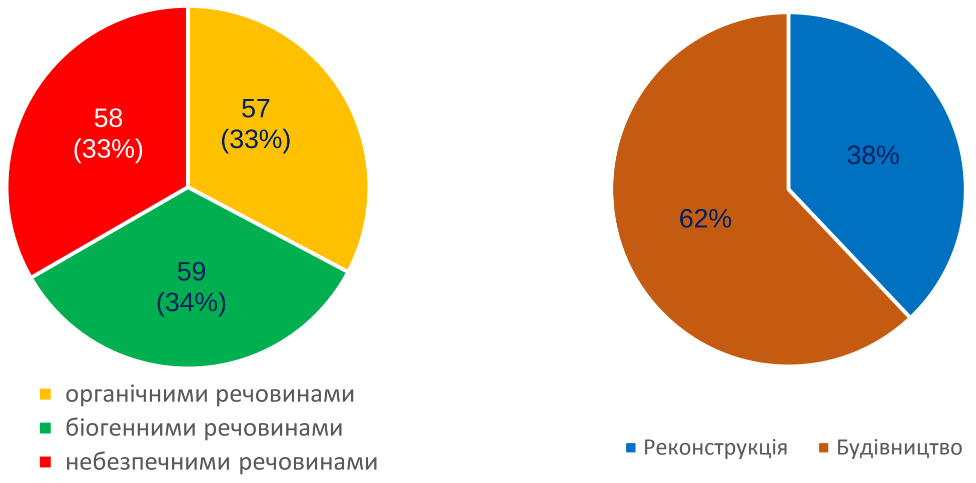


Figure 82. Percentage of measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources and the method of their implementation (reconstruction or construction of CWS and CM), %.

Measures aimed at reducing pollution by nutrients (diffuse sources) also include: "Establishment of water protection zones and coastal protection strips of water bodies within the Transcarpathian region" (No. 99 in the list of measures, Annex 13 (M.5.3.1)) and "Assessment, monitoring of changes in the state of water intake and implementation of works on restoration of water intakes of Polyanske forestry, Polyanske territorial community, Mukachevo district, Transcarpathian region" (No. 71, only for specific 8 MWPs: Pynia, Velyka Pynia and Mala Pynia). The latter measure is a pilot project to be implemented in the Tisza sub-basin to preserve and protect the "good" condition of the MNR in the forest fund (the forest covers more than 50% of the territory of Zakarpattia oblast), flood prevention, erosion control and fire protection measures.

Measures aimed at reducing pollution by hazardous substances (diffuse sources) include the measure: "Construction of a waste processing plant in the Polyanska territorial community, Mukachevo district, Zakarpattia region" (measure No. 98). The plant's capacity will allow processing newly generated solid waste that will be collected in the region, as well as raw materials from existing old landfills that need to be remediated. The event will cover three districts of the region (16 DHs) and more than 40 MSW in the upper reaches of the Latorytsia, Uzh, Borzhava and Rika rivers.

In accordance with the requirements of the Law of Ukraine "On Wastewater Disposal and Treatment" dated 12 January 2023 No. 2887-IX, in order to ensure high-quality centralised wastewater disposal while reducing the impact of return (wastewater) on the IBA, it is planned to build/reconstruct Sewage Treatment Plants and KMs for 50 settlements (34%) of the Tisa sub-basin with a population equivalent of 2,000 or more. The proposed measures to reduce pollution by organic, biogenic and hazardous substances and their implementation in terms of new construction or reconstruction/modernisation indicate the following: 19 TSs and CMs need reconstruction/modernisation, including 10 TSs with tertiary (proper) wastewater treatment with removal of nitrogen and phosphorus compounds. Construction of new WWTPs and CWTPs is planned in 31 TCs. There is a clear trend towards the intention to aggregate (combine) the CWSs and CWSs of settlements into separate agglomerations (treatment clusters) around cities, in particular rayon centres. A single sewage treatment complex for wastewater around cities is planned: Mukachevo, Svalyava, Khust, Tyachiv, with the merger of neighbouring communal wastewater treatment plants. The issue of establishing such an association, a conglomerate with a single sewage treatment plant on the left and right banks of the Uzh River, which would cover settlements around the city of Uzhhorod, is being agreed upon by Uzhhorod and neighbouring ATCs. A positive example of solving the issue of a single complex of SWM and KM is demonstrated by the Polyanska ATC of the Mukachevo Rayon, which planned to build a single network of wastewater collection and treatment from the community and all sanatorium-resort complexes on its territory.

Among the measures aimed at reducing pollution by organic, biogenic and hazardous substances (diffuse and point sources): 47 measures are classified as IAPs that are "at risk" of failing to achieve environmental objectives, and only 3 measures are classified as IAPs of the "possibly at risk" of failing to achieve environmental objectives. As for business entities (production enterprises in the automotive, chemical and food industries, and livestock sectors), the proposed measures fall into different categories of risk of failure to achieve environmental targets for IAPs. The share of the proposed measures aimed at reducing pollution by organic, biogenic and hazardous substances from point sources of pollution, depending on the risk assessment, is shown in Figure 83.

Figure 83. Distribution of measures aimed at reducing pollution by organic, biogenic and hazardous substances, depending on the risk assessment of IWR, %.

All the proposed measures aimed at reducing pollution by organic, nutrient and hazardous substances are related to the category "rivers" and have a single objective: to achieve/maintain "good" ecological status of the IWB. Only two measures are related to the SHMS (UA_M5.3.1_0285, Kodach Canal; UA_M5.3.1_0348, Vysokoberezhnyi Canal) and one measure is related to the IZMS (UA_M5.3.1_0204, Stary Botar River).

8.1.2 Measures aimed at improving/restoring hydrological regime and morphological indicators

The number of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology in the Tisza sub-basin is 39. Almost all of them are aimed at mitigating/reducing the negative impact of channel regulation works planned as part of the implementation of the "Flood Risk Management Plan for Certain Areas within the Danube River Basin Region for 2023-2030", approved on 8 October 2022 by CMU Resolution No. 895-r (hereinafter referred to as the Danube Flood Risk Management Plan). When developing the measures, it was taken into account that the environmental objectives for the SSS are to maintain the "good" status of 8 SSS and achieve "good" status for 31 SSS where channel regulation works are planned. Measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology depending on the risk assessment are presented in Figure 84.

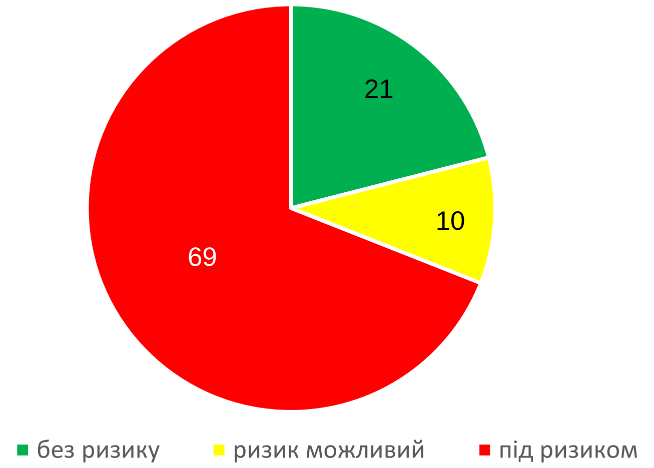


Figure 84. Distribution of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology, depending on the assessment of IWR risks, %.

8.1.3 Measures to reduce the negative impact of infrastructure projects

The RP includes two measures aimed at reducing (mitigating) the negative impact on the hydrological regime and morphological indicators of the MWR of infrastructure projects:

- "Implementation of measures to mitigate the infrastructure project: "Bridge over the Tisa River on the Teplytsia - Sighetu Marmatiei section", Ukraine-Romania border, NW 298-299, Bila Tserkva village, Solotvyno territorial community, Tyachiv district, Transcarpathian region" (No. 9);
- "Implementation of measures to mitigate the infrastructure project: "Construction of a road bridge over the Teresva River on the national road of state importance H-09 "Mukachevo-Rakhiv-Bohorodychany-Ivano-Frankivsk-Rohatyn-Bibarka-Lviv", between the villages of Bedevlya and Teresva, Bedevlyanska and Teresvyanska territorial communities, Tyachiv district, Transcarpathian region" (No. 24).

These measures are aimed at stabilising/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology. Both MEAs were assessed as being at "risk" of not achieving environmental objectives.

8.1.4 Measures aimed at reducing pollution and improving/restoring hydrological regime and morphological characteristics on transboundary IBAs

The PA includes measures aimed at reducing pollution (reconstruction/construction of WWTPs and KMs of cross-border agglomerations: Rakhiv, Velyky Bychkiv, Solotvyno, Teresva, Tyachiv, Vynohradiv, Pyiterfolvo, Vylok, Chop, Mukachevo, Uzhhorod, Storozhnytsia), improvement/restoration of hydrological regime and morphological indicators (mitigation of channel regulation works on the Tisa River, Ukrainian-Romanian border). The measures are planned to be implemented in 2025-2030 on transboundary MPAs that will have a potential impact on the neighbouring countries of the Tisza sub-basin (Romania, Hungary, Slovakia): UA_M5.3.1_0007, UA_M5.3.1_0008 (Tisza River, Ukraine-Romania), UA_M5.3.1_00011, UA_M5.3.1_0012, UA_M5.3.1_0014 (Tisza River, Ukraine-Hungary); UA_M5.3.1_0300 (Latorytsia River, Ukraine-Slovakia), UA_M5.3.1_0433 (Uzh River, Ukraine-Slovakia), as well as achieving "good" ecological potential of the Staryi Batar IBA on the Ukrainian-Hungarian border: UA_M5.3.1_0204. The number of activities at transboundary IBAs by country in the Tisza sub-basin is shown in Figure 85.

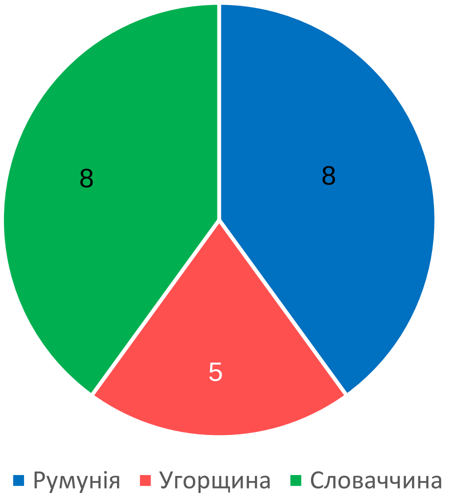


Figure 85. Number of events at MoUs with neighbouring countries

8.2 Groundwater

For groundwater, the RMP includes the following key measures:
- measures aimed at reducing pollution (diffuse and point sources);
- measures aimed at preventing groundwater depletion;
- measures aimed at reducing the impact of planned infrastructure projects on water conditions.

To achieve/maintain a good quantitative and qualitative state of the IWZs, the following two measures should be implemented first of all: "Establishing the boundaries of sanitary protection zones for groundwater intakes used for centralised water supply to the population, medical and recreational needs, indicating them in land management documentation, urban planning documentation at the local and regional level, entering information on relevant restrictions on land use into the State Land Cadastre and marking these boundaries on the ground with information signs" and "Mandatory equipping of all water intake wells with water regulating and controlling devices. These measures cover all the subbasin's WMSs and will be implemented at the expense of water users and local TGs.

8.3 Other measures

Other measures include the following additional measures: legislative, administrative, fiscal, research, educational, aimed at introducing new technologies, environmental and communication, design, and others.

Additional activities include awareness-raising activities for groundwater and surface water, in particular, awareness-raising activities on the protection, conservation and restoration of water resources in all TGs of Zakarpattia Oblast. It is planned to hold a Wetlands Day (2 February), International Water Day (22 March), and a Danube Day/eco-event every year: "Tisa is the Danube's younger sister" (29 June), and Clean Shores Day (third Saturday of September). It is also planned to clean up and restore river sources, as well as to conduct outreach and educational activities with local community groups, NGOs, NPOs, schoolchildren and youth in the field of solid waste management. Implementation of local measures by local executive authorities to conserve, protect and restore water resources.

For groundwater, an additional measure is also "Inventory, rehabilitation of observation wells and monitoring of groundwater in the Tisa River sub-basin". The previous inventory of wells in the Tisza sub-basin was carried out in 2006, when 31 wells were found to be in working condition (23 - groundwater, 2 - interstitial water, 6 - at the reference sites for studying operational reserves), in 2018 only 19 groundwater wells remained. Since 2018, groundwater monitoring has not been carried out, and the condition of water intake facilities is unknown. The inventory is necessary to resume monitoring observations and assess the need to drill additional observation wells.

8.4 Overall assessment of the effectiveness of the proposed measures for the LIP

The RP includes measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources, measures to improve/restore the hydrological regime and morphological indicators in case of disturbance of free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology, and other additional measures aimed at achieving or maintaining the "good" status/potential of the MES. Some measures have an impact on several GWEs. The largest share of measures is aimed at reducing pollution of IWRs (77%). The general structure of the PAs in terms of proposed measures for surface waters of the Tisza sub-basin is presented in Figure 86.

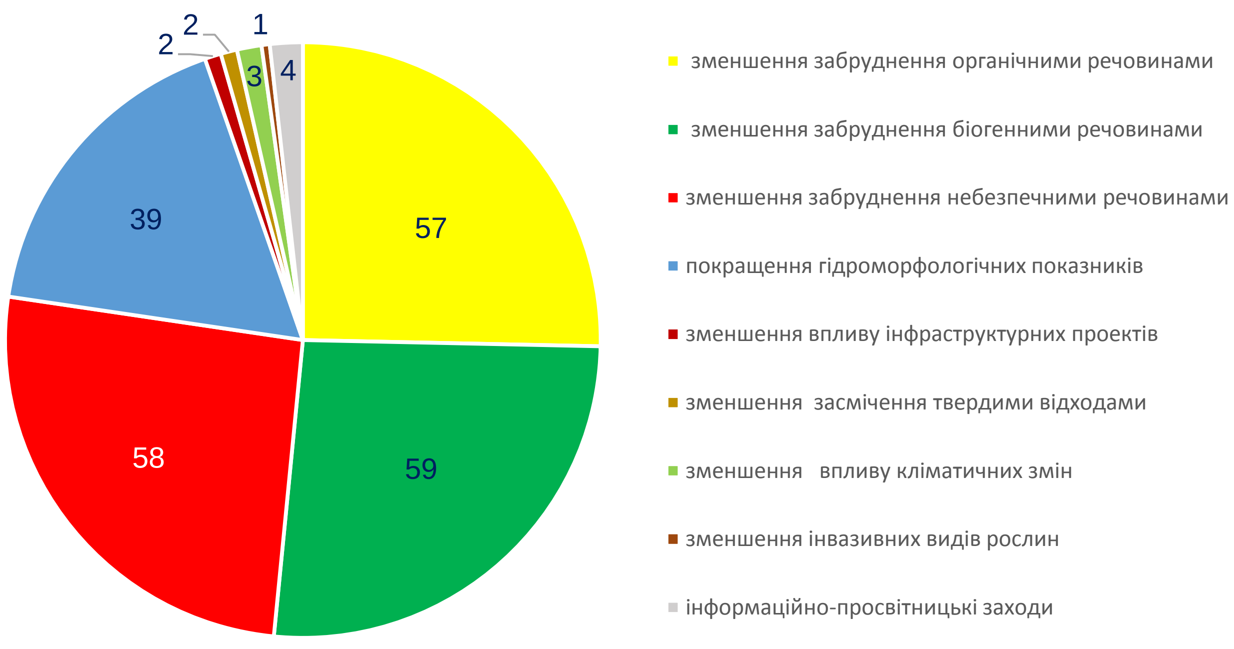


Figure 86. Main and additional measures for the Tisza RBM MEA, number of measures

The overwhelming majority of measures relate to communities/settlements with a population of 2.0 to 10.0 thousand. There are 82 (80%) of such measures, and only 16 (16%) for hromadas with a population of 10 to 100.0 thousand - these are practically measures in the administrative and rayon centres of the oblast (Mukachevo, Berehove, Khust, Tyachiv, Rakhiv). There are only 4 measures for the agglomeration with a population of more than 100.0 thousand, and these are measures for the Uzhhorod city. This social specificity of the measures is due to the fact that the vast majority of the region's residents - 62.9% - live in rural areas. The population of one village in Zakarpattia is on average 1.4 thousand people (the average in Ukraine is 0.7 thousand). One fifth of the population lives in 192 settlements of the region that have the status of mountainous.

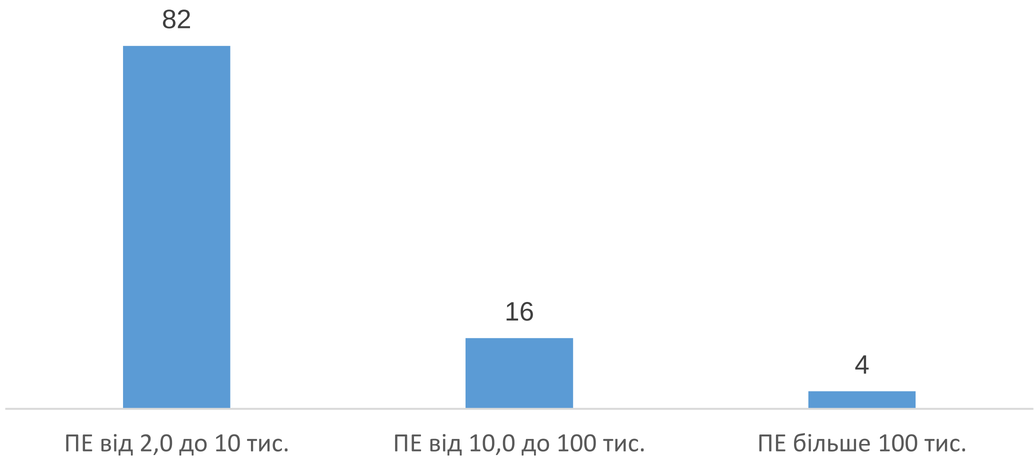


Figure 87. Number of measures depending on PE in the Tisza sub-basin

According to the RBMP Development Procedure, the measures envisaged in the RBMP will be financed from the state and local budgets, as well as other sources not prohibited by law. These measures shall be financed from the state budget within the limits of expenditures envisaged by the State Budget of Ukraine for the respective year.

The total cost of all the proposed measures for the period 2025-2030 is UAH 9,945.6 million, per AH (64) - UAH 155.4 million (UAH 25.9 million per year), per inhabitant of Zakarpattia (1.254 million people, data for 2020) - UAH 7,931.1 (UAH 1,321.9 per year). The most costly measures are the reconstruction/modernisation of the KWS and KM. For example, the implementation of such measures in the cities of Uzhhorod and Mukachevo requires up to UAH 2,363.2 million.

According to the cost-effectiveness analysis (CEA), no measures with a very high level of efficiency were identified among the proposed measures in the Tisa RDB.

The group with a high level of efficiency includes 4 measures: "Reconstruction of Sewage Treatment Facilities and Networks in Uzhhorod, Uzhhorod TG, Uzhhorod Rayon, Zakarpattia Oblast", "Reconstruction of Sewage Treatment Facilities and Networks in Mukachevo, Mukachevo TG, Mukachevo Rayon, Zakarpattia Oblast", "Reconstruction of Sewage Treatment Facilities and Sewerage Network in Berehove, Berehove TG, Berehove district, Zakarpattia region", "Reconstruction of sewage treatment facilities and sewerage network in Khust, Khust TG, Khust district, Zakarpattia region", with a total cost of UAH 3,407.0 million (34% of the cost of all measures in the sub-basin), one of them is very high cost, over UAH 1 billion. Social impact is expected for 288.1 thousand people. These measures are aimed at reducing pollution by organic, biogenic and hazardous substances - HAPs 1, 2, 3. All the objects of implementation of the measures belong to the sector of very high water use pressure - the housing and utilities sector.

The group with an average level of efficiency includes 50 measures with a total cost of UAH 3,995.9 million (40%). The measures are mainly aimed at addressing WUP 1-4 and WUP 10 - reducing pollution by organic, nutrient and hazardous substances, hydromorphological changes, and clogging of water bodies with solid waste in small towns and villages in the sub-basin. The social effect is 525,049 thousand people. 47 of the sites for implementation of the measures belong to the sector of very high water use pressure - the housing and communal sector. This group is the largest in terms of the number of measures.

The group with low efficiency includes 27 measures with a total cost of UAH 2,088.2 million (21%). These are mainly measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology (HUC 4), as well as HUCs: 5, and GVEPs 9-11. Social effect - 478.431 thousand people.

The group with a very low level of efficiency includes 21 measures with a total cost of UAH 454.5 million (5%) aimed at improving hydromorphological indicators (GWEP 4). The implementation of these measures will achieve a social effect for 59.2 thousand people. The economic sector's pressure on water resources is minimal and corresponds to the lowest score.

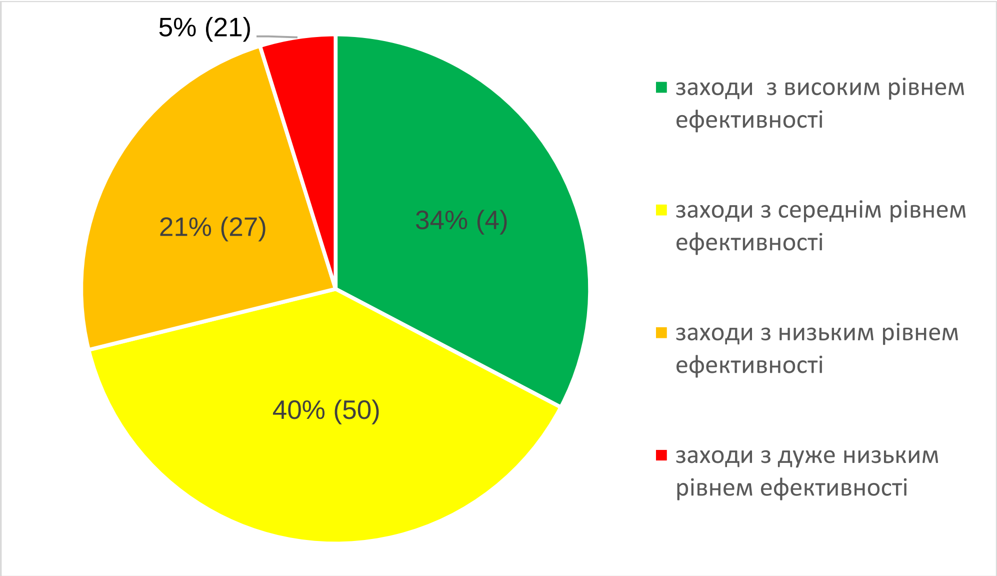


Figure 88. Distribution of measures with different levels of efficiency by total cost of measures

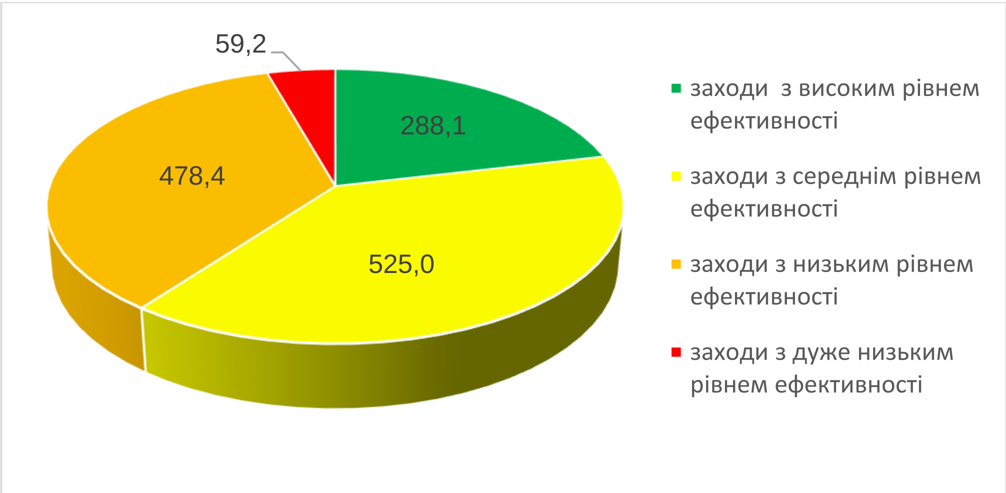


Figure 89. Distribution of measures with different levels of effectiveness by social component

A detailed AEA of the measures is provided in Annex 14 (M5.3.1).

9 REPORT ON PUBLIC INFORMATION AND PUBLIC DISCUSSION OF THE DRAFT RIVER BASIN MANAGEMENT PLAN

During 2022-2023, the Tisza River Basin Water Resources Management Authority (hereinafter referred to as the Tisza RWRA) consulted with the public of Zakarpattia Oblast on the main water and environmental issues (hereinafter referred to as the MAI) of the Tisza sub-basin, the development of a complete list of programmes (plans) for the Tisza sub-basin, their content and problems to be solved (hereinafter referred to as the PA), and the preparation of a draft Tisza River Sub-basin Management Plan (hereinafter referred to as the TRSMP) for 2025-2030.

In order to timely prepare the Danube RBMP, approved by the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine of 27 November 2020 No. 313 "Schedule for the development of the draft Danube River Basin Management Plan", to implement the orders of the State Agency of Water Resources of Ukraine of 16 May 2022 No. 44 "On approval of the action plan", of 18 December 2020 No. 1105 "On the development of draft river basin management plans", the Tisa RBMU held a working meeting with the Zakarpattia Department of Housing, Utilities and Energy Conservation. Based on the results of the working meeting, the First Deputy Head of the Zakarpattia Regional State Administration - First Deputy Head of the Regional Military Administration prepared and signed an instruction to the district military administrations (hereinafter referred to as RMAs) and executive bodies of local councils (hereinafter referred to as LCs) to submit proposals for the RMPs aimed at addressing the GWMPs of the Tisa river sub-basin (pollution by organic, nutrient and hazardous substances, hydromorphological changes, uncontrolled water use, and clogging) by 1 October 2022 for the respective

In order to ensure the preparation of the RAP for the development of the Tisza RBMP for the period 2025-2030, the Tisza RBMU prepared and sent letters to business entities providing water supply and sewerage services (water utilities), industrial enterprises, and agricultural enterprises, hotel, tourist and sanatorium complexes of the region that discharge waste water into surface water bodies (SWB) of the Tisza sub-basin with a request to submit their proposals to the RWP aimed at addressing the GWP of the Tisza river sub-basin no later than 1 October 2022.

At a regular meeting of the Tisza River Basin Council, a separate Working Group on the development of the Tisza RBMP software (hereinafter referred to as the Working Group) was established. The Working Group included representatives of the Tisza RBMU and the main surface water polluters (by agreement).

The working group processed all proposals aimed at addressing the GWEI of the Tisza river sub-basin, summarised and presented the RBMP for the period 2025-2030 at the meeting of the Tisza River Basin Council on 30 September 2023.

In accordance with the Law of Ukraine "On Strategic Environmental Assessment" dated 20.03.2018 No. 2354-VIII, river basin (sub-basin) management plans are subject to strategic environmental assessment (SEA) prior to their approval.

According to Art. 2 of the Law of Ukraine "On Strategic Environmental Assessment", an SEA is mandatory for projects of the PPA that meet two criteria at the same time: related to agriculture, forestry, fisheries, energy, industry, transport, waste management, water resources, environmental protection, telecommunications, tourism, urban planning or land management (scheme) and the implementation of which will involve the implementation of activities (or contain activities and objects) for which the legislation

The SEA provides an opportunity to focus on a comprehensive analysis of the possible environmental impact of planned activities, which allows for a reasonable assessment of strategic documents in terms of environmental and health impacts, to reconcile them with each other and to use the results of this analysis to prevent or mitigate environmental impacts in the strategic planning process.

The SEA helps to increase the overall transparency of strategic decision-making and enables the opinions and suggestions of key stakeholders to be taken into account at an early stage of planning and development of the LDP.

The SEA provides for clear procedures for consultations and communication between key authorities, business and civil society representatives, which contributes to more informed and balanced decision-making.

The section will be supplemented after public consultations in 2024 and the completion of the SEA procedure.

10 LIST OF COMPETENT STATE AUTHORITIES RESPONSIBLE FOR IMPLEMENTING THE RIVER BASIN MANAGEMENT PLAN

According to part two of Article 13 of the Water Code of Ukraine, the Cabinet of Ministers of Ukraine, the Council of Ministers of the Autonomous Republic of Crimea, village, town and city councils and their executive bodies, district and regional councils, executive authorities and other state bodies are responsible for public administration in the field of water use and protection and water resources restoration in accordance with the legislation of Ukraine.

The executive authorities in the field of water use and protection and water resources reproduction are the Ministry of Ecology, the State Water Agency, the State Geological Survey, the State Ecological Inspectorate and other bodies in accordance with the law.

Table 68. Central executive authorities in the field of water use and protection and water resources restoration

Name of the body (full and abridged)	Legal address	Official website
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	35, Metropolitan Vasyl Lypkivsky Street, Kyiv, 03035; tel.: (044) 206-31-00, (044) 206-31-15; fax: (044) 206-31-07; e-mail: info@mepr.gov.ua	www.mepr.gov.ua
State Agency of Water Resources of Ukraine (SAWR)	8 Velyka Vasylkivska St., Kyiv, 01024; tel./fax: (044) 235-31-92; tel. (044) 235-61-46; e-mail: dar@davr.gov.ua	www.davr.gov.ua
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	16, Anton Tsedik Street, Kyiv, 03057; tel: (044) 536-13-18; e-mail: office@geo.gov.ua	www.geo.gov.ua
State Environmental Inspectorate of Ukraine (SEI)	3, building 2, Novopecherskyi lane, Kyiv, 01042 tel./fax +38 (044) 521-20-40, tel: (044) 521-20-38; e-mail: info@dei.gov.ua	www.dei.gov.ua

Table 69. Main regulatory acts that define the powers of central executive authorities in the field of water use and protection and water resources reproduction

Name of the body (full and abridged)	Legal act	Link on the official web portal of the Verkhovna Rada of Ukraine
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Articles 15 and 15^1	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the Ministry of Environmental Protection and Natural Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 25 June 2020, No. 614 (Official Gazette of Ukraine, 2020, No. 59, p. 32, Article 1853)	https://zakon.rada.gov.ua/laws/show/614-2020-%D0%BF#Text

State Agency of Water Resources of Ukraine (SAWR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 16	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Agency of Water Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 20 August 2014, No. 393 (Official Gazette of Ukraine, 2014, No. 71, p. 34, Article 1995)	https://zakon.rada.gov.ua/laws/show/393-2014-%D0%BF#Text
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 17	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Service of Geology and Subsoil of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 30 December 2015 No. 1174 (Official Gazette of Ukraine, 2016, No. 3, p. 284, Article 192)	https://zakon.rada.gov.ua/laws/show/1174-2015-%D0%BF#Text
State Environmental Inspectorate of Ukraine (SEI)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 15[2]	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Environmental Inspectorate of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 19 April 2017 No. 275 (Official Gazette of Ukraine, 2017, No. 36, p. 73, Article 1131)	https://zakon.rada.gov.ua/laws/show/275-2017-%D0%BF#Text
	Regulation on Territorial and Interregional Territorial Bodies of the State Environmental Inspectorate, approved by the Order of the Ministry of Energy and Environmental Protection of Ukraine dated 07 April 2020 No. 230, registered with the Ministry of Justice of Ukraine on 16 April 2020 under No. 350/34633 (Official Gazette of Ukraine, 2020, No. 33, p. 25, Article 1116)	https://zakon.rada.gov.ua/laws/show/z0350-20#Text

In order to ensure the implementation of the state policy in the field of management, use and reproduction of surface water resources within the Tisza River Sub-basin Area (hereinafter - the TISZA), to direct and coordinate the activities of organisations under the management of the State Agency of Water Resources of Ukraine on the management, use and reproduction of surface water resources within the Tisza River Sub-basin Area, as well as to ensure the implementation of the state policy in the field of water management within the Transcarpathian region, the State Agency of Water Resources of Ukraine established the Basin Department

Table 70. Representative of the central executive authority in the field of water use and protection and water resources restoration in the Tisza River sub-basin

Name of the body (full and abridged)	Legal address	Tel./fax	Email.	Website.
Basin water management Tisza River (Tisza Boulevard)	5 Slavyanskaya Embankment, м. Uzhhorod, 88018	(0312) 64-61-91	office@buvrtysa.gov.ua	buvrtysa.gov.ua

(*Source:* https://davr.gov.ua/vodogospodarskiorganizacii)

The names of sub-basins and water management areas (WMAs) within river basin districts (RBDs) and sub-basins (SBWAs) are given in the Annex to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 25 dated 26 January 2017 "On the Allocation of Sub-Basins and Water Management Areas within Established River Basin Districts", registered with the Ministry of Justice of Ukraine on 14 February 2017 under No. 208/30076 (https://zakon.rada.gov.ua/laws/show/z0208-17#Text).

The boundaries of the RRB, RRSB and IOP were approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 dated 03 March 2017, registered with the Ministry of Justice of Ukraine on 29 March 2017 under No. 421/30289 (https://zakon.rada.gov.ua/laws/show/z0421-17#Text).

The Tisza RBMU is a budgetary non-profit organisation that is managed by the State Water Agency. The Regulation on the Tisza RBMU was approved by the Order of the State Agency of Water Resources of Ukraine No. 83 dated 12 July 2023 (https://buvrtysa.gov.ua/newsite/?page_id=56).

The purpose of the Tisza River Basin Council is to develop proposals and ensure coordination of interests of enterprises, institutions and organisations in the field of water use and protection and water resources restoration within the Tisza RBF, to promote integrated water resources management within the Tisza RBF, to ensure coordination of interests and coordination of actions of stakeholders in water resources management within the Tisza RBF, to promote cooperation between central and local executive authorities, local self-government bodies, enterprises, institutions, organisations, international organisations, and the public. The Tisza River Basin Council is an advisory body of the State Agency of Ukraine for Water Resources within the Tisza River RBM. The Regulation on the Tisza River BR was approved by the Order of the State Agency of Water Resources of Ukraine No. 887 dated 26 November 2018 (https://buvrtysa.gov.ua/newsite/wp-content/uploads/2018/08/polojennya.pdf).

According to the List approved by Resolution of the Cabinet of Ministers of Ukraine No. 1371 dated 13 September 2002 (as amended by Resolution of the Cabinet of Ministers of Ukraine No. 1276 dated 30 November 2011) (https://zakon.rada.gov.ua/laws/show/1371-2002-%D0%BF#n38), the Ministry of Environment and/or the State Agency of Water Resources of Ukraine are responsible for fulfilling international obligations in the field of water protection arising from Ukraine's membership in international organisations or in accordance with international treaties concluded by Ukraine.

In addition, pursuant to Article 9 of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (https://zakon.rada.gov.ua/laws/show/801-14#Text), the Government of Ukraine has concluded bilateral agreements on the protection of border/boundary waters, the responsibility for which lies with the State Agency of Water Resources:

- Agreement between the Government of Ukraine and the Government of the Republic of Hungary on Water Management on Boundary Waters of 11 November 1997 (https://zakon.rada.gov.ua/laws/show/348_001-97#Text)
- Agreement between the Government of Ukraine and the Government of the Slovak Republic on Water Management on Boundary Waters of 14 June 1994 (https://zakon.rada.gov.ua/laws/show/703_061#Text)
- Agreement between the Government of Ukraine and the Government of Romania on Cooperation in the Field of Water Management on Boundary Waters of 30 September 1997 (https://zakon.rada.gov.ua/laws/ show/642_059#Text).
- The Commissioners of the Cabinet of Ministers of Ukraine for Cooperation on Boundary Waters and their deputies were appointed by the Resolution of the Cabinet of Ministers of Ukraine No. 126 of 10 March 2017 as amended (as amended by the Resolutions of the Cabinet of Ministers of Ukraine No. 489 of 05.06.2019, No. 45 of 13.01.2021, No. 1186 of 18.10.2022) (https://zakon.rada.gov.ua/laws/show/126-2017-%D0%BF#Text).

11 PROCEDURE FOR OBTAINING INFORMATION, INCLUDING PRIMARY INFORMATION, ON THE STATE OF SURFACE AND GROUNDWATER

In order to ensure proper organisation of access to public information, implementation of the Law of Ukraine "On Access to Public Information", Presidential Decree No. 547 of 05 May 2011 "Issues of Ensuring Access to Public Information by Executive Authorities", resolutions of the Cabinet of Ministers of Ukraine No. 583 of 25 May 2011 "Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the Secretariat of the Cabinet of Ministers of Ukraine, Central and Local Executive Authorities", No. 835 of 21 October 2015 "On Approval of the Regulation on

To regulate the procedure for access to public information, the State Agency of Ukraine for Water Resources adopted Order No. 163 dated 08.12.2023 "On Certain Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the State Agency of Ukraine for Water Resources".

In accordance with paragraphs 16-18 of the Procedure for State Water Monitoring, approved by Resolution of the Cabinet of Ministers of Ukraine No. 758 of 19 September 2018, the results of state water monitoring are:

- Primary information (observation data) provided by the subjects of state water monitoring;
- generalised data relating to a certain period of time or a certain territory;
- Assessment of the ecological and chemical state of surface water bodies, the ecological potential of artificial or significantly altered surface water bodies, the quantitative and chemical state of groundwater bodies, the ecological state of marine waters and identification of sources of negative impact on them;
- forecasts of water conditions and their changes;
- scientifically based recommendations necessary for making management decisions in the field of water use and protection and water resources reproduction.

Subjects of state water monitoring are obliged to store primary information (observation data) obtained as a result of state water monitoring for an indefinite period of time.

The information obtained and processed by the state water monitoring bodies is official.

Primary information (observation data), generalised data, assessment results, forecasts and recommendations resulting from the state water monitoring are provided free of charge:

- for surface waters (including coastal waters) - to the State Agency of Water Resources and the Ministry of Environment;
- for groundwater massifs - to the State Service of Geology and Subsoil of Ukraine and the Ministry of Ecology and Natural Resources, as well as to the State Agency of Water Resources in terms of generalised data, assessment results and forecasts;
- for marine waters - the Ministry of Environment.

The subjects of state water monitoring shall exchange information with each other on the data and results of state water monitoring on a free-of-charge basis.

The State Agency of Ukraine for Water Resources collects and publishes information on the state of surface waters in the public domain by maintaining the following information resources:

- Water Resources of Ukraine geoportal (http://geoportal.davr.gov.ua:81/);
- the web-based system "Monitoring and Environmental Assessment of Water Resources of Ukraine" (http://monitoring.davr.gov.ua/EcoWaterMon/GDKMap/Index).

Automatic data exchange has been set up between these information resources and the Ministry of Ecology's EcoHazard resource.

MANAGEMENT PLAN RIVER SUB-BASINS ROD AND SIRETTE (2025-2030)

December 2023

1 GENERAL CHARACTERISTICS OF **SURFACE** AND GROUNDWATER **SUB-BASINS OF THE PRUT AND SIRET U**

1.1 Description of the river sub-basin

1.1.1 Hydrographic and water management zoning

The transboundary sub-basins of the Prut and Siret are located in three countries: Ukraine, Romania and the Republic of Moldova.

The catchment area of the Prut sub-basin rivers within Ukraine **is** 8849 km^2 .

The Prut River sub-basin is located within Ivano-Frankivsk and Chernivtsi regions. The hydrographic network of the sub-basin includes 113 rivers with a catchment area of more than 10 km^2 and 2 reservoirs (with a volume of more than 1 million m).[3]

The catchment area of the Siret sub-basin rivers within Ukraine is 2070 km^2 .

The Siret River sub-basin is entirely located within one region - Chernivtsi.

The hydrographic network of the sub-basin includes 20 rivers with a catchment area of more than 10 km^2 , and no reservoirs with a volume of more than 1 million m .[3]

The Prut and Siret sub-basins cover 1.9% of Ukraine's territory.

According to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 3 March 2017 "On Approval of the Boundaries of River Basin Areas, Sub-basins and Water Management Areas", two water management areas were allocated in the Prut and Siret sub-basins.

1.1.2 Climate.

The climate is temperate continental and its peculiarities are determined by the location of sub-basins on the border of Volyn-Podillya and the alpine mountain formations of the Carpathians. The climate conditions are formed under the influence of continental air masses from the east and southeast and humid maritime air masses from the west and southwest.

Precipitation is distributed very unevenly and depends on the altitude and exposure of the slopes. The greatest amount of precipitation falls in the mountains at an altitude of over 1000 m and amounts to 1200-1500 mm per year, and in the foothills - 600-700 mm per year. The western and southwestern exposure slopes receive the most precipitation. The bulk of precipitation (70-80%) falls during the warm season, and 20-25% of the annual precipitation falls in winter. The snow cover is unevenly distributed depending on the forest cover, altitude, and relief forms.

The spring floods begin in March. A characteristic feature of the spring period is floods of mixed origin, when rainfall contributes to the river's nutrition along with meltwater runoff. The water level rise in spring is 0.5-1.5 metres.

Summer and autumn floods occur during the warm season. Floods occur most often in May and July, less frequently in August, and even less frequently in September and October. During floods, the water level rises very sharply with an intensity of 15-20 cm per hour, and the water level drops by 10-15 cm. In normal years, the rise in water level during floods is 1.5-2.0 m, and in significant floods - 5-6 m.

The winter period is characterised by frequent intrusions of warm, humid air from the west and southwest. This causes the snow cover to melt rapidly, leading to high water levels. The recurrence of floods varies greatly from year to year, and it is impossible to determine the frequency of their recurrence. The frequency of floods decreases in autumn (October-November) and during winter.

1.1.3 Terrain

The Prut sub-basin is pear-shaped with an average width of 40 km. The basin is divided into three parts: mountainous, foothill and plain. The mountainous part of the basin consists of medium-altitude ridges of the Ukrainian Carpathians, which run almost parallel to each other from northwest to southeast, like the entire arc of the Carpathians. The mountainous part is divided into three zones: the axial zone, the Central Carpathian Depressions zone and the Skibovy Carpathians zone. The axial zone includes the Chornohora massif (Hoverla) and is marked by the deepest dissection, reaching 500 m. Some peaks reach a height of 2000 m (Pip Ivan, Petros). The Central Carpathian Depression has absolute heights of 800-950 m. The Skibovi Carpathians zone is an alternation of narrow parallel asymmetrical ridges. The mountain ranges adjacent to the plain with absolute heights of 700-800 m are called the Kraevy Karpaty. The foothill part of the sub-basin occupies the area between the Carpathians and the Prut. This area is characterised by a complex, rugged relief. The absolute height is 350-550 m. The plain part of the basin lies on the Prut-Dniester interfluve and is drained by the left tributaries of the Prut, which form a wavy valley and gully relief.

The area of the Siret River sub-basin is unevenly distributed in terms of altitude zones. A significant part of it is 400-600 m and only 0.7% of the area is above 1200 m. The uppermost, south-western part of the basin up to the village of Beregomet is located on the spurs of the Carpathians. The watersheds run along separate ridges, with mountain peaks reaching 1000-1300 metres. The ranges have rounded flat peaks, steep slopes are dissected by numerous river valleys. Gradually, the mountains give way to a foothill zone (Prykarpattia-Bukovyna) with elevations of 500-600 m, which passes into the Podilske plateau. Landslides contribute to the formation of soft surface forms. A part of the Siret sub-basin is located in the Eastern Carpathians, in the Pokutsko-Bukovyna Carpathians and on the Bukovyna foothills.

1.1.4 Geology

Part of the Prut sub-basin is located in the Carpathians and is composed of Mesozoic sediments (shale, quartzite) overlain by Tertiary flysch (sandstones, clays, marls and limestones) and thicker Quaternary alluvial gravel deposits.

An analysis of the geological structure of the Prut sub-basin has shown that the most water-rich aquifers are in the southern part of the Precarpathian trough. In the areas along the left bank of the Prut, water is associated with alluvial deposits of the Eopleistocene and Lower Pleistocene. The water-bearing rocks here are sands and pebbles of the floodplain terraces up to 20 m thick.

The mountainous part of the Siret sub-basin is composed of Paleozoic mica and other metamorphic shales, the foothill part is composed of sandstones, clay shales and limestones (mainly Cretaceous), and the plain part is composed of sandstones, marls, limestones and clay shales. Aquifers with water suitable for drinking and other technical purposes are found in the sand and sandstone layers at a depth of 250-300 m, but they are not widespread.

1.1.5 Hydrogeology

There are three hydrogeological areas in the Prut and Siret sub-basins: Volyn-Podillya artesian basin, Predkarpatsky foothill artesian basin, and the Carpathian fold region.

The Volyn-Podillya artesian basin occupies the Prut-Dniester and partially the Prut-Siret interfluve. The area is covered by sedimentary rocks of the Paleozoic, Mesozoic and Cenozoic periods, which are represented by clay-sandy deposits. The area is also covered by a cover of eluvial-deluvial loams. A densely developed river network results in significant groundwater drainage and a predominance of surface runoff over groundwater.

The Pre-Carpathian foothill artesian basin occupies the area in front of the Carpathian trough and in geostructural terms occupies an intermediate position between the weakly dislocated sediments of the Volyn-Podilska plate and the intensely dislocated sediments of the Carpathians. The rocks are dominated by molasses and flysch clay formations. A special feature is that almost all groundwater accumulated in it is highly mineralised.

The Carpathian fold region occupies the southwestern part of Chernivtsi Oblast. Its geological structure consists of flysch formations of the Paleogene and Cretaceous. The hydrogeological conditions are mainly due to tectonic features.

A characteristic feature is the presence of karst in the Neogene sediments.

1.1.6 Soils

In the Prut River valley, chernozems are becoming more widespread: podzolised, shallow and deep low-humus soils. In the lower reaches, moisture deficit has led to the spread of southern chernozems and chestnut soils with signs of salinity.

Part of the Prut sub-basin, within the mountains, consists of sandy-light and medium loamy, sometimes sod-podzolic soils in combination with podzolic, occasionally mountain peat-podzolic soils. The channel is composed mainly of sandy-pebble and pebble-stony soils.

The mountainous part of the Siret sub-basin is dominated by medium-podzolic and mountain podzolic soils, while in the foothills and on the plain they are replaced by soddy-medium podzolic surface-ashy soils, and in the river valleys by soddy-podzolic-ashy soils in combination with meadow podzolic soils. By their mechanical composition, the soils in the mountains are sandy-medium loamy, and on the plains - light loamy. The underlying layer has low water permeability.

1.1.7 Vegetation

Vegetation plays an important role in shaping the hydrological regime of rivers and reservoirs and water quality. About 35% of the Prut River sub-basin is covered by broadleaf and coniferous forests. The forested Carpathians have a pronounced landscape zonation. The foothill zone is characterised by oak and hornbeam forests, where winter oak and Western European beech, typical of Western Europe, grow alongside summer oak.

The lower slopes of the mountains (300-600 m) are occupied by broadleaf forests (summer oak, hornbeam, beech, maple, linden, sometimes with spruce and fir). Such forests are also found above 600 m, but are somewhat modified, with beech predominating with increasing altitude and conifers playing an increasingly important role. Spruce forests dominate at altitudes of 1350-1600 m. The mountain tops are occupied by subalpine meadows, mountain pine and alder thickets. The left-bank part of the Prut sub-basin is mostly open and ploughed, with sparse forests.

A significant part of the Siret sub-basin (41% of the total area) is covered by forests. The foothills and mountain slopes up to an altitude of 600 m are predominantly oak forests, above and up to 1000 m beech forests prevail, and even higher, up to 1300 m, coniferous forests.

The tops of some mountains are open and represent subalpine meadows - polonyny.

In the flat part, the forest has been preserved only in some places, while the rest of the area has been ploughed and covered with meadows.

1.1.8 The animal world

The fauna in the Prut and Siret sub-basins is diverse. The vertebrate fauna alone within the Ukrainian Carpathians includes 435 species. The inhabitants of the Central European broadleaf forests include red deer, European roe deer, and marsh turtle; representatives of the Mediterranean Sea include green frogs and spotted salamanders; and inhabitants of the Siberian taiga include grouse and black grouse.

There are many endemic species, such as the Carpathian squirrel and the Carpathian newt. Brown bears migrate from the river valleys to subalpine shrubs for the summer. Predators include martens, ferrets, lynxes, and wolves.

Almost 200 species of birds live in forests, gardens, fields and water bodies. Most of them are forest dwellers (numerous species of passerines: woodpeckers, pigeons). Wetlands are inhabited by coots, waders, herons, and storks. There are also mountain plover, jay, mountain siskin and Carpathian grouse.

The rivers of the Prut and Siret sub-basins are home to a variety of fish species: Ukrainian lamprey, sterlet, brook trout, rainbow trout, pike, roach, verizub, oatmeal, rudd, tench, bream, pike perch, perch, goby, crucian carp, bream, catfish, ruff, carp, chub, silver bream, burbot, minnow, and dace. The fast current, rocky, liquid muddy bottom, poor plankton and poorly developed vegetation determined the composition of the fish fauna. Rhyophilous, omnivorous species are common here, laying their eggs on stony or shaved sandy substrates.

1.1.9 Hydrological regime

Prut River sub-basin

Food: snow and rain.

The main area of Prut runoff formation is the upper part of the sub-basin, whose watercourses are characterised by flood conditions throughout the year, and its foothill section up to Chernivtsi (6890 km^2 , 25% of the total catchment area).

In the Carpathian area of the Prut sub-basin, the average long-term values of the annual runoff module are the highest (16.2-20.6 l/s km^2), in the foothill area (Chernivtsi) - 10.7 l/s km^2 and the lowest in the Podilska part of the Prut sub-basin (Leovo, Republic of Moldova) - 3.13 l/s km^2 . Thus, the upper part of the basin accounts for about 2/3 of the annual flow of the Prut.

The average annual discharge is 78-94 m^3 /s, with fluctuations from 40 to 162 m /s.[3]

Intra-annual runoff distribution

The water resources of the Prut River are unevenly distributed throughout the year. The highest discharges are observed from April to July, with a maximum average discharge in June of 124-127 m /s^3 . Minimum discharges of no more than 60 m^3 /s are recorded in the winter months.

The annual rainfall in the Prut sub-basin is significantly influenced by the altitude of the area. Precipitation is very unevenly distributed over the territory and increases with increasing altitude. On average, the increase in annual precipitation amounts to 13-15% with a rise of 100 m. The bulk of precipitation falls during the warm season. In winter, 20-25% of the annual precipitation falls. On average, there are 150-190 days of precipitation per year. Effective rains from a hydrological point of view (those that form a hydrological runoff) fall 5-20 times a year.

The snow cover is unevenly distributed across the territory, depending on the forest cover, the roughness of the terrain, and the terrain. The average water content in snow in the mountainous areas is 40-50 mm, and 20-30 mm in the plains.

The maximum runoff is formed due to intense rainfall. The amount of precipitation per day can be 300-320 mm. Heavy rainfall causes catastrophic floods. They occur mainly in June and August.

The lowest runoff is observed in late summer, autumn and winter. During this period, the amount of precipitation decreases. Winter minimums are usually lower than summer minimums.

The ice regime is characterised by instability. The main phases of the ice regime depend on the altitude. The average duration of the period with ice phenomena lasts 80-140 days.

Increased storm activity on the north-eastern slopes of the Carpathian Mountains causes frequent storm floods, which is a characteristic feature of the Prut regime. The Carpathian tributaries of the Prut River are mountain rivers with high gradients, rocky boulder and pebble beds and low-lying underlying soils. Air humidity is high and evaporation is low. The orographic and climatic features noted create favourable conditions for surface runoff.

Siret River sub-basin

The Siret sub-basin is fed by snow and rain. The main area of Siret runoff formation is the upper part of the basin, whose watercourses are characterised by a flood regime throughout the year.

On the Carpathian territory of the Siret sub-basin, the average long-term values of the annual runoff module are the highest - 15.7 l/s km^2 (Lopushna village), and downstream - 8.2 l/s km^2 (Storozhynets town). The average annual discharge is 5.51 m^3 /s (Storozhynets).

Intra-annual runoff distribution

The intra-annual flow regime is characterised by floods from March to August, during which the rivers in the Siret sub-basin carry an average of 55-70% of the annual runoff. This period includes the seasons of spring (March-May) and summer (June-August). The season that accounts for the smallest share of the annual runoff (10-15%) is winter (December-February). This season also has the lowest monthly runoff - about 1% of the annual runoff.

The annual precipitation pattern in the Siretu sub-basin is significantly influenced by the altitude of the area. Precipitation is very unevenly distributed over the territory and increases with increasing altitude. On average, the increase in annual precipitation is 13-15% with an elevation of 100 m.

The snow cover in the sub-basin is unevenly distributed, depending on the forest cover, the brokenness of the relief, and the terrain. The average water content in snow in the mountainous part is 40-50 mm, and 20-30 mm in the plains.

The maximum runoff is formed due to intense rainfall. The amount of precipitation per day can be 300-320 mm. Heavy rainfall causes catastrophic floods. They occur mainly in June and August.

The ice regime is characterised by instability. The main phases of the ice regime depend on the altitude. The average duration of the period with ice phenomena in the Siret sub-basin at altitudes of 501-700 m asl is 105-125 days, at altitudes of 251-500 m asl - 95-115 days, and at altitudes less than 250 m absc. - 85-110 days.

1.1.10 Specifics of river sub-basins

Increased storm activity on the north-eastern slopes of the Carpathian Mountains causes frequent storm floods, which is a characteristic feature of the Prut and Siret regime. The Carpathian tributaries of the rivers are mountain rivers with high gradients, rocky boulder and pebble beds and low-lying underlying soils. Air humidity is high and evaporation is low. The orographic and climatic features create favourable conditions for surface runoff.

After the confluence with the Cheremosh, the Prut's water content almost doubles. The rapid increase in water content occurs in the foothills, where the river receives its right tributaries. A characteristic feature of the Prut River is that it reaches its full water content in the vicinity of Chernivtsi.

An important feature of the Prut and Siret rivers is their high water content and frequent flooding, which poses a real threat not only to the economic sector but also to the lives of people living in the Prut and Siret sub-basins.

The Prut sub-basin is home to two internationally important wetlands located within the Carpathian National Nature Park, which were designated by the Ramsar Secretariat in 2019. Functioning as flood regulators and freshwater reservoirs, the wetland is a habitat for biodiversity, including endemic, rare and threatened species listed in the Red Data Book of Ukraine and the IUCN Red List. Due to its favourable climate and attractive landscapes, the wetland is very popular with visitors. Human activity has a significant impact on the ecosystems of these areas. There are certain gaps in the management of these ecosystems, including an integrated monitoring system.

1.1.11 Typology of surface water bodies

The IWM typology was developed in accordance with the Methodology for Determining Surface Water Massifs (hereinafter - the Methodology) approved by the Order of the Ministry of Ecology and Natural Resources No. 4 dated 14 January 2019 to detail the hydrographic zoning of Ukraine, prepare a state water monitoring programme, and develop and evaluate the effectiveness of the RBMP implementation.

In the Prut and Siret river sub-basins, two categories of surface water bodies have been identified - rivers and significantly altered surface water bodies (hereinafter referred to as "SAWBs").

The EU WFD system A was used for river typology and delineation (Table 71).

Table 71. Descriptors for rivers (system A)

Descriptors		
Catchment height, m	**Catchment area, km²**	**Geological rocks**
• midlands: over 800 • lowlands: 500 - 800 • upland: 200 - 500 • lowland: < 200	• small: 10 - 100 • average: >100 - 1000 • Large: >1 000 - 10 000 • very large: > 10 000	• limestone • silicate • organic

In accordance with the above descriptors, 14 types of MNRs in the Prut and Siret sub-basins have been identified in the category of rivers (Table 72).

The sub-basins of the Prut and Siret rivers are located within two ecoregions - the Carpathians (number 10) and the Eastern Plains (number 16).

Rivers are classified as small (with a catchment area of less than 100 km^2), medium (100 to 1000 km^2), and large (1000 to 10,000 km^2) rivers by catchment area.

According to the elevation of the catchment area, the rivers of the sub-basin are located in the midlands (over 800 m), lowlands (500 to 800 m), uplands (200 to 500 m) and lowlands (less than 200 m).

The geological rocks of the Prut and Siret sub-basin are represented by one type: silicate (Si).

Table 72. Types of IBAs in the "rivers" category

№	Type code	Typ e
1	UA_R_10_S_2_Si	a small river on a hill in silicate rocks
2	UA_R_10_S_3_Si	a small river in the lowlands in silicate rocks
3	UA_R_10_S_4_Si	a small river in the middle mountains in silicate rocks

4	UA_R_10_M_2_Si	medium-sized river on a hill in silicate rocks
5	UA_R_10_M_3_Si	medium-sized river in the lowlands in silicate rocks
6	UA_R_10_M_4_Si	a medium-sized river in the midlands in silicate rocks
7	UA_R_10_L_2_Si	a large river on a hill in silicate rocks
8	UA_R_16_S_1_Si	a small river in the lowlands in silicate rocks
9	UA_R_16_S_2_Si	a small river on a hill in silicate rocks
10	UA_R_16_S_3_Si	a small river in the lowlands in silicate rocks
11	UA_R_16_M_1_Si	medium-sized river in the lowlands in silicate rocks
12	UA_R_16_M_2_Si	medium-sized river on a hill in silicate rocks
13	UA_R_16_L_1_Si	a large river in the lowlands in silicate rocks
14	UA_R_16_L_2_Si	a large river on a hill in silicate rocks

1.1.12 Reference conditions

The assessment of the ecological state of the MPA is based on a comparison of biological indicators (benthic macroinvertebrates, macrophytes, phytobenthos, phytoplankton and fish) with reference conditions that characterise the state of the MPA, which has not been subjected to anthropogenic impact or is minimal.

Reference conditions are determined on the basis of data obtained from reference sites, by modelling (predictive models or retrospective forecasting methods that take into account historical, paleogeographic and other available data that provide a sufficient level of confidence in the values for reference conditions for each type of MPE) or by a combination of these methods or based on expert opinion.

In order to establish reference values for biological indicators based on data from reference sites, it is necessary to establish such sites for each type of MPA of all natural categories. The network should cover a sufficient number of sites to provide a sufficient level of confidence and to account for the variability of values for indicators that correspond to the different ecological status of the MPA type.

Key criteria for selecting reference sites:

- characterise the state of the MPA without anthropogenic impact or with minimal impact;
- There is no industry or intensive agriculture;
- concentrations of specific synthetic pollutants are zero or below the detection limits;
- no morphological changes;
- water intake and flow control cause only minor fluctuations in water levels and do not affect surface water quality;
- the vegetation of the coastal zone is appropriate for the type of MPA and geographical location;
- no invasive species;
- fishing and aquaculture do not affect the functioning of the ecosystem.

In accordance with paragraph 2, clause VII. of the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14.01.2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Conditions of a Surface Water Body, as well as Assigning an Artificial [...]", type-specific reference conditions may also be determined on the basis of existing reference sites in other countries for the same type of MWB or by combining the procedures described above.

Given that reference conditions for all types of IPAs are not currently defined in Ukraine, it was proposed to use the reference conditions established for the same or similar types in neighbouring EU countries, namely the Republic of Moldova and Romania.

The methodology includes four hydrobiological indicators (benthic macroinvertebrates, phytoplankton, phytobenthos, macrophytes, macroalgae and eutrophication, respectively) for four natural categories of surface waters (rivers, lakes, transitional waters and coastal waters) that have been identified in Ukraine.

A draft order has been developed to approve environmental water quality standards for the MWR and to amend certain regulatory acts that establish reference conditions and type-specific classifications.

1.2 Defining arrays

1.2.1 Surface water and

In the Prut and Siret sub-basins, the MWC was determined on 133 rivers (according to the Water Resources of Ukraine geoportal of the State Agency of Water Resources of Ukraine).
Within the Prut and Siret sub-basins, 298 MNRs have been identified. The designated MPAs belong to the following categories of surface water:

- rivers;
- substantially modified (MSMR).

Category "rivers"
According to the Methodology, 249 MPEs were identified. The number of identified IAPs, depending on descriptors and types, is shown in Tables 73 and 74.

Table 73. Distribution of IBAs of the "rivers" category by descriptors

Descriptor	Indicator.	Number of MWPs
by eco-region	Eastern plains	110
	Carpathians	139
by catchment area	small (S)	201
	average (M)	42
	large (L)	6
by the height of the catchment area	in the midlands	44
	in the lowlands	61
	on a hill	113
	in the lowlands	31
by geological type	in silicate rocks	249

Table 74. Distribution of IBAs of the "rivers" category by type

№	Type code	Type	Number of designated MPAs
Ecoregion No. 10 Carpathians			
1	UA_R_10_S_2_Si	a small river on a hill in silicate rocks	27
2	UA_R_10_S_3_Si	a small river in the lowlands in silicate rocks	50
3	UA_R_10_S_4_Si	a small river in the middle mountains in silicate rocks	41
4	UA_R_10_M_2_Si	medium-sized river on a hill in silicate rocks	7
5	UA_R_10_M_3_Si	medium-sized river in the lowlands in silicate rocks	10
6	UA_R_10_M_4_Si	a medium-sized river in the midlands in silicate rocks	3
7	UA_R_10_L_2_Si	a large river on a hill in silicate rocks	1
Ecoregion 16 Eastern Plains			
8	UA_R_16_S_1_Si	a small river in the lowlands in silicate rocks	18
9	UA_R_16_S_2_Si	a small river on a hill in silicate rocks	64
10	UA_R_16_S_3_Si	a small river in the lowlands in silicate rocks	1
11	UA_R_16_M_1_Si	medium-sized river in the lowlands in silicate rocks	11
12	UA_R_16_M_2_Si	medium-sized river on a hill in silicate rocks	11
13	UA_R_16_L_1_Si	a large river in the lowlands in silicate rocks	2
14	UA_R_16_L_2_Si	a large river on a hill in silicate rocks	3

Category "significantly altered surface water bodies"

A total of 49 IWRMs have been identified in the sub-basins. The share of IZMVRs in the total number of MWRs in the sub-basins is 16.4%. Most of them (24 MWBs) are classified as IZMV due to morphological changes. 9 MWRs are classified as IZMV due to a combination of disruption of the continuity of water flow and media and accumulation. 16 MPAs are classified as IZMW due to a combination of disruption of water and media flow, accumulation and morphological changes (Figure 90).

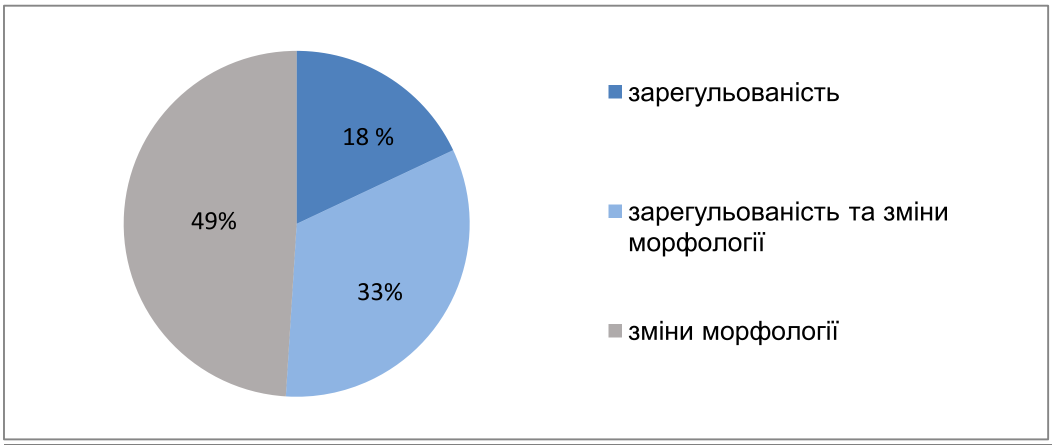


Figure 90. Distribution of IHMW by hydromorphological loads, %.

The percentage distribution of the identified WFDs in the Prut and Siret sub-basins by category is shown in Figure 91.

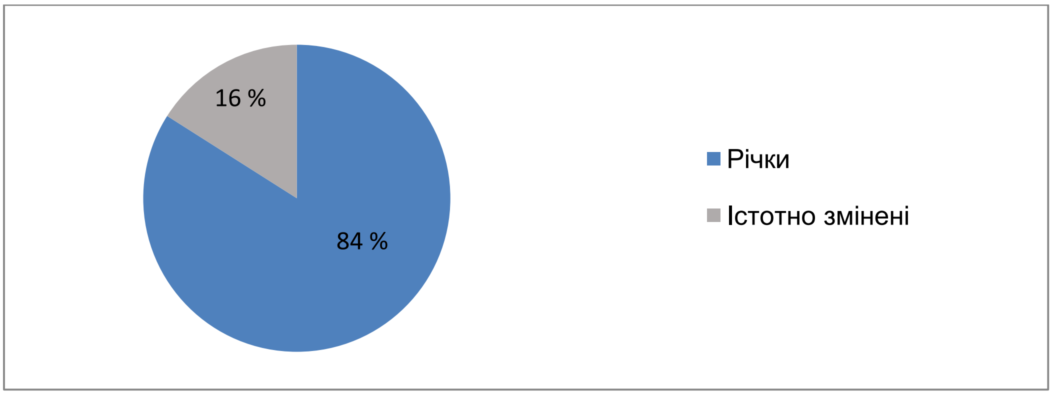


Figure 91. Breakdown of identified MSPs by category, %.

Each of the 298 MPAs identified in the Prut and Siret sub-basins has been assigned a unique code that looks like this:

UA_ M5.3.2 _YYYY, UA_ M5.3.3 _YYYY, where:

- UA - Ukraine;
- M5.3.2 and M5.3.3 - codes of the Prut and Siret sub-basins (according to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 29 March 2017 "On Approval of the Boundaries of River Basin Areas, Sub-basins and Water Management Areas");
- YYYY is the unique number of the identified WFD in the sub-basins.

Each linear IBA (categories "rivers", "artificial or significantly modified IBA") has a length (km). The length of the IBA ranges from 0.3 km (UA_M5.3.2_0143 - Vyzhenka River) to 119.7 km (UA_M5.3.2_0007 – Prut River).

Figure 92 shows the distribution of the identified linear MFLs in the sub-basins by length.

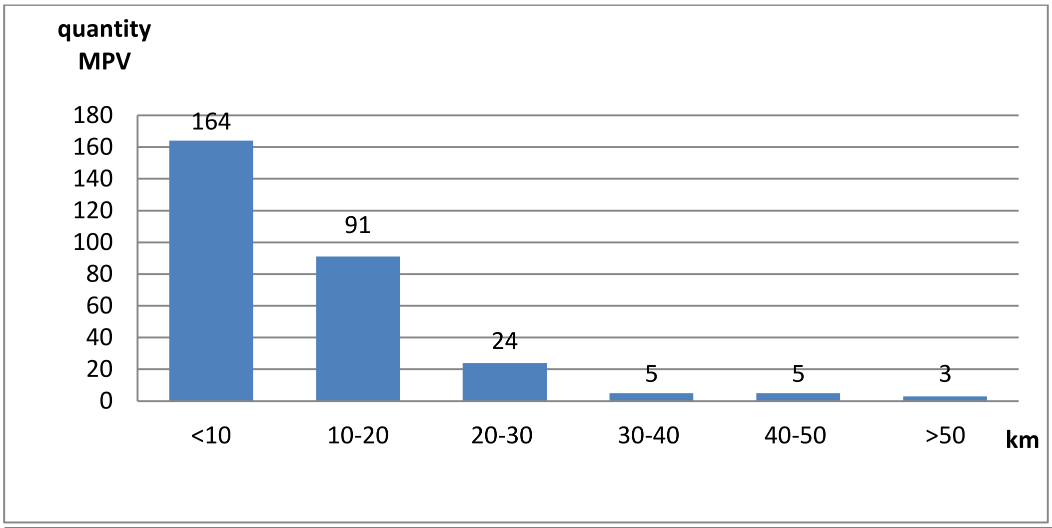


Figure 92. Distribution of the identified linear IPPs by length

Each polygonal MPA (of the "significantly altered MPA" category) has an area (km^2). The area of the MPAs ranges from 0.16 km^2 (UA_M5.3.2_0229 - Glodos River Reservoir) to 0.47 km^2 (UA_M5.3.2_0217 - Cherlena River Reservoir).

Figure 93 shows the distribution of the identified polygonal WFDs in the sub-basins by area.

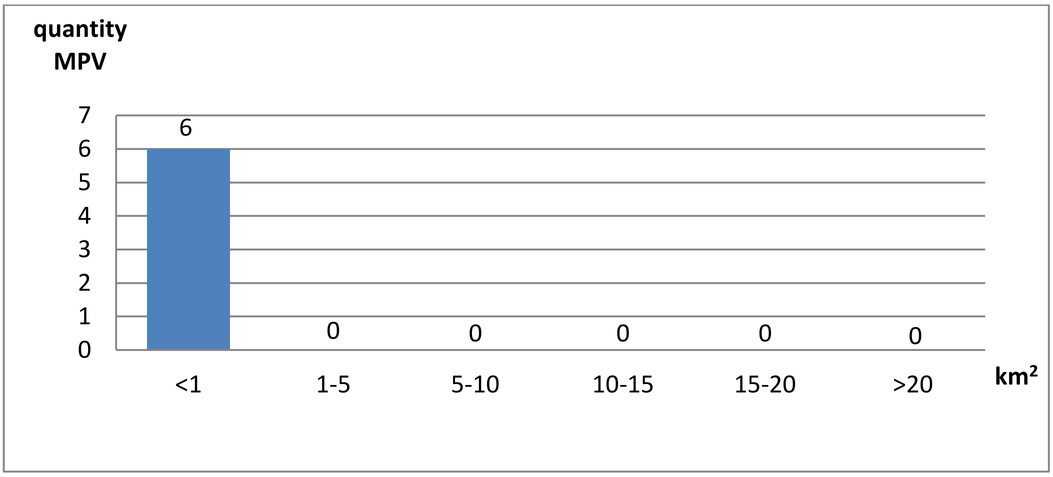


Figure 93. Distribution of identified polygonal MPAs by area

1.2.2 Groundwater and

The groundwater massifs were determined in accordance with the Methodology for Determining Surface and Groundwater Massifs (hereinafter referred to as the Methodology), approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 4 dated 14.01.2019.

In the process of identifying IBAs in the Prut and Siret sub-basins, 8 IBAs with a total area of 8471 km were identified^2 (Table 75). In total, 2 non-pressure IBAs, 2 pressure IBAs and 4 pressure and non-pressure IBAs were identified in the sub-basins.

In the process of defining the MWP, MWP codes were developed, for example, UAM5200Q100, where:

- *UA is a* country;
- *M5 is an* international maritime system code;
- *3* - river basin, according to the Water Code;
- *0* - river sub-basin, according to the Water Code;
- *0Q* - geological system (geological age of water-bearing rocks);
- *100* - the number of the MPZV.

Table 75. List of identified MNRMs in the Prut and Siret sub-basins

№	IPO code	Aquifer (complex)	Geological index	The area of the MWP, km²
1	2	3	4	5
Siret River sub-basin				
1	UAM5330Q100	MWP in alluvial sediments of Holocene floodplains and upper Neopleistocene floodplain terraces	a P +aH^{1-5}_{III}	379,0
2	UAM5330N100	MWP in Miocene sediments	N s_{11} , N_1 ks, N_1 tr, N_1 op	844
3	UAM533PG100	MWP in Paleocene-Eocene sediments	$₽_{1-2}$	327
4	UAM5330K100	MWP in Upper Cretaceous sediments	K_2	78
Prut River sub-basin				
5	UAM5320Q100	MWP in alluvial sediments of Holocene floodplains and upper Neopleistocene floodplain terraces	a P +aH^{1-5}_{III}	810
6	UAM5320N100	MWP in Miocene sediments	N s_{11} , N_1 ks, N_1 tr, N_1 op	5400
7	UAM532PG100	MWP in Paleocene-Eocene sediments	$₽_{1-2}$	252
8	UAM5320K100	MWP in Upper Cretaceous sediments	K_2	381

Characteristics of groundwater massifs in the Prut River sub-basin

MWP in alluvial sediments of Holocene floodplains and floodplain terraces Upper Neopleistocene

The aquifer in the alluvial deposits of Holocene floodplains and Upper Neopleistocene I-III overflow terraces (a P^{1-3}_{III+} aH) is confined to the floodplains of numerous rivers and streams. It is widely developed both on the platform and in the Precarpathian trough.

The main aquifer is associated with alluvial deposits of the floodplain and I-III overflow terraces of the Prut and Cheremosh rivers.

The aquifer is the first to be reached from the surface and is usually unconfined. Water-bearing rocks are characterised by a variety of lithological and particle size distribution. Within the Carpathians, they are represented by gravel and pebble, sometimes coarse rubble material cemented with different grains of sand or clay. Within the Outer Zone of the Fore-Carpathian Trough and partly of the platform, in the valleys of the Prut and Cheremosh rivers and their tributaries, water-bearing modern alluvial deposits are mainly sands, fine and medium gravels, and occasionally loams. In the area between the Prut and Dniester rivers, where rivers and streams are embedded in Miocene clays, individual waterlogged layers and lenses of sands and pebbles are most common in the thickness of modern alluvial clay deposits. In the Prut valley, the waterlogged aquifer is underlain by Miocene mudstone clays.

While the total thickness of modern alluvial deposits is up to 26 m, the thickness of water-bearing rocks varies from 0.4 to 17 m, with predominant values of 2-6 m (floodplains) and 7-10 m (terraces). The depth of the aquifer ranges from 0-11 m, with the most common occurrence at depths of 3-4 m. In areas of close occurrence of the aquifer to the surface, waterlogging is often observed.

The thickness of water-saturated rocks in the Prut and Cheremosh river valleys varies from 3.0 to 7.0 m, with filtration coefficients of 100-200 m/day, decreasing to 20-50 m/day in the lower reaches of the Prut River. The band of these rocks is sustained and its width is 500-800 m.

Alluvial deposits of the II and III terraces (a^{2-3} P_{II}) of the rivers. The Prut and Cheremosh rivers are more widely developed. Their developmental width is 5-7 km. The filtration coefficients of these sediments vary within a fairly wide range from 1.0 to 50 m/day. In general, the coarseness of the rocks and the value of their filtration coefficient decrease with distance from the riverbed.

The waters of the modern alluvial deposits are mostly fresh and have a varied chemical composition. Along with calcium bicarbonate waters, the platform contains calcium sulphate, sodium-calcium sulphate-hydrocarbonate, calcium-magnesium hydrocarbonate waters with salinity ranging from 0.5 to 1.8 g/dm^3 , which is caused by the inflow of highly saline waters from Miocene sediments and surface pollution. The total water hardness varies from 1.87 to 9.9 mg-eq/dm^3 , in some cases reaching 30-40 mg-eq/dm^3 .

Due to the absence of a water-resistant layer, the water is often contaminated with decay products of organic matter. The ammonia content is 0.4-0.08 mg/dm^3 , nitrates up to 225 mg/dm^3 (Novoselytsia).

The aquifer is recharged mainly by infiltration of precipitation and groundwater inflow from underlying aquifers, as well as by water inflow from rivers during floods (floodplains).

The water regime in modern alluvial deposits is closely dependent on the nature and amount of precipitation. The annual amplitude of water level fluctuations according to observations reaches 2-3 m, the water regime of the I-III floodplain terraces is unstable, with significant fluctuations depending on the amount of precipitation. The annual amplitude of water level fluctuations is 1.5-2 m.

The aquifer of modern alluvial sediments of Holocene floodplains and I-III over floodplain terraces of the Upper Neopleistocene is the main one for centralised water supply in the region and is widely used for water supply to the population and is the main one for assessing the state of forecast resources and operational groundwater reserves of the region.

The Middle Neopleistocene alluvial terrace aquifer (a^{4-5} P_{II}) is developed in the Prut River valley in the deposits of the IV-V floodplain terraces. The water-bearing rocks are represented by sands of various sizes with lenses of pebbles, loams and sandy loams. The thickness of the water-bearing sediments varies from 0.9 to 22 m, with the most common thickness being 7-10 m. The aquifer is usually the first to occur from the surface.

The watered aquifer is underlain in the Prut River valley by Miocene mudstone clays.

The depth of the aquifer varies from 2 to 5 metres, and the water is mostly non-pressurised, with pressure only in places where there are weakly permeable layers in the roof.

The waters of alluvial deposits of the IV-V terraces are predominantly fresh (0.4-2.6 g/dm^3), calcium hydrocarbonate. The waters contain organic decomposition products. The content of micro-components is insignificant. The water hardness ranges from 1.95 to 35 mg-eq/dm^3 , with a prevalence of 3-8 mg-eq/dm^3 .

The aquifer is recharged over almost the entire area of its distribution by infiltration of precipitation and partially by water inflow from underlying aquifers. Alluvial deposits are classified as reservoir waters. Their regime is unstable. Water levels in wells are subject to significant fluctuations depending on the amount of precipitation. The annual amplitude of water level fluctuations is 1.5-2.0 m. The highest level is observed in July-October, and the lowest in November-January.

The waters of this aquifer have limited use.

MWP in Miocene sediments

The aquifer is locally distributed in Lower Sarmatian-Miocene sediments (N s_{11}) and is widely spread in the Prut-Dniester interfluve and the interfluve of the Prut, Siret and Small Siret.

The water-bearing rocks are numerous layers of sands, rarely sandstones, sandy clays and organogenic limestones, ranging in thickness from 0.4 to 22 m. The horizons are not consistent along strike and are often faulted.

Sometimes, layers of aquiferous sands and sandstones alternating with clays make up a single aquifer and are hydraulically interconnected. In such cases, the total thickness of the aquifers increases to 60 m.

The depth of the Sarmatian sediments' base varies from 4 m to 167.6 m in the western part of the Fore-Carpathian Trough, thus determining the depth of the water that is associated with them. In the eastern part of the Chernivtsi region, the water is mostly free-flowing. In the western direction, the pressure increases and reaches 165 m. The water enrichment of Lower Sarmatian sediments is extremely uneven, which is determined by the degree of drainage, feeding conditions and heterogeneous lithological composition of water-bearing rocks. Spring flow rates range from 0.001 to 1.1 l/s, well flow rates from 0.34 to 1.3 l/s; well flow rates from 0.24 l/s at a water level of 72.5 m to 1.4 l/s at a water level of 24.0 m.

By chemical composition, the waters are fresh and slightly mineralised, characterised by calcium bicarbonate, magnesium bicarbonate, and rarely sodium calcium bicarbonate-sulfate composition with a mineralisation of 0.3-1.3 g/dm^3 , in some places up to 5 g/dm^3 (Zhylivka, Bilivtsi). A characteristic defect of sodium bicarbonate waters is the presence of small amounts of bromine, iodine, iron and metabolic acid with a content of up to 45-50 mg/dm^3 . The total water hardness in the eastward direction varies from 0.53 to 9.0 mg-eq/dm^3 , in rare cases it reaches 40.0 mg-eq/dm^3 (Bilivtsi village and others). The concentration of hydrogen ions (pH) is 6.8-9.0. Products of organic water pollution (nitrites, nitrates, ammonia) are usually found in small quantities.

The aquifer is recharged mainly by infiltration of precipitation in shallow areas and outcrops of water-bearing rocks to the surface, as well as by flow from overlying Quaternary alluvial deposits.

The importance of groundwater from Sarmatian deposits for water supply is insignificant, however, in the Prut and Siret interfluve, due to good water quality and shallow occurrence of the horizon, and the absence of other aquifers, it is recommended for local water supply.

Aquifers in the deposits of the Kosiv, Tyras and Opillya Miocene (N1ks, N1tr, N1op) are widespread, mainly in the southern half of the Prut-Siret interfluve and in the Prut River valley. The water-bearing rocks on the right bank of the Dniester and in the eastern part of the Prut-Dniester interfluve are various types of fractured limestone (N_1 op), and in the rest of the territory - sands, sandstones, siltstones, limestones, marls. The gypsum anhydrite stratum of the Tyraska Formation serves as a water barrier between the sandy-clay Upper Badenian (Kosivska Formation) and the lower Opilska Badenian. The total thickness of the water-bearing layers of the aquifers is 10-40 m, rarely up to 70-85 m. The waters are of the formation and fracture type.

Almost everywhere, the Badenian rocks are overlain by Sarmatian sand and clay deposits, which often form the upper water table. The aquifers are underlain by rocks of the Cenomanian (Albanian) stage, which provides for hydraulic connection (eastern part of the region).

Depths of aquifers range from 0.5-1.0 m on valley slopes to 140 m in watershed areas, and increase to 1140-1240 m in the area of Krasnoilsk.

The water is predominantly pressure water, with the head increasing from 9-29 m on the platform to 360-430 m in the Pre-Carpathian trough towards the Carpathians. The water content of the rocks varies. On the right bank of the Dniester, where deeply incised river and gully valleys are observed, the Badenian aquifer is partially drained and its water supply is insignificant.

The flow rates of the springs vary widely and amount to 0.05-25 l/s (Babyn, Verbivtsi, Tovtry), with the predominant flow rates of 0.3-0.5 l/s (N1tr, N1op). The well flow rates also vary widely: from 0.2 l/s at a depth of 9.0 m to 17.7 l/s at self-pouring (Novoselytsia), with flow rates of 1-2 l/s prevailing.

The chemical composition of the waters is very diverse. According to their chemical composition, the horizon waters can be divided into calcium sulphate and sodium calcium sulphate waters in the western part of the region, calcium hydrocarbonate waters in the eastern part and in the upper horizons (Kosivska Sveta) in the western part. Water salinity is 0.3-2.4 g/dm^3 . In the area of Krasnoilska village, in the direction of the thrust, the mineralisation increases to 20.8-22.0 g/dm^3 and the waters become of sodium chloride type. The content of trace elements increases with depth. The content of Br is 4.5-21.0 mg/dm3, J - 6.6-8.5 mg/dm^3 , Sr - 0.1-1.0 mg/dm^3 , Ba - 0.1-1.0, Cu, Ca, V - 0.0001-0.1, Ba, Ni, Ti, Cr - traces.

The total water hardness ranges from 7 to 36 mg-eq/dm^3 .

The NO content$_3$ - is 5-10 mg/dm^3 , rarely up to 260 mg/dm^3 (Repuzhyntsi village). The concentration of hydrogen ions (pH) is 6.7-7.5. The aquifers are fed by infiltration of precipitation in the northern part of the territory on the right bank of the Dniester River and by water flow from the underlying Cenomanian (Albanian) sediments. There are no sharp seasonal fluctuations in water levels. Discharge occurs in river valleys and ravines and through a system of tectonic fractures.

The practical significance of the waters of the described aquifers for water supply is small due to the variability of their chemical composition. They are mainly used for technical and domestic water supply of small farms, individual consumers and as mineral water.

MWP in Paleocene-Eocene sediments

The Paleocene and Eocene sediments (₽$_{1-2}$) are widely distributed within the Folded (Flysch) Carpathians and the Inner Zone of the Fore-Carpathian Trough. They are mainly represented by thin-core alternation of siltstones, mudstones and sandstones, rarely limestones and gravels. The water-bearing capacity of the strata is determined by the fracturing of rocks, which is maximally developed in the weathering zone, i.e., to a depth of 100 m. The most intense fracturing is typical for sandstones and siltstones; mudstones are mostly waterless. The water is found at depths ranging from 0 to 39 m and is characterised as both pressurised and non-pressurised; the groundwater level ranges from 0-28.0 m, more often from 1.5-10.0 m. The head reaches 36.2 m. Depending on the lithological composition of the water-bearing rocks and the degree of their fracture, the flow rates of the springs vary from 0.08 to 3.0 l/s.

The water supply in the Paleocene and Eocene is approximately the same and mostly insignificant. Slightly increased water enrichment is observed in the areas where sandy formations predominate in the section (Vygoda-Pasichnyanska and Yamnenska formations).

The waters found in the near-surface part of the sediments are calcium hydrocarbonate, less often calcium-sodium hydrocarbonate, hydrocarbonate-sulfate with a salinity of 0.1-0.3 g/dm^3 . The total hardness varies from 0.86 to 5.06 mg-eq/dm^3 . The concentration of hydrogen ions (pH) is 5.0-10.0. Nitrogen-containing compounds are absent in most samples.

The aquifer is fed by infiltration of precipitation. The water regime is unstable. The practical value of groundwater is insignificant.

MWP in Upper Cretaceous sediments

It is distributed within the platform and the Outer Trough Zone, except for the area of Stavchany village (Kitsman district). Water-bearing sediments are represented mainly by sands, sandstones, and less frequently by marls, limestones, flints, and opals. These rocks are facially replaced. In the Dniester River valley, where the Cenomanian (Alba) deposits are represented by glauconite sands and sandstones and are exposed to the surface, the aquifer is the first to be found from the surface. Towards the south of the Dniester, the rocks sink to a depth and carbonate rock types begin to prevail. In the western part of the Chernivtsi region, Cenomanian (Albanian) sediments lie unconformably on fractured Jurassic formations. To the east of Chernivtsi city, the lower water-bearing horizon is covered by clay shales of the Silurian period. The Cenomanian (Alba) deposits are overlain by Badenian sediments to the east of the Sadhora-Kitsman-Stavchany line, and by Turonian deposits to the west. The thickness of the aquifer is from 2.0 to 38.0 m, mainly 20.0-25.0 m. The depth varies from several metres to 1300 m within the Outer Trough Zone.

The aquifer is a pressure aquifer. The head height varies from 8.0 to 155.0 m. The degree of water enrichment is unstable and depends on the lithological composition of the water-bearing rocks and their spatial exposure. Well flow rates range from 0.2 to 1.7 litres per day at a water depth of 4.0-36.0 metres. Mostly, the flow rates are 0.7-1.0 l/s. Specific flow rates vary between 0.004 and 0.5 l/s. In the vicinity of Chernivtsi, water enrichment is increased: the flow rate is 2.0 l/s at a 2m drop (gravity) and 3.4 l/s at a 36.0m drop. The waters on the right bank of the Dniester are calcium bicarbonate with a salinity of 0.3-0.4 g/dm^3 , a total hardness of about 4.3 mg-eq/dm^3 and a pH of 7.5. In the rest of the territory, the water is predominantly calcium sulphate, calcium sulphate-hydrogen carbonate, changing to chloride with the submergence of the aquifer. The mineralisation varies from 0.5 to 8.3 g/dm^3 , mainly 1.0-1.5 g/dm^3 . Near the landslide in the area of Krasnoyilsk at a depth of 1363 m, the mineralisation of sodium chloride water in the aquifer increases to 16.9 g/dm^3 .

The water hardness ranges from 6.0 to 35.0 mg-eq/dm^3 , mainly 6.0-8.0 mg-eq/dm^3 , pH concentration is around 6.5. Content of microcomponents: Zr, Ti - traces; Ga, Cu, V - 0.001- 0.01; Ba - 0.1-1.0; Sr >1.0; Br - 24.0; J - 7.0 mg/dm^3 .

The aquifer is recharged in some areas by the flow of water from the Baden sediments, and in river and gully valleys and in places close to the surface, by infiltration of precipitation. Within the area of water supply, the regime is unstable and the water table is subject to seasonal fluctuations.

The water is used by the local population. The aquifer is of practical importance for centralised water supply (eastern part of the region).

The water-bearing complex in the Lower-Upper Cretaceous sediments (Rakhiv, Cheremosh, Svydovets and Burkut formations) - (K_{1-2}) is distributed in the southwestern part, within the Inner Carpathian zone. The flysch rocks here are crumpled into narrow folds. The water-bearing rocks are represented by rhythmic alternation of siltstones, mudstones and sandstones, and less frequently limestones, conglomerates and gravels, with sandstones, limestones, conglomerates and gravels being of subordinate importance. The sediments are water-bearing in the near-surface part, where weathering cracks are intensively developed, i.e. to the depths of 30.0-100.0 m. The aquifer occurs at depths from 0 to 50 m and is described only by sources. In the zones located near the day surface, mainly non-pressure water circulates, which is confirmed by numerous leaks from downward springs.

With increasing depths, especially within tectonic fault zones, water acquires pressure properties. Depending on the lithological and petrographic composition of the water-bearing rocks, the degree of their fracturing and the gypsometric position, the flow rate of the springs varies from 0.01 to 1.0 l/s. By chemical composition, the waters are calcium hydrocarbonate with a mineralisation of 0.1-0.3 g/dm^3 , less often calcium sodium hydrocarbonate-sulfate and calcium sulfate-hydrocarbonate with a mineralisation of 0.4 to 0.7 g/dm^3 . The total hardness ranges from 0.95 to 5.63 mg-eq/dm^3 , the concentration of hydrogen ions (pH) is 5.0-7.3. Waters containing hydrogen sulphide (from 2.5 to 33.2 mg/dm^3) and microcomponents are common: Br - 10.0, J - 5.8, Fe - 15 mg/dm^3

The aquifer is fed by infiltration of precipitation. The practical value of the aquifer complex is small, but given the lack of other aquifers, it is widely used by the population.

Characterisation of groundwater massifs in the Siret River sub-basin

MWP in alluvial sediments of Holocene floodplains and floodplain terraces Upper Neopleistocene

The aquifer in the alluvial deposits of Holocene floodplains and Upper Neopleistocene I-III overflow terraces (a P^{1-3}_{III+} aH) is confined to the floodplains of numerous rivers and streams. It is widely developed both on the platform and in the Precarpathian trough.

The main aquifer is associated with alluvial deposits of the floodplain and I-III overflow terraces of the Siret River.

The thickness of the water-bearing rocks in the Siret River valley is mainly 7.0-11.0 m. The filtration coefficients of the 200-400 m wide strip, which extends downstream to 1.5 km, are 13-32 m/day.

Alluvial sediments of the II - III terraces of the Siret River have lower filtration properties (Kf = 1.0-5.0 m/day) and their development is also limited (narrow distribution areas from 200-300 m to 2.0 km).

The aquifer is non-pressure, sometimes the upper water table is one-age alluvial loams, where local heads of up to 4 m may occur (floodplain terraces). The water availability of the aquifer varies widely due to the heterogeneity of the granulometric composition of water-bearing rocks. In the valleys of the Carpathian rivers, the flow rate varies from 0.1 to 0.4 l/s at water levels of 5.9-16.4 m. On the platform, in the Prut River floodplain, east of Chernivtsi, the wells have a flow rate of 10.8 l/s at a water table of 2.9 m. Specific flow rates vary from 0.1 to 3.9 l/s. The flow rates of springs are 0.1-0.3 l/s.

The waters of the modern alluvial deposits are mostly fresh and have a varied chemical composition. Along with calcium bicarbonate waters, the platform contains calcium sulphate, sodium-calcium sulphate-hydrocarbonate, calcium-magnesium hydrocarbonate waters with salinity ranging from 0.5 to 1.8 g/dm^3 , which is caused by the inflow of highly saline waters from Miocene sediments and surface pollution. The total water hardness varies from 1.87 to 9.9 mg-eq/dm^3 , in some cases reaching 30-40 mg-eq/dm^3 .

The aquifer is recharged mainly by infiltration of precipitation and groundwater inflow from underlying aquifers, as well as by water inflow from rivers during floods (floodplains).

The water regime in modern alluvial deposits is closely dependent on the nature and amount of precipitation. The annual amplitude of water level fluctuations according to observations reaches 2-3 m, the water regime of the I-III floodplain terraces is unstable, with significant fluctuations depending on the amount of precipitation. The annual amplitude of water level fluctuations is 1.5-2 m.

The aquifer of modern alluvial sediments of Holocene floodplains and I-III over floodplain terraces of the Upper Neopleistocene is the main one for centralised water supply in the region and is widely used for water supply to the population and is the main one for assessing the state of forecast resources and operational groundwater reserves of the region.

The Middle Neopleistocene alluvial terrace aquifer (a^{4-5} P_{II}) is developed in the Siret River valley in the deposits of the IV-V floodplain terraces. The water-bearing rocks are represented by sands of various sizes with lenses of pebbles, loams and sandy loams. The thickness of the water-bearing sediments varies from 0.9 to 22 m, with the most common thickness being 7-10 m. The aquifer is usually the first to occur from the surface.

The watered aquifer is underlain by Miocene mudstone clays.

The depth of the aquifer varies from 2 to 5 metres, and the water is mostly non-pressurised, with pressure only in places where there are weakly permeable layers in the roof.

Groundwater massif in Miocene sediments

The aquifer is locally distributed in Lower Sarmatian-Miocene sediments (N s_{11}) and is widely spread in the Prut-Dniester interfluve and the interfluve of the Prut, Siret and Small Siret.

The water-bearing rocks are numerous layers of sands, rarely sandstones, sandy clays and organogenic limestones, ranging in thickness from 0.4 to 22 m. The horizons are not consistent along strike and are often faulted.

Sometimes, layers of aquiferous sands and sandstones alternating with clays make up a single aquifer and are hydraulically interconnected. In such cases, the total thickness of the aquifers increases to 60 m.

The depth of the Sarmatian sediments' base varies from 4 m to 167.6 m in the western part of the Precarpathian Trough, thus determining the depth of the water table associated with them. In the western direction within the Siret River sub-basin, the head increases and reaches 165 m. The water enrichment of Lower Sarmatian sediments is extremely uneven, which is determined by the degree of drainage, feeding conditions and heterogeneous lithological composition of water-bearing rocks. Spring flow rates range from

0.001 to 1.1 l/s, well flow rates from 0.34 to 1.3 l/s; well flow rates from 0.24 l/s at a water level of 72.5 m to 1.4 l/s at a water level of 24.0 m.

According to the chemical composition, the waters are fresh and slightly mineralised, characterised by calcium bicarbonate, magnesium bicarbonate, and rarely sodium calcium bicarbonate-sulfate composition with a mineralisation of 0.3-1.3 g/dm^3 . A characteristic defect of sodium bicarbonate waters is the presence of small amounts of bromine, iodine, iron and metabolic acid with a content of up to 45-50 mg/dm^3 . The total water hardness in the eastward direction varies from 0.53 to 9.0 mg-eq/dm^3 . The concentration of hydrogen ions (pH) is 6.8-9.0. Products of organic water pollution (nitrites, nitrates, ammonia) are usually found in small quantities.

The aquifer is recharged mainly by infiltration of precipitation in shallow areas and outcrops of water-bearing rocks to the surface, as well as by flow from overlying Quaternary alluvial deposits.

The importance of groundwater from Sarmatian deposits for water supply is insignificant, however, in the Prut and Siret interfluve, due to good water quality and shallow occurrence of the horizon, and the absence of other aquifers, it is recommended for local water supply.

The aquifers and sediments of the Kosiv, Tyras and Opillya Miocene are (N_1 ks, N_1 tr, N_1 op) widespread mainly in the southern half of the Prut-Siret interfluve. The water-bearing rocks are sands, sandstones, siltstones, limestones, marls. The gypsum anhydrite stratum of the Tiras Formation serves as a water barrier between the sandy-clay Upper Badenian (Kosiv Formation) and the lower Opillya Formation of the Badenian. The total thickness of the water-bearing layers of the aquifers is 10-40 m, rarely up to 70-85 m. The waters are of the formation and fracture type.

Almost everywhere, the Badenian rocks are overlain by Sarmatian sand and clay deposits, which often form the upper water table. The aquifers are underlain by rocks of the Cenomanian (Albanian) stage, which provides for hydraulic connection (eastern part of the region).

Depths of aquifers range from 0.5-1.0 m on valley slopes to 60 m in watershed areas.

The waters are predominantly pressure, with the head increasing from 9-29 m on the platform to 360-430 m in the Fore-Carpathian trough towards the Carpathians.

The discharge of springs varies widely and amounts to 0.05-25 l/s (Babyn, Verbivtsi, Tovtry), with the predominant flow rates of 0.3-0.5 l/s (N_1 tr, N_1 op). The flow rates of the wells also vary widely: from 0.2 l/s, at a depth of 9.0 m, to 17.7 l/s, at self-discharge (Novoselytsia), with flow rates of 1-2 l/s prevailing.

The chemical composition of the waters is very diverse. According to their chemical composition, the horizon waters can be divided into calcium sulphate and sodium calcium sulphate waters in the western part of the region, calcium hydrocarbonate waters in the eastern part and in the upper horizons (Kosivska Sveta) in the western part. The mineralisation of the waters is 0.3-2.4 g/dm^3 . The content of trace elements increases with depth. Br content is 4.5-21.0 mg/dm^3 , J - 6.6-8.5 mg/dm^3 , Sr - 0.1-1.0 mg/dm^3 , Ba - 0.1-1.0, Cu, Ca, V - 0.0001-0.1, Ba, Ni, Ti, Cr - traces.

The total water hardness ranges from 7 to 36 mg-eq/dm^3 .

The NO content$_3$ - is 5-10 mg/dm^3 , rarely up to 260 mg/dm^3 . The concentration of hydrogen ions (pH) is 6.7-7.5. The aquifers are fed by infiltration of precipitation in the northern part of the territory on the right bank of the Dniester River and by water flow from the underlying Cenomanian (Albanian) sediments. There are no sharp seasonal fluctuations in water levels. Discharge occurs in river valleys and ravines and through a system of tectonic fractures.

The practical significance of the waters of the described aquifers for water supply is small due to the variability of their chemical composition. They are mainly used for technical and domestic water supply of small farms, individual consumers and as mineral water.

MWP in Paleocene-Eocene sediments

The Paleocene and Eocene sediments ($P_{1-2)}$. are widely distributed within the Folded (Flysch) Carpathians and the Inner Zone of the Fore-Carpathian Trough. They are represented mainly by thin-core alternation of siltstones, mudstones and sandstones, and occasionally limestones and gravels. The water-bearing capacity of the strata is determined by the fracturing of rocks, which is maximally developed in the weathering zone, i.e., to a depth of 100 m. The most intense fracturing is typical for sandstones and siltstones; mudstones are mostly waterless. The water is found at depths ranging from 0 to 39 m and is characterised as both pressurised and non-pressurised; the groundwater level ranges from 0-28.0 m, more often from 1.5-10.0 m. The head reaches 36.2 m. Depending on the lithological composition of the water-bearing rocks and the degree of their fracturing, the flow rates of the springs vary from 0.08 to 3.0 l/s.

The water supply in the Paleocene and Eocene is approximately the same and mostly insignificant. Slightly increased water enrichment is observed in the areas where sandy formations predominate in the section (Vygoda-Pasichnyanska and Yamnenska formations).

The waters found in the near-surface part of the sediments are calcium hydrocarbonate, less often calcium-sodium hydrocarbonate, hydrocarbonate-sulfate with a salinity of 0.1-0.3 g/dm^3 . The total hardness varies from 0.86 to 5.06 mg-eq/dm^3 . The concentration of hydrogen ions (pH) is 5-10. Nitrogen-containing compounds are absent in most samples.

The aquifer is fed by infiltration of precipitation. The water regime is unstable. The practical value of groundwater is insignificant.

Groundwater massif in Upper Cretaceous sediments

It is sporadically distributed. Water-bearing sediments are represented mainly by sands and sandstones, with less frequent interlayers of marls, limestones, flints, and opals. These rocks are facially replaced. In the Dniester River valley, where the Cenomanian (Alba) deposits are represented by glauconite sands and sandstones and are exposed to the surface, the aquifer is the first to be found from the surface. Towards the south of the Dniester, the rocks sink to a depth and carbonate rock types begin to prevail. In the western part of the Chernivtsi region, Cenomanian (Albanian) sediments lie unconformably on fractured Jurassic formations. To the east of Chernivtsi city, the lower water-bearing horizon is covered by clay shales of the Silurian period. The Cenomanian (Alba) deposits are overlain by Badenian sediments to the east of the Sadhora-Kitsman-Stavchany line, and by Turonian deposits to the west. The thickness of the aquifer is from 2.0 to 38.0 m, mainly 20.0-25.0 m. The depth varies from several metres to 1300 m within the Outer Trough Zone.

The aquifer is a pressure aquifer. The head height varies from 8.0 to 155.0 m. The degree of water enrichment is unstable and depends on the lithological composition of water-bearing rocks and their spatial exposure. Well flow rates range from 0.2 to 1.7 litres per day at a water depth of 4.0-36.0 metres. Mostly, the flow rates are 0.7-1.0 l/s. Specific flow rates vary between 0.004 and 0.5 l/s. In the vicinity of Chernivtsi, water enrichment is increased: the flow rate is 2.0 l/s at a 2m drop (gravity) and 3.4 l/s at a 36.0m drop. The waters on the right bank of the Dniester are calcium bicarbonate with a salinity of 0.3-0.4 g/dm^3 , a total hardness of about 4.3 mg-eq/dm^3 and a pH of 7.5. In the rest of the territory, the water is predominantly calcium sulphate, calcium sulphate-hydrogen carbonate, changing to chloride with the submergence of the aquifer. The mineralisation varies from 0.5 to 8.3 g/dm3, mainly 1.0-1.5 g/dm^3 .

The water hardness ranges from 6.0 to 35.0 mg-eq/dm^3 , mainly 6.0-8.0 mg-eq/dm^3 , pH concentration is around 6.5. Content of microcomponents: Zr, Ti - traces; Ga, Cu, V - 0.001- 0.01; Ba - 0.1-1.0; Sr >1.0; Br -24.0; J -7.0 mg/dm^3 .

The aquifer is recharged in some areas by the flow of water from the Baden sediments, and in river and gully valleys and in places close to the surface, by infiltration of precipitation. Within the area of water supply, the regime is unstable and the water table is subject to seasonal fluctuations.

The water is used by the local population. The aquifer is of practical importance for centralised water supply (eastern part of the region).

The water-bearing complex in the Lower-Upper Cretaceous sediments (Rakhiv, Cheremosh, Svydovets and Burkut formations) - (K_{1-2}) is distributed in the southwestern part, within the Inner Carpathian zone. The flysch rocks here are crumpled into narrow folds. The water-bearing rocks are represented by rhythmic alternation of siltstones, mudstones and sandstones, and less frequently limestones, conglomerates and gravels, with sandstones, limestones, conglomerates and gravels being of subordinate importance. The sediments are aquiferous in the near-surface part, where weathering cracks are intensively developed, i.e. to depths of 30.0-100.0 m.

The aquifer occurs at depths ranging from 0 to 50 m and is described only by springs. In the zones located near the day surface, mainly non-pressure water circulates, which is confirmed by numerous leaks from downward springs. With increasing water depths, especially within tectonic fault zones, water acquires pressure properties. Depending on the lithological and petrographic composition of the water-bearing rocks, the degree of their fracturing and the gipsometric position, the flow rate of the springs varies from 0.01 to 1.0 l/s. According to the chemical composition, the waters are calcium hydrocarbonate with a salinity of 0.1-0.3 g/dm^3 , less often calcium sodium hydrocarbonate-sulfate and calcium sulfate-hydrocarbonate with a salinity of 0.4 to 0.7 g/dm^3 . The total hardness ranges from 0.95 to 5.63 mg-eq/dm^3 , the concentration of hydrogen ions (pH) is 5.0-7.3. Waters containing hydrogen sulphide (from 2.5 to 33.2 mg/dm^3) and microcomponents are common: Br - 10.0, J - 5.8, Fe - 15 mg/dm^3 .

The aquifer is fed by infiltration of precipitation. The practical value of the aquifer complex is small, but given the lack of other aquifers, it is widely used by the population.

2 MAJOR ANTHROPOGENIC IMPACTS ON THE QUANTITATIVE AND QUALITATIVE STATE OF SURFACE AND GROUNDWATER, INCLUDING POINT AND DIFFUSE SOURCES

2.1 Surface water

The sub-basins of the Prut and Siret rivers are located within two oblasts: Chernivtsi and Ivano-Frankivsk. The socio-economic structure of the sub-basins creates preconditions for the formation of anthropogenic pressure that affects surface water ecosystems. The main factors of anthropogenic pressure include:

- **Population (municipal return (waste) water)**. The Prut and Siret sub-basins have 8 administrative districts, 74 TGs, 628 settlements, about 2.2 million people, and a population density of about 90 people/km in Chernivtsi and Ivano-Frankivsk oblasts[2] .
- **Enterprises in various sectors of the economy.** The main industrial sectors include: chemical and petrochemical industry, construction products, timber and wood products, light industry, machine building, electricity generation and distribution, food industry and agricultural processing.
- **Agriculture.** The agricultural sector within the sub-basins includes livestock farming, cereals, sugar beet, vegetables, fodder and industrial crops, horticulture, including irrigation, and fisheries.
- **Hydromorphological changes.** Cross structures on small and medium-sized rivers prevent the free passage of water, sediments and migration of aquatic life, and change the transit mode of rivers to an accumulation mode. Urbanisation, agriculture, sand and gravel extraction, etc. have a negative impact on river morphology.

The characterisation of anthropogenic load and its impact was carried out on the basis of chemical, physico-chemical and hydromorphological indicators that reflect the conditions of existence of the biotic component of aquatic ecosystems. Changes in these parameters under conditions of significant anthropogenic pressure may lead to the risk of not achieving the "good" ecological status of the MEA.

The assessment of anthropogenic pressure on the MWR was carried out in accordance with the "Methodological Recommendations for the Analysis of the Main Anthropogenic Pressures and Their Impacts on the State of Surface Waters" (hereinafter referred to as the Methodology), which were approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources on 20 April 2023, Minutes No. 2.

The methodological basis of the assessment was the DPSIR model developed by the European Environment Agency (EEA)[1] and adapted to the conditions of Ukraine. The determination of anthropogenic pressure was based on a sequential analysis of Drivers/Activities → Pressures → State → Impact → Response (Figure 94).

[1] CIS Guidance #3 Pressure and Impact Analysis, EU, 2003

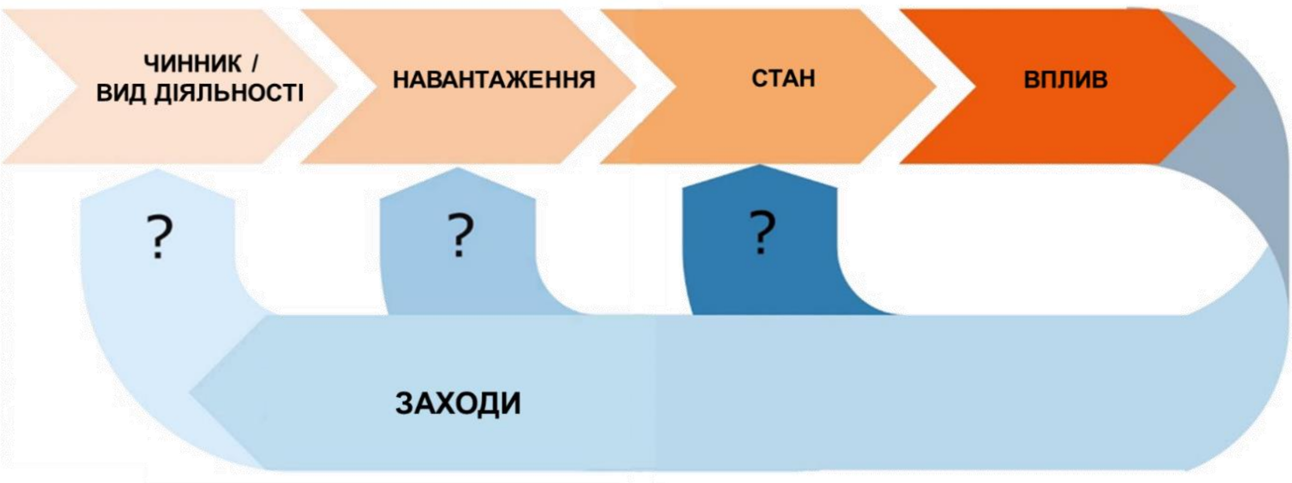


Figure 94. DPSIR conceptual model

Assessing the risk of not achieving "good" environmental status

The analysis of anthropogenic load and related impacts is aimed at determining the probability of compliance/non-compliance of a water body with the objectives of environmental quality of the water environment.

Assessment of the risk of failure to achieve environmental goals from point sources of pollution

Based on the results of the assessment of anthropogenic loads from point sources of pollution and their impact on the status of the sub-basins' MWP, the risk of not achieving a "good" ecological status/potential was determined (Fig. 95) for

- 272 MPV - "no risk";
- 14 MPR - "possibly at risk";
- 12 MPV - "at risk".

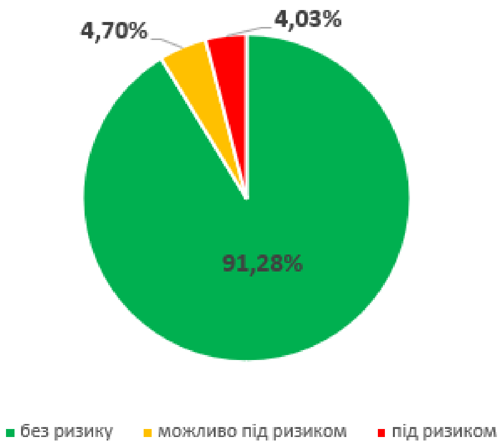


Figure 95. Risk assessment of failure to achieve "good" ecological status/potential based on the results of the assessment of anthropogenic pressures from point sources

Assessment of the risk of failure to achieve environmental goals from diffuse sources of pollution

Based on the results of the assessment of anthropogenic loads from diffuse sources of pollution and their impact on the sub-basin's MES, the risk of failure to achieve "good" ecological status/potential was determined (Fig. 96) for

- 208 MPV - "no risk";
- 51 MPV - "possibly at risk";
- 39 MWP - "at risk".

Figure 96. Risk assessment of failure to achieve "good" ecological status/potential based on the results of the assessment of anthropogenic pressures from diffuse sources

Assessing the risk of not achieving environmental goals: hydromorphological changes

Based on the results of the hydromorphological changes assessment, it was found that:

- 249 MPV - "no risk";
- 49 MPV - "at risk".

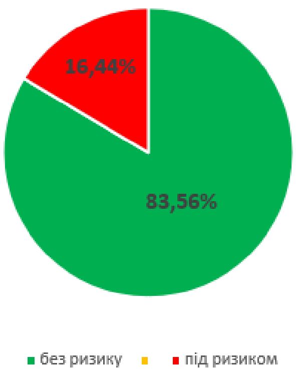


Figure 97. Risk assessment of failure to achieve 'good' ecological status/potential based on anthropogenic pressure assessment: hydromorphological changes

Generalised risk assessment of failure to achieve 'good' environmental status/potential

The risk of not achieving a "good" environmental status/potential has been assessed as follows:

- 160 MPV - "no risk";
- 42 PEP - "possibly at risk";
- 96 MMBs are "at risk".

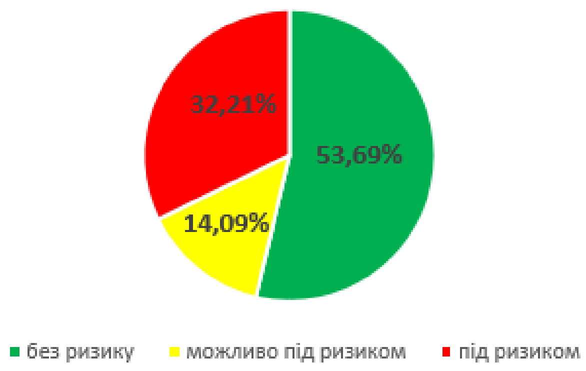


Figure 98. Assessment of the risk of not achieving "good" environmental status/potential of MNR

The risk of failure to achieve environmental objectives based on hydromorphological changes was not assessed for the SSSI.

Impact of military operations on the state of surface water bodies

No cases of military impacts were recorded in the Prut and Siret sub-basins.

2.1.1 Organic pollution

The main cause of organic pollution is insufficient or no wastewater treatment. Organic pollution can lead to significant changes in the oxygen balance of surface waters and, as a result, to changes in the species composition of aquatic life or even their death. The input of organic matter with wastewater is usually assessed by the indirect indicators of BOD_5 and COD.

Diffuse sources

Organic pollution from diffuse sources is mainly caused by rural households that are not connected to sewerage networks. Such individual households dispose of wastewater by accumulating it in lagoons, from which it is filtered into the nearest groundwater horizons.

The load from the rural population was assessed using the calculation method. For this purpose, we used the coefficients of organic matter intake due to the vital activity of 1 person. In European countries, the generation of load from the population is calculated using the following indicators: BOD_5 - 60 g/day/person, COD - 110 g/day/person.

The assessment revealed that in just one year, distributed sources in the Prut and Siret sub-basins contribute a total of 44 tonnes of BOD_5 and 81 tonnes of COD, which is significantly higher than the total input from point sources. The reason for this is the low level of connection of the population to sewage treatment plants. In rural settlements and small towns, wastewater is discharged into lagoons built in the ground, from where pollutants easily enter groundwater and are transported to surface waters.

Rivers have the greatest impact of diffuse organic pollution in the basin: Prut, Peremyska, Lyubizhna, Oslava, Bila Oslava, Krasna, Tovmachyk, Tovmach, Pistynka, Brusturka, Lyuchka, Akra, Rybnitsa, Volytsia.

Point sources

Housing and utilities

The main cause of organic pollution is insufficient or no wastewater treatment. Organic pollution can lead to significant changes in the oxygen balance of surface waters and, as a result, to changes in the species composition of aquatic life or even their death. The input of organic matter with wastewater is usually assessed by indirect indicators of BOD_5 and COD.

In the sub-basins of the Prut and Siret rivers, city and district centres are connected to municipal wastewater treatment plants. Wastewater is collected in rural and urban settlements in individual septic tanks or cesspools, which are one of the potential sources of contamination of groundwater aquifers in the Prut and Siret sub-basins.

In 2020, organic pollution from municipal point sources amounted to 0.329 thousand tonnes by BOD_5 and 0.629 thousand tonnes by COD.

The main polluters of organic matter in the Prut and Siret river basins are municipal enterprises: Municipal enterprise "ChernivtsiVodokanal" (Chernivtsi), Municipal enterprise "Kosivmiskvodoservis" in Kosiv. Kosiv, Verkhovyna VKP in Verkhovyna, Zastavna, Hlyboka, Storozhynets production departments of housing and communal services, and Novoselytsia City Heating Network.

The dominant part of organic pollution is generated by the city of Chernivtsi with a population of about 260 thousand people. Wastewater from this city contains 91% of organic substances in terms of BOD_5 and 60% in terms of COD.

Industry

The organic pollution of the WBW of the Prut and Siret sub-basins is mainly due to woodworking and food (meat processing) industries. Organic pollution from industrial point sources amounted to 0.002 thousand tonnes in terms of BOD_5 and 0.009 thousand tonnes in terms of COD.

Agriculture

Organic pollution from agricultural point sources is insignificant and in 2020 amounted to 0.001 thousand tonnes by COD. This is due to the predominant discharge of normatively clean water by fish farms, which accounts for 99% of the total wastewater from agricultural enterprises.

2.1.2 Pollution by nutrients

Nutrient inputs to the surface waters of the Prut and Siret sub-basins are the driving force behind eutrophication, which leads to an increase in primary production and accumulation of organic matter. The enrichment of water with nutrients, which stimulates the development of autotrophic aquatic organisms, resulting in an undesirable imbalance of organisms in the aquatic environment and a decrease in water quality.

Phosphorus and nitrogen compounds play a dominant role among biogenic substances. Phosphorus plays a greater role, while nitrogen is much less likely to limit the development of autotrophic organisms, due to the ability of many bacteria and cyanobacteria to fix it.

Nutrients can come from both point and diffuse sources, with untreated municipal and industrial wastewater being the main source.

In 2020, all business entities discharged to the surface waters of the Prut and Siret:

- ammonium nitrogen - 0.077 thousand tonnes;
- nitrate nitrogen - 0.622 thousand tonnes;
- Nitric nitrogen - 0.007 thousand tonnes;
- orthophosphates - 0.032 thousand tonnes.

The sources of this pollution are municipal and industrial wastewater. The widespread use of phosphorus-containing detergents and laundry detergents with insufficient wastewater treatment increases nutrient pollution. Ukraine has established phosphate content limits in detergents that are in line with European Parliament regulations. The efficiency of phosphorus removal from wastewater at most wastewater treatment plants in Ukraine does not exceed 20%, but due to outdated equipment, the efficiency of phosphorus removal by treatment plants often does not reach the design values.

Diffuse sources

Diffuse sources are defined as the washing away of substances from the surface of the catchment and the soil layer of the soaking zone. This type of pollution is the most difficult to assess, as it cannot be directly measured, but must be estimated through probable pathways. Diffuse runoff can be caused by both natural factors (precipitation, geological structure and soil composition) and anthropogenic factors, which in this case act as indirect factors (degree of ploughing, crop yields).

Land cover type is the dominant factor in the anthropogenic load from diffuse sources.

In accordance with the physical and geographical division, there are clear differences in land cover types, which significantly affect the emission of elements. In general, in the direction from the source to the mouth of the Prut and Siret rivers, there is a decrease in the degree of forest cover, while the share of agricultural land, which provides the main supply of nutrients, is increasing. The disturbance of soil cover due to ploughing leads to significant losses of nutrients due to deflation and water runoff.

There is no intensive agricultural production in the upper reaches of the Prut and Siret rivers, in a mountainous area with low temperatures and high rainfall. Meat and dairy farming and sheep breeding are developed here.

Another important indicator of the anthropogenic load from diffuse sources of pollution is the intensity of agriculture, which is expressed primarily in the amount of fertiliser applied. Nitrogen fertilisers dominate in the composition of applied fertilisers.

Point sources

Housing and utilities

Pollution from point sources is mainly caused by the discharge of insufficiently treated or untreated urban wastewater.

Within the Prut and Siret river basins, there were no discharges of municipal wastewater in 2020:

- 0.075 thousand tonnes of ammonium nitrogen;

- 0.615 thousand tonnes of nitrate nitrogen compounds;
- 0.007 thousand tonnes of nitrogen in nitrite form;
- 0.031 thousand tonnes of phosphorus orthophosphate.

The widespread use of phosphorus-containing laundry detergents and cleaning agents with insufficient wastewater treatment increases nutrient pollution. The efficiency of phosphorus removal from wastewater at most wastewater treatment plants in Ukraine does not exceed 20%, but due to outdated equipment, the efficiency of phosphorus removal by treatment plants often does not reach design values.

2.1.3 Pollution by hazardous substances

Hazardous substances are represented by priority pollutants subject to control in accordance with the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45 dated 06.02.2017 "On Approval of the List of Pollutants for Determining the Chemical State of Surface and Groundwater Massifs and the Ecological Potential of an Artificial or Significantly Modified Surface Water Massif" (hereinafter - the Order) and the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14.01.2019 No. 5 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial or Significantly Modified Surface Water Body to One of the Classes of Ecological Potential of an Artificial or Significantly Modified Surface Water Body".

The available information on the discharge of priority pollutants in the Prut and Siret sub-basins is currently quite limited. According to the state water use accounting, reporting on water use in the form No. 2TP-water farm (annual), approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 78 of 16.03.2015, for the period 2016-2021, no business entity in the Prut and Siret sub-basins reported the presence of pollutants in the discharge of return (waste) water included in the list of priority pollutants by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45.

According to the monitoring of the content of priority and other hazardous substances in surface waters and bottom sediments of the rivers of the Prut and Siret sub-basins, the presence of organic substances, including priority substances such as pesticides, polyaromatic hydrocarbons, halogenated hydrocarbons, and heavy metals (cadmium, lead, nickel) was identified.

The monitoring results showed that the concentration of cadmium, lead and nickel exceeded the environmental quality standard for priority substances in water for the rivers of the Prut and Siret sub-basin.

In accordance with the Resolution of the Cabinet of Ministers of Ukraine No. 758 of 19.09.2018 "On Approval of the Procedure for State Water Monitoring", the Prut and Siret RBM Laboratory collected water samples on a monthly basis during 2019-2020 to determine chemical and physicochemical parameters at 15 (2019) and 19 (2020) monitoring points of surface water massifs from which water is taken to meet the drinking and household needs of the population; at-risk massifs based on anthropogenic impacts.) observation points of surface water bodies from which water is abstracted to meet the drinking and domestic needs of the population; bodies at risk based on anthropogenic impacts on the quality and quantity of water; and surface water bodies in transboundary areas identified in accordance with interstate agreements on water management in border waters between the Government of Ukraine and the Governments of Romania and Moldova.

Water samples from surface water massifs were transferred to the water monitoring laboratory of the Western Region of the Dniester BWR in compliance with the requirements of regulatory documents (DSTU ISO 6468-2002, DSTU ISO 10301:2004, DSTU ISO 5667-1:2009, DSTU ISO 5667-2:2009, DSTU ISO 5667-6:2009) for measurements of priority pollutants approved by the relevant Order.

Based on the results of the monitoring of priority pollutants in the Prut and Siret sub-basin, 8 hazardous specific pollutants were identified (5 synthetic pollutants and 3 non-synthetic pollutants (heavy metals: cadmium, lead, nickel). The list of hazardous substances is presented in Table 76.

Table 76. Specific pollutants (synthetic pollutants) for the Prut and Siret sub-basins

Chemical registration number	Indicators for determining the environmental status of the MPE	Average annual concentration, μg/dm^3	Maximum concentration, μg/dm^3
206-44-0	Fluoranthene μg/dm^3	0,046	0,35
205-99-2	Benzo (b) fluoranthene μg/dm^3	-	0,053
207-08-9	Benzo(k) fluoranthene μg/dm^3	-	0,045
74070-46-5	Aklonifene mcg/dm^3	-	0,14

Chemical registration number	Indicators for determining the environmental status of the MPE	Average annual concentration, μg/dm³	Maximum concentration, μg/dm³
67-66-3	Trichloromethane (chloroform) μg/dm³	3,24	-
7440-43-9	Cadmium μg/dm³	0,52	2,26
7439-92-1	Lead μg/dm³	1,35	-
7440-02-0	Nickel μg/dm³	6,04	41,14

The preliminary assessment of synthetic and non-synthetic specific substances will be based on the assessment of compliance with the relevant environmental quality standards and expressed as an annual average and as a maximum permissible concentration. Failure to comply with an environmental quality standard will be established if the arithmetic mean of the measured concentrations is higher than the value of the relevant environmental quality standard. When assessing the values of non-synthetic specific substances, background concentrations of heavy metals for each WFD in the Prut and Siret sub-basins should be taken into account.

Control of the content of hazardous pollutants in the discharges of waste water from business entities mainly consists of determining the content of only the parameters stipulated in the draft maximum permissible discharges of water users (mainly pollution with organic and nutrients). The actual presence of hazardous substances, volumes and values need to be further verified, confirmed by research monitoring data and screening results of samples of wastewater discharged into the MEWs of the Prut and Siret sub-basins.

The sources of hazardous pollutants in the Prut and Sireu sub-basins may include industrial sources, livestock and food production, industrial and municipal waste.

2.1.4 Accidental pollution and impact of contaminated areas (landfills, sites, zones, etc.)

In the Prut and Siret sub-basins, "hazardous" industrial activities are underdeveloped, but there are potential sources of accidental pollution both through wastewater discharges and runoff from sites where industrial waste is stored.

The mechanism for preventing and minimising the risk of accidental pollution is established in the EU member states through the implementation of the Seveso-III Directive (Directive 2012/18/EU), the Industrial Waste from Mining Directive (2006/21/EC)10 and the Industrial Emissions Directive-IED (2010/75/EU)11 and for non-EU countries through the implementation of the recommendations of the UNECE Convention on the Transboundary Effects of Industrial Accidents.

At the level of the Prut and Siret river sub-basins, a list of potential accident risk sites has been developed, including operating industrial facilities with a high risk of accidental pollution due to the nature of chemicals stored or used at industrial facilities, contaminated sites, including landfills and dumps located in flood zones. This register includes facilities that pose risks of accidental pollution, primarily, the CWS and sites where industrial waste and sludge ponds are located.

Recent studies conducted in the Prut and Siret sub-basins have revealed excessive levels of polyaromatic hydrocarbons, pesticides, halogenated hydrocarbons and heavy metals such as cadmium, lead and nickel, which confirms a significant anthropogenic load on the MPAs of the Prut and Siret sub-basins.

The Ministry of Environmental Protection and Natural Resources of Ukraine has launched an electronic service that also contains the Register of Waste Disposal Sites and the List of Facilities that are the largest polluters of the environment in terms of discharging pollutants into water bodies.

The register of business entities with risks of accidental pollution of the Prut and Siret sub-basins as of 01.01.2023 is presented in Table 77.

Table 77. Register of facilities in the sub-basins of the Prut and Siret rivers that are at risk of accidental pollution

№	Name of the object
1	Communal Unitary Enterprise "Kommunalnyk", Vyzhnytsia
2	Hlyboka Production Department of Housing and Communal Services, Hlyboka village
3	Kitsman Production Department of Housing and Communal Services, Kitsman

№	Name of the object
4	Chernivtsi Vodokanal, Chernivtsi city
5	Storozhynets Utility Company, Storozhynets
6	Municipal enterprise Novoselytsia City Heating Network, Novoselytsia
7	Verkhovyna Water Supply and Sewerage Enterprise, Verkhovyna village
8	Kolomyiavodokanal, Kolomyia city
9	Hvizdetsky Combine of Utilities, Hvizdets village
10	Zabolotivskyi KKP, Zabolotiv village
11	Housing and communal services company Technoservice, Pyadyky village
12	Municipal enterprise "Selyshche KP", Vorokhta village
13	Municipal enterprise "Village water worker", Turka village

According to the register of waste disposal sites (hereinafter referred to as WDS), there are 23 certified WDS in the Prut and Siret sub-basins (10 in Chernivtsi Oblast and 13 in Ivano-Frankivsk Oblast):

5 - solid waste disposal sites;
1 - wood waste (sawdust);
1 - oil and sludge collector;
7 - landfills;
5 - manure storage facilities;
1 - waste industrial oils;
1 - sludge from treated wastewater;
1 - storage of recyclable waste;
1 - residues of oil and fat refining.

One of the most acute environmental problems in Chernivtsi region (as well as in Ukraine as a whole) is the issue of waste (its generation, accumulation, recycling, disposal, removal to unorganised storage sites, etc.) The main way of solid waste management in Chernivtsi region is disposal at landfills/dumps. The majority of solid waste is disposed of at 1 landfill in Chernivtsi and 282 organised landfills with a total area of 260 hectares. Today, the situation has become particularly acute: landfills in the region are a big problem, and their number is growing every year. Landfills are one of the main sources of environmental pollution. Tonnes of garbage are dumped on the sides of roads and forests. The region has separate household waste collection in 39 settlements. 17 enterprises in the region have 50 waste incineration facilities and 3 enterprises have 4 waste disposal and recycling facilities with a total capacity of 28.7 thousand tonnes per year and 2.3 thousand tonnes per year, respectively.

There are 15 permanent solid waste landfills in Ivano-Frankivsk Oblast, of which 8 have been certified. The largest landfills in the Prut sub-basin are located near Kolomyia and Nadvirna (village of Pniv). Separate solid waste collection has been partially introduced in 57 settlements and 6 cities of regional significance.

Given the current situation, solving the problem of solid waste management should be included in the programme of measures to achieve good environmental condition of the Municipal Railway.

2.1.5 Hydromorphological changes

Hydromorphological changes are one of the main water-environmental problems (WEPs) that impede the achievement of environmental objectives set out in the River Basin Management Plan (RBMP). Hydromorphological changes as a result of economic activity affect the habitats of aquatic communities. The presence of hydromorphological changes in surface water bodies (SWBs) leads to the deterioration of the ecological status of many SWBs in the Prut and Siret sub-basins.

Hydromorphological changes are divided into types:

- disruption of the continuity of water flow and habitats - longitudinal disruption of the continuity of rivers and habitats (transverse artificial structures in the river channel, interruption of water flow, disruption of the free flow of rivers, movement of sediments, migration of fish and other aquatic life);
- disruption of the hydraulic connection between river channels and their floodplains;

- hydrological changes (water abstraction, hydropicking / fluctuations in water levels of artificial origin);
- morphological changes (modification of the morphology of the riverbed, banks, and adjacent parts of the floodplain, e.g. straightening).

The main activities that have led to hydromorphological changes are urbanisation, flood protection, channelisation and regulation of river flow (ponds and reservoirs).

Dams, ramps, weirs and other structures that cross the riverbed from one bank to the other disrupt the free flow of the river and restrict the migration of fish and other living organisms. The criterion for classifying a structure as one that disrupts flow and migration is a structure height of more than 0.3 m for rivers dominated by carp fish and 0.8 m for rivers dominated by salmonids.

In the Prut and Siret sub-basins, dams and other artificial cross-basin structures located in the riverbeds were built primarily to accumulate water for use in water supply for households and industry. Some dams were built as part of hydropower plants (mini-hydroelectric power plants).

A total of 25 IBAs have been identified where there is a violation of the continuity of water flow and environment, of which 6 IBAs are ponds and reservoirs located on the Vitsa, Gukiv, Stalinesti, Glodos, Cherlena and Shcherbintsy rivers, including two reservoirs with a volume of more than 1 million m^3 , namely:
- Cherlena reservoir with a volume of 3.16 million $m3^3$, the maximum head at the dam is 10 m, located on the territory of the Vanchykovets village council in Chernivtsi region;
- Reservoir on the Shcherbintsy River with a volume of 1.37 million $m3^3$, maximum head at the dam is 9 m, located outside the village of Kostychany in the territory of Kostychany village council, Chernivtsi region (distance from the river mouth to the dam is 4 km).

Unfortunately, most of the transverse structures on rivers are not equipped with fish passage, which limits the migration of fish species. In addition, dams restrict the free migration of some aquatic organisms and change the flow regime of suspended and largely sedimented sediments that roll along the bottom. Fine sediment fractions accumulate upstream of the dams, and leaching and erosion occur below them.

Disruption of the hydraulic connection between river channels and floodplains. The hydraulic connection between the riverbed and the floodplain plays an important role in the functioning of aquatic ecosystems, providing water for important habitats for fish and aquatic life, and has a positive impact on the condition of surface and groundwater.

The assessment of this type of hydromorphological changes is included in the hydromorphological protocol for assessing the MWP used by the SES in the course of state monitoring of surface waters (indicators No. 10: "Interaction between the channel and the floodplain: 10a - Possibility of floodplain inundation, 10b - Limiting factor for the development of horizontal deformations of the channel"). Currently, there is no monitoring data for this indicator within the Prut and Siret sub-basins.

Hydrological changes. Hydrological changes affect water bodies through water withdrawals and fluctuations in water levels below dams, and as a result, lead to changes in the regime and distribution of river flows. Discharges, water withdrawals and artificial periodic fluctuations in water levels (hydroelectricity) are key pressures that require compensatory measures to be implemented on a river basin-wide scale.

Decreased natural flows in the context of global warming and natural water shortages, reduced flow velocities and the formation of stagnant zones contribute to eutrophication processes, and, as a result, lead to a deterioration in biodiversity and degradation of aquatic ecosystems.

Criteria for assessing hydrological changes that lead to the failure to achieve good ecological potential: water withdrawals (small and medium-sized rivers - water withdrawals exceeding 75% of the discharge; large and very large rivers - water withdrawals exceeding 90% of the discharge), and water level fluctuations exceeding 0.5 m per day for most of the year.

No hydrological changes have been observed in the Prut and Siret sub-basins.

Morphological changes. The sub-basins of the Prut and Siret rivers are characterised by a high natural intensity of channel reformation. Due to meandering (channel tortuosity) and water erosion, river banks are constantly being eroded and destroyed. These phenomena are observed on almost all high banks of concave bends. The banks of convex bends are accumulative channel forms. In some parts of the river, there is a tendency for meanders to break through, resulting in the formation of a new channel. As a rule, high river banks are subject to intensive erosion, the deformation of which is accompanied by the collapse of large masses of soil from the bank ledges into the river and the fall of growing trees and bushes that cover a large part of the coastal areas. Destruction of banks in large areas or natural channel straightening (breakthroughs) can cause negative environmental consequences, such as stagnation, water level subsidence, etc., and valuable coastal land is lost as a result of bank erosion.

However, the main factors that adversely affect the natural morphology of the riverbeds, banks and floodplains of the Prut and Siret sub-basins are urbanisation, flood protection and agriculture. As a result of these activities, the rivers in certain areas are straightened, banked, the floodplain is ploughed up almost to the channel, and its natural vegetation is changed.

Within the sub-basins of the Prut and Siret rivers, morphological changes are observed at 24 IWMSs.

For flood protection purposes, hydraulic engineering structures (protective dams and fixed bank sections) and river channels have been built and reconstructed. Protecting people's lives and property, as well as economic infrastructure, is no less important than the good ecological status of rivers, so the construction and reconstruction of flood control dams in the past, now and in the future is absolutely appropriate. A compromise between nature conservation and flood protection is to make the widest possible space between dams when building new dams, to build polders that would be flooded during high floods, to build hydraulic structures (e.g. sluices) to supply river water to floodplain lakes and cut-off river arms, and to dismantle or relocate existing dams deeper into the floodplain where there is no current need for flood protection. Recently, flood control dams have been built locally to protect a particular settlement or economic facility, rather than along the entire river, and this is a clear example of a compromise between nature and man.

Reduced variability in channel depth and width, disruption of the natural balance of erosion and accumulation, narrowing of the inter-dam space and restriction of free river meandering lead to an impoverishment of the composition and reduction in the number of biological indicators, such as fish, benthic invertebrates, higher aquatic vegetation and phytoplankton. In some areas, the floodplain is used for agricultural production, which results in soil and fertilisers being washed into the river during floods, and a decrease in the proportion of natural vegetation. The reduction of the river's natural floodplain (including through haphazard development of floodplain areas) is a factor that negatively affects the ecological status of water bodies. In the future, it is necessary to restore natural floodplains and adapt economic activities accordingly,

Over time, when the amount of monitoring data increases and the network of observation points expands, the assessment of hydromorphological changes in the WBM can be performed using the monitoring data.

In the Prut and Siret sub-basins, 298 MPVs have been identified. Based on the data on existing cross structures in the riverbed, water intake locations and level fluctuations, as well as using satellite imagery, topographic and cadastral maps, a part of the identified MWBs - 49 MWBs (16.4% of all identified MWBs) - were identified as significantly modified (SMM). Among them:

- 24 MPV - due to morphological changes;
- 9 MPV - due to disruption of the continuity of water and media flow and accumulation;
- 16 MPAs - due to disruption of the continuity of water and media flow, accumulation and morphology (Fig. 99, Table 78).

Table 78. Hydromorphological changes in the MWP of the Prut and Siret sub-basins

№	Hydromorphological changes	Load	Quantity IHRM	% of the total number of MPAs
1	disruption of the continuity of water and media flow	regulation (water accumulation)	9	3
2	disruption of the continuity of water and media flow	regulation (water accumulation), morphological changes	16	5,4
3	morphological changes	overregulation	24	8

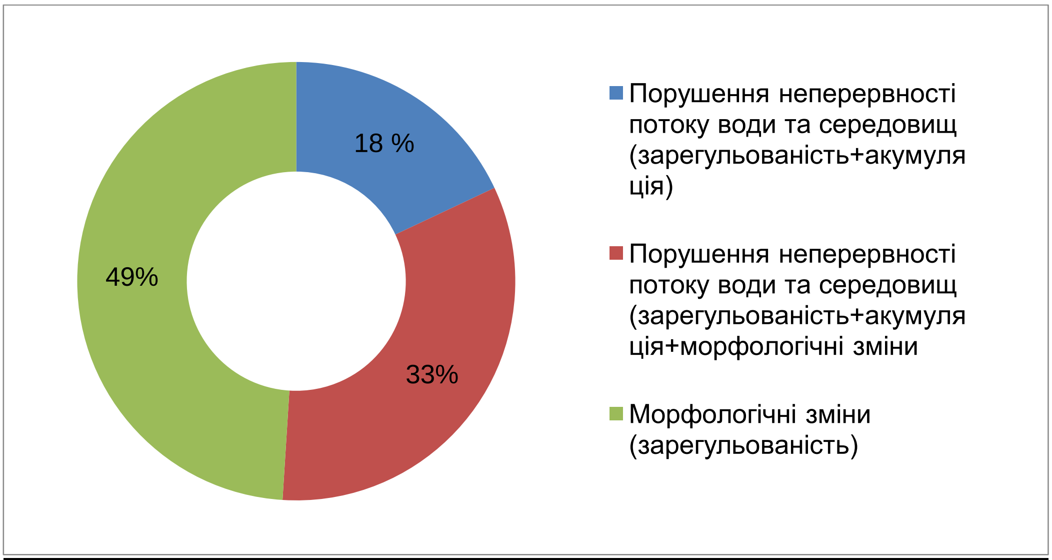


Figure 99. Distribution of IHMW by types of hydromorphological loads

All of these MEAs should be considered as having a risk of not achieving good environmental potential.

The criteria for assessing the failure to achieve good environmental potential are as follows:

- disruption of the continuity of water flow and environments (transverse artificial structures in the riverbed, disruption of the continuity of water flow and sediment movement and migration of fish and other aquatic life);
- water withdrawals (small and medium-sized rivers - water withdrawals exceeding 75% of the supply; large and very large rivers - water withdrawals exceeding 90% of the supply) - according to the results of the analysis of anthropogenic impacts, there are several large water withdrawals, but none of them exceeds 75% and 90% of the supply on small and medium-sized and large and very large rivers.
- water accumulation (ponds with a ponding area of more than 1 km or several ponds with a ponding area of less than 1 km, but their total length is more than 30% of the length of the MPA, as well as reservoirs with a volume of more than 1 million m);[3]
- fluctuations in the water level below the dam (water level fluctuations exceeding 0.5 m per day for most of the year);
- disturbance of natural morphological characteristics of rivers (hydromorphological class below the third according to the monitoring results, or straightening of more than 70% of the length of the main river channel in the absence of monitoring data).

Table 79. Distribution of IWMPs in the Prut and Siret sub-basins by administrative region

№	Area.	disruption of the continuity of water and environmental flows (overregulation + water accumulation)	disruption of the continuity of water and media flow (regulated + accumulation + morphological changes)	morphological changes (overregulation)
1	Cherni-vetska	9	16	20
2	Ivano-Fran-kivsk	0	0	4

30 rivers in the Prut and Siret sub-basins are identified as significantly altered along their entire length (12 of them are completely hydromorphologically altered due to disruption of water flow and environment, accumulation and morphological changes). Out of 133 rivers in the Prut and Siret sub-basins, 103 rivers (77%) have not undergone any hydromorphological changes (Figure 100).

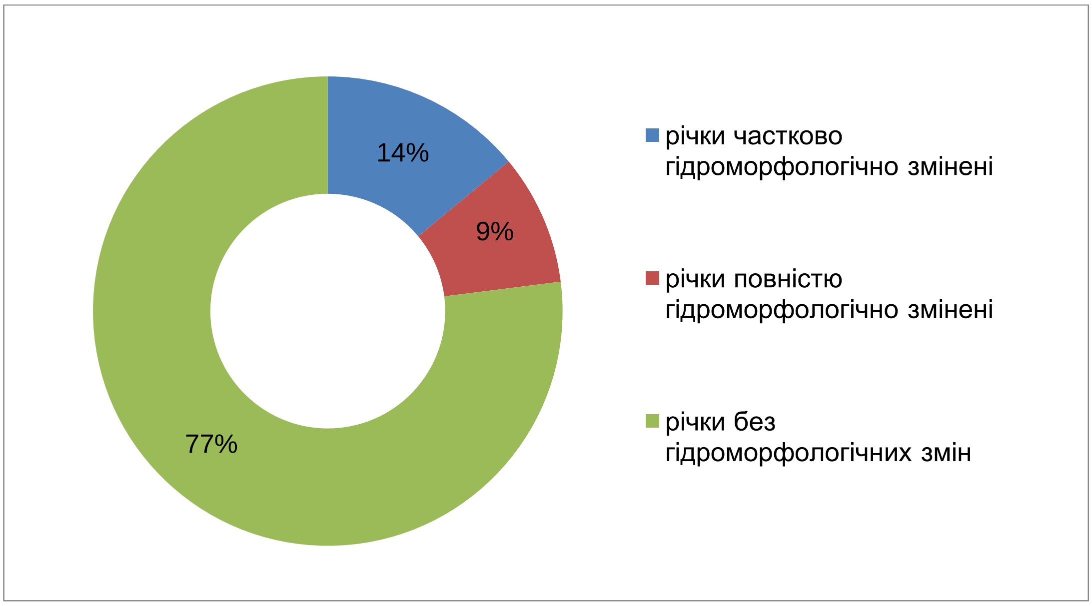


Figure 100. Distribution of rivers in the Prut and Siret sub-basins by hydromorphological changes

Based on the analysis of the main water and environmental problems associated with hydromorphological loads in the Prut and Siret sub-basins, it can be concluded that 49 MPAs identified as IWMPAs require restoration (revitalisation).

A total of 133 MNRs of the "river" category have been identified in the Prut and Siret sub-basins, of which 30 are classified as "artificial or significantly altered surface water bodies" (27 in the Prut sub-basin and 3 in the Siret sub-basin). In the mountainous part of the Prut sub-basin, some types of IBAs, primarily small rivers in the midlands, have remained practically undisturbed or minimally disturbed. Unfortunately, there are very few undisturbed areas in the middle rivers, especially those located at altitudes below 500 m above sea level.

2.2 Groundwater

2.2.1 Pollution

Rural urbanisation prevails in the Prut and Siret sub-basins. There are no large urban agglomerations or large industrial facilities associated with the extraction and processing of significant amounts of natural resources. Largest cities by population: Chernivtsi and Kolomyia.

In the context of rural urbanisation, the anthropogenic load on the MHW is associated with agricultural activities of the population: intensive farming and gardening with intensive use of fertilisers, pesticides and herbicides prevails. Cattle are raised mainly in stationary conditions.

The mountains are dominated by pasture farming and forestry.

Among the hydrotechnical types on the plain, amelioration and, to some extent, fisheries are very common.

Research carried out in the early 1990s to study the elements of the groundwater regime showed that land reclamation measures disrupt the natural hydraulic and hydrochemical connection between aquifers and contribute to the deterioration of groundwater and surface water quality.

When the main drainage channels were laid, the surface layer of low-permeability rocks was completely or partially destroyed, which led to a deterioration in the protection of the MPZV throughout the plain. Negative processes of groundwater quality deterioration are observed during flood filling of the canals and in the post-flood filtration period. Within the reclamation systems, the intensity of surface and groundwater pollution due to agricultural production (mineral and organic fertilisers, pesticides, etc.) is increasing. The filtration of flood water enriched with oxygen from canals leads to an increase in oxidised iron in the water and its accumulation in soils. In addition, during the flood period, an increase in groundwater mineralisation and soil salinity was observed in a number of areas.

At present, a significant part of the reclamation network is out of order - the canals are silted up, overgrown with various vegetation, and the locks are out of order.

The mining and industrial type of anthropogenic load is very common in the development of MNR. It includes water intakes of fresh and mineral groundwater, open and underground mining, and oil and gas exploration sites.

An important place among the types and objects of technogenic (anthropogenic) load that negatively affects the MHPS is occupied by domestic pollution due to the lack of centralised sewage systems with treatment and discharge of domestic wastewater in rural areas and partially in cities. There are solid waste dumps near almost every settlement. There is no industrial-scale sorting and recycling of this waste.

A detailed assessment of the current state of the anthropogenic load on the MWR is required.

2.2.2 Volumes/inventories

Prognostic groundwater resources (PGR) are the volumes of groundwater estimated on the basis of geological surveys that characterise the potential for their extraction from the subsoil in the respective territory. The estimated EOR in the Prut and Siret sub-basins amount to 590.54 thousand m^3 /day (in Ivano-Frankivsk region - 260.86 thousand m^3 /day, in Chernivtsi region - 329.67 thousand m^3 /day), their distribution over the territory is uneven, which is explained by differences in geological, structural and physical geographical conditions. The exploration of forecasted groundwater resources in Ukraine is insignificant - 26%, for Ivano-Frankivsk region this figure is 38%, for Chernivtsi region - 43%. It is necessary to conduct a detailed assessment of the current state of anthropogenic pressure on the IWRM.

Out of the total number of EORPs, operational groundwater reserves in the amount of 240.89 thousand m^3 /day have been explored and approved (in Ivano-Frankivsk region - 99.13 thousand m^3 /day, in Chernivtsi region - 141.76 thousand m^3 /day). Operational groundwater reserves are calculated based on the data of geological study of groundwater that can be extracted from the subsoil by rational technical and economic indicators of water intake in a given extraction mode, provided that the quality characteristics of groundwater meet the requirements of their intended use and the permissible degree of environmental impact during the estimated period of water use.

The development of projected groundwater resources is most intensive in densely populated areas with high economic potential. Most groundwater is withdrawn in areas with high population density and developed industry.

According to statistical reporting No. 2TP-Vodhoz (annual), the share of groundwater abstraction from natural bodies was 5.618 million m^3/year (25%) in 2020. Accordingly, the water supply in the Prut and Siret sub-basins is largely dependent on surface water.

Table 80. Extraction of drinking and industrial groundwater and its use in the Prut and Siret sub-basins

Year	Production, million m3 /year^3	Use, million m /year^3					Groundwater discharge without use, million m3 /year^3
		Total	Household and drinking water	Production and technical	Agricultural	Irrigation	
Chernivtsi region							
2020	5,056	2,075	0,385	1,526	0,164	-	-
Ivano-Frankivsk region							
2020	0,562	0,492	0,122	0,354	0,017	-	-
	5,618	**2,567**	**0,507**	**1,88**	**0,181**	**-**	**-**

State accounting is carried out for the extraction and use of groundwater from explored, preliminary explored deposits and subsoil areas with unevaluated reserves within the Prut and Siret sub-basins. Groundwater extraction is subject to mandatory accounting based on the statistical reporting data of the State Agency of Ukraine for Water Resources No. 2TP-Vodkhoz (annual).

The current water supply within the Prut and Siret sub-basins is based on a network of centralised and dispersed water intakes and a dense network of individual production wells located in large settlements and rural areas.

The State Research and Production Enterprise Geoinform of Ukraine annually analyses the groundwater regime in natural and disturbed conditions.

2.3 Other significant anthropogenic impacts

2.3.1 Climate change

One of the main manifestations of regional climate change against the backdrop of global warming is a significant increase in air temperature, changes in the thermal regime and precipitation patterns, an increase in the number of dangerous meteorological events and extreme weather conditions, and the damage they cause to various sectors of the economy and the population. These trends are typical for Ukraine in general and for the Prut and Siret sub-basins in particular. The greatest changes have been observed over the past thirty years, which have been the warmest for the period of instrumental weather observations.

The rise in air temperature is observed not only near the Earth's surface but also in the lower troposphere, accompanied by an increase in tropospheric moisture content, and causes an increase in atmospheric instability and convection intensity. Such changes have led to an increase in the frequency and intensity of convective weather phenomena: thunderstorms, showers, hail, squalls, and an increase in the maximum intensity of precipitation and its storm component.

Representative concentration trajectories (RCPs) of greenhouse gases have different trajectories of emissions and concentrations in the atmosphere, emissions of pollutants, and specifics of land use in the 21st century (in particular, changes in the area of forested areas) and their corresponding consequences. Two RTC scenarios were selected for this study: "soft" scenario 2.6, which, in accordance with the Paris Agreement, provides for a reduction in greenhouse gas emissions, and "hard" scenario 8.5, which does not take into account any adaptation or mitigation measures. All scenarios demonstrate a steady increase in average annual temperature throughout the 21st century in all regions. By the end of the century, the average annual temperature averaged across regions under different scenarios is expected to increase by 2-5°C. Global greenhouse gas emissions scenarios (Sources: USGCRP/GlobalChange.gov, UHMI 2014) The study calculated simulated changes in the average annual river flow (flow rate) of the RBD of Ukraine for two future periods (2041-2070 and 2071-2100) under GWP 2.6 and GWP 8.5 scenarios

The water-heat balance of river basins is highly sensitive to climate change. Rising air temperatures and changes in precipitation patterns affect not only the hydrological regime of rivers, but also the overall water resources. Climate change is increasing the frequency of floods and droughts, which makes agriculture, energy, transport and the social sector vulnerable, as they depend on water resources.

The average annual runoff is expected to fluctuate between 2041 and 2070. Increased water flows in the rivers of the Carpathian region will result in catastrophic floods on mountain rivers and may cause significant economic losses in all sectors of the economy and in territorial communities in the Prut and Siret sub-basins.

2.3.2 Pollution of water bodies with solid household waste, including plastic

The pollution of water bodies by solid waste, primarily plastic, is one of the pressures that leads to the deterioration of the ecological and chemical state of surface waters. This problem is not specific to a particular river basin, but to the whole country and reflects the problem of waste management at both national and local levels.

Gaps in national legislation, an inefficient system of waste collection, transport and disposal, and a low culture of waste management are manifested in a large number of unauthorised and spontaneous landfills, including on river banks. Some of the waste ends up directly in rivers and water bodies, which is not only an aesthetic problem, but also leads to chemical pollution of water, poisoning of living organisms and deterioration of their living conditions.

Over time, plastic breaks down and turns into microplastics, which get into living aquatic organisms, contributing to the accumulation of toxins.

Microplastics are less than 5 mm in size and fall into two groups: primary and secondary. Primary microplastics are part of cosmetics (toothpastes, scrubs, shower gels, etc.), industrial cleaning products, and are also formed as a result of wear and tear on car tyres and when washing synthetic products.

Recycled plastic is produced by shredding large plastic waste such as bottles, disposable tableware, packaging, etc.

No special studies have been conducted on the amount of waste on the banks and directly in the rivers and water bodies in the Prut and Siret sub-basins, nor on their direct impact on the ecological and chemical state of water bodies.

Given the current situation, addressing the problem of MSW management should be included in the programme of measures to achieve good environmental status of the Prut and Siret sub-basins.

2.3.3 Invasive species

Invasions of alien species outside their "native" habitats are global in nature. The naturalisation and further spread of invaders can cause irreversible environmental damage and undesirable economic and social consequences.

Currently, biological invasions are considered to be biological pollution, but unlike most pollutants that can decompose in natural ecosystems through self-purification processes and whose content is controlled by humans, alien organisms that have successfully invaded begin to multiply uncontrollably and spread rapidly in the environment. This phenomenon can have unpredictable and irreversible consequences.

In addition, the introduction of alien species leads to irreparable losses of biodiversity, both through direct destruction of native species by predators, food and spatial competition, and as a result of displacement of native species, changes in their habitats and hybridisation. The emergence of any alien species is an indicator and, at the same time, a cause of the deterioration of the ecological state of a water body. All this causes a special danger of invasions and determines the specifics of control measures in terms of the risks of not achieving a "good" ecological state of MPAs where the process of invasion of adventive species is carried out. It is possible that alien species pose a threat as agents of biological interference, or are intermediate hosts of human and domestic animal diseases and can be used for sabotage. Therefore, this problem is becoming increasingly urgent in terms of ensuring the environmental safety of the river basin, part of which is located in the temporarily occupied territory.

According to the Convention on Biological Diversity (The Hague, 2002), measures aimed at mitigating the effects of invasions by alien species should be mainly preventive, but it is usually not possible to effectively control the process of invasions, primarily due to the lack of a biodiversity monitoring system.

Therefore, after mandatory special studies of alien aquatic species in the Prut and Siret sub-basins and determination of the list of species and their location, the first and most important control measure is the creation of a basin-wide monitoring system for invasions in the IWR.

Monitoring should be focused on identifying and analysing the species composition of alien species, invasive corridors, vectors, geography and dynamics of invasions; population dynamics of the most significant invasions from emergence to naturalisation, as well as invasive species that have already been naturalised and the consequences of their impact on habitats, native species, communities and ecosystems; geographical location of invasive sub-corridors and ecosystems vulnerable to invasions. The most likely centres for the penetration, naturalisation and spread of alien species are places in the area of municipal wastewater outflows from large cities where the aquarium services market is developed, as well as discharges of heated water from thermal power plants and large industrial enterprises. Therefore, an inventory of such possible entry points and their survey should be the first step in implementing a monitoring system.

3 ZONES (TERRITORIES) TO BE PROTECTED AND THEIR MAPPING

3.1 Emerald Network facilities

The Emerald Network is an ecological network consisting of special areas for the conservation of biological diversity created (designated) in accordance with the Convention on the Conservation of Wild Flora and Fauna and Natural Habitats in Europe (Bern Convention). Its goal is to ensure the long-term survival of species and habitats listed in the Bern Convention that require special protection.

On 30 November 2018, six countries: Belarus, Georgia, the Republic of Moldova, Norway, Switzerland and Ukraine have officially approved the lists of Emerald Network sites on their territories. The full list of Ukraine's Emerald Network includes 271 sites[2] , and the network covers about 8% of Ukraine's territory.

There are 8 Emerald Network sites within the Prut and Siret sub-basins.

According to the categories (Fig. 101), the Emerald Network facilities are divided into:

- national natural park - 3;
- regional landscape park - 1;
- a nature reserve - 4.

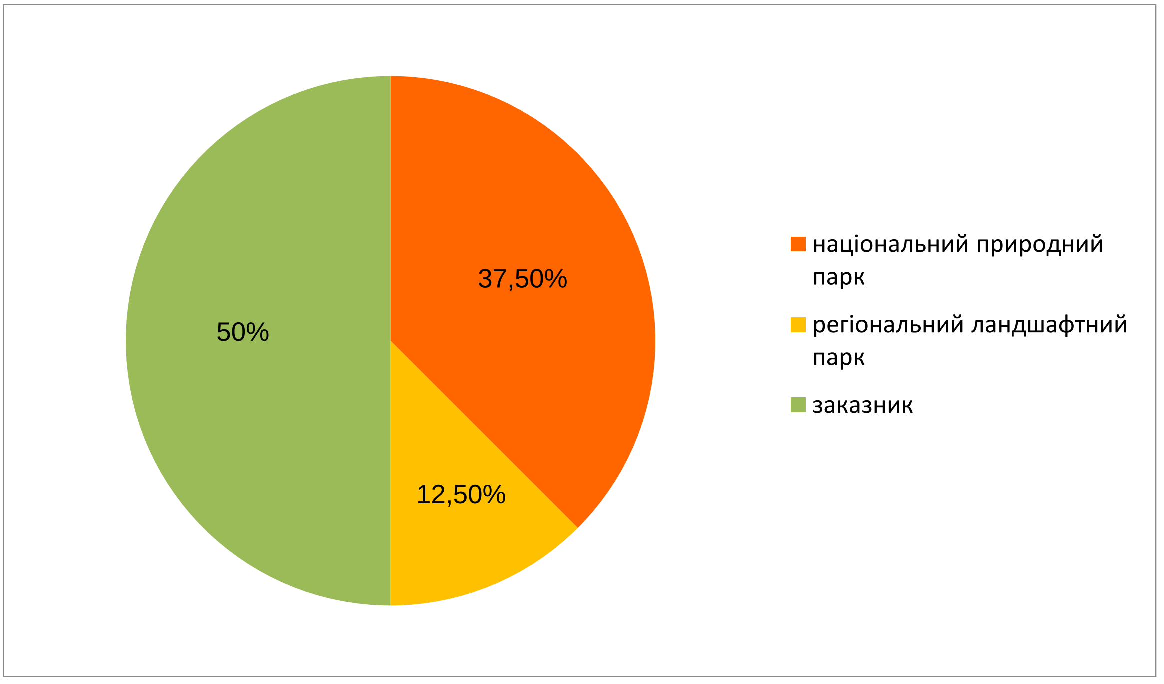


Figure 101. Breakdown of Emerald Network facilities by category, %.

None of the sites has a management and development plan in place. The list of sites of the Emerald Network of the Prut and Siret sub-basins is provided in Annex 4 (M5.3.2, M5.3.3).

3.2 Sanitary protection zones

Sanitary protection zones include the areas where water intakes for drinking water supply are located. According to the Resolution of the Cabinet of Ministers of Ukraine on the Legal Regime of Sanitary Protection Zones of Water Bodies No. 2024 of 18 December 1998, these zones are classified as the so-

[2] UPDATED LIST OF OFFICIALLY ADOPTED EMERALD SITES (NOVEMBER 2018) Document prepared by the Directorate of Democratic Partic- ipation and Marc Roekaerts (EUREKO) https://rm.coe.int/updated-list-of-officially-adopted-emerald-sites-november-2018-/16808f184d

called first zone (strict regime) of compliance with the use regime. The Resolution provides for a number of permitted and prohibited activities within drinking water intakes.

According to the EU WFD (Art. 7), "Member States shall identify in each RBI:

- All surface/groundwater bodies used for abstraction of water intended for human consumption, providing an average of more than 10 m³ of water per day or providing water consumption for more than 50 people and
- Those water bodies that are intended for future use for the same purpose."

In the Prut and Siret sub-basins, there are 156 water intakes that withdraw more than 10 m³ per day. Of these, 91 are groundwater intakes and 65 are surface water intakes (Figure 102).

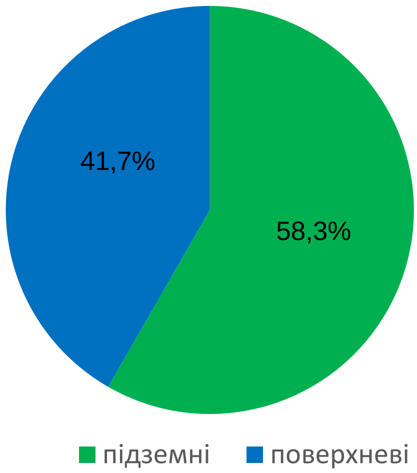


Figure 102. Distribution of drinking water intakes by type, %.

The State Agency of Water Resources of Ukraine is responsible for maintaining state water accounting.

3.3 Protection zones for valuable aquatic bioresources

Areas designated for the protection of economically important aquatic species or areas for the protection of valuable aquatic bioresources include those areas where such aquatic resources of significant economic value are found or cultivated.

Depending on the specifics of the protection zone for valuable aquatic bioresources, the monitoring programme may include additional indicators or sampling frequency.

According to the Resolution of the Cabinet of Ministers of Ukraine No. 1209 "On Approval of Tariffs for Calculating the Amount of Compensation for Damage Caused by Illegal Harvesting (Collection) or Destruction of Valuable Aquatic Bioresources" dated 21 November 2011 (as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 1039 dated 6 October 2021), the list of valuable bioresources includes both rare and common fish species throughout Ukraine.

At the same time, according to Article 1 of the Law of Ukraine "On Fisheries, Commercial Fishing and Protection of Aquatic Bioresources", a fishery water body (or part thereof) is a water body (or part thereof) that is used or may be used for fisheries purposes.

Thus, taking into account the above, as well as the lack of an appropriate legislative and regulatory framework, the protection zones for valuable bioresources in Ukraine have not been defined.

3.4 Arrays of surface/ground water used for recreational, medical, resort and health purposes, as well as water intended for bathing

Recreation areas of water bodies are land plots with adjacent water space intended for organised recreation of the population on the coastal protective strips of water bodies. Places of mass recreation are determined by local governments in accordance with the powers vested in them every year before the start of the summer swimming season. Water protection zones are established along rivers, around lakes, reservoirs and other water bodies, within which land plots are allocated for coastal protection strips.

It is prohibited in water protection zones and coastal protection zones:

- storage and use of pesticides and fertilisers;
- construction of cemeteries, summer camps for livestock, manure storage facilities, cattle cemeteries, waste dumps, filtration fields, liquid and solid waste storage facilities, etc;
- discharge of untreated wastewater;
- construction of any structures (except for hydrotechnical, hydrometric and linear structures), including recreation centres, summer cottages, garages and car parks;
- Washing and maintenance of vehicles and equipment.

Requirements for the location and organisation of water body recreation areas:

- To organise recreational areas on water bodies, their owners or lessees are required to agree the operation of the beach with the State Service of Ukraine for Food Safety and Consumer Protection before the start of each swimming season;
- the recreation area should be located outside the sanitary protection zones of industrial enterprises. The recreation area should be located at the maximum possible distance (at least 500 m) from sluices, hydroelectric power plants, wastewater discharge sites, stables, livestock watering places and other sources of pollution;
- beaches should not be located within the first zone of the sanitary protection belt of drinking water sources.

Environmental goals for recreational areas:

- The water quality of reservoirs and rivers used in recreational areas must meet the requirements of sanitary legislation;
- the composition and properties of water in the area of recreational water use must meet the requirements for physical, chemical and sanitary-microbiological indicators;
- requirements for water monitoring in recreational areas:
- water sampling for departmental control in water bodies should be carried out annually by local self-government bodies at least 2 times before the start of the swimming season (at a distance of 1 km upstream from the swimming area on watercourses and at a distance of 0.1-1.0 km in both directions from it on water bodies, as well as within the swimming area);
- during the swimming season, such water sampling shall be carried out at least twice a month at at least two points selected in accordance with the nature, length and intensity of use of swimming areas.

Pursuant to CMU Resolution No. 264 of 06.03.2002 "On Approval of the Procedure for Registration of Places of Mass Recreation on Water Bodies", local executive authorities and territorial fishery protection authorities are required to identify on maps and schemes land plots and water areas suitable for the organisation of beaches, boat rental facilities, water attractions, as well as places for water sports and places for amateur and sport fishing in winter.

Approved copies of the maps are submitted to the emergency rescue services that serve water bodies in their area of responsibility and to the regional coordination emergency rescue centres of the State Specialised Emergency Rescue Service on Water Bodies of the Ministry of Emergencies (currently the State Emergency Service).

Information on places of mass recreation is submitted annually by 1 April by local governments, and information on places of recreational and sport fishing is submitted on 10 February and 30 October by territorial fish protection authorities to regional coordination emergency rescue centres of the SES.

Within the Prut River sub-basin (as of July 2023), there are 5 recreation and leisure sites (Annex 5 (M5.3.2, M5.3.3)).

3.5 Areas vulnerable to (accumulation of) nitrate

Ukraine has approved a methodology for determining nitrate vulnerable zones (Order of the Ministry of Ecology No. 244 dated 15.04.2021), as required by the EU Nitrate Directive. The methodological approach relies heavily on a large amount of high-resolution spatial and temporal data, mainly surface and groundwater monitoring data, but statistical data such as livestock numbers, fertiliser application and nitrogen surplus calculations should also be used to identify these zones. All of this information is needed to identify nitrate vulnerable areas, and it needs to be of high quality and with a sufficient level of confidence. At the moment, the existing surface water monitoring network is not sufficient in its continuity and spatial coverage to apply the developed method, and groundwater monitoring is not carried out at all.

Therefore, and taking into account the fact that in Ukraine

- the highest percentage of ploughed land in the world (53.9%, 2021 data), while the rate of ploughed agricultural land is 78.2%;
- There is a lack of representative and reliable information on the content of nutrients in surface and groundwater;
- Eutrophication of water bodies is a widespread phenomenon;
- the initial level of implementation of the Nitrate Directive,

For the period 2025-2030, it is proposed to define the entire territory of Ukraine as a nitrate vulnerable zone. This is in line with the requirements of the EU WFD, which provides for the "protection of seas and coastal waters" and the prevention of deterioration of MPAs and MEAs (it is more appropriate to classify more MPAs as vulnerable than to change their status from "good" to "poor"). This "whole country" approach is also used in many EU countries. Areas vulnerable to nitrate accumulation can be refined or defined in subsequent river basin management plan cycles based on improved, more accurate information.

This approach makes it possible to extend the main measures to the entire territory of the country and plan more specific measures for surface and groundwater bodies where there is a risk of not achieving environmental objectives due to the impact of agriculture based on confirmed data.

During the period 2025-2030, the focus should be on improving the monitoring network (both groundwater and surface water) and the database to ensure a more detailed approach to zone designation and monitoring and thus achieve full compliance with the EU WFD during the 2nd cycle of the river basin management plan (2031-2036).

3.6 Vulnerable and less vulnerable areas identified in accordance with the criteria approved by the Ministry of Environment

As of 2023, no vulnerable or less vulnerable zones have been identified in Ukraine.

The regulatory document governing this issue is the Order of the Ministry of Ecology and Natural Resources of 14 January 2019 No. 6 (registered with the Ministry of Justice of Ukraine on 5 February 2019 under No. 125/33096) "On Approval of the Procedure for Determining the Population Equivalent of a Settlement and the Criteria for Determining Vulnerable and Less Vulnerable Zones".

Also, in accordance with the Law of Ukraine "On Water Disposal and Wastewater Treatment" of 12 January 2023 (to enter into force on 07 August 2023), Article 12. *Powers of Local Self-Government Bodies*, the powers of local self-government bodies in the field of water disposal include:

- upon the submission of the central executive body implementing the state policy in the field of water sector development, identification of vulnerable and less vulnerable zones in accordance with the criteria approved by the central executive body ensuring the formation of the state policy in the field of environmental protection.

The State Agency of Ukraine for Water Resources has prepared and sent submissions to local authorities. The process of making relevant decisions by the competent authorities is ongoing.

4 MAPPING OF THE MONITORING SYSTEM, RESULTS OF MONITORING PROGRAMMES IMPLEMENTED FOR SURFACE WATER (ECOLOGICAL AND CHEMICAL), GROUNDWATER (CHEMICAL AND QUANTITATIVE), AREAS (TERRITORIES) SUBJECT TO PROTECTION

4.1 Surface water

Surface water monitoring is carried out in accordance with the Procedure for State Water Monitoring approved by the Cabinet of Ministers of Ukraine on 19 September 2018, No. 758. The Ministry of Ecology, the State Agency of Water Resources and the State Emergency Service are the subjects of state water monitoring.

Every year, starting from 2020, surface water monitoring programmes are approved by the relevant orders of the Ministry of Ecology (Order No. 410 of 31.12.2020 "On Approval of State Water Monitoring Programmes", Order No. 3 of 05.01.2022 "On Approval of the State Water Monitoring Programme", Order No. 27 of 17.01.2023 "On Approval of the State Water Monitoring Programme").

4.1.1 Monitoring system

In the Prut sub-basin, monitoring was carried out at 30 monitoring sites at 23 WSCs, and in the Siret sub-basin - at 5 monitoring sites at 4 WSCs, including:

- at transboundary IBAs identified in accordance with intergovernmental cooperation agreements - 4;
- at the IWPs from which water is abstracted to meet the drinking and household needs of the population - 4;
- to determine reference conditions and at Emerald Network facilities - 5;
- 27 monitoring points have been installed at the MPAs that are at risk based on anthropogenic impacts on the quality and quantity of water.

4.1.2 Hydromorphological assessment/condition

Hydromorphological monitoring was carried out at 23 MPAs. According to the monitoring results, 13 WBMs belong to the first class (high status), 10 WBMs - to the second class (Fig. 103).

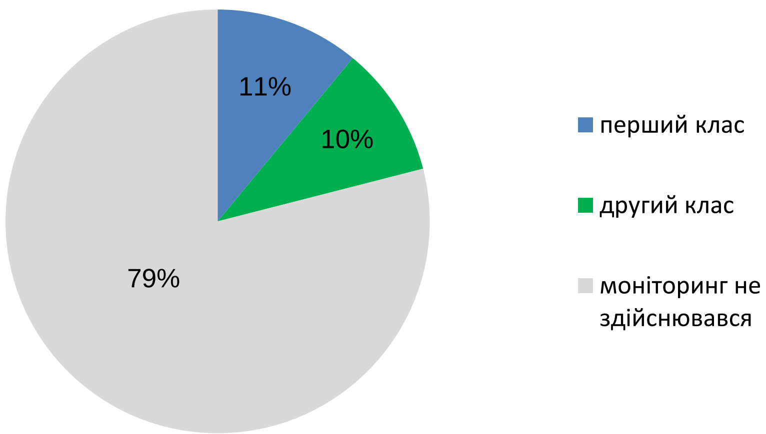


Figure 103. Hydromorphological state of the MWP

4.1.3 Assessment of the chemical state

The assessment of the chemical state of the IWB of the Prut and Sireta sub-basins (Danube River basin area) is based on the determination of the concentrations of priority substances specified in Directive 2008/105/EC, taking into account Directive 2013/39/EU250, which sets the maximum values of environmental quality standards (hereinafter - EQS). At the legislative level, the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45 dated 6 February 2017, registered with the Ministry of Justice of Ukraine on 20 February 2017 under No. 235/30103, defines the list of MQS indicators for which the list is set out in Annex 8 of the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14 January 2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial [...]" (the "Order").

The requirements of Directive 2009/90/EC, which sets out technical requirements for the processing of monitoring data, were also taken into account when assessing the chemical state of the MPV.

Article 5 of Directive 2009/90/EC sets out the criteria for statistical processing of monitoring data, namely:

- if the measured value was below the limit of quantification (LOQ), the calculation uses the value of half the LOQ for this indicator;
- when summarising the results of individual isomers or mixtures (e.g. polycyclic aromatic hydrocarbons, cyclodiene pesticides, DDT), in the case of values measured below the LOQ, zero "0" should be used to calculate the average concentrations.

In addition, Article 4 of Directive 2009/90/EC stipulates that the methods for measuring the content of indicators must meet the minimum criteria: have a measurement uncertainty value below 50% (k=2) and a quantification limit equal to or below 30% of the relevant EQOA.

Valuation reliability

The reliability of the chemical state assessment was performed using the criteria for establishing the reliability of the correct determination of the chemical state of the MPE specified in Annex 11 of the Order.

According to the established criteria, a three-stage scheme was used to assess the reliability of the correct determination of the chemical state of the MPV:

- a high level of assessment reliability means that most of the requirements have been met, namely: measurement data are available for all indicators identified in the List of Pollutants for Determining the Chemical State of MSW that meet the requirements of the Procedure (almost all relevant requirements for the list of indicators, methods and frequency have been met); MSW aggregation demonstrates reliable results;
- the medium level of reliability of the assessment of the state of the IAP is established in the absence of sufficient monitoring data, frequency and measurement of all indicators identified in the List;
- low reliability of the assessment of the state of IWM means that the assessment of the state of IWM was based on risk assessment, transfer of monitoring data through aggregation of IWM according to certain criteria.

To assess the chemical state of the WIPPs, we used statistically processed data of measurements of pollutants in surface waters carried out as part of the state water monitoring programme (diagnostic and operational monitoring of the WIPPs) at 38 monitoring points located at 30 WIPPs in 2020-2022, namely, the average and maximum values.

Background concentrations for non-synthetic substances (mercury, lead, cadmium, nickel) were not taken into account when assessing the chemical state of the MPW.

Compliance of the EQA measurement results with the requirements established for the annual average and maximum permissible concentrations is considered to be in compliance with the requirements established for the "good" chemical condition of the Waste Water Treatment Plant.

For MPEs that were not monitored in the reporting period, the chemical state was assessed by interpolating (transferring) the assessment results from MPEs that were monitored, according to the aggregation of MPEs.

Article 5 of Directive 2009/90/EC also establishes criteria for statistical processing of monitoring data, namely:

- if the measured value was below the limit of quantification (LOQ), the calculation uses the value of half the LOQ for this indicator;
- when summarising the results of individual isomers or mixtures (e.g. polycyclic aromatic hydrocarbons, cyclodiene pesticides, DDT), in the case of values measured below the LOQ, zero "0" should be used to calculate the average concentrations.

In addition, Article 4 of Directive 2009/90/EC stipulates that the methods for measuring the content of indicators must meet the minimum criteria: have a measurement uncertainty value below 50% (k=2) and a quantification limit equal to or below 30% of the relevant environmental quality standard.

The following parameters were not measured: brominated diphenyl ethers (esters), chloralkanes, C $_{,10-13}$ di-(2-ethylhexyl)-phthalate, diuron, isoproturon, pentachlorophenol, tributyltin compounds (tributyltin cation), perfluorooctane sulfonate and its derivatives (PFOS), dioxins and dioxin-like compounds, hexabromocyclo-dodecane (HBCDD).

For the indicators fluoranthene, hexachlorobenzene, hexachlorobutadiene, mercury and its compounds, dicofol, heptachlor and heptachloroepoxide, for which the recommended object of control is biota, due to the lack of technical capabilities and measurement methods, concentrations were determined only in surface water samples.

The results of the assessment of the chemical state of the WBM in the Prut and Siret sub-basins based on monitoring data are presented in Annex 8 (M5.3.2, M5.3.3).

Based on the results of the assessment of the chemical state of the WFD of the Prut and Siret sub-basins in 2020-2022, the following conclusions can be drawn from the monitoring data (Table 81):

- chemical status is "good": 19 MPAs (7% of the total number of linear MPAs), with a length of 436.8 km (14% of the total length of linear MPAs in the Prut and Siret sub-basins);
- chemical status of "not achieving good": 11 MPAs (4% of the number of linear MPAs), with a length of 330.5 km (10% of the length of linear MPAs in the Prut and Siret sub-basins).

There are no monitoring points in the sub-basins of the Prut and Siret rivers at the polygonal MPAs.

Table 81. Chemical state of the Prut and Siret sub-basins (based on monitoring data)

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	total area of the MWP, km^2
"good"	19	436,8	0	0
"failure to achieve the good"	11	330,5	0	0

The following substances have been found to exceed the MAC$_{MAX}$ - maximum permissible concentration and/or MAC$_{CP}$ - average annual concentration:

– cadmium (for 3 MPVs);
– fluoranthene (for 8 MPV);
– lead and its compounds (for 1 MPE);
– mercury and its compounds (for 2 MPVs);
– Nickel and its compounds (for 1 MPE);
– benzo(a)pyrene (for 20 MPV);
– benzo(b)fluoranthene (for 1 MPV);
– benzo(k)fluoranthene (for 1 MPV);
– benzo(g,h,i) perylene (for 2 MPV);
– Cypermethrin (for 4 MPVs).

Based on interpolation of the monitoring results according to the aggregation of IAPs (low level of reliability of the IAPs assessment) (Table 82), the following was established:

- chemical status is "good": 21 linear MPAs (7% of the number of linear MPAs in the Prut and Siret sub-basins), with a length of 199.1 km (6% of the length of linear MPAs in the Prut and Siret sub-basins);

- chemical status of "failure to achieve good": 66 linear MPAs (23% of the number of linear MPAs in the Prut and Siret sub-basins), with a length of 848.6 km (26% of the length of linear MPAs in the Prut and Siret sub-basins).

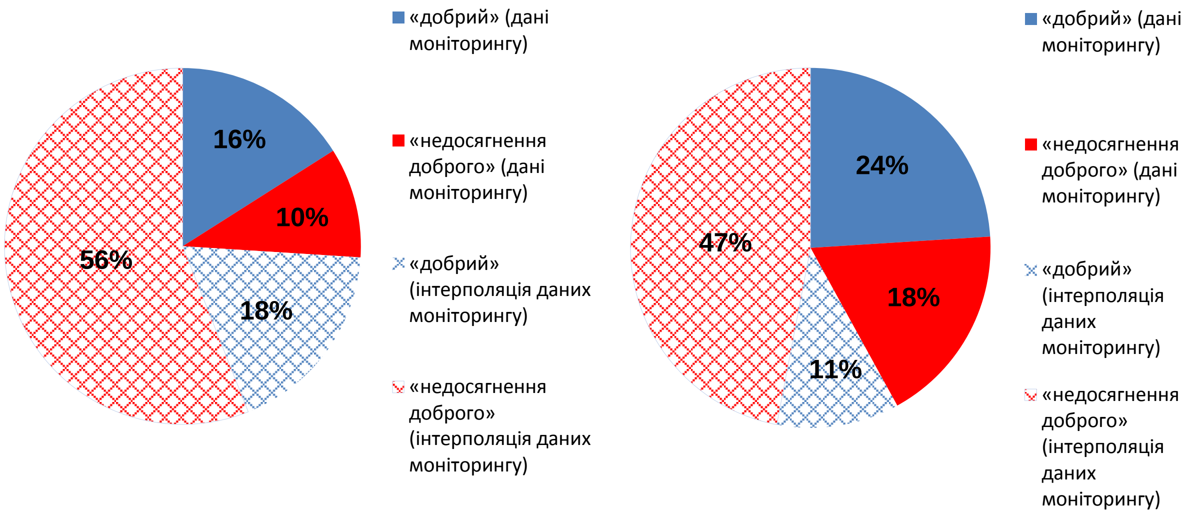
Table 82. Chemical state of the WBM of the Prut and Siret sub-basins (based on interpolation of monitoring data)

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	total area of the MWP, km^2
"good"	21	199,1	0	0
"failure to achieve the good"	66	848,6	0	0

A summary assessment of the chemical state of the WIP is given in Table 83, Annex 9 (M5.3.2, M5.3.3) and Figure 104.

Table 83. Total assessment of the chemical state of the WBM of the Prut and Siret sub-basins for the period 2020-2022 (monitoring data and interpolation of monitoring data)

Chemical state	number of linear MPVs	total length of linear IPPs, km	number of polygonal MPAs	general area of polygonal landfill sites, km^2
"good"	40	635,9	0	0
"failure to achieve the good"	77	1179,1	0	0



a) by number b) by length

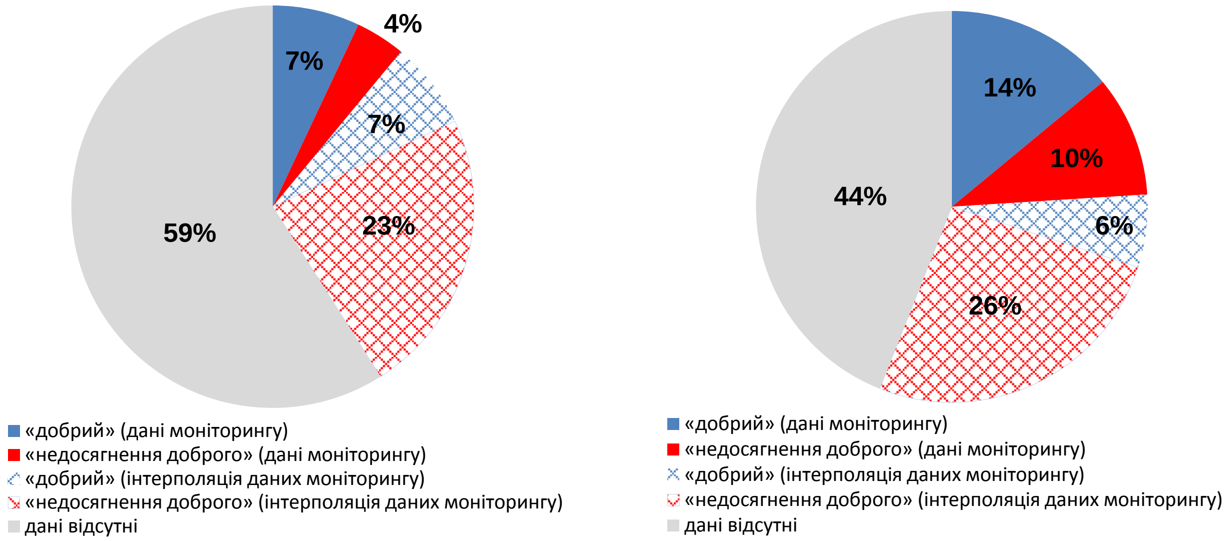
Figure 104. Assessment of the chemical state of the linear MPAs in the Prut and Siret sub-basins (monitoring data and interpolation of monitoring data)

Taking into account the interpolation of monitoring data, the chemical status was assessed for 117 linear MPEs (the total number of linear MPEs in the Prut and Siret sub-basins is 292) with a total length of 1815.0 km (the length of all MPEs in the Prut and Siret sub-basins is 3210.6 km). The total number of polygonal MPAs in the Prut and Siret sub-basins is 6 with an area of 1.86 km^2 . No monitoring of polygonal landfill sites was carried out in 2020-2022.

For 30 MPAs in the Prut and Siret sub-basins, the reliability of the assessment of the correct chemical status was determined according to the criteria of Annex 11 of the Order and corresponds to the average level of reliability.

87 MPUs were assessed with a low level of assessment reliability based on the transfer of results obtained under the surface water quality monitoring programme to MPUs where monitoring was not conducted in the specified period, according to the aggregation of MPUs.

The overall assessment of the chemical state of the linear MPAs of the Prut and Siret sub-basins is shown in Figure 105.



a) by the number of MPAs *b) by the length of the IPA*

Figure 105. Total assessment of the chemical state of the linear MPAs of the Prut and Siret sub-basins in

4.1.4 Environmental assessment

The assessment of the ecological status of the MWBs of the Prut and Siret sub-basins is carried out in accordance with the criteria and the list of indicators set out in the Order of the Ministry of Ecology and Natural Resources No. 5 dated 14.01.2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial [...]" (hereinafter - the Order).

Five classes are used to classify the ecological status of a surface water body: "excellent", indicated in blue, "good", indicated in green, "satisfactory", indicated in yellow, "poor", indicated in orange, and "very poor", indicated in red.

At the legislative level, no environmental quality standards (EQS) have been adopted to assess the environmental condition of the MWR.

To prepare the assessment of the ecological status of the Prut and Siret MEAs in terms of biological indicators, the Detailed Methodology for Assessing the Ecological Status Based on Biological Indicators for Selected Types of Surface Water Massifs in Ukraine prepared by Jarmila Makovinska (Water Management Research Institute, Bratislava, Slovakia, 2023) was used.

The methodology includes four biological indicators: phytoplankton, phytobenthos, macrophytes, macroalgae, bryophytes and vascular plants, and macrozoobenthos (bottom invertebrates) for four types of surface water bodies (rivers, lakes, transitional waters and coastal waters).

The ecological status of any of the MPAs has not been determined.

In 2022, biological indicators (phytoplankton, phytobenthos, macrophytes, benthic invertebrates) were monitored at 24 MPVs in the Prut and Siret sub-basins.

No fish monitoring was carried out.

The assessment of the status of the MNR by biological indicators (except fish) is presented in Figure 106.

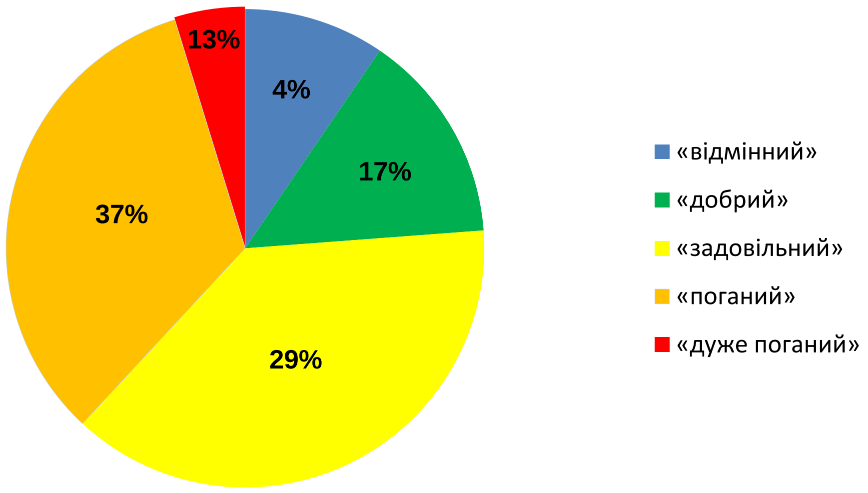


Figure 106. Evaluation of MWP by biological indicators

4.1.5 Assessment of environmental potential

The assessment of the environmental potential of the Prut and Siret sub-basins is carried out in accordance with the criteria and the list of indicators set out in the Order of the Ministry of Ecology and Natural Resources of 14.01.2019 No. 5 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial [...]" (hereinafter - the Order).

For an artificial or significantly altered surface water body, the ecological potential is determined, for which four classes are used - "good", indicated by parallel bars of green and grey, "satisfactory", indicated by parallel bars of yellow and grey, "poor", indicated by parallel bars of orange and grey, and "very poor", indicated by parallel bars of red and grey.

No assessment of the ecological potential of significantly altered and artificial MPAs has been carried out.

4.2 Groundwater

4.2.1 Monitoring system

Inventory of wells in the Prut and Siret sub-basins has not been carried out in the last 10 years. No monitoring of underground wells has been carried out, and the condition of water intake structures is unknown.

4.2.2 Chemical assessment/risk assessment

As of the end of 2023, the environmental assessment/risk assessment of the Mine was not conducted.

4.2.3 Estimation of groundwater volumes/reserves

As of the end of 2023, no assessment of groundwater volumes/reserves had been made.

5 LIST OF ENVIRONMENTAL OBJECTIVES FOR SURFACE WATER, GROUNDWATER AND AREAS (TERRITORIES) SUBJECT TO PROTECTION AND DEADLINES FOR THEIR ACHIEVEMENT (IF NECESSARY, JUSTIFICATION FOR SETTING LESS STRINGENT OBJECTIVES AND/OR POSTPONEMENT OF DEADLINES FOR THEIR ACHIEVEMENT)

Environmental targets for surface water, groundwater and protected areas (territories) are set separately.

Surface water:

- Preventing the deterioration of all MPEs;
- Achievement/maintenance of "good" ecological and chemical status of all natural MPAs (rivers, lakes, transitional and coastal waters);
- Achievement/maintenance of "good" ecological potential and chemical state of significantly altered and artificial MPAs;
- Gradual reduction to the complete absence of hazardous substances.

Groundwater:

- Prevention of deterioration of all MSW;
- Achievement/maintenance of "good" quantitative and chemical condition of all MSW;
- Preventing and limiting groundwater pollution.

Areas (territories) to be protected:

Achieving standards and targets as required by applicable law for:

- Emerald Network facilities;
- sanitary protection zones;
- protection zones for valuable aquatic bioresources;
- surface/ground water bodies used for recreational, medical, resort and health purposes, as well as water intended for bathing;
- areas vulnerable to (accumulation of) nitrates;
- vulnerable and less vulnerable areas identified in accordance with the criteria approved by the Ministry of Environment.

In cases where several objectives are set for a particular MEA or MEA, the most stringent should be applied, while all other objectives should also be met.

In some cases, the deadlines for achieving environmental targets or the targets themselves may be postponed as an exception.

It is allowed to postpone the date of achievement of the target for a period of 6 years (until 2036), but not longer than 12 years (until the end of 2042) from the end of the implementation of the first cycle of the RBMP (2030).

An exemption applied to a particular MNR or MNR should not create a risk of not achieving the environmental objectives of the upstream (for MNRs) or downstream (for MNRs) and adjacent (for MNRs) massif or massifs.

The exceptions include:

- **Achieving less stringent targets or postponing the date of their achievement** due to technical reasons (e.g. lack of a technical solution, technical impracticality or impracticability), disproportionately high cost or the existing natural state of the water body that does not allow for its improvement in a timely manner (e.g. inert groundwater to be restored). The presence or absence of disproportionality is determined by the results of an economic assessment of costs and benefits;

– **Temporary deterioration of the state (goals) as a result of an unforeseen force majeure of** natural origin (e.g. extreme flood, drought) or anthropogenic (accident);

– **New physical modifications of the MPA as a result of new infrastructure projects** aimed at economic development (e.g., a road or railway, a hydroelectric power station). In other words, hydromorphological changes to the MPA are allowed (up to the point of classifying it as "significantly altered"), but any water pollution from point or diffuse sources is not allowed. New physical modifications of a water body are allowed when the benefits to society are higher than the environmental ones, and there is no other option to avoid these modifications for technical and/or financial reasons.

5.1 Environmental targets for surface water

Based on the results of the assessment of the anthropogenic pressure on the MPA of the Prut and Siret sub-basins:

- 160 MNEs are "at no risk" of failing to achieve "good" environmental status/potential, 42 MNEs are "possibly at risk", and 96 MNEs are "at risk";
- 272 MPEs are "without risk" of not achieving "good" chemical status, 14 MPEs are "possibly at risk", and 12 MPEs are "at risk".

By 2030, 169 MNPs will have achieved "good" environmental status/potential, of which 160 MNPs are currently "without risk" (they need to maintain this status), 9 MNPs are 6.5% of MNPs that are "at risk" or "possibly at risk" of not achieving environmental objectives based on the results of the anthropogenic load assessment and will achieve environmental objectives through the implementation of PA measures.

The remaining 'at risk' or 'possibly at risk' MNRs in the Prut and Siret sub-basins (129 MNRs) could reach 'good' ecological status/potential by 2036 or 2042, subject to the implementation of the M&E measures.

By 2030, 272 MPEs will have reached "good" chemical status, these are those that are currently "without risk" (they need to maintain this status), 26 MPEs that are "at risk" according to the results of the anthropogenic load assessment will achieve environmental objectives no earlier than 2036 or 2042, provided that environmental protection measures are implemented.

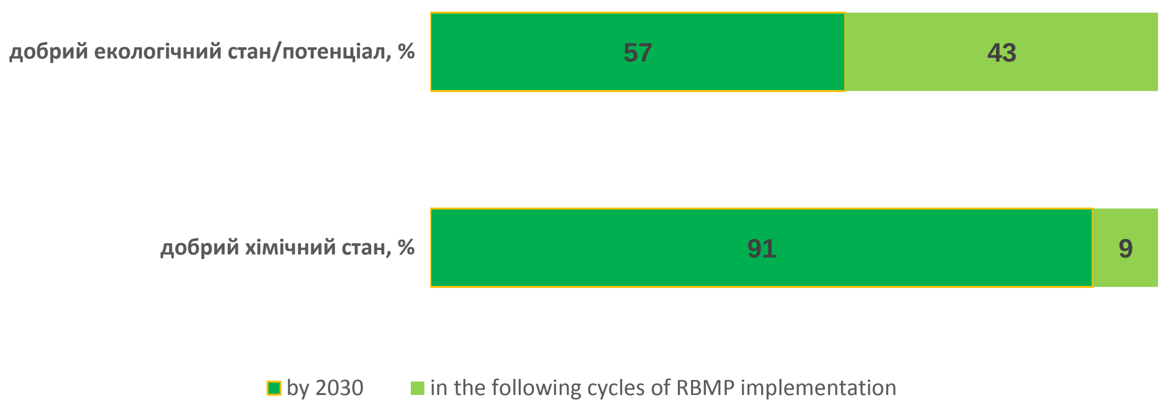


Figure 107. Timeframe for achieving the environmental objectives of the MNP

Annex 10 (M5.3.2, M5.3.3) contains the environmental targets of the MIP, the timeframe for achieving them, reasons for postponement and setting less stringent targets.

5.2 Environmental objectives for groundwater

Environmental targets are set for each MPZ in terms of both their quantitative and qualitative (chemical) status. According to the WFD, the main objective is to achieve good groundwater status.

Additional targets for each individual IWR are defined depending on the existing quantitative and qualitative state of IWR, their use or potential use for water supply to the population, anthropogenic pressure and possible impact on surface ecosystems.

The main criterion for the good quantitative condition of the MPS should be the absence of groundwater depletion.

Depletion is the state of aquifers in which, under the influence of artificial drainage, the decline in groundwater levels has reached such indicators that exclude the possibility of further use of the horizon to meet the needs of society using traditional technical means.

The assessment of the depletion of the ASGM is based on information on the level regime, data on groundwater extraction volumes and their comparison with the resources and approved operational reserves.

In addition, for non-pressure IWRMs, the criterion of good condition is the appropriate condition of the associated surface water bodies and the absence of negative impact on surface ecosystems, primarily vegetation suppression.

The criteria for the good quality (chemical) state of the MPW are the natural background content of chemical elements and compounds, as well as the standards set for drinking water by the State Sanitary Norms and Rules "Hygienic Requirements for Drinking Water Intended for Human Consumption" (SanPiN 2.2.4-171-10).

Quantitative state of low-pressure MPPs

The environmental objective is to avoid depletion of groundwater and no deterioration in its quantitative state.

The groundwater massifs identified in the alluvial deposits of Holocene floodplains and Upper Pleistocene floodplain terraces are in good quantitative condition.

The aquifer of modern alluvial deposits of Holocene floodplains and I-III over floodplain terraces of the Upper Neopleistocene is the main source of centralised and agricultural water supply and is widely used for water supply to the population. The waters of the aquifer of alluvial deposits IV-V of the Middle Neopleistocene floodplain terraces have low water enrichment and unsatisfactory water quality and are of limited use.

Groundwater from alluvial deposits of Holocene floodplains and upper Pleistocene floodplain terraces is the only source of water supply for large settlements.

Qualitative (chemical) state of weakly napyrinic MWPs

The environmental objective is compliance with Sanitary and Epidemiological Norms and Regulations 2.2.4-171-10 and no deterioration in the quality of the water.

The quality of the MWP in the alluvial sediments of Holocene floodplains and Upper Pleistocene floodplain terraces is good.

The waters of the modern alluvial deposits are mostly fresh and have a varied chemical composition. Along with calcium bicarbonate waters, the platform contains calcium sulphate, sodium-calcium sulphate-carbonate, and calcium-magnesium bicarbonate waters, which are caused by the inflow of highly saline waters from Miocene sediments and surface pollution. Due to the absence of an impermeable layer, the water is often contaminated with decay products of organic matter (nitrates, nitrites, ammonia).

Quantitative state of pressure vessels

The environmental goal is to avoid groundwater depletion and to avoid deterioration of the quantitative state.

Groundwater massifs are found in Upper Cretaceous sediments. The quantitative condition is good.

The head varies from 8.0 m to 155.0 m. The degree of water enrichment is not constant and depends on the lithological composition of the water-bearing rocks and their spatial exposure. Well flow rates range from 0.2 to 1.7 litres per day. In the Chernivtsi area, the water content is higher: the flow rate is 2.0 l/s at a depth of 2.0 m (gravity) and 3.4 l/s at a depth of 36.0 m. The aquifer is recharged in some areas by flow from the Badenian sediments, and in the valleys of the Tap River and in places close to the surface, by infiltration of precipitation. The feeding regime is unstable and the water levels are subject to seasonal fluctuations.

Water from the Upper Cretaceous aquifer is mainly used by individual consumers.

Qualitative (chemical) state of pressure vessels

Environmental objective - compliance of the content of elements and compounds with SanPiN 2.2.4-171-10 and no deterioration in the quality of pressure water treatment plants

The chemical condition of the MPZV in the Upper Cretaceous sediments is good.

The chemical composition of water is calcium bicarbonate, less commonly calcium sodium bicarbonate-sulfate and calcium sulfate-hydrocarbonate. Waters containing hydrogen sulphide and microcomponents are often found: Br, J, Fe.

Quantitative state of pressure and non-pressure MPPs

The environmental objective is to avoid depletion of groundwater and no deterioration in its quantity.

The groundwater massifs are found in Miocene and Paleocene-Eocene sediments. The quantitative condition is good.

The aquifer is locally distributed in the Lower Sarmatian-Miocene sediments of the Prut-Dniester interfluve and the interfluve of the Prut, Siret and Maly Siret.

In the eastern part of the Chernivtsi region, the water is mostly free-flowing. In the western direction, the pressure increases and reaches 165 m. The water enrichment of Lower Sarmatian sediments is extremely uneven, which is determined by the degree of drainage, feeding conditions and heterogeneous lithological composition of water-bearing rocks. The importance of groundwater from Sarmatian sediments for water supply is insignificant, however, in the Prut and Siret interfluve, due to good water quality and shallow occurrence of the horizon, and the absence of other aquifers, it is recommended for local water supply.

The aquifers in the deposits of the Miocene Kosiv, Tyras and Opillya formations are widespread in the southern half of the Prut-Siret interfluve and in the Prut River valley. The total thickness of the water-bearing layers of the aquifers is 10-40 m, rarely up to 70-85 m.

Almost everywhere, the Badenian rocks are overlain by Sarmatian sandy-clay deposits, which often form the upper water table. Depths of aquifers range from 0.5-1.0 m on valley slopes to 140 m in watershed areas, and increase to 1140-1240 m in the area of Krasnoilsk village. The water is predominantly pressure water, with the head increasing from 9-29 m on the platform to 360-430 m in the Precarpathian trough towards the Carpathians.

The practical importance of water from the above-mentioned aquifers for water supply is small due to the variability of their chemical composition. They are mainly used for technical and household water supply to small farms, individual consumers and as mineral water.

The water enrichment in the Paleocene and Eocene is approximately the same and mostly insignificant. Slightly increased water enrichment is observed in areas where sandy formations predominate in the section (Vygoda-Pasichnyanska and Yamnenska formations).The aquifer is fed by infiltration of precipitation. The water regime is unstable. The practical value of groundwater is insignificant.

Water is abstracted mainly for non-centralised water supply.

Quality condition of pressure and non-pressure MPPs

The environmental objective is compliance with Sanitary and Epidemiological Norms and Regulations 2.2.4-171-10 and no deterioration in the quality of the water.

By chemical composition, the waters are fresh and slightly mineralised, characterised by calcium bicarbonate, magnesium bicarbonate, and rarely sodium calcium bicarbonate sulphate composition. A characteristic feature of sodium bicarbonate waters is the presence of small amounts of bromine, iodine, iron and metabolic acid. Products of organic water pollution (nitrites, nitrates, ammonia) are usually found in small quantities.

The poor state of groundwater monitoring over the past decades and, consequently, insufficient information on the current state of the MPZs allows to define environmental objectives only in the most general form. In the course of monitoring, the environmental objectives for each MPZ will be specified.

Annex 10 (M5.3.2, M5.3.3) (Table 2) contains the environmental targets of the Mine Action Plan and their groups, the timeframe for achieving them, reasons for postponement and setting less stringent targets.

Among the currently identified works, 100% of the MNRFs are projected to remain in "good" quantitative and qualitative condition by 2030.

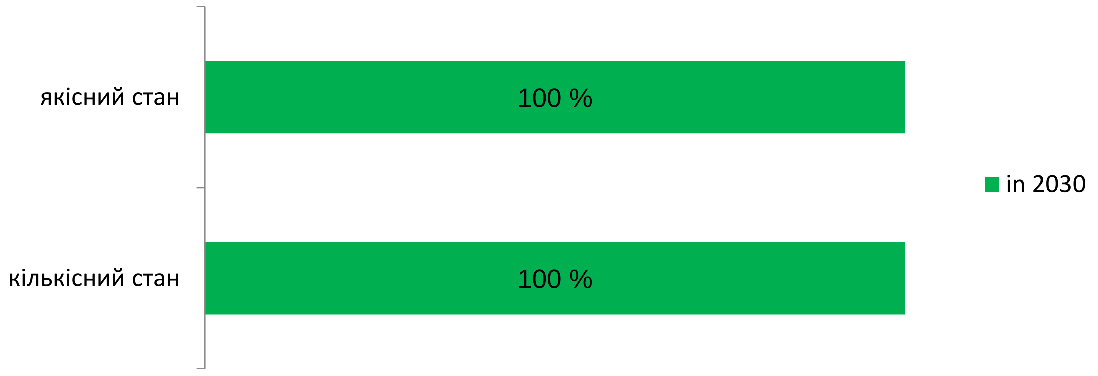


Figure 108. Timeframe for achieving the environmental objectives of the MNR

6 ECONOMIC ANALYSIS OF WATER USE

6.1 Economic development of the sub-basin

In terms of territory, the Prut and Siret sub-basins partially cover 2 oblasts, Ivano-Frankivsk and Chernivtsi, and account for 1.9% of Ukraine's territory (Table 84).

The total population of the river sub-basins is 1.17 million people, which is 2.8% of the population of Ukraine.

Table 84. Share of area and population of oblasts within the Prut and Siret sub-basins, %. [3]

Areas.	Share of oblast area within sub-basins	Share of regional population within sub-basins
Ivano-Frankivsk	35	30
Chernivetska	81	86

Thus, there is a relative balance between the area of oblasts within the sub-basins and the population living in the oblasts. The majority of the population lives in Chernivtsi Oblast, which is explained by the location of the sub-basins.

Analysis of the Prut and Siret sub-basins

In 2019, the GRP of the Prut and Siret sub-basins totalled UAH 61.6 billion. The dynamics of this indicator over the entire study period of 2015-2019 shows a tendency to grow at different rates in different periods - the highest GRP growth rates were observed in 2017 (at 30%), while in 2019 these rates decreased (to 17%). The share of the sub-basin's GRP in the country's total GDP is mainly 1.5% (Table 85).

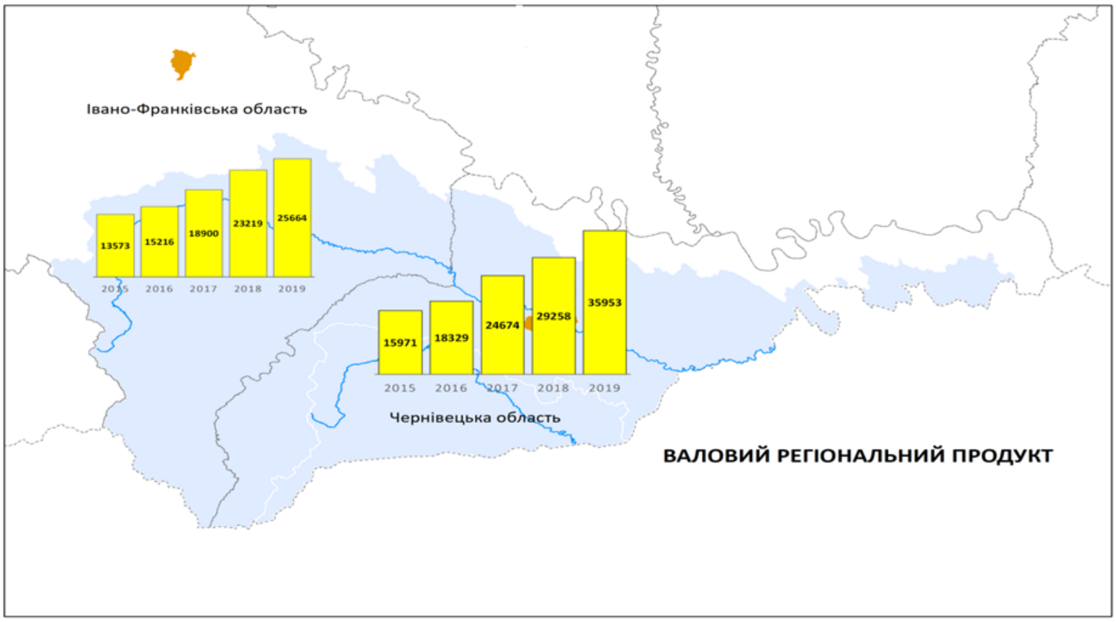


Figure 109. Gross regional product by oblast within the Prut and Siret sub-basins (2015 - 2019)

Table 85. Evolution of GRP in the Prut and Siret sub-basins, 2015-2019 [4]

Indicators.	2015	2016	2017	2018	2019
GRP in actual prices, UAH billion	29,5	33,5	43,6	52,5	61,6
Share of river basin GRP in the total GDP of Ukraine, %.	1,5	1,4	1,5	1,5	1,5

[3] Determined by working with shapefiles from the Water Resources of Ukraine geoportal and population using ArcGIS
[4] Calculated based on data from the State Statistics Service of Ukraine http://www.ukrstat.gov.ua/

Growth rate of GRP in sub-basins, % compared to the previous year	100,0	113,6	130,1	120,4	117,3

In the sub-basins of the Prut and Siret rivers, Chernivtsi Oblast has the highest share of GRP (58% of sub-basin GRP). Within Ivano-Frankivsk region, 42% of the sub-basin GRP is generated, while the population share is only 30%. This indicates a more developed economic activity in Ivano-Frankivsk Oblast.

The GRP per capita in the Prut and Siret sub-basins is UAH 58.5 thousand, which is lower than the total GRP in Ukraine (as of 2019, the GRP per capita is UAH 94.7 thousand).

Analysis of the Prut and Siret sub-basins

The value of GVA in actual prices is UAH 53.7 billion for the sub-basins, or 1.6% of the total GVA of Ukraine.

Agriculture, forestry and fisheries account for the largest share in the total GVA of the sub-basins, accounting for UAH 8.4 billion or 16%, and its share in the total GVA of Ukraine is 0.2%. The GVA by economic activity in the Prut and Siret sub-basins is presented in Table 6.3. Among the water-dependent economic sectors, the processing industry has a fairly high share in the overall structure of the sub-basins' GRP - UAH 4.7 billion or 8.8%, which corresponds to 0.1% of the total GRP of Ukraine. The share of water-dependent economic activities in the sub-basins is almost 40%. Other, non-water-dependent economic activities in the Prut and Siret sub-basins account for 60% of the total GVA.

Table 86. GVA of the Prut and Siret sub-basins by economic sectors, 2019

Sectors of the economy	AIRBORNE FORCES , billion UAH	Share in Ukraine's airborne troops, %.	Share in the basin's GVA, %.
Agriculture, forestry and fisheries	8,4	0,2	15,7
Mining and quarrying	2,0	0,1	3,8
processing industry	4,7	0,1	8,8
supply of electricity, gas, steam and air conditioning	3,0	0,1	5,5
Water supply; sewerage, waste management	0,2	<0,1	0,3
transport, warehousing, postal and courier services	3,0	0,1	5,5
TOTAL water-dependent economic activities	**21,3**	**1**	**39,7**
Other types of economic activity	32,4	0,9	60,3
TOTAL BY SUB-BASINS	**53,7**	**1,6**	**100**

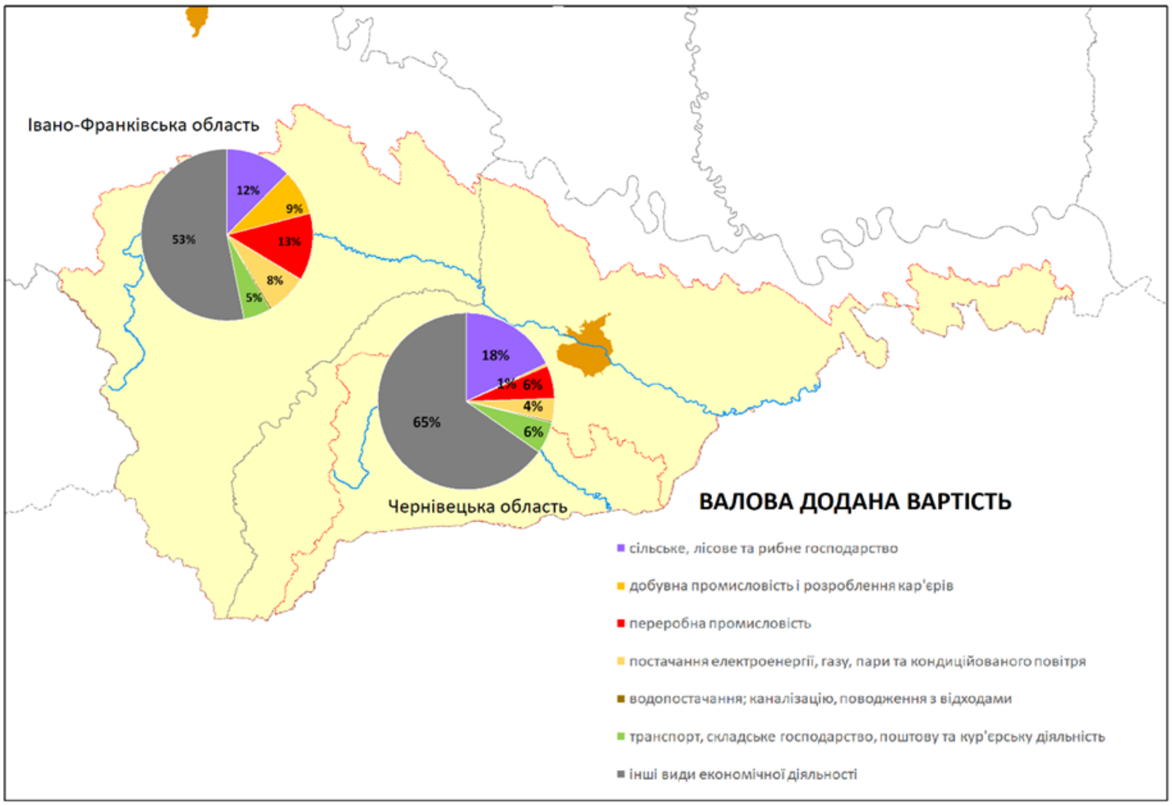


Figure 110. Gross value added by regions within the Prut and Siret sub-basins by economic sector (2019)

The dynamics of the GVA of water-dependent economic activities in the Prut and Siret sub-basins during 2015-2019 decreased from 45% in 2015 to 40% in 2019 of the sub-basin's GVA and shows a downward trend. The decline in the total value of the GVA of water-dependent sectors was due to a decrease in the GVA of agriculture, forestry and fisheries over the past 5 years. Other water-dependent sectors of the economy show fluctuations in GVA, with the manufacturing industry showing a slight increase in its share of GVA from 7.9% in 2015 to 8.8% in 2019. In turn, the growth of the total GVA of the Prut and Siret sub-basins is driven by other non-water-dependent sectors of the economy.

In terms of regions, the largest share of water-dependent industries is in Ivano-Frankivsk Oblast (47%), while in Chernivtsi Oblast the share of water-dependent sectors of the economy is only 35%.

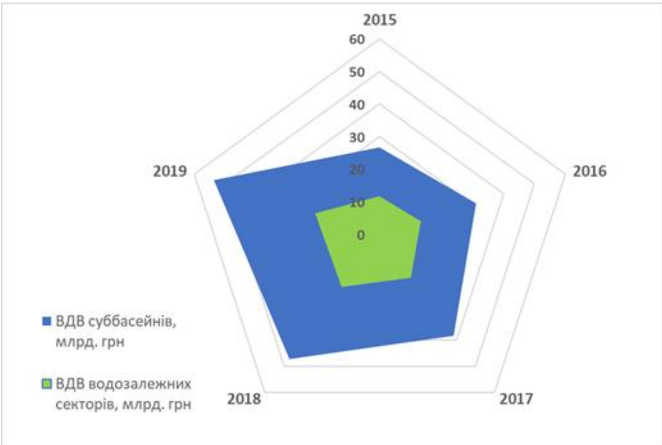


Figure 111. Dynamics of the share of GVA of water-dependent economic activities in the total GVA of the Prut and Siret sub-basins, 2015-2019, billion UAH

6.2 Characteristics of modern water use

In 2019, water users withdrew 34.31 million m^3 of water from groundwater and surface water bodies in the Prut and Siret sub-basins, which is about 5% of the total withdrawal in the Danube basin and less than 1% of the total withdrawal in Ukraine.

The ratio of water use by source of abstraction is almost equal, but most of the water abstracted is from groundwater bodies (56% of water abstraction in the sub-basins). The main surface sources that supply the sub-basin economies with water resources are the Prut and Siret rivers.

Ivano-Frankivsk oblast uses mainly groundwater sources to meet water needs within sub-basins, while in Chernivtsi oblast the share of water abstraction from surface sources is predominant and amounts to more than 60%.

Figure 112. Sources of water intake

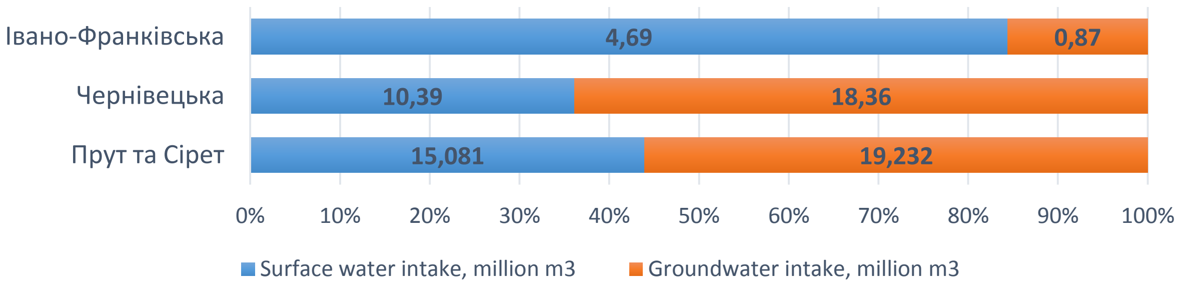


Figure 113. Distribution of water sources by region

The majority (84%) of water abstraction is carried out by water users in Chernivtsi Oblast, which is almost equal to the ratio of the oblast's area (territory) to the population within the sub-basins.

The main water users within the sub-basin are the following economic sectors: industry, housing and communal services, agriculture and transport.

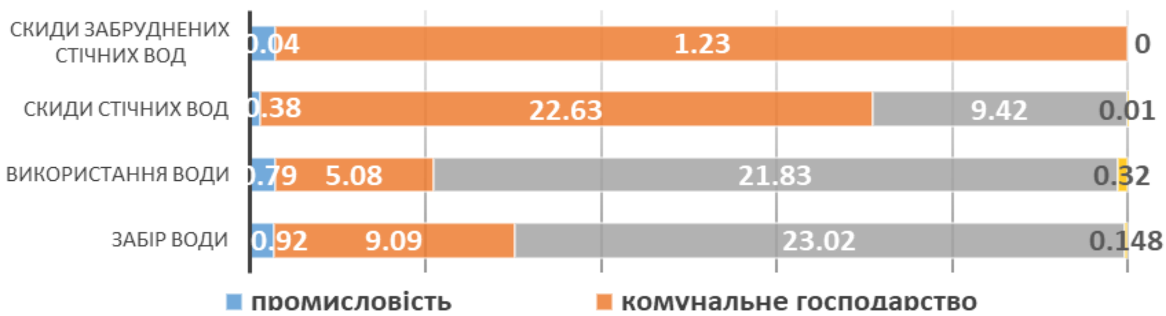


Figure 114. Characteristics of water use in the Prut and Siret sub-basins [5]

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[5] Data source: State water cadastre data, section "Water use", 2019 State Agency of Water Resources of Ukraine

The structure of water use is as follows: 67% of water resources are withdrawn by agriculture, 29% by housing and communal services, 3% by industry, less than 1% by transport and about 3% by other sectors.

Water use in the sub-basins is 28 million m3[3] , which is only 14% of the total water use in the Danube basin.

A detailed description of water use in the Prut and Siret sub-basins by economic sectors is presented in Annex 11.1 (M5.3.2, M5.3.3).

As for the structure of wastewater discharge, more than 70% of wastewater is discharged into surface water bodies by housing and communal services, 29% by agriculture, and only 1% by industrial water users.

Almost 67% of the wastewater volume is normatively treated at wastewater treatment plants, 29% is normatively clean without treatment and 4% is polluted wastewater.

Almost all (97%) of the polluted wastewater comes from residential and municipal water users.

Information on wastewater discharges to water bodies by categories of discharged water is provided in Annex 11.2 (M5.3.2, M5.3.3).

To assess the socio-economic importance of water for economic sectors, we used a ranking of water users by 5 indicators adapted to the recommendations of the methodology[6] :

- GVA generated by the industry is an economic indicator of the sector's weight in the sub-basin economy;
- the volume of water withdrawn by the industry;
- water intensity of the industry compared to other industries;
- The industry's dependence on water quality;
- pollution of water bodies by the industry's waste water.

Table 87. Water intensity of economic sectors

Industry sector	Water intake, million m^3	Gross domestic product, UAH million	Water intensity of airborne troops, m^3 /1000 UAH
Industry	0,92	9709,6	0,09
Housing and utilities	9,09	176,5	51,51
Agriculture	23,02	8436,5	2,73
Transport	0,148	2972,1	0,05
Total by sub-basin	**34,31**	**21294,6**	**1,61**

Table 88. Socio-economic weight of major water users

Sectors of the economy	Scope of airborne forces creation	Water intake by the industry	Water intensity of the industry	Dependence on water quality	Waste water contamination
Energy	moderate	low	low	low	low
Ferrous metallurgy	moderate	low	low	low	low
Chemical industry	moderate	low	low	low	low
Mechanical engineering and metalworking	moderate	low	low	low	low
Food industry	moderate	moderate	low	high	moderate
Coal industry	moderate	low	low	low	low
Housing and utilities	low	high	high	high	high
Fisheries	high	high	moderate	moderate	low
Irrigation	high	low	moderate	moderate	low
Other types of agriculture (including livestock and crop production)	high	low	moderate	moderate	low

6 Report of the European Union "The Economic Value of Water - Water as a Key Resource for Economic Growth in the EU"

Transport	moderate	moderate	low	low	low
Recreation and healthcare	moderate	low	low	high	low

Based on the results of the assessment of dependence on the five criteria above, the economic sectors were divided into 5 groups according to their socio-economic importance in these sub-basins.

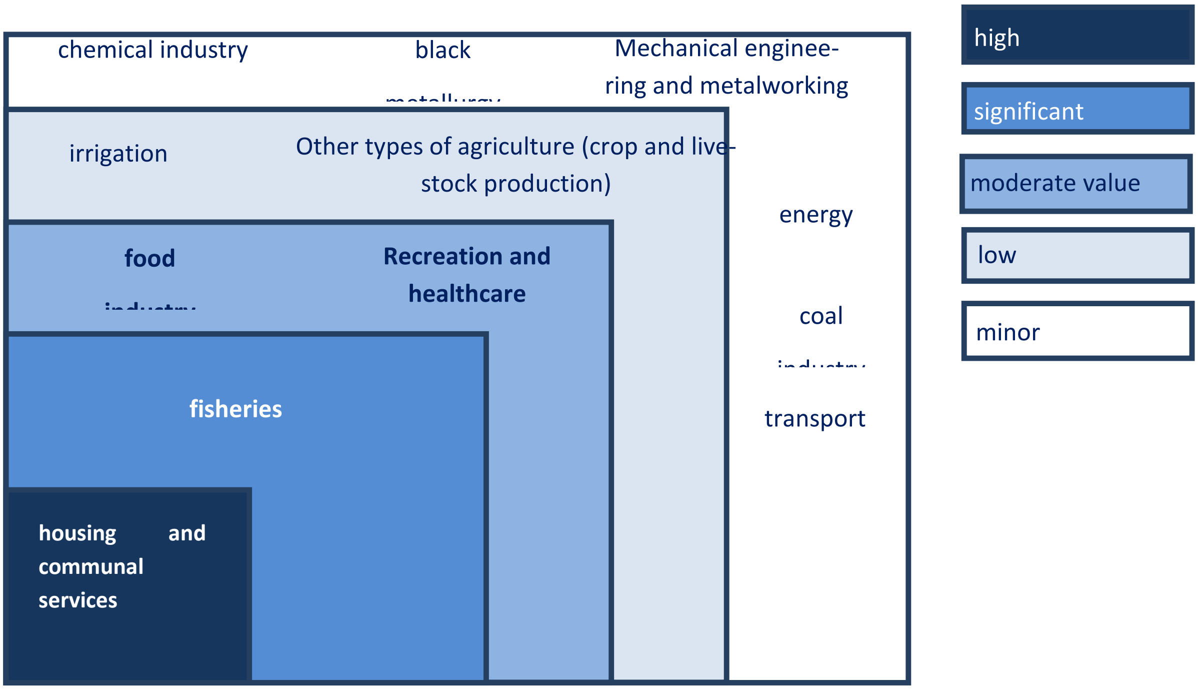


Figure 115. Socio-economic importance of economic sectors

Group 1 "Full dependence" includes water users that are highly dependent on 4 indicators - water quality, high water intensity, exert significant pressure on water resources and produce small amounts of GWP, such as housing and communal services. Water in these sectors is a key factor for their operations.

Group 2 "Multiple dependence" includes those with high dependence on at least two indicators, such as fisheries.

Group 3 "Specific dependence" includes those with high dependence on one of the indicators - food industry, recreation and healthcare.

Group 4 "Moderate dependence" includes those with moderate dependence on at least 1 indicator, such as irrigation and other types of agriculture.

Group 5, "Dependence without water use", includes economic sectors that use water without abstraction from natural water bodies, generate low volumes of GWP and are not significant polluters. This group includes the chemical and coal industries, energy, ferrous metallurgy, machine building and metal processing, and transport.

According to the assessment of socio-economic significance, the housing and communal sector is completely dependent on water resources and is the most water-intensive sector of the economy (51.51 m^3 /1000 UAH).

6.2.1 Municipal water use

The municipal water use in the Prut and Siret sub-basins is aimed at meeting the drinking and domestic needs of the population. Municipal water use is mainly concentrated in large settlements, such as Chernivtsi, Kolomyia, Kosiv, Verkhovyna, Yaremche, Sniatyn, Kitsman, Storozhynets, Hlyboka, etc.

In 2019, water users in the housing and communal sector withdrew 9 million m^3 of water as a result of their activities, which is 26.5% of the total water withdrawal by sub-basins.

The largest water users in this sector in the sub-basins are ChernivtsiVodokanal - 4.766 million $m3^3$; Kitsmanske Utility Company - 0.226 million $m3^3$, Storozhynets Utility Company - 0.257 million $m3^3$ and Hlyboka Utility Company - 0.131 million $m3^3$.

The percentage of water losses in the housing and communal sector in the sub-basin is significant and ranges from 34.8% (Ivano-Frankivsk oblast) to 52.1% (Chernivtsi oblast), with a volume of 3.5 million m^3 of water, which is significantly higher than the average value of water losses during transportation in Ukraine (30.3% according to the performance report of the National Commission for State Regulation of Energy and Utilities).

The housing and communal sector is the main polluter within the sub-basins and discharges 97% of polluted wastewater.

6.2.2 Industrial water use (by major water users, including energy)

Water abstraction by industrial water users is only 2.7% in the sub-basins (0.92 million m^3).

The needs of industrial water users are met both from surface water bodies and groundwater.

According to state water accounting data, the main industrial water use in the Prut and Siret sub-basins is carried out by food industry water users and enterprises of the mining and processing industry.

There are no losses during water transportation by industrial enterprises.

Water was used the most:

- Mamalyga Gypsum Plant (Mamalyga village, Novoselytsia district) - 0.284 million m^3 ;
- SE "Ukrspirt" Zaluchanske MPD Sniatyn district - 0.213 million m^3 ;
- Gravel and sand quarry (Nepolokivtsi) - 0.071 million m^3 ,
- Bukovyna Factory LLC, GKD Lamel, Krasnoilsk, Storozhynets district - 0.06 million m^3 ;
- Chernivtsi Oil and Fat Plant (Chernivtsi) - 0.051 million m^3 ;
- PJSC Ukrnafta Nadvirna oil and gas production division m. Nadvirna - 0.031 million m^3 ;
- LLC KKNK Technobud - 0.023 million m^3 ;
- LLC Leonie Wareng Systems UA GmbH m. Kolomyia - 0.022 million m^3 .

The share of wastewater discharges from industrial water users is only 1.2% (0.382 million m^3), of which 0.037 million m^3 is polluted, mainly from the food industry.

6.2.3 Water use in agriculture

Agriculture is a significant economic sector in the Prut and Siret sub-basins, accounting for 67% of the total abstraction in the sub-basins.

In agriculture, water resources are used mainly for fisheries, including trout farms, crop production, livestock and poultry farming.

In the structure of water withdrawals for agricultural purposes, fisheries account for 42% of the total withdrawals in this category.

In 2019, agricultural water users discharged 9.42 million m3 of wastewater into surface water bodies[3] , which is 28.6% of the total water discharge by sub-basins.

Agriculture does not exert significant pressure on the water resources of the Prut and Siret sub-basins due to the almost absence of polluted water discharges from water users in this sector. The bulk (99.7%) of the wastewater discharged by agricultural water users is normatively clean water without treatment.

Water was used the most:

- Pokuttya-Frukt LLC c. Stetseva, Sniatyn district - 0.390 million m^3 ;
- LLC VK firm "Varto" m. Sniatyn - 0.068 million m^3 ;
- Poultry farm "Sniatynska Nova" LLC m. Sniatyn - 0.032 million m^3 ;
- Rodnyk Plus LLC, Budyliv village, Sniatyn district - 0.022 million m^3 .

The main water users are in livestock production: Koteleve LLC, Koteleve village, Novoselytsia district - 0.069 million m^3 and Kolosok-2 LLC, Tsuren village, Hertsaiv district - 0.045 million m^3 ; in poultry farming: UPG-Invest LLC, Vytylivka village, Kitsman district - 0.074 million m^3 , Tarasovetska Poultry Farm LLC, Tarasivtsi village, Novoselytsia district - 0.034 million m^3 .

6.2.4 Water use in transport

Water use in transport involves the use of water resources, both surface and groundwater, for the needs of different types of transport, including water and land transport.

Water use in the transport sector in the Prut and Siret sub-basins is carried out for the needs of passenger and land transport in urban and suburban areas.

Water users in the transport sector used 0.2 million m^3 of water (almost 1% of the total water withdrawal).

The largest water users in the industry:

- Ivano-Frankivsk water supply distances of Hluboko-Bukovynska and Storozhynets stations - 0.056 million m^3 ;
- PJSC "Ukrzaliznytsia" Kolomyia state station - 0.036 million m^3 ;
- PJSC "Ukrzaliznytsia" state station Korshiv - 0.008 million m^3 ;
- separate enterprise Motor Car Depot Kolomyia - 0.006 million m^3 .

Water users in the transport sector discharged 0.01 million m^3 of wastewater treated to the standard standards at wastewater treatment plants into surface water bodies.

6.2.5 Other types of water use

Other types of water use carry out insignificant water withdrawals in the amount of 1.5% (0.05 million m^3) of the total water withdrawal in the sub-basins.

Other water users include forestry, communications, construction, trade and catering, and logistics companies.

The low values of water intake and discharge from other water uses indicate that there are no significant pressures on the water status from the above-mentioned sectors.

6.3 Forecast of water demand by major economic sectors

The forecast of water demand in general within sub-basins and by major economic sectors is made for the period of the River Basin Management Plan (until 2030) under three scenarios: realistic, optimistic and pessimistic.

The forecast is based on water withdrawals within the Prut and Siret sub-basins for the period 2015-2020, their volume and by economic sector. The forecast of water withdrawals is based on the GDP of Ukraine for the same period and its forecast value for the short, medium and long term. The increment of optimistic and pessimistic scenarios was calculated by determining the average annual deviations for previous years from the forecasted values.

The main factors affecting water use in the Prut and Siret sub-basins:

- economic development trends - mainly agriculture;
- the spread of COVID-19 coronavirus infection and the introduction of restrictive measures;
- Natural and geographical: flood-prone region.

The forecast of water withdrawal for the short-term period - for 2021 - is based on the consensus forecast of the Ministry for Development of Economy, Trade and Agriculture of Ukraine (April 2021). Ukraine's GDP forecast shows a resumption of the positive trend in economic development after significant losses in 2020 caused by the COVID-19 pandemic, with rapid growth in 2021-2023 and gradual stabilisation thereafter. Thus, GDP growth is expected to reach 4.1% in 2021.

In the medium term, GDP is expected to grow by 3.7% in 2022-2024, with economic growth in Ukraine expected to reach 3.5% in 2023 and 3.9% in 2024.

The long-term forecast period - 2024-2030 - was calculated on the basis of the World Bank's forecast values of global development indicators, Oxford Economic Forecasting ,[7][8] , which forecasts Ukraine's GDP growth by 3.2% annually until 2030.

The global outlook remains highly uncertain due to the pandemic. Provided that effective strategies for Ukraine's recovery and development are developed, including their high-quality and smooth

[7] Forecast of global economic development until 2030. Ukrainian Institute for the Future. URL: https://strategy.uifuture.org/prognoz-rozvitku-sv%D1%96tovoi-ekonom%D1%96ki-do-2030e.html.

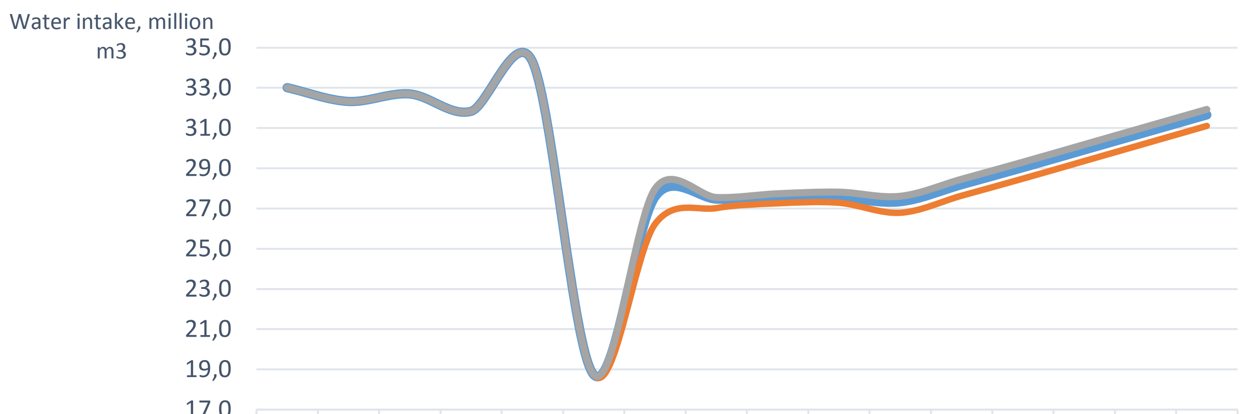
[8] International Macroeconomic Data Set. United States Department of Agriculture. URL: https://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx.

implementation, it is possible to eliminate the effects of the pandemic on the economy and stimulate further development of economic potential in a fairly short period of time.

The method used to forecast water withdrawal rates was to calculate the projected exponential growth based on available data.

Preliminary expert forecasts on water withdrawal trends indicate an increase in water withdrawal, taking into account the resumption of economic growth.

The analysis of Figure 116 shows an increase in water use in the Prut and Siret sub-basins in 2021, with a gradual stabilisation of the trend. In the period 2026-2030, there is a trend of consistent growth in water intake due to the growing needs of economic sectors.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
realistic	33,01	32,33	32,70	31,83	34,31	18,74	27,6	27,5	27,4	27,5	27,3	28,2	29,0	29,9	30,8	31,7
pessimistic	33,01	32,33	32,70	31,83	34,31	18,74	26	27	27	27,3	26,8	27,6	28,5	29,4	30,2	31,1
optimistic	33,01	32,33	32,70	31,83	34,31	18,74	28,0	27,6	27,7	27,8	27,6	28,5	29,3	30,2	31,1	31,9

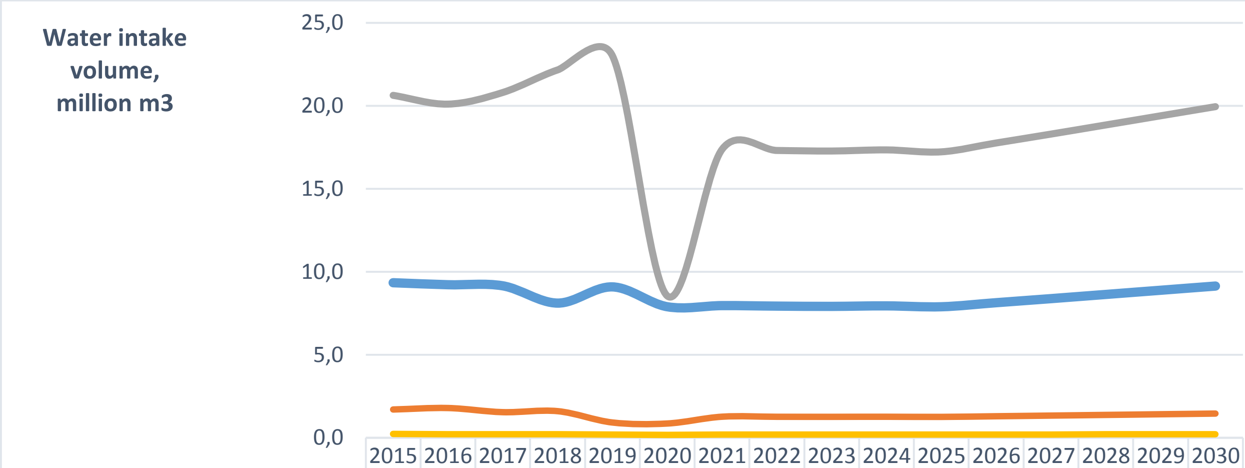
Figure 116. Forecast of water abstraction in the Prut and Siret sub-basins until 2030.

The results of forecasting water abstraction volumes in the Prut and Siret sub-basins by 2030 by economic sector are shown in Figure 117.

An analysis of water use data from[9] shows a significant drop in water withdrawals in sub-basins, in particular in the agriculture sector by more than 2.5 times. This may be due to the decline in the agricultural production index in 2020, as well as to the conversion of water use reporting to electronic format and incomplete reporting data.

In the municipal sector, the decline in water intake in 2020 was 15%.

[9] Based on water intake data for 2015-2019 provided by the Prut and Siret BWRs and data from the State Agency of Water Resources' Electronic Services Portal for 2020



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
public utility	9,34	9,22	9,16	8,12	9,09	7,90	8,0	7,9	7,9	7,9	7,9	8,1	8,4	8,6	8,9	9,1
industry	1,71	1,79	1,55	1,61	0,92	0,86	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,4	1,4	1,5
agriculture	20,6	20,1	20,8	22,2	23,0	8,6	17,4	17,3	17,3	17,3	17,2	17,8	18,3	18,8	19,4	19,9
transport	0,24	0,22	0,22	0,22	0,20	0,18	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2

Figure 117. Forecast of water abstraction in the Prut and Siret sub-basins by 2030 by economic sector

In 2021, water withdrawals for housing and communal services are forecast to increase slightly, affected by quarantine restrictions and hygiene and sanitary innovations **due to the** impact of the COVID-19 pandemic. Starting from 2022, water withdrawals by the housing and utilities sector are forecast to stabilise.

The industry in the Prut and Siret sub-basins is expected to increase its projected water withdrawals as a result of the economic growth of the regions. By 2030, the growth in water abstraction in these sub-basins could reach 60% compared to 2020.

The forecast of water abstraction for agricultural purposes in the Prut and Siret sub-basins is characterised by significant fluctuations. In 2021, water abstraction in this sector is expected to roughly double. 2022-2026 - the projected indicators are expected to stabilise. In the long-term period until 2030, there is a trend of gradual increase in water use in the sub-basin areas.

No significant increase in water withdrawals by transport sector water users is forecast.

6.4 Tools of economic control

6.4.1 Payback of water resources use

The payback of water resources use is the ratio of funds received from the use of water resources to funds spent on the provision of water services. The description of water services and water use in the Prut and Siret sub-basins is presented in accordance with the institutional structure of water services regulation:

I. Centralised water supply and sewerage services;

II. Special water use by economic sectors - payments and fees are paid to the budgets of all levels (rent, environmental tax for discharges into water bodies in Ukraine, lease of water bodies).

I. PAYBACK OF CENTRALISED WATER SUPPLY AND SEWERAGE SERVICES

In the Prut and Siret sub-basins, centralised water supply and sewerage services are provided by licensed companies of the National Energy and Utilities Regulatory Commission and organisations licensed by local governments.

Table 89. Register of natural monopolies in the spheres of heat supply, centralised water supply and centralised sewerage[10]

No. p/n	Name of the company

[10] According to the NEURC, as of 30.09.2021

Ivano-Frankivsk region	
1	Verkhovyna Water Supply and Sewerage Company
2	Kosiv Municipal Utility Company "Kosivmiskvodoservice"
3	Vodokanal municipal enterprise in Kyiv. Sniatyn
4	Zabolotivskyi Combined Plant of Public Utilities
5	Subsidiary enterprise "Rural Utility Company" LLC "Kolomyia District Agricultural Enterprise" of Kolomyia district, Turka village
6	Municipal enterprise "Selyshche municipal enterprise" of Vorokhta village
7	Kolomyiavodokanal Utility Company
8	Production Department of the Water Supply and Sewerage Company of Yaremche
9	Hvizdetsky Combine of Public Utilities
10	Kolomyateploenergia
11	Zakhidteploenergoinvest-Snyatyn LLC
12	Strumok Ltd.
13	Kosivrembudservice LLC
Chernivtsi region	
14	**ChernivtsiVodokanal utility company**
15	Beregomet enterprise Krynytsia
16	Communal Unitary Enterprise "Kommunalnyk", m. Vyzhnytsia
17	Hertsaivka Production Department of Housing and Communal Services
18	Glubotsk Production Department of Housing and Communal Services
19	Zastavna Housing and Utility Department heat and water supply
20	Kitsman Production Department of Housing and Communal Services
21	Nepolokovetsky Communal Enterprise
22	Municipal enterprise Novoselytsia City Heating Network
23	Putyla Production Department of Housing and Communal Services
24	Municipal enterprise "Storozhynetske Housing and Communal Services"
25	State Enterprise "Nepolokovets Bread Products Plant" State Reserve Agency of Ukraine
26	State enterprise of alcohol and alcoholic beverages industry "Ukrspirt", (Luzhansky place of business of SE "Ukrspirt")
27	Dobrobut 2012 utility company
28	Mykola Ivanovych Sinchuk, sole proprietor
29	Housing and maintenance department
30	Limited Liability Company "New Era - Energy Group"
31	Private enterprise Nadpredteploservis
32	Municipal enterprise Novoselytsia City Heating Network
33	Municipal utility company ChernivtsiTeplocomunenergo
34	Chernivtsi Heat Networks LLC

The largest revenues are received by water and sewerage companies. According to estimates, water and sewerage companies - NEURC licensees in the Prut and Siret sub-basins (1 licensee, only 1% of the Ukrainian market[11]) received about UAH 255 million in 2020[12] (including VAT).

The cost recovery of water supply and wastewater services, calculated as the ratio of tariff to cost, is more than 100% in the Prut and Siret sub-basins. Due to the insufficient level of customer payments for the services provided, which amounted to 91% in 2020 (90% for water supply and 94% for sewerage), a situation arises where water services are not sufficiently covered by customer payments and the sustainability of water services is threatened. The level of consumer payments for ChernivtsiVodokanal is 93.1%, which corresponds to a high level.

The condition of the water supply and sewerage networks in the Prut and Siret sub-basins is unsatisfactory, which affects water quality. The main source of investment in 2020 in the Prut and Siret sub-basins, as in previous years, was depreciation in the amounts provided for in the tariff structures. Funds were also raised from the profits provided for in the tariff structure of licensees.

Given that the profit in the tariffs was on average 2%, in the Prut and Siret sub-basins, the estimated profit of the utilities of the NEURC licensees was about UAH 5 million (out of a total of about UAH 810 million

[11] As of the beginning of 2021, the NEURC licensed 55 water and wastewater companies
[12] Hereinafter, calculations were made on the basis of available statistics in Ukraine

received by the companies). However, none of the companies provided for the use of profits for the formation of a reserve fund (capital) for modernisation or for production investments, which should have been provided for in their business activities.

According to the NEURC, "the amount of production investments from profits is determined in the amounts necessary for the gradual restoration of networks (improvement of the functioning of water and sewerage enterprises), and taking into account the needs to fulfil the financial obligations of licensees to international financial organisations". However, this level is extremely insufficient.

II. PAYBACK OF THE USE OF WATER DIVERSIONS IN THE PRUT AND SIRET SUB-BASINS

(based on public finance calculations)

1) REVENUES FOR SPECIAL WATER USE

In accordance with the principles of "user pays" and "polluter pays" The Tax Code of Ukraine establishes a fee for special water use:

A. Rent for water abstraction for different types of water users;
Б. Environmental tax on discharges into water bodies;

In addition, there is a fee for the use of water bodies for aquaculture purposes:
C. Rent for water bodies;
D. Payment for special use of water bioresources.

A. Rent for special water use

The state (general and special funds combined) and local (general fund) budgets received a total of UAH 17.2 million from business entities in the Prut and Siret sub-basins by administrative region in 2017, UAH 23.5 million in 2018, and UAH 23.1 million in 2019.

In 2019-2020, there is a downward trend in rent revenues.

The Prut and Siret sub-basins are among the lowest in Ukraine in terms of special water use rents.

Table 90. Dynamics of rent revenues for special water use to the state and local budgets in the Prut and Siret sub-basins, UAH[13]

Year/ area	Ivano-Frankivsk		Chernivetska		Together		Total by sub-basin
	state budget	local budgets	state budget	local budgets	state budget	local budgets	
2017	3397526,1	3397526,0	5187707,5	5187804,1	8585233,7	8585330,2	**17170563,84**
2018	5000265,2	4091246,8	7940289,8	6497068,4	12940555,0	10588315,2	**23528870,24**
2019	5224232,4	4274605,8	7454752,8	6099472,6	12678985,1	10374078,3	**23053063,46**
2020	4031805,0	3298813,8	7085986,2	5797503,1	11117791,2	9096316,8	**20214108,07**

Б. Environmental tax on discharges of pollutants into water bodies

In the Prut and Siret sub-basins, *in* 2018-2020, the state budget and the special fund of local budgets received tax revenues for pollutant discharges directly into water bodies at the level of UAH 1.5-1.6 million. More than half of these funds (55%) are collected by local budgets in accordance with the budget allocation (Table 91). Since 2019, there has been an upward trend in environmental tax revenues in Chernivtsi region.

Table 91. Revenues from environmental tax on discharges into water bodies to the state and local budgets in the Prut and Siret sub-basins, UAH[13]

Year/ area	Ivano-Frankivsk		Chernivetska		Together		Total by sub-basin
	state budget	local budgets	state budget	local budgets	state budget	local budgets	
2017	146977,5	587910,1	117325,7	469302,7	264303,2	1057212,8	**1321516,0**
2018	423428,7	517524,3	287611,1	351524,9	711039,8	869049,2	**1580089,0**
2019	336207,1	410920,0	348058,7	425405,4	684265,9	836325,4	**1520591,3**
2020	340329,6	415958,6	365007,5	446120,6	705337,1	862079,2	**1567416,3**

13 Source: Reports on local budget revenues, Reports on state budget revenues

C. Payment for the lease of water bodies

The weighted average rent is unified for all water bodies in the Prut and Siret sub-basins and is constantly increasing. Its dynamics is as follows: in 2017 - UAH 156.9 per hectare, in 2018-2020 - UAH 162.7 per hectare.

According to estimates, local budgets in the sub-basin regions received rent for water bodies (parts of them) in the amount of UAH 148-109 thousand or 1.5-0.8% of the national figure in 2017-2020.

In the Prut and Siret sub-basins, the trend is towards a decrease in water body rental fees, by almost 40% compared to 2017.

According to the State Tax Service, local budgets of all levels in Ukraine received a total of UAH 10 million for the lease of water bodies in 2017-2018, UAH 13.5 million in 2019, and UAH 14 million in 2020 (Table 92).

Table 92. Dynamics of rent revenues to local budgets in the Prut and Siret sub-basins, UAH

Region/year	2017	2018	2019	2020
Ivano-Frankivsk	38497,7	55248,9	51027,4	32261,3
Chernivetska	109861,3	93786,8	84309,1	76393,3
Total by sub-basin	**148359,0**	**149035,7**	**135336,5**	**108654,6**

D. Payment for special use of fish and other aquatic bioresources

The fee for the use of fish and other aquatic bioresources is ***levied in*** accordance with the Resolution of the Cabinet of Ministers of Ukraine.[14] According to the report on local budgets, only Ivano-Frankivsk region (with a 35% share in the sub-basin) received UAH 8.1 thousand from the fee for the special use of fish and other aquatic bioresources in 2020.

In 2017-2019, there were no revenues from fees for the special use of fish and other water resources.

Table 93. Dynamics of revenues from fees for special use of water bioresources to local budgets in the Prut and Siret sub-basins, UAH

Region/year	2017	2018	2019	2020
Ivano-Frankivsk	-	-	-	8146,86
Chernivetska	-	-	-	-
Total by sub-basin	-	-	-	**8146,86**

2) EXPENDITURES ON WATER RESOURCES IN THE PRUT AND SIRET SUB-BASINS

A. Capital and current expenditures from the state and local budgets for environmental programmes in the field of water resources protection

According to state statistical reports, capital investments and current expenditures are allocated to nine environmental areas, including those directly related to the reproduction and protection of water resources:

- waste water treatment;
- protection and rehabilitation of soil, groundwater and surface water.

The share of the former is more significant than the latter, accounting for about half of all expenditures out of the total amount of capital and current expenditures in all areas - Tables 94-96.

14 Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Charging Fees for the Special Use of Water Bioresources and the Amount of Fees for Their Use" of 12 February 2020, No. 125

These two areas are covered by expenditures from the state (including the State Environmental Protection Fund) and local budgets (including local environmental protection funds), own funds, and other sources of funding. In 2019, UAH 224.278 million was allocated.

In 2018 and 2019, the information on capital and current expenditures reported in the state statistical reports is the same in the respective oblasts.

In 2020, capital and current expenditures will increase by more than 40% due to capital investments in the area of soil, groundwater and surface water protection and rehabilitation. These expenditures are aimed at implementing flood protection and bank protection measures, given the growing hazards and periodic destructive effects of floods and floods in sub-basins.

Table 94. Dynamics of capital investments in the Prut and Siret sub-basins, thousand UAH

Area.	2017			2018			2019			2020		
	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water
Ivano-Frankivsk	138101,6	30536,7	26833,8	86973,3	43940,3	19679,5	86973,3	43940,3	19679,5	93654,9	14657,9	62492,3
Chernivetska	19245,3	2321,9	14518,4	24391,4	14114,0	5705,8	24391,4	14114,0	5705,8	64753,3	5475,3	58563,9
Total by sub-basin	**157346,8**	**32858,6**	**41352,2**	**111364,7**	**58054,3**	**25385,3**	**111364,7**	**58054,3**	**25385,3**	**158408,2**	**20133,2**	**121056,2**
% of programmes from the total		**20,9**	**26,3**		**52,1**	**22,8**		**52,1**	**22,8**		**12,7**	**76,4**
A total of 2 water protection programmes		**74210,8**			**83439,6**			**83439,6**			**141189,4**	

Table 95. Dynamics of current investments in the Prut and Siret sub-basins, thousand UAH

Area.	2017			2018			2019			2020		
	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water
Ivano-Frankivsk	110681,1	49112,2	11609,9	221745,4	77535,5	13336,3	221745,4	77535,5	13336,3	205347,0	86174,3	9415,4
Chernivetska	70420,9	36724,2	1543,2	98881,5	48287,3	1678,9	98881,5	48287,3	1678,9	131759,9	84522,4	1393,0
Total by sub-basin	181102,0	85836,4	13153,1	320626,8	125822,8	15015,2	320626,8	125822,8	15015,2	337106,9	170696,7	10808,4
% of programmes from the total		**47,4**	**7,3**		**39,2**	**4,7**		**39,2**	**4,7**		**50,6**	**3,2**

A total of 2 water protection programmes		**98989,6**		**140838,0**		**140838,0**		**181505,1**

Area.	**2017**			**2018**			**2019**			**2020**		
	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total expenditure on environmental programmes, including:	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water
Ivano-Frankivsk	248782,7	79648,9	38443,7	308718,6	121475,8	33015,8	308718,6	121475,8	33015,8	299001,9	100832,2	71907,7
Chernivetska	89666,2	39046,1	16061,7	123272,9	62401,3	7384,7	123272,9	62401,3	7384,7	196513,2	89997,7	59956,8
Total by sub-basin	338448,9	118695,0	54505,3	431991,5	183877,1	40400,5	431991,5	183877,1	40400,5	495515,1	190829,9	131864,6
% of programmes from the total		**35,1**	**16,1**		**42,6**	**9,4**		**42,6**	**9,4**		**38,5**	**26,6**
A total of 2 water protection programmes		**173200,4**			**224277,6**			**224277,6**			**322694,4**	

Table 96. Dynamics of capital and current investments in the Prut and Siret sub-basins, thousand UAH

B. State budget expenditures for the maintenance of water infrastructure under the management of the State Agency of Water Resources

In the Prut and Siret sub-basins, water infrastructure maintenance activities are carried out by organisations under the management of the State Agency of Ukraine for Water Resources located in the respective sub-basin areas - the Prut and Siret River Basin Water Resources Administration and the Dniester River Basin Water Resources Administration (in terms of activities within Ivano-Frankivsk Oblast).

Expenditures for the operation of water infrastructure are carried out under the comprehensive programme "Operation of the State Water Management Complex and Water Resources Management"; in 2020, expenditures in the Prut and Siret sub-basins amounted to UAH 3,6804.5 thousand (UAH 23321.08 thousand for the Prut and Siret sub-basins and UAH 1,483.42 thousand for the Dniester sub-basin).

DETERMINING THE PAYBACK OF WATER RESOURCES USE IN THE PRUT AND SIRET SUB-BASINS

If the payback ratio of water resources use, calculated using the formula "Revenues / Expenses * 100":

- is more than 100%, it means that all costs are reimbursed by paying tax and non-tax revenues for services to budgets of all levels or by tariffs; budget revenues, if intended for their intended purpose, can be used for water resources restoration; enterprises receive profits that can be used for production development - production investments, formation of a reserve fund (capital), etc. (part of them will be used to pay income tax);
- If the indicator is less than 100%, this indicates a threat to the sustainability of the service, as the costs of budgets or enterprises are not covered by the revenues received.

The calculated return on water use is 6.1%, which means that costs are higher than tax revenues for water services (Table 97).

This level of payback indicates a critical situation in terms of covering the costs of water services. Revenues are significantly lower than expenditures from the state and local budgets. The main share of expenditures is made up of funds from the state and local budgets allocated for measures in the area of "Protection and rehabilitation of soil, groundwater and surface water" (flood protection measures).

The calculated level of cost recovery indicates that tax mechanisms in the area of water resources use recovery in the Prut and Siret sub-basins do not ensure the sustainability of service provision.

Table 97. Balance of revenues and capital expenditures in 2020 in the sub-basin of the ah Prut and Siret

SOURCES.	Receipts, thousand UAH	EXPENSES	Expenses , thousand UAH
Rent for special water use (state and local budgets)	**20214,1**	Capital investments in water resources restoration and protection	**322694,4**
Environmental tax on discharges into water bodies (state and local budgets)	**1567,4**	Expenditures from the state budget for the operation of the state water management complex	**36804,5**
Rent for water bodies (parts thereof) provided for use on a lease basis (local budgets)	**108,7**		
Payment for aquatic bioresources	**8,2**		
TOTAL RECEIPTS	**21898,4**	**TOTAL EXPENSES**	**359498,9**
ROI	**6,1%**		

6.4.2 Water tariffs

Tariffs for centralised water supply and sewerage

According to the institutional structure in Ukraine, the NEURC and local governments set the following types of tariffs for centralised water supply and sewerage services:

1) tariff for centralised supply (cold water) and sewerage (cold and hot water together) (calculated by water utilities, approved by the NEURC for its own licensees, by local authorities for other local licensees) and centralised water supply (hot water) (calculated by Teploenergo enterprises, approved by the NEURC for its own licensees, by local authorities for other local licensees);

2) tariff for centralised supply (cold water, hot water separately) and sewerage (cold and hot water) using in-building systems.

The NEURC licenses the activities of water supply companies (water utilities) if these companies serve more than 100,000 people, the volume of water supply is more than 300,000 m³, and the volume of water disposal is more than 200,000 m³.

When setting tariffs, the NEURC is guided by the principle of balancing the interests of consumers, business entities and the state: it limits the planned costs of licensees to an economically justified level that should ensure self-sufficiency of their activities, provided that they are managed efficiently and use resources economically, while at the same time providing for the necessary investments for the safe and sustainable operation of water and sewerage systems.

As of the beginning of 2021, the NEURC set tariffs for centralised water supply and sewerage in the Prut and Siret sub-basins for 1 licensee that has tariffs for other water utilities (water and wastewater business entities) - Table 98.

Table 98. Tariffs for centralised water supply and wastewater disposal of the NEURC licensees providing services in the Prut and Siret sub-basins [15]

Name of the company	**Tariffs set by the NEURC, UAH/m³/ Cost price, UAH/m³/ Reimbursement, %.**			
	Water supply		**Drainage**	
	for consumers who are business entities in the field of water supply and sanitation (water utilities)	for consumers who are not business entities in the field of CWS (households, budgetary organisations, others)	for consumers who are business entities in the field of water supply and sanitation (water utilities)	for consumers who are not business entities in the field of CWS (households, budgetary organisations, others)
Chernivtsi region				
MUNICIPAL ENTERPRISE "CHERNIVTSIVODOKANAL"	4,65	12,18/11,86/102,**7**	-	7,21/ 7,1/101,**5**

In 2020, the main items in the structure of the NEURC licensees' cost of services continued to be labour costs (including social benefits) and electricity purchase. Their shares are 42% and 25% in water supply (38% and 28% in 2019) and 53% and 22% in wastewater treatment (51% and 25% in 2019), respectively. Less significant cost components are depreciation, repair costs, reagents and fuels and lubricants, as well as taxes and fees, including a fee for special use of water (rent), and subsoil use fees for fresh groundwater extraction.

In the structure of the weighted average tariffs for centralised water supply and sewerage, the main share is made up of labour costs (39.73% and 51.26% respectively) and electricity (23.9% and 20.92% respectively).

15 According to the NEURC, tariffs as of 01.07.2021

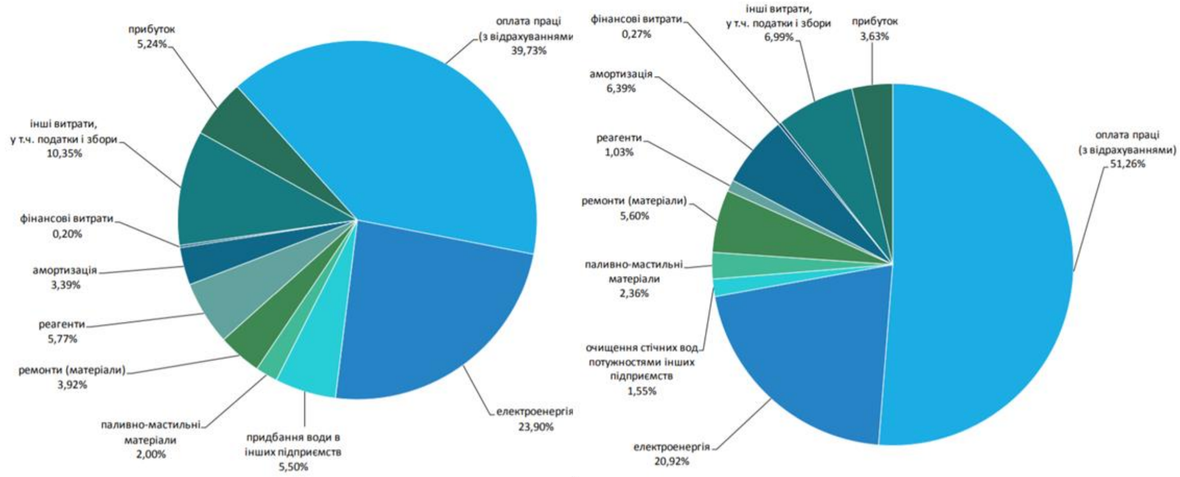


Figure 118. Structure of weighted average tariffs for centralised water supply and sewerage, 2020

Water supply and wastewater services are provided in the Prut and Siret sub-basins by enterprises licensed by local authorities - these are communal enterprises of district, city, town and sometimes village councils. The tariffs differ for different categories of users: households, budgetary organisations and commercial organisations. In general, local tariffs are 2-5 times higher than those of the NEURC licensees. Another peculiarity is that usually the tariff for wastewater disposal, which includes wastewater treatment, is higher than the tariff for water supply (Table 99).

Table 99. Tariffs for water supply and sewerage services set by local governments, including VAT

Vodokanal, licensed by the local government	Area.	Water supply, UAH per 1 м³			Wastewater disposal, UAH per 1 m³		
		Population / (apartment buildings separately, if the tariff was set in this way)	Budgetary organisations	Others (including commercial organisations and other institutions)	Population / (apartment buildings separately, if the tariff was set in this way)	Budgetary organisations	Others (including commercial organisations and other institutions)
Kolomyia Vodokanal [16]	Ivano-Frankivsk	25,36	25,36	25,36	12,89	12,89	12,89
Snyatyn Municipal Utility Company "Vodokanal" [17]	Ivano-Frankivsk	29,84	45,06	45,06	17,04	26,96	26,96
Production Department of Water Supply and Sewerage Services м. Yaremche[18]	Ivano-Frankivsk	20,0-25,0	30,0	30,0	20,0-25,0	35,0	35,0
Municipal enterprise "Storozhynetske ZhKh" [19]	Chernivetska	24,24	24,24	24,24	7,74	7,74	7,74
Kitsman City Council[20]	Chernivetska	26.00/ per service 27.00	36,00	36,00	20.00/ per service 20.50	38,00	38,00
Municipal enterprise Putivlmiskvodokanal [21]	Chernivetska	12,53	13,99	15,81	7,40	8,26	9,34
Beregomet enterprise Krynytsia	Chernivetska	21,75	23,92	23,94	16,92	18,60	18,60

16 According to https://kpvodokanal.if.ua/taryfy/ based on the decision of the Executive Committee of Kolomyia City Council No. 42 of 25.02.2021.

17 http://snyatyn.if.ua

18 https://yaremcha-miskrada.gov.ua/news/1581933183/

19 https://storozhynets.info/archives/48832

20 http://www.kitsman-rada.gov.ua/

21 https://old.bukoda.gov.ua/new/8086

Communal unitary enterprise "Kommunik" in the city of Vyzhnytsia[22]	Chernivetska	21,60	21,60	21,60	22.03 + subsidy from the local budget 11.87	33,90	33,90
Hlybotske Utility Company[22]	Chernivetska	9,00	14,46	18,86	6,80	8,85	11,55
Zastavna Housing and Utility Department for Heat and Water Supply[22]	Chernivetska	23,24	23,24	23,24	22,06	26,15	26,15
Kelmenetsky housing and communal services	Chernivetska	17,81	19,50	25,44	15,82	17,33	22,61
Municipal enterprise "Novoselytsia city heating network" [22]	Chernivetska	21,64	24,88	24,88	11,05	12,70	12,70
Nepolokovetsky Communal Enterprise [22]	Chernivetska	5,80	6,67	8,70	19,85	20,78	22,97
DOBROBUT 2012 [22]	Chernivetska	15,00	16,40	19,30	missing	missing	missing

The cost of water for industrial enterprises

The cost of water is actually paid by industrial enterprises in the form of a mandatory payment for special water use - rent. The object of taxation for rent for special water use is the actual volume of water used by water users.

In the case of surface water use, the rental rate depends on the needs of the use, the place and region of consumption, and the actual volume of water used. No rent is paid if the volume of consumption is less than 5 m³ per day and the water user does not have its own water intake facilities. Rental rates in the Prut and Siret sub-basins are among the lowest in Ukraine.

In the case of groundwater use, the rates of rent for special water use are set by the Tax Code of Ukraine and are differentiated by region. In the Prut and Siret sub-basins, the rates are shown in Table 100. The rates for groundwater use are among the highest in Ukraine.

Table 100. Rates of rent for special water use[22]

River basins, including tributaries of all orders	Rent rate, UAH per 100 cubic metres
For the use of surface water	
Danube	23,32
Name of the region	**Rent rate, UAH per 100 cubic metres**
For the use of groundwater	
Ivano-Frankivsk:	
Bohorodchany, Verkhovyna, Dolyna, Kosiv, Nadvirna, Rozhnyativ districts	145,42
other administrative and territorial units of the region	81,48
Chernivetska	101,8
Other rates for special water use	
For the needs of hydropower	UAH 11.31 per 10 thousand m^3
For the needs of water transport on all rivers	UAH 0.1938 per 1 tonne-day of operation
For the needs of fish farming	UAH 59.36 per 10 thousand m^3 of surface water; 71.36 - groundwater
For water in beverages	55.21 UAH per 1 m^3 of surface water; 64.39 - groundwater
For mine, quarry and drainage water	UAH 12.79 per 100 m^3

Charges for water pollution are received in the form of fines and environmental tax for discharges of pollutants into water bodies. The environmental tax is increasing annually, with the last increase in environmental tax rates occurring in 2019, when the emission rates increased by more than 2.2 times in

[22] Tax Code of Ukraine, Article 255

accordance with the Tax Code of Ukraine. The tax rates for discharges of pollutants into water bodies are presented in Table 101.

Table 101. Environmental tax rates for discharges of certain pollutants into water bodies[23]

Name of the pollutant	Tax rate, UAH per 1 tonne
Ammonium nitrogen	1610,48
Organic matter (based on biochemical oxygen demand (BOD 5)	644,6
Suspended solids	46,19
Petroleum products	9474,05
Nitrates	138,57
Nitrites	7909,77
Sulphates	46,19
Phosphates	1287,18
Chlorides	46,19

Currently, the Verkhovna Rada of Ukraine is considering draft law 5600, which provides for changes in rent rates.

Table 102. Rates of rent for special water use (draft)[24]

River basins, including tributaries of all orders	Rent rate, UAH per 100 cubic metres
For the use of surface water	
Danube River Basin Region	29,96
Name of the region	**Rent rate, UAH per 100 cubic metres**
For the use of groundwater	
Ivano-Frankivsk	**166,51**
Chernivetska	**116,56**
Other rates for special water use	
For the needs of hydropower	UAH 12.95 per 10 thousand m^3
For the needs of water transport on all rivers except the Danube	
for self-propelled and non-self-propelled freight fleets in operation	UAH 0.2219 per 1 tonne-day of operation
for the passenger fleet in operation,	UAH 0.0246 per 1 place - day of operation
For the needs of fish farming	UAH 67.97 per 10 thousand m^3 of surface water; 81.71 - groundwater
For water in beverages	63.22 UAH per 1 m^3 of surface water; 73.73 - groundwater
For mine, quarry and drainage water	UAH 14.64 per 100 cubic metres of water

Housing and communal enterprises apply a coefficient of 0.3 to rent rates in terms of water volumes of technological standards for the use of drinking water determined in accordance with the legislation on drinking water, drinking water supply and sewerage.

23 Article 245, Tax Code of Ukraine
24 http://w1.c1 gov.ua/pls/zweb2/webproc4_1?pf3511=72106

7 A REVIEW OF THE IMPLEMENTATION OF PROGRAMMES OR ACTIVITIES, INCLUDING HOW THE OBJECTIVES HAVE BEEN ACHIEVED

This section provides an overview of the implementation of environmental protection measures within the Prut and Siret sub-basins, which were funded by national targeted programmes, the State Environmental Protection Fund, relevant regional and local programmes or funds, the State Regional Development Fund, state investment projects, international technical assistance projects, regional and local infrastructure projects, etc. (Annex 12 (M5.3.2, M5.3.3)).

Among the national environmental programmes, we will analyse the implementation of the measures of the National Target Programme for the Development of Water Management and Environmental Rehabilitation of the Dnipro River Basin for the period up to 2021 (hereinafter referred to as the Dnipro Programme). Clause 4 of the Resolution of the Cabinet of Ministers of Ukraine No. 336 of 18 May 2017 "On Approval of the Procedure for Developing RBMPs" states that the first RBMPs for each RBF are to be developed during the period of implementation of the Dnipro Programme. In accordance with clause 11 of the said Procedure, the first RBMPs for each RBF are financed from the state budget, which is provided for by the Dnipro Programme within the expenditures envisaged by the state budget of Ukraine for the respective year, as well as from other sources. The implementation of this programme is important both in the context of preparing RBMPs for the Prut and Siret sub-basins and in implementing measures to achieve the strategic environmental objective for the Prut and Siret RBMs.

The Dnipro Programme aims to define the main directions of state policy in the field of water management, conservation and restoration of water resources, implementation of an integrated water resources management system based on the basin principle, restoration of the role of reclaimed land in the food and resource supply of the state, optimisation of water consumption, prevention and elimination of the consequences of harmful water impact.

The main objectives of the Dnipro Programme are:

- harmonisation of Ukrainian legislation with international standards and improvement of the regulatory framework for innovation and investment development of the water sector (partially completed);
- Implementation of an effective, justified and balanced mechanism for the use, protection and reproduction of water resources, ensuring sustainable development of the state water monitoring system in accordance with international standards (achieved);
- Implementation of the integrated water resources management system based on the basin principle, development and implementation of river basin management plans, application of the economic model of targeted financing of activities in river basins, establishment of river basin councils, as well as enhancement of the role of existing and creation of new basin water resource management agencies (partially implemented);
- Improving the technological level of water use, introducing low-water and waterless technologies, developing more rational water use standards, construction, reconstruction and modernisation of water supply and sewage systems (partially completed);
- bank protection and regulation of river channels, construction and reconstruction of hydraulic structures, protective dams, polders, flood control reservoirs, clearing of river channels, arrangement of water protection zones and coastal protection strips, development of schemes for comprehensive flood protection of territories from the harmful effects of water, improvement of methods and technical devices for hydrometeorological observations, flood forecasting (partially completed);
- Ensuring the development of land reclamation and improvement of the ecological condition of irrigated and drained lands, including restoration of the water management and reclamation complex, reconstruction and modernisation of reclamation systems and their facilities, engineering infrastructure of reclamation systems with the creation of integrated technological complexes, introduction of new methods of irrigation and land drainage, application of water and energy-saving environmentally safe irrigation and water regulation regimes (not fulfilled).

The creation of the so-called "single" water management programme was supposed to consolidate state and local funds specifically for the implementation of the Dnipro Programme's tasks and objectives. The estimated amount of its funding was UAH 46478.46 million, including UAH 21029.03 million from the state budget, UAH 9294.2 million from the local budget, and UAH 16155.2 million from other sources not prohibited by law (in dollar terms, the equivalent of USD 6.193 billion (as of 1 January 2012), or an average of USD 688 million annually, or 0.4% of Ukraine's gross domestic product (GDP)). The amount of funding for the Dnipro Programme was determined each year when the draft State Budget Law of Ukraine for the respective year was prepared, taking into account the real possibilities of the state budget, and each year less and less funds were allocated to it. Since the start of the Dnipro Programme, as of 1 January 2019, 26% of the envisaged need has been allocated from budgets of all levels and other sources, and as of 1 January 2020, 17% of the envisaged need has been allocated, which has led to a significant failure to complete its tasks and activities on time. The main implementer of the Dnipro Programme is the State Agency of Water Resources of Ukraine. If we analyse in detail the distribution of state budget expenditures by the State Agency of Water Resources in recent years, we can see the following trend. State funds are allocated mainly for the costs of consumption of the water sector, labour remuneration, utilities, the share of financing from the state budget, for example, in 2020 was 93.5% (UAH 2092158.5 thousand) from the general fund and 81.1% (UAH 2261343.4 thousand) from the special fund. Total state budget expenditures to finance the Dnipro Programme in 2020 amounted to UAH 5022671.0 thousand. The lion's share of all funds is used for the operation of the state water management complex and water resources management - UAH 4561352.5 thousand (90.8%). In the context of the Prut and Siret RBM, all these generalisations and conclusions on the implementation and financing of the Programme are approximated to the relevant regional water management units. Measures to maintain water infrastructure in the Prut and Siret RBMs are carried out by organisations under the management of the State Agency of Water Resources located in the respective oblasts - the Prut and Siret RBMs within Chernivtsi Oblast and the Dniester RBM within Ivano-Frankivsk Oblast. For the third year in a row, the issue of extending the Programme's term from 2022 to 2024 until the RBMP is prepared has been resolved by reviewing the amount of funding for the measures and agreeing on their scope at the central and regional levels. As of 8 June 2021, the Accounting Chamber of Ukraine conducted an audit of the effectiveness of the implementation of the Dnipro Programme measures for the period up to 2021. The purpose of the audit is to identify existing problems with the implementation of the Dnipro Programme and to confirm or deny the need to extend the National Target Programme for the Development of Water Management and Environmental Improvement of the Dnipro River Basin until 2024.

Equally important and necessary was the National Target Programme "Drinking Water of Ukraine for 2011-2020" approved by the Law of Ukraine No. 2455-IV of 3 March 2005 (hereinafter referred to as the Drinking Water Programme). Its main goal was to ensure the rights of citizens to an adequate standard of living and environmental safety guaranteed by the Constitution of Ukraine by providing drinking water in the required volumes and in accordance with the established standards. To achieve this, the Drinking Water Programme was designed to ensure the implementation of the state policy on the development and reconstruction of centralised water supply and sewerage systems; protection of drinking water sources; bringing the quality of drinking water in line with the requirements of regulatory acts; regulatory support in the field of drinking water supply and sewerage; development and implementation of research and development projects using the latest materials, technologies, equipment and devices. The estimated amount of funding for the Drinking Water Programme was UAH 9,471.7 million (in 2010 prices), of which UAH 3,004.3 million was allocated from the state budget and UAH 6,467.4 million from other sources. Due to the lack of adequate funding over the 10 years of the Drinking Water Programme in Ukraine, there have been no significant positive changes in the provision of drinking water in the required volumes and of the appropriate quality. Thus, as of 1 January 2020, about 1% of cities, more than 10% of urban-type settlements and almost 70% of villages in Ukraine (8.934 million people) were not provided with centralised drinking water supply. Almost 1 in 4 citizens of the country is not provided with centralised water supply. The problem of using imported water covers at least 9 regions of the country and directly affects at least 268,000 people living in 824 settlements. According to global standards for water quantity and quality, Ukraine is classified as a low-water country. Ukraine ranks 37th among 40 European countries in terms of drinking water quality. And over the past 10 years, our performance has only been deteriorating. And in terms of water per capita, Ukraine is 125th in the global ranking. At the same time, the National Target Programme Drinking Water of Ukraine is not being implemented or financed at all. The last time the Drinking Water Programme was funded was in 2018. In 2018, UAH 200 million was allocated from the state budget of Ukraine for the Drinking Water Programme, while only water and sewerage companies in Ukraine submitted projects totalling UAH 1.3 billion. Such activity of the companies is caused by their unsatisfactory financial and economic condition, as well as the inability of local governments to provide the necessary support for the renewal of fixed assets from local budgets. In addition, it is worth noting that the procedures for obtaining grants and loans from international financial institutions are quite lengthy and involve significant risks, so obtaining state funds for the implementation of a particular infrastructure project was a desirable goal for each water utility. In 2019-2020, the Drinking Water Programme was not funded and ended in 2020. In order to continue supporting the water supply and wastewater treatment companies, in 2019, the Ministry of Regional Development developed and submitted to the central executive authorities and specialised associations a draft law "On

Amendments to the Law of Ukraine "On the National Target Programme "Drinking Water of Ukraine" for 2011-2020", which provided for the extension of the Programme for another 5 years. Interagency approval, coordination, and consultations with the Ministry of Finance lasted for two years. The Resolution of the Verkhovna Rada of Ukraine No. 980-IX of 5 November 2020 provides for the possibility and expediency of increasing/foreseeing expenditures and providing loans from the general fund of the draft state budget for 2021 under the budget programme "Implementation of the National Target Programme "Drinking Water of Ukraine" for the Ministry of Communities and Territories Development of Ukraine (instead of MinRegion) (clause 2.17.68). The Drinking Water of Ukraine programme will be extended until 2025. "No one should be left behind" is the principle on which state policy should be based, based on the global agenda. However, this does not automatically mean that the state level should bear the entire burden, including the financial burden. Public funds are not enough for everything and everyone - this is obvious and clear to everyone. So what should we do with limited resources? Assessing the initial conditions and prospects and helping those who are in the worst situation compared to others would seem to be a logical and balanced decision. In our opinion, a "cumulative effect" or "synergy effect" from the combination of the two programmes Dnipro and Drinking Water could be achieved in the country's water sector. For example, the construction of main water pipelines at the expense of the State Agency for Water Resources (Dnipro Programme) could be simultaneously supplemented by the creation or reconstruction of both local water supply and sewage networks at the expense of the Ministry of Communities and Territories Development (Drinking Water Programme). When analysing the implementation of these two programmes, which operated almost in parallel to each other in 2013-2020, we did not track the effect of synergy, continuation, or combination of actions of one and the other agencies. The lack of interaction and coordination of activities led to a lack of complementary effect. The trend of programme synergy could be transferred to the regional level, where national programmes could also be complemented by regional programmes.

One of the elements of the RBMP structure is Section 3 "Areas (territories) to be protected and their mapping: Emerald Network sites; sanitary protection zones; protection zones for valuable aquatic bioresources; surface/groundwater bodies used for recreational, medical, resort and health purposes, and bathing waters; zones vulnerable to (accumulation of) nitrates", therefore, in the context of preparing and implementing the RBMP, it is very important to have information on the implementation of the National Programme for the Development of Nature Reserves for the period up to 2020, approved by the Cabinet of Ministers of Ukraine on 8 February 2006, No. 70-r (hereinafter referred to as the NRF Programme). According to the data on the registration of protected areas and sites submitted by the local executive authorities responsible for implementing the state policy in the field of environmental protection (hereinafter referred to as the "National Environmental Protection Agency"), as of 1 January 2020, the Ukrainian PA system comprised 8,512 territories and sites with a total area of 4.418 million hectares within the territory of Ukraine (actual area 4.085 million hectares) and 4,2500.0 hectares within the Black Sea. The ratio of the actual area of the nature reserve fund to the area of the state (the "reserve indicator") is 6.77%. The NRF is managed by the Ministry of Ecology and is funded through the state budget programme KPKVK 2701160 "Conservation of protected areas". In 2020, UAH 403734.6 thousand (state fund) and UAH 25644.9 thousand (special fund) were used for measures to conserve and expand the NRF, totalling UAH 429581.5 thousand. In general, the performance indicators under this budget programme were met.

The State Target Programme for the Development of Land Relations in Ukraine for the Period up to 2020, approved by the Cabinet of Ministers of Ukraine, was established to define and implement the main directions of state policy aimed at improving land relations and creating favourable conditions for sustainable development of land use in urban and rural areas, facilitating the solution of environmental and social problems of rural areas, developing highly efficient competitive agricultural production, and preserving the natural values of agricultural landscapes. The result of the underfunding of the Land Programme is excessive ploughing of agricultural land, which leads to a violation of the ecologically balanced ratio of agricultural, nature reserve and other environmental, health, recreational, historical, cultural, forestry, water fund lands, and an increase in the area of degraded, low-productive, and technogenically polluted land (diffuse sources of pollution). As of 1 January 2021, more than 500,000 hectares of degraded, underutilised and technogenically contaminated land are subject to conservation, 143,000 hectares of disturbed land need reclamation, and 294,000 hectares of underutilised land need improvement. Currently, a separate Ministry for Development of Economy, Trade and Agriculture of Ukraine has been established (Ministry of Economy, Resolution of the Cabinet of Ministers of Ukraine No. 838 of 19 September 2019), which will implement the new State Target Programme for the Development of Land Relations and National Geospatial Data Infrastructure in Ukraine for the period up to 2030 (Land Programme, draft order of the Cabinet of Ministers of Ukraine of 13 April 2021).

Budgetary environmental funds are one of the most important sources of financing environmental activities. Currently, Ukraine has a three-tiered system of environmental funds, consisting of the State Environmental Protection Fund (SEPF), regional and local (city, town and village) environmental protection funds. At the regional level, the regional and local environmental protection funds are a significant source of funding for environmental protection measures.

The environmental funds are used for targeted financing of environmental protection measures in accordance with the List of activities related to environmental protection measures approved by the Resolution of the Cabinet of Ministers of Ukraine No. 1147 dated 17 September 1996. In accordance with the Law of Ukraine "On Environmental Protection" dated 25 June 1991 No. 1264-XII (as amended on 18 December 2019), the financing of environmental protection measures, including water protection, is carried out at the expense of the state budget of Ukraine, local budgets, funds of enterprises, institutions and organisations, environmental protection funds, voluntary contributions and other funds. In order to finance environmental protection and resource conservation measures, the National Environmental Protection Agency's target funds are created at the state and local levels, the so-called environmental funds. The idea of environmental funds is that polluters should finance the restoration or improvement of an object that is subject to pollution or deterioration as a result of their activities. Based on the experience of international practice, it is believed that earmarked revenues are a reliable way to secure sources of funding, so environmental funds are considered as sources of earmarked revenues for common environmental protection costs.

However, Ukraine faces a paradoxical situation: business entities that pollute the environment pay these funds, while most environmental, including water management, problems remain unresolved. According to the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Regulation on the State Environmental Protection Fund" of 7 May 1998, No. 634 (as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 1065 of 4 December 2019), the State Environmental Protection Fund became part of the State Budget of Ukraine. All environmental funds go to the consolidated budget, and environmental protection measures are financed on a residual basis, or on the principle of urgent need, when a critical, emergency environmental situation has already occurred. In fact, the entirety of the environmental tax collected is dissipated within the general and special funds of the state and local budgets. According to the Ministry of Finance, in 2018, environmental tax revenues amounted to UAH 2779.6 million, which significantly exceeds the budget expenditures of UAH 361.1 million for targeted environmental protection measures, which has signs of inefficient and misuse of environmental tax and is a violation of the current legislation. In 2013, the Budget Code of Ukraine stipulated that 33% of 53%, and in 2014 - 50% of 65% of the funds received by the special fund of the state budget should be used to finance exclusively targeted environmental modernisation projects of enterprises within the amount of environmental tax paid by them in accordance with the procedure established by the Cabinet of Ministers of Ukraine. However, not a single Ukrainian company has been able to take advantage of this provision due to the lengthy development of bylaws. According to 2018 data, the share of environmental revenues (rent, environmental tax, special permits, fines) in the state budget was over UAH 52 billion, of which UAH 4.6 billion was allocated to support the activities of the relevant central government agencies and environmental control, and only UAH 4.2 billion, or only 8% of environmental funds, was allocated to implement environmental protection measures. This also includes the allocation of funds for the national budget programmes Dnipro and Drinking Water, the actual funding status of which is presented above. The distribution of environmental funds among agencies and entities is as follows: the State Agency of Water Resources (38%), local budgets (24%), SAUEZM (22%), the Ministry of Ecology (now the Ministry of Environment) (9%), the State Environmental Inspectorate (4%), and the State Service of Geology and Subsoil (2%) received the most. The state budget for 2020 allocated UAH 496.356 million to finance environmental protection measures. It is clear that such expenditures cannot play a significant role in solving environmental problems, including addressing the issue of pollution and depletion of water resources, and even more so in fulfilling the obligations assumed by Ukraine to the global community in the field of environmental protection and, in particular, the preparation of RBMPs to achieve a "good" environmental status for the MEAs of each RBF. For comparison, on average, EU countries spend 0.8% of their GDP on environmental protection. For example, in Poland, the average annual funding for environmental programmes is EUR 1-1.3 billion. Half of these funds are covered by national funding, and the other half by attracting international funding. In our realities, it is obvious and undeniable that we need to urgently restore and increase the targeted use of environmental tax funds and possibly create an extra-budgetary State Environmental Protection Fund with clear directions for using the funds and create an independent, effective, transparent instrument for financing environmental protection measures. The implementation of Ukraine's international commitments in the field of environmental protection is impossible without financial support for the environmental modernisation of business entities themselves, which need to bring their operations in line with high European standards. Public investment projects in Ukraine have once again proved to be inefficient and highly dependent on state funding.

In 2019-2020, the State Fund for Regional Development (hereinafter referred to as the SFRD) was much better funded, with funds allocated for specific investment projects in the regions, although the share of environmental projects, in particular water supply and sewage construction/reconstruction projects, was negligible. The SFRD was established in 2012 with the aim of increasing the competitiveness of regions by unlocking their own potential. The SFRD is the main instrument of the state to finance social, economic, infrastructure, cultural and sports projects throughout the country. In 2015-2020, a total of UAH 27.1 billion was distributed from the SFRD. During this time, about 4,500 projects were funded, most of them in the field of education (35%). Other projects that received significant funding included healthcare and social protection (18%), sports (14%), road infrastructure (12%), energy supply and sewage (11%). Over the past three years, the SFRD has allocated UAH 9.48 billion for projects in all regions of Ukraine. In total, about 10 thousand project proposals are available on the SFRD website. In 2020, we managed to significantly increase the percentage of disbursement of the SFRD funds. In 2020, UAH 4.9 billion was financed from the SFRD, half of which went to educational projects. The second largest area of funding was for sports facilities (22%). A significant portion of the SFRD funds was allocated to healthcare (12.2%), road transport projects (5%), and water supply and sewerage projects (6% (or UAH 294 million). In total, 284 projects were implemented at the expense of the SFRD in 2020.

With regard to the review of funding for regional local programmes and the implementation of environmental protection measures, it can be stated that in the two administrative regions that are part of the Prut and Siret RBMs, targeted regional programmes were developed and approved by the sessions of the regional councils in accordance with the national target programmes. Given that these oblasts belong to the flood-prone region of the Carpathian Mountains, priority was given to flood protection measures, construction of bank protection on mountain rivers, restoration of the hydrological regime of rivers, conservation and expansion of protected areas, and increase in forest cover. However, most of the environmental protection measures in the Prut and Siret RBMs envisaged by these programmes were not implemented due to lack of adequate funding. Funding of both national and regional programmes is not based on the basin principle, but on the administrative-territorial principle, so in the context of reviewing the implementation of programmes or activities, including ways to achieve the set goals in the RBMs of the Prut and Siret, it is reasonable to assume that their funding at the regional level is practically very different, both in terms of capital investments and the number of implemented projects. Of course, given the economic situation in the country, the state budget is unable to finance significant expenditures on water management and reclamation, housing and communal services, or environmental protection, so at present and in the near future, some new administrative units (territorial communities) have begun to focus on their own investments, seeking internal reserves of enterprises and funds in the regional, district and amalgamated territorial community budgets to solve the problems addressed by the regional programmes. The first RBMP for the Prut and Siret, with specific measures for each identified MNE in the Prut and Siret sub-basins, should be the first to help local communities lay the foundation for future action planning.

8 FULL LIST OF PROGRAMMES (PLANS) FOR THE PRUT AND SIRET RIVER SUB-BASINS, THEIR CONTENTS AND PROBLEMS TO BE SOLVED

The RBMP has been developed in accordance with the requirements of the "Methodological Recommendations for Setting Environmental Objectives, Developing an Action Programme and Performing a Cost-Effectiveness Analysis of the River Basin Management Plan Action Programme" (hereinafter referred to as the Methodological Recommendations), approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources on 12 July 2023. The RBMP was developed by the Prut and Siret RBMU in accordance with the Methodological Recommendations and the Procedure for Developing RBMPs in cooperation with local executive authorities, local self-government bodies, non-governmental organisations (NGOs), scientific and educational institutions (SEIs) and other stakeholders, taking into account the proposals and decisions of the Prut and Siret Basin Council.

The development of the RBMP took into account the measures implemented or planned in the national RBMPs of the neighbouring countries of the Prut and Siret sub-basins (Romania, Republic of Moldova) and the chemical state of the transboundary IWBs according to the monitoring data for 2022-2023. The Programme is developed for a period of 6 years, starting with the first cycle of the plan for 2025-2030. The start of the measure implementation should be no later than the third year from the beginning of the cycle (no later than 1 January 2028). During the implementation, it is allowed to make additions and changes to the approved programme. In total, 161 main and 6 additional measures are proposed for the Programme. A full list of measures for the Prut and Siret river sub-basins and their content is provided in Annex 13 (M5.3.2, M5.3.3).

8.1 Surface water

For surface waters, the RMP includes the following key measures:

- measures aimed at reducing organic pollution (diffuse and point sources);
- measures aimed at reducing pollution by nutrients (diffuse and point sources);
- measures aimed at reducing pollution by hazardous substances (diffuse and point sources);
- measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology.

In addition to these measures, the RP also includes other measures aimed at addressing other GWPs of the Prut and Siret sub-basins, identified in view of the specifics and transboundary nature of the sub-basins.

8.1.1 Measures to reduce pollution by organic matter, nutrients and hazardous substances (diffuse and point sources)

Anthropogenic loads and their impacts on the state of the IWM include pollution with organic, biogenic and hazardous substances from the main sources of pollution - sewage treatment plants (STPs) of agglomerations (point pollution) and deterioration/damage/absence of drainage systems (diffuse pollution). The same measure for the construction/reconstruction/modernisation of the agglomeration's SSS and sewerage networks (hereinafter referred to as the "S&S"), including stormwater networks (melt and rainwater), combines the reduction of pollution of the MSW with organic, nutrient and hazardous substances from point and diffuse sources. Anthropogenic loads and their impacts on the state of the IWM allow establishing reasonable correlations between them and developing a software to achieve environmental goals.

The proposed measures aimed at reducing the pollution of the Prut and Siret sub-basins fall into three groups:

- measures aimed at reducing organic pollution (diffuse and point sources) - 146 measures;
- measures aimed at reducing pollution by nutrients (diffuse and point sources) - 148 measures;

- measures aimed at reducing pollution by hazardous substances (diffuse and point sources) - 146 measures.

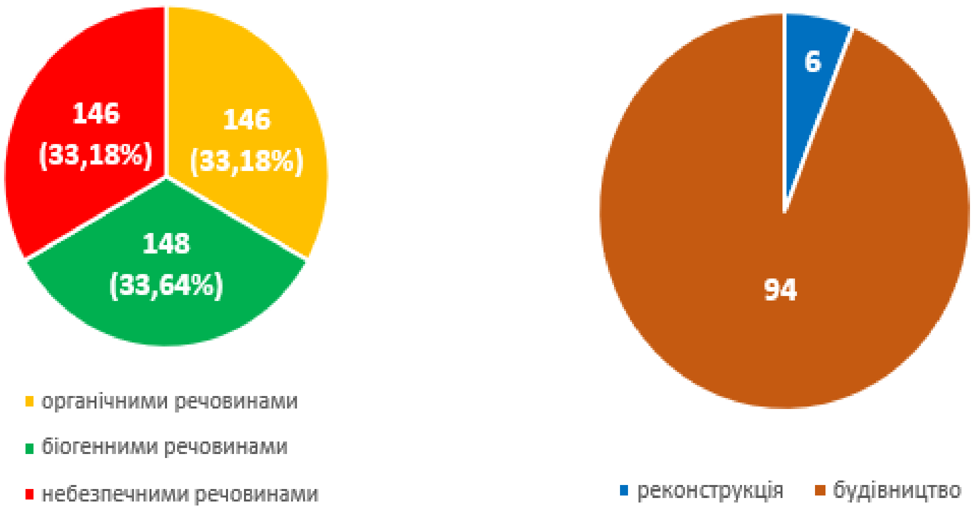


Figure 119. Percentage of measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources and the method of their implementation (reconstruction or construction of CWS and CM), %.

Measures aimed at reducing pollution by organic, biogenic and hazardous substances (diffuse sources) also include the following: "Establishment of water protection zones and coastal protection strips in Chernivtsi and Ivano-Frankivsk oblasts" (Nos. 162, 163 in the list of measures, Annex 13 (M.5.3.2, M5.3.3)), flood prevention and erosion control measures.

In accordance with the requirements of the Law of Ukraine "On Wastewater Disposal and Treatment" dated 12 January 2023 No. 2887-IX, in order to ensure high-quality centralised wastewater disposal while reducing the impact of return (wastewater) on the IBA, it is planned to build/reconstruct WTPs and KMs for 146 settlements (44%) of the Prut and Siret sub-basins with a population equivalent (PE) of 2,000 or more. The proposed measures to reduce pollution by organic, biogenic and hazardous substances and their implementation in terms of new construction or reconstruction/modernisation indicate the following: 9 TCs (9 settlements) need reconstruction/modernisation of CWS and CM, including 2 with tertiary (proper) wastewater treatment with removal of nitrogen and phosphorus compounds. Construction of new CWSs and CWs is planned by 66 TCs (137 settlements). There is a clear trend towards the construction of single sewage treatment plants for closely located settlements in the communities of Chernivtsi and Ivano-Frankivsk oblasts.

These include measures aimed at reducing pollution by organic, biogenic and hazardous substances (diffuse and point sources): 70 measures belong to the IAPs that are "at risk" of failing to achieve environmental objectives and 46 measures belong to the IAPs of the category "possibly at risk" of failing to achieve environmental objectives. The share of the proposed measures aimed at reducing pollution by organic, biogenic and hazardous substances from point sources of pollution, depending on the risk assessment, is shown in Figure 120.

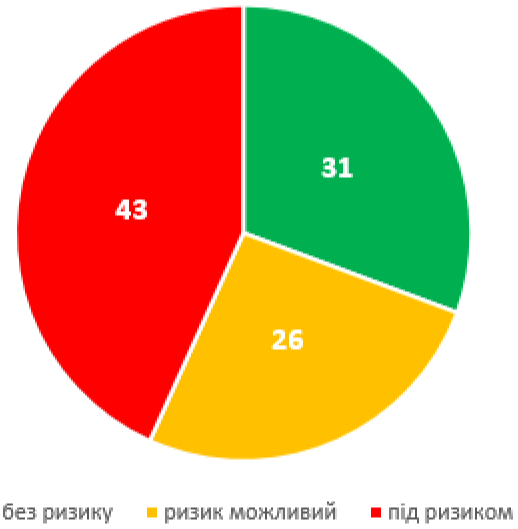


Figure 120. Distribution of measures aimed at reducing pollution by organic, biogenic and hazardous substances, depending on the risk assessment of IWR, %.

All the proposed measures aimed at reducing pollution by organic, biogenic and hazardous substances fall under the category of "rivers" and have a single goal: to achieve/maintain "good" ecological status of the MNR. 21 measures are related to the IZMPV.

8.1.2 Measures aimed at improving/restoring hydrological regime and morphological indicators

The number of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology in the Prut and Siret sub-basins is 15. Almost all of them are aimed at mitigating/reducing the negative impact of channel regulation works planned as part of the implementation of the "Flood Risk Management Plan for Certain Areas within the Danube River Basin Region for 2023-2030", approved on 8 October 2022 by CMU Resolution No. 895-r (hereinafter referred to as the Danube FRAP). When developing the measures, it was taken into account that the environmental objectives for the SSSs are to maintain the "good status" of 3 SSSs and achieve "good status" for the 12 SSSs where channel regulation works are planned. Measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology depending on the risk assessment are presented in Figure 121.

Figure 121. Distribution of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology, depending on the assessment of IWR risks, %.

8.1.3 Measures to reduce the negative impact of infrastructure projects

In the Prut and Siret sub-basins, there are no measures to mitigate the negative impact of infrastructure projects.

8.1.4 Measures aimed at reducing pollution and improving/restoring hydrological regime and morphological characteristics on transboundary IBAs

The PA includes measures aimed at reducing pollution (reconstruction/construction of WWTPs and STPs) in cross-border agglomerations: Chernivtsi, Novoselytsia, Marshyntsi, Mamalyha, Vanczykivka, Tarasivtsi, Podvirne, Zelena, Podvirivka, Lukachivka, Vashkivtsi (Prut sub-basin), Storozhynets, Ropcha, Cherepkivtsi, Petrychanka, Turyatka (Siret sub-basin). The measures are planned to be implemented in 2025-2030 at transboundary MPAs with potential impact on the neighbouring countries of the Prut and Siret sub-basins (Romania, Moldova): UA_M5.3.2_0007 (Prut River, Ukraine-Romania), UA_M5.3.2_0231 (IZMV, Patzapule River, Ukraine-Moldova), UA_M5.3.2_0233 (Zelena River, Ukraine-Moldova), UA_M5.3.2_0235 (Medvedka River, Ukraine-Moldova), UA_M5.3.2_0239 (Vilia River, Ukraine-Moldova), UA_M5.3.2_0242 (Lopatinka River IZMV, Ukraine-Moldova); UA_M5.3.3_0005, UA_M5.3.3_0006 (Siret River, Ukraine-Romania). The number of activities on transboundary LBAs by country in the Prut and Siret sub-basins is shown in Figure 122.

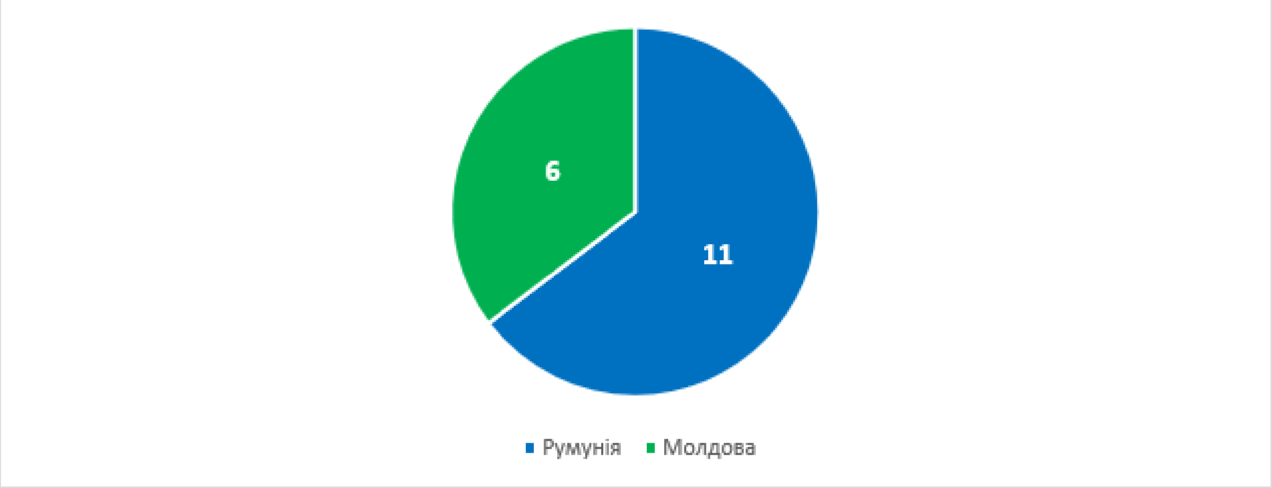


Figure 122. Number of events at MoUs with neighbouring countries

8.2 Groundwater

For groundwater, the RMP includes the following key measures:
- measures aimed at reducing pollution (diffuse and point sources);
- measures aimed at preventing groundwater depletion;
- measures aimed at reducing the impact of planned infrastructure projects on water conditions.

In order to achieve/maintain a "good" quantitative and qualitative state of the IAPZ, the following two measures should be implemented first of all: "Establishing the boundaries of sanitary protection zones for groundwater intakes used for centralised water supply to the population, medical and recreational needs, indicating them in land management documentation, urban planning documentation at the local and regional level, entering information on relevant restrictions on land use into the State Land Cadastre and marking these boundaries on the ground with information signs" and "Mandatory equipping of all water intake wells with water regulating and controlling devices. These measures cover all sub-basin WMPs and will be implemented at the expense of water users and local TGs.

8.3 Other measures

Other measures include the following additional measures: legislative, administrative, fiscal, research, educational, aimed at introducing new technologies, environmental and communication, design, and others.

Additional activities include awareness-raising activities for groundwater and surface water, in particular, conducting awareness-raising activities on the protection, conservation and restoration of water resources in the TGs of Ivano-Frankivsk and Chernivtsi oblasts.

Annual events are planned to include Wetlands Day (2 February), International Water Day (22 March), Environment Day (third Saturday in April), Danube Day/Prut and Siret Day (29 June), and International Clean Shores Day (third Saturday in September). It is also planned to clean up and restore river sources, as well as to conduct outreach and educational activities with local community groups, NGOs, NPOs, schoolchildren and youth in the field of solid waste management. Implementation of local measures by local executive authorities to conserve, protect and restore water resources.

For groundwater, an additional measure is "Inventory, rehabilitation of observation wells and monitoring of groundwater in the Prut and Siret river sub-basins". Since 2018, groundwater monitoring has not been carried out, and the condition of the water intake facilities is unknown. The inventory is necessary to resume monitoring observations and assess the need to drill additional observation wells.

8.4 Overall assessment of the effectiveness of the proposed measures for the LIP

The RP includes measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources, measures to improve/restore the hydrological regime and morphological indicators in case of disturbance of free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology, and other additional measures aimed at achieving or maintaining the "good" status/potential of the MES. Some measures have an impact on several GWEs. The largest share of measures is aimed at reducing pollution of IWRs (87%). The overall structure of the PA in terms of proposed measures for surface waters of the Prut and Siret sub-basins is presented in Figure 123.

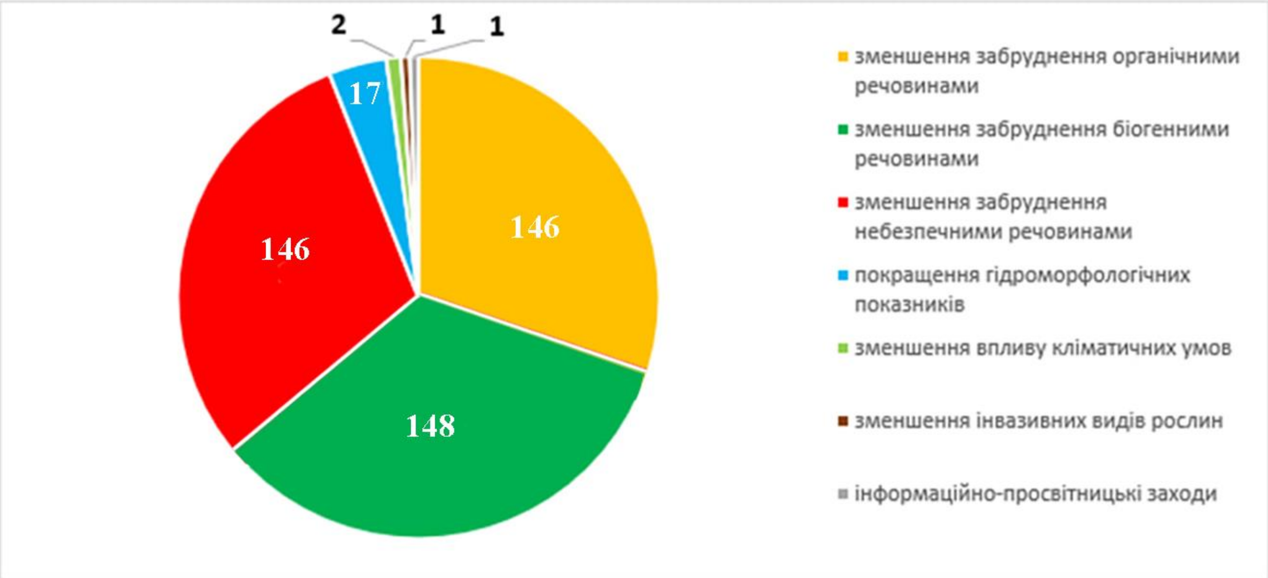


Figure 123. Core and additional measures for the RBM Prut and Siret MSP, number of measures

The overwhelming majority of measures relate to hromadas/settlements with a population of 2.0 to 10.0 thousand. There are 139 such measures (83%), for communities with a population of 10 to 100.0 thousand - only 11 (7%) - these are measures in the settlements of Ivano-Frankivsk and Chernivtsi regions (Kolomyia, Yaremche, Vashkivtsi, Storozhynets, Krasnoyilsk, Nyzhniy Verbizh, Stopchativ, Miliyeve, Chornohuzy, Slobidka, Velykyi Kuchuriv). There is only 1 measure for an agglomeration with more than 100.0 thousand PEs, and this is the measure for the city of Chernivtsi. This social specificity of the measures is due to the fact that the vast majority of residents of the regions live in rural areas.

Figure 124. Number of measures depending on PE in the Prut and Siret sub-basins

In accordance with the RBMP Development Procedure, the measures envisaged in the RBMP will be financed from the state and local budgets, as well as other sources not prohibited by law. These measures shall be financed from the state budget within the limits of expenditures envisaged by the State Budget of Ukraine for the respective year.

The total cost of all the proposed measures for the period 2025-2030 is UAH 7099.47 million, per AH (74) - UAH 95.94 million (UAH 16.0 million per year), per capita (1.170 million people, data for 2020) - UAH 6067.9 (UAH 1011.3 per year). The most costly measures are the reconstruction/modernisation of the KWS and KM. For example, the implementation of such measures in the cities of Kolomyia and Chernivtsi requires up to UAH 170.54 million.

The cost-effectiveness analysis (CEA) of the proposed measures in the RDBs of Prut and Siret does not identify any measures with a very high level of efficiency.

The group with a high level of efficiency includes 2 measures: "Reconstruction of sewage treatment facilities and sewerage networks in Kolomyia, Kolomyia TG, Kolomyia rayon, Ivano-Frankivsk oblast" and "Completion of reconstruction of sewage treatment facilities in Chernivtsi, Chernivtsi TG, Chernivtsi rayon, Chernivtsi oblast", with a total cost of UAH 170.54 million (2.40% of the cost of all measures). The social impact is expected to reach 315.8 thousand people. These measures are aimed at reducing pollution with organic, biogenic and hazardous substances - GWEP 1,2,3. All the objects of the measures belong to the sector of very high water use pressure - housing and communal services.

The group with an average level of efficiency includes 144 measures with a total cost of UAH 6488.83 million (91.4%). The measures are mainly aimed at addressing GWEPs 1, 2, 3 - reducing pollution by organic, biogenic and hazardous substances. The social impact is 695.02 thousand people. All 144 objects of measure implementation belong to the sector of very high water use pressure - housing and communal services. This group is the largest in terms of the number of measures.

The group with a low level of efficiency includes 16 measures with a total cost of UAH 409.73 million (5.77%). These are mainly measures aimed at reducing pollution by organic, biogenic and hazardous substances, improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology - GWEP 1,2,3,4, as well as GWEP: 11. Social effect - 30.80 thousand people.

The group with a very low level of effectiveness includes 5 measures with a total cost of UAH 30.37 million (0.43%) aimed at improving hydromorphological indicators (HME 4), as well as other HMEs. The implementation of these measures will achieve a social effect for 3.0 thousand people. The economic sector's pressure on water resources is minimal and corresponds to the lowest score.

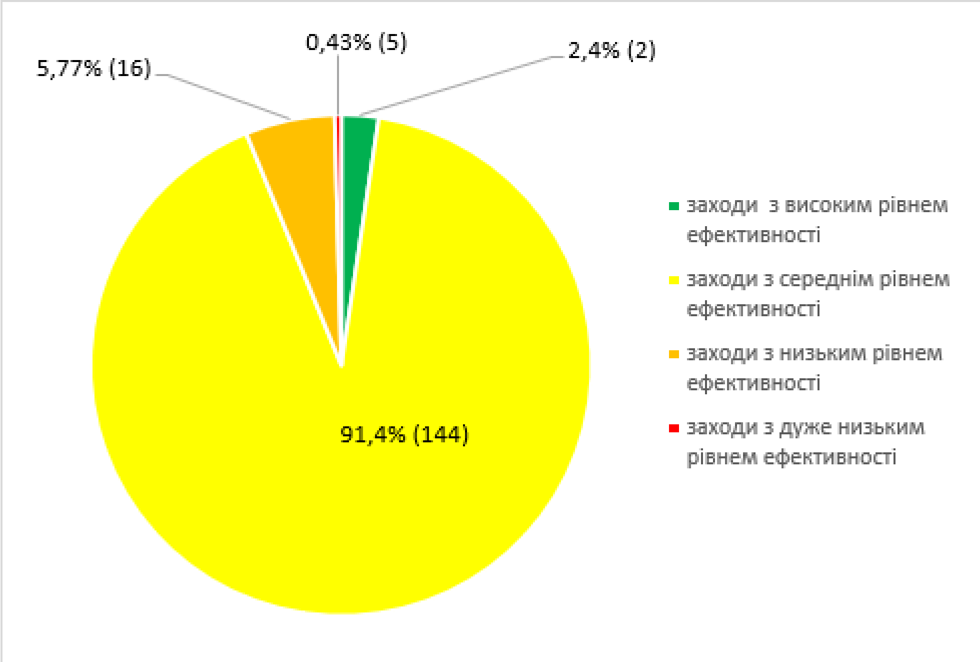


Figure 125. Distribution of measures with different levels of efficiency by total cost of measures

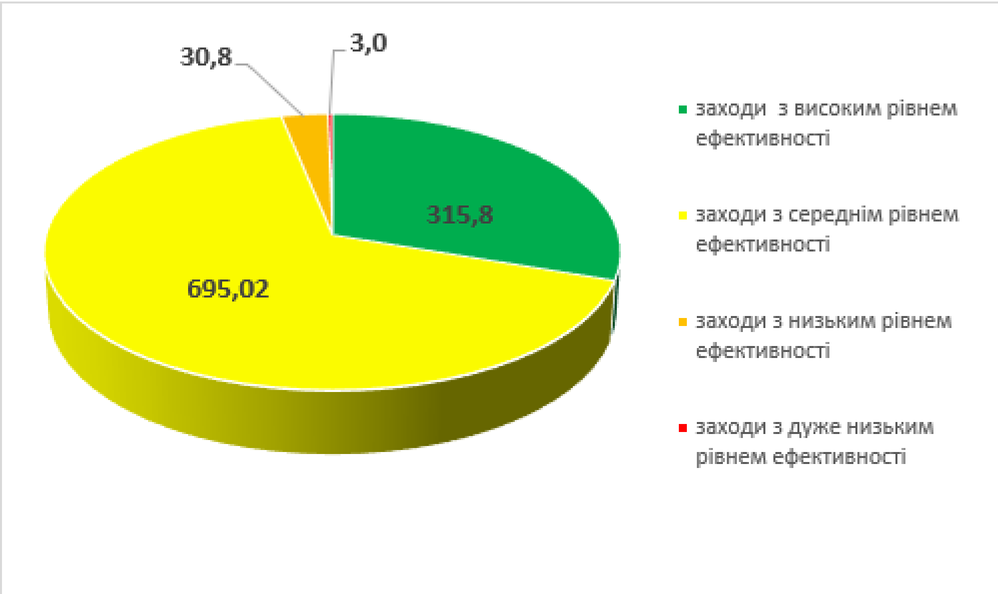


Figure 126. Distribution of measures with different levels of effectiveness by social component

The detailed AEA of the measures is provided in Annex 14 (M5.3.2, M5.3.3).

9 REPORT ON PUBLIC INFORMATION AND PUBLIC DISCUSSION OF THE DRAFT RIVER BASIN MANAGEMENT PLAN

During 2022-2023, the Prut and Siret River Basin Water Resources Authority (hereinafter referred to as the Prut and Siret RWRA) held consultations with the public in Chernivtsi and Ivano-Frankivsk oblasts on the main water and environmental issues (hereinafter referred to as the WEEI) of the Prut and Siret sub-basins, development of a complete list of programmes (plans) for the Prut and Siret sub-basins, their content and problems to be solved (hereinafter referred to as "the Programme") and preparation of a draft management plan for the Prut and Siret river sub-basins for 2025-2030.

In order to ensure the timely preparation of the Danube RBMP, approved by the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 313 of 27 November 2020 "Schedule for the Development of the Draft Danube River Basin Management Plan", and to implement the orders of the State Agency of Water Resources of Ukraine No. 44 of 16 May 2022 No. 44 "On Approval of the Action Plan", No. 1105 "On Development of Draft River Basin Management Plans" dated 18 December 2020, the Prut and Siret RBMU held two meetings with heads and representatives of local communities and water utilities to submit proposals for the action programme of the Prut and Siret River Sub-Basin Management Plan for the period 2025-2030. The preparation of the RBMP was also discussed at a roundtable meeting held to mark World Water Day 2023 with the participation of the Deputy Head of the Chernivtsi Regional Military Administration and the Head of the Prut and Siret Basin Council, as well as representatives of the State Environmental Inspectorate of the Carpathian District, the Department of Life Support Systems of the Chernivtsi Regional Military Administration, the Department of Ecology and Natural Resources of the Chernivtsi Regional Military Administration, the Chernivtsi Regional Centre for Hydrometeorology and the Chernivtsi Regional Fisheries Department.

In order to prepare the RBMP for the Prut and Siret river sub-basins for the period 2025-2030, the Prut and Siret RBMU prepared and sent letters to the territorial communities of Chernivtsi and Ivano-Frankivsk oblasts, as well as to business entities providing water supply and sewerage services (water utilities), asking them to submit proposals for the RBMP aimed at addressing the GWPs of the Prut and Siret sub-basins.

In order to improve cooperation with local executive authorities and major water users, the Deputy Head of the Chernivtsi Oblast State Administration (Deputy Head of the Oblast Military Administration) signed an order No. 34-YA dated 3 May 2023 "On Preparation of the RBMP Action Programme", namely, the submission by territorial communities of proposals aimed at addressing the GWE of the Prut and Siret sub-basins (pollution by organic, biogenic and hazardous substances, hydromorphological changes, uncontrolled water use, contamination of the water supply system, etc.

In 2018, at the first meeting of the Prut and Siret Basin Council, a Working Group was formed to develop a management plan for the Prut and Siret river sub-basins, headed by Hryhorii Kikerchuk, Deputy Head of the Prut and Siret BWRB. The Working Group included representatives of the Prut and Siret BWR, Dniester BWR, the Department of Ecology and Natural Resources of the Chernivtsi Oblast State Administration, the Department of Ecology and Natural Resources of the Ivano-Frankivsk Oblast State Administration, the State Ecological Inspectorate of the Carpathian District, and the Yaremche Mama-86-Yaremche City Environmental NGO, Yuriy Fedkovych Chernivtsi National University, Chernivtsi Regional Centre for Hydrometeorology, Ivano-Frankivsk Regional Centre for Hydrometeorology, Institute of Hydrobiology of the National Academy of Sciences of Ukraine, and the State Fisheries Agency in Chernivtsi Oblast.

The proposals collected for the software were presented for discussion at a meeting of the Prut and Siret Basin Council.

In accordance with the Law of Ukraine "On Strategic Environmental Assessment" dated 20.03.2018 No. 2354-VIII, river basin (sub-basin) management plans are subject to strategic environmental assessment (SEA) prior to their approval.

In accordance with Article 2 of the Law of Ukraine "On Strategic Environmental Assessment", an SEA is mandatory for projects of the CBA that meet two criteria at the same time: relating to agriculture, forestry, fisheries, energy, industry, transport, waste management, water resources, environmental protection, telecommunications, tourism, urban planning or land management (scheme) and the implementation of which will involve the implementation of activities (or contain activities and objects) for which the legislation

The SEA provides an opportunity to focus on a comprehensive analysis of the possible environmental impact of planned activities, which allows for a reasonable assessment of strategic documents in terms of environmental and health impacts, to reconcile them with each other and to use the results of this analysis to prevent or mitigate environmental impacts in the strategic planning process.

The SEA helps to increase the overall transparency of strategic decision-making and enables the opinions and suggestions of key stakeholders to be taken into account at an early stage of planning and development of the LDP.

The SEA provides for clear procedures for consultations and communication between key authorities, business and civil society representatives, which contributes to more informed and balanced decision-making.

The section will be supplemented after public consultations in 2024 and the completion of the SEA procedure.

10 LIST OF COMPETENT STATE AUTHORITIES RESPONSIBLE FOR IMPLEMENTING THE RIVER BASIN MANAGEMENT PLAN

According to part two of Article 13 of the Water Code of Ukraine, the Cabinet of Ministers of Ukraine, the Council of Ministers of the Autonomous Republic of Crimea, village, town and city councils and their executive bodies, district and regional councils, executive authorities and other state bodies are responsible for public administration in the field of water use and protection and water resources restoration in accordance with the legislation of Ukraine.

The executive authorities in the field of water use and protection and water resources reproduction are the Ministry of Ecology, the State Water Agency, the State Geological Survey, the State Ecological Inspectorate and other bodies in accordance with the law.

Table 103. Central executive authorities in the field of water use and protection and water resources restoration

Name of the body (full and abridged)	Legal address	Official website
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	35, Metropolitan Vasyl Lypkivsky Street, Kyiv, 03035; tel.: (044) 206-31-00, (044) 206-31-15; fax: (044) 206-31-07; e-mail: info@mepr.gov.ua	www.mepr.gov.ua
State Agency of Water Resources of Ukraine (SAWR)	8 Velyka Vasylkivska St., Kyiv, 01024; tel./fax: (044) 235-31-92; tel. (044) 235-61-46; e-mail: dar@davr.gov.ua	www.davr.gov.ua
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	16, Anton Tsedik Street, Kyiv, 03057; tel: (044) 536-13-18; e-mail: office@geo.gov.ua	www.geo.gov.ua
State Environmental Inspectorate of Ukraine (SEI)	3, building 2, Novopecherskyi lane, Kyiv, 01042 tel./fax +38 (044) 521-20-40, tel: (044) 521-20-38; e-mail: info@dei.gov.ua	www.dei.gov.ua

Table 104. Main regulatory acts that define the powers of central executive authorities in the field of water use and protection and water resources restoration

Name of the body (full and abridged)	Legal act	Link on the official web portal of the Verkhovna Rada of Ukraine
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Articles 15 and 15[1]	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text

Name of the body (full and abridged)	Legal act	Link on the official web portal of the Verkhovna Rada of Ukraine
	Regulation on the Ministry of Environmental Protection and Natural Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 25 June 2020, No. 614 (Official Gazette of Ukraine, 2020, No. 59, p. 32, Article 1853)	https://zakon.rada.gov.ua/laws/show/614-2020-%D0%BF#Text
State Agency of Water Resources of Ukraine (SAWR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 16	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Agency of Water Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 20 August 2014, No. 393 (Official Gazette of Ukraine, 2014, No. 71, p. 34, Article 1995)	https://zakon.rada.gov.ua/laws/show/393-2014-%D0%BF#Text
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 17	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Service of Geology and Subsoil of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 30 December 2015 No. 1174 (Official Gazette of Ukraine, 2016, No. 3, p. 284, Article 192)	https://zakon.rada.gov.ua/laws/show/1174-2015-%D0%BF#Text
State Environmental Inspectorate of Ukraine (SEI)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 15^2	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Environmental Inspectorate of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 19 April 2017 No. 275 (Official Gazette of Ukraine, 2017, No. 36, p. 73, Article 1131)	https://zakon.rada.gov.ua/laws/show/275-2017-%D0%BF#Text

Name of the body (full and abridged)	Legal act	Link on the official web portal of the Verkhovna Rada of Ukraine
	Regulation on Territorial and Interregional Territorial Bodies of the State Environmental Inspectorate, approved by the Order of the Ministry of Energy and Environmental Protection of Ukraine dated 07 April 2020 No. 230, registered with the Ministry of Justice of Ukraine on 16 April 2020 under No. 350/34633 (Official Gazette of Ukraine, 2020, No. 33, p. 25, Article 1116)	https://zakon.rada.gov.ua/ laws/show/z0350-20#Text

In order to ensure the implementation of the state policy in the field of management, use and reproduction of surface water resources within the Prut and Siret river sub-basins, to direct and coordinate the activities of organisations under the management of the State Agency of Ukraine for Water Resources on management, use and reproduction of surface water resources within the Prut and Siret river sub-basins, as well as to ensure the implementation of the state policy in the field of water management within the Chernivtsi region, the State Agency of Ukraine for Water Resources established the Basin Management Department.

Name of the body (full and abridged)	Legal address	Tel./fax	Email.	Website.
Basin water resources management of the Prut and Siret rivers (BOVR of the Prut and Siret)	58013, м. Cherniv-tsi, 194-b Heroiv Maidanu Street	(0372) 51-14-56	dpbuvr@gmail.com	dpbuvr.gov.ua

(*Source:* https://davr.gov.ua/vodogospodarskiorganizacii)

The names of sub-basins and water management areas within river basin districts are given in the Annex to the Order of the Ministry of Ecology and Natural Resources of Ukraine of 26 January 2017 No. 25 "On the Allocation of Sub-Basins and Water Management Areas within Established River Basin Districts", registered with the Ministry of Justice of Ukraine on 14 February 2017 under No. 208/30076 (https://zakon.rada.gov.ua/laws/show/z0208-17#Text).

The boundaries of river basin districts, sub-basins and water management areas are approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine dated 03 March 2017 No. 103, registered with the Ministry of Justice of Ukraine on 29 March 2017 under No. 421/30289 (https://zakon.rada.gov.ua/laws/show/z0421-17#Text).

The Prut and Siret Rivers Basin Water Resources Management Authority is a budgetary non-profit organisation that belongs to the management of the State Agency of Ukraine for Water Resources. The Regulation on the Prut and Siret River Basin Water Resources Management was approved by the Order of the State Agency of Ukraine for Water Resources dated 30 December 2020 No. 1159 (https://dpbuvr.gov.ua/polozhennia-pro-upravlinnia-2/).

To develop proposals and ensure coordination of interests of enterprises, institutions and organisations in the field of water use and protection and water resources restoration within the Prut and Siret sub-basins, to promote integrated water resources management within the Prut and Siret sub-basins, to ensure coordination of interests and coordination of actions of stakeholders in water resources management within the Prut and Siret sub-basins, to facilitate cooperation between central and local executive authorities, local authorities and municipalities. The Prut and Siret Basin Council is an advisory body of the State Agency of Ukraine for Water Resources within the Prut and Siret sub-basins. The Regulation on the Prut and Siret Basin Council was approved by the Order of the State Agency of Water Resources of Ukraine No. 947 dated 18 December 2018 (https://davr.gov.ua/polozhennya-pro-basejnovu-radu-prutu-ta-siretu).

According to the List approved by Resolution of the Cabinet of Ministers of Ukraine No. 1371 dated 13 September 2002 (as amended by Resolution of the Cabinet of Ministers of Ukraine No. 1276 dated 30

November 2011) (https://zakon.rada.gov.ua/laws/show/1371-2002-%D0%BF#n38), the Ministry of Ecology and/or the State Agency of Water Resources of Ukraine are responsible for fulfilling international obligations in the field of water protection arising from Ukraine's membership in international organisations or in accordance with international treaties concluded by Ukraine.

In addition, pursuant to Article 9 of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (https://zakon.rada.gov.ua/laws/show/801-14#Text), the Government of Ukraine has concluded bilateral agreements on the protection of border/boundary waters, the responsibility for which lies with the State Agency of Water Resources:

- Agreement between the Government of Ukraine and the Government of Romania on Cooperation in the Field of Water Management on Boundary Waters of 30 September 1997 (https://zakon.rada.gov.ua/laws/show/642_059#Text)
- Agreement between the Government of Ukraine and the Government of the Republic of Moldova on the Joint Use and Protection of Boundary Waters of 23 November 1994 (https://zakon.rada.gov.ua/laws/show/498_051#Text).

On the appointment of the Commissioners of the Cabinet of Ministers of Ukraine for Cooperation on Boundary Waters and their deputies, the Cabinet of Ministers of Ukraine appointed by Resolution No. 126 of 10 March 2017 as amended (as amended by CMU Resolution No. 489 of 05 June 2019, No. 45 of 13 January 2021 and No. 1186 of 18 October 2022) (https://zakon.rada.gov.ua/laws/show/126-2017-%D0%BF#Text).

11 PROCEDURE FOR OBTAINING INFORMATION, INCLUDING PRIMARY INFORMATION, ON THE STATE OF SURFACE AND GROUNDWATER

In order to ensure proper organisation of access to public information, implementation of the Law of Ukraine "On Access to Public Information", Presidential Decree No. 547 of 05 May 2011 "Issues of Ensuring Access to Public Information by Executive Authorities", resolutions of the Cabinet of Ministers of Ukraine No. 583 of 25 May 2011 "Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the Secretariat of the Cabinet of Ministers of Ukraine, Central and Local Executive Authorities", No. 835 of 21 October 2015 "On Approval of the Regulation on

To regulate the procedure for access to public information, the State Agency of Ukraine for Water Resources adopted Order No. 163 dated 08.12.2023 "On Certain Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the State Agency of Ukraine for Water Resources".

In accordance with paragraphs 16-18 of the Procedure for State Water Monitoring, approved by Resolution of the Cabinet of Ministers of Ukraine No. 758 of 19 September 2018, the results of state water monitoring are:

- Primary information (observation data) provided by the subjects of state water monitoring;
- generalised data relating to a certain period of time or a certain territory;
- Assessment of the ecological and chemical state of surface water bodies, the ecological potential of artificial or significantly modified surface water bodies, the quantitative and chemical state of groundwater bodies, the ecological state of marine waters and identification of sources of negative impact on them;
- forecasts of water conditions and their changes;
- scientifically based recommendations necessary for making management decisions in the field of water use and protection and water resources reproduction.

The subjects of state water monitoring shall be obliged to store the primary information (observation data) obtained as a result of state water monitoring for an indefinite period of time. The information obtained and processed by the subjects of state water monitoring is official.

Primary information (observation data), generalised data, assessment results, forecasts and recommendations resulting from the state water monitoring are provided free of charge:

- for surface waters (including coastal waters) - to the State Agency of Water Resources and the Ministry of Environment;
- for groundwater massifs - to the State Service of Geology and Subsoil of Ukraine and the Ministry of Ecology and Natural Resources, as well as to the State Agency of Water Resources in terms of generalised data, assessment results and forecasts;
- for marine waters - the Ministry of Environment.

The subjects of state water monitoring shall exchange information with each other on the data and results of state water monitoring on a free-of-charge basis.

The State Agency of Ukraine for Water Resources collects and publishes information on the state of surface waters in the public domain by maintaining the following information resources:

- Water Resources of Ukraine geoportal (http://geoportal.davr.gov.ua:81/);
- the web-based system "Monitoring and Environmental Assessment of Water Resources of Ukraine" (http://monitoring.davr.gov.ua/EcoWaterMon/GDKMap/Index).

Automatic data exchange has been set up between these information resources and the Ministry of Ecology's EcoThreat resource.

MANAGEMENT PLAN
RIVER SUB-BASIN
LOWER DANUBE
(2025-2030)

December 2023

1 GENERAL CHARACTERISTICS OF SURFACE AND GROUNDWATER **IN THE LOWER DANUBE SUB-BASIN**

1.1 Description of the river sub-basin

1.1.1 Hydrographic and water management zoning

The river sub-basin of the Lower Danube rivers is entirely located in Ukraine.

The sub-basin covers an area of 6363 km^2 . The basin covers 1% of Ukraine's territory.

The Lower Danube sub-basin covers the territory of one region of Ukraine - Odesa.

The hydrographic network of the Lower Danube sub-basin includes 37 rivers with a catchment area of more than 10 km^2 , 16 lakes and 15 reservoirs (with a volume of more than 1 million m).[3]

According to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 3 March 2017 "On Approval of the Boundaries of River Basin Districts, Sub-basins and Water Management Areas", 3 water management areas are allocated in the sub-basin.

1.1.2 Climate.

The climate of the sub-basin is moderately warm, with short mild winters with frequent thaws, long hot, dry summers, and insufficient rainfall.

These climate features are caused by a complex interaction of many physical and geographical factors, of which the most important are: radiation regime, peculiarity of atmospheric circulation, relief and sea influence.

The average annual temperature is above zero, around +10°C. The warmest month of the year is July, with an average temperature of +22 to 23°C, and on some days it reaches +38 to 41°C. The coldest month is February, with an average temperature of +0.2 to 1.4°C. In summer, the air temperature is quite stable, while in winter it is unstable, with frequent thaws.

The total amount of precipitation varies from 370 to 525 mm/year. The largest amount of precipitation (up to 60-70%) falls during the warm season (April - October) and amounts to 275-325 mm. In the cold season (November - March), the amount of precipitation rarely exceeds 30 - 40% of the annual amount (up to 200 mm).

Winter is dominated by unstable cloudy weather with frequent thaws (50-60 days) and short-term cold snaps. The snow cover is unstable, forming in the first decade of December, with an average duration of less than 40 days.

For most of the year, winds from the north and north-west prevail. In summer, westerly and north-westerly winds prevail. The average annual wind speed is 3.5-4.5 m/s. Strong winds prevail in the cold season and reach speeds of 16-20 m/s.

1.1.3 Terrain

The sub-basin is distinguished by the Black Sea lowland, with an absolute height of 150-130 m. The lowland gradually slopes down to the Black Sea. There are landforms of various genesis in the area: accumulative, erosion, denudation, subsidence, and artificial. Wide watersheds (primary accumulative plains) are typical for the northern and north-eastern parts of the basin. In the southeast, there are Upper Pliocene marine terraces. Along the sea coast, there are marine accumulative landforms such as beaches, spits, and spits. Some of the sea shores, estuaries and lakes are abrasive, landslide and sometimes landslide.

In terms of tectonic structure, the lowland is part of the Black Sea Basin, filled with almost horizontal thick layers of sedimentary rocks, mainly marine sediments of the Paleogene and Neogene (clays, sands, sandy-clay and sandy-limestone rocks, limestone), overlain by continental sediments of anthropogenic age - red-brown clays, loess, loess-like loams.

Steppe landscapes with dark chestnut soils prevail. Most of the steppes are ploughed and used as agricultural land. The generally flatter topography of the territory facilitates intensive economic development of the region.

1.1.4 Geology

The geological structure of the sub-basin comprises Precambrian, Paleozoic, Mesozoic and Cenozoic deposits.

The section contains fine and medium-grained calcareous sands with lenses and layers of weakly cemented sandstones, greenish and light grey marls, dense and fractured, clays and siltstones. The Neogene system is widespread and is represented by Miocene and Pliocene deposits. The Upper Pliocene amovial terrace deposits are developed in the southern part of the basin and are represented by sands of various compositions with clay interlayers and gravel and pebble inclusions. They occur at depths ranging from 1 m to 25 m.

The Upper Pliocene deposits are developed in the southern part of the basin and are represented by clay, sands, silts, and loams.

Deluvial formations are almost universally distributed on the slopes of river valleys, beams, ravines and reservoirs. They are represented by sandy-clayey rocks, sandy loam, loam and limestone. Their thickness varies from 0.5 to 15 m.

1.1.5 Hydrogeology

The sub-basin is a part of the Black Sea artesian basin and is characterised by rather complex hydrogeological conditions.

Groundwater is found in almost all sediments. Groundwater is found in Quaternary and Neogene rocks and is characterised by a variety of depths, extraction methods and availability, distribution and quality. The direction of movement in Quaternary and Neogene sediments (groundwater) in natural conditions coincides mainly with the inclination of the earth's surface, the area of recharge coincides with the area of distribution, and discharge takes place in valleys.

There are nine aquifers in the region. Within the basin, the depth to the aquifers is typically between 20 and 30 m.

Groundwater salinity ranges from 5 to 3 g/l, which is significantly higher than the standard. The chemical composition is dominated by hydrocarbonates, chloride, chloride-sulfate, sulfate, and sodium.

The total groundwater resources in the sub-basin are limited and require strict control over their abstraction and use.

1.1.6 Soils

The Lower Danube sub-basin is dominated by steppe landscapes. The soil in the region is made up of ordinary and southern chernozems, with exclusively micellar carbonate soils in the Danube terrace plain and in the south-west of the watershed plain.

The chernozems were formed in the conditions of fescue-fescue and wormwood-fescue-fescue vegetation in combination with some annual and biennial grasses. The region's chernozems are distinguished by high biological activity, which contributes to the mineralisation of organic matter, a well-defined and strong "coprogenic" structure, high porosity (up to 50-55%) and water permeability (filtration coefficient of 1.5-3.5 mm/min).

The grain-size distribution of ordinary chernozems is heavy loamy, with a slightly lighter composition towards the south, and medium loamy varieties of southern chernozems dominate the terraced plain. In the profile of ordinary chernozems at a depth of 85-120 (130) cm, the white-eye horizon (usually the Phca horizon) is well defined, while in southern chernozems it approaches a depth of 65-90 cm. The carbonate content in this horizon reaches 17-22%. The gypsum horizon is not visible in the profile of chernozems up to a depth of 2-3 m. Primary chernozems are not saline to a depth of 5-7 m, and often deeper.

In general, chernozem soils are highly fertile and constitute the main natural resource of the region. Unfortunately, due to intensive and not always correct use, a significant part of the soil cover is noticeably degraded.

1.1.7 Vegetation

The vegetation of the sub-basin is predominantly steppe. According to the current geobotanical zonation, the area is part of the Danube-Dniester geobotanical district with fescue-fescue and wormwood-fescue-fescue steppes in combination with halophytic communities and saline meadows. The Danube geobotanical floodplain and deltaic region with sedge and reed beds - floodplains - stands out separately.

Floodplain meadows are common in the river valleys and floodplain of the Danube River. The grass cover here includes meadow bluegrass, couch grass, creeping wheatgrass, beardless brome, red fescue, clover, and sedges, sews, marsh bluegrass, and yarrow in areas that are flooded. There are many representatives of the salt marsh flora - carrotwort, salt marsh wormwood, sea wormwood, Mayer's kermek, salt marsh aster, salt marsh plantain. The Danube lowlands are occupied by floodplains, which are characterised by a complex of aquatic and coastal vegetation with tall grasses (reeds, reeds, cattails), grass bogs and flood-plain forests of white willow.

The southern steppe sub-zone is characterised by the predominance of fescue-fescue associations in the grass stand and a decrease in the proportion of steppe herbs, which are represented by ephemerals (croup, veronica), ephemeroids (goose onions, tulips, steppe hyacinth), and in lower reliefs by moisture-loving species (Romanian alfalfa, dry steppe sage, etc.). On the Black Sea coast, the grassland is dominated by fescue, crested rye, spikelet feather grass, and wormwood. Many of the plants are listed in the Red Book of Ukraine (water walnut, astragalus, cuckoo's feet, feather grass, etc.).

It should be noted that almost all of the territory has undergone radical changes in its natural vegetation cover as a result of long-term human activity, and, first of all, the destroyed natural vegetation has been widely replaced by cultivated vegetation. Almost everywhere, the natural steppes and partially the Danube floodplain have been converted into arable land and are occupied by agricultural crops, with the main crops being wheat, barley, sunflower, rapeseed, peas, soybeans and rice. In addition, gardens and vineyards occupy a significant place. At the same time, the former steppes are now partially intersected by field protection strips, which are home to drought-resistant woody and shrubby vegetation.

1.1.8 The animal world

The Danube Delta is one of the richest places in modern Europe in terms of the number of fauna species.

The fauna of the sub-basin is represented by steppe, forest-steppe and intrazonal species, including birds, mammals, reptiles and fish. Within the district, there are two zoogeographic districts - the Danube-Dniester and Black Sea districts and one zoogeographic area - the Lower Danube Delta intrazonal area.

The entire territory of the basin belongs to the Black Sea-Azov steppe province, which is divided into two zoogeographical districts. In the Danube-Dniester zoogeographical district, the main faunal complex is steppe, and in agrocenoses - forest. There are many birds here, including field harrier, blackbird, avocet, pheasant, and grey partridge. Mammals include wild rabbits, hamsters, white-toothed slipstream, and steppe ferret (light).

The fauna of the Lower Danube, which forms the Lower Danube Delta Intrazonal Area, is extremely rich. There are many waterfowl here: grebes (great grebe, grey-cheeked grebe), pelicans (pink and Dalmatian pelicans), cormorants, herons, egrets, caravans, swans, white-tailed eagle, geese (grey goose), goose geese (red-breasted and white-breasted), ducks (mallard, mallard, grebe), herring gulls, gulls, terns. Fish include Black Sea herring, sprat, hamsa, gobies, carp, bream, roach, silver carp, white cupid, crucian carp, pike perch, mullet, chops (large and small), striped ruff, beluga, sterlet, stellate sturgeon, Black Sea salmon, umber, and horse mackerel. Mammals include three species of dolphins, European mink, river otter, musk-rat, and many reptiles: marsh turtle, snake, four-striped and yellow-bellied snakes.

Several dozen species of fauna are listed in the Red Book of the World and the Red Book of Ukraine and are subject to protection.

1.1.9 Hydrological regime

The hydrological regime of the Lower Danube sub-basin is mainly dependent on climatic conditions. The water regime is characterised by three distinct phases: spring floods, summer and autumn floods, and autumn and winter low water.

Long-term stationary (multi-year) observations at special gauging stations on the Danube River have shown that the Danube River level is not stable throughout the year. In January-March, the water level sometimes rises to a critical level (232 cm BS at Kiliya), and in summer it drops to 10 cm BS (Vilkovo). The average annual flow of the Danube River is 198 km^3 . In winter and spring, significantly high levels are observed due to significant precipitation throughout the basin.

The water level in the Danube Delta is significantly influenced by wind-driven wind phenomena. In exceptional cases, under their influence, the water in the delta can rise by a metre or more.

Due to climate change and anthropogenic activities, the water content of small rivers is decreasing. The rivers are mainly fed by snow, which is characterised by spring floods and high water and a long summer and autumn low water period with rare flash floods.

The group of Danube reservoirs includes freshwater reservoirs located on the left of the Kilia arm of the Danube in the area from Reni: Kagul, Kartal, Yalpug-Kugurlui, Katlabukh, Safyan, China.

The hydrological regime of these reservoirs depends on a number of factors, but the most important factor affecting the hydrological regime of the reservoirs is the water level in the Danube River and the condition of the hydraulic structures that carry out water exchange between the reservoirs.

The level regime of the Soleniy Kut, Limba, Lebedynka, Kryve, Dervent, and Gradeshka lakes affects fishing conditions, water use, natural processes (land flooding, shoreline alteration), and the interests of a number of economic sectors.

1.1.10 Specifics of the river basin

The Danube River is the second longest river in Europe in terms of length and basin area, with a length of 2,860 km, including 174 km in Odesa Oblast, and is the main waterway in southern Ukraine for supplying water to the population and economic sectors (irrigation, drinking water, industry, shipping, etc.):

The Danube Biosphere Reserve is located on the Ukrainian part of the Danube River;

The Danube reservoirs (Kagul, Kartal, Yalpug-Kugurlui, Katlabug, Safiany, China) and the Danube Biosphere Reserve are included in the Emerald Network, and the wetlands located in the basin of the Ukrainian part of the Danube River are protected by the Ramsar Convention.

In order to improve water quality, in case of favourable hydrological conditions on the Danube River, water is exchanged. In particular, in the spring and summer, reservoirs are filled, and in the autumn and winter, water is discharged from the reservoirs into the Danube River to the dead volume level.

All the Danube reservoirs are multi-purpose reservoirs, and Cahul and Yalpug are transboundary water bodies. To ensure proper living conditions for the population and intensive agricultural production, the territory along the Ukrainian section of the Danube River is protected by water protection dams.

The complex of flood control structures protects more than 80,000 hectares of land (including 32,000 hectares of agricultural land), 33 settlements in Reni, Bolhrad, Izmail and Kiliya districts of Odesa region, a network of international, state and local roads and other economic infrastructure facilities from flooding.

1.1.11 Typology of surface water bodies

The IWM typology was developed in accordance with the Methodology for Determining Surface Water Massifs (hereinafter referred to as the Methodology) approved by the Order of the Ministry of Ecology and Natural Resources No. 4 dated 14 January 2019 to detail the hydrographic zoning of Ukraine, prepare a state water monitoring programme, and develop and evaluate the effectiveness of the RBMP implementation.

In the Lower Danube sub-basin, MFLs have been identified for five categories of surface water - rivers, lakes, artificial and significantly modified surface water bodies, transitional and coastal waters.

For the typology and delineation of rivers and lakes, the EU WFD system A was used (Table 105, Table 106).

Table 105. Descriptors for rivers (system A)

Descriptors		
Catchment height, m	Catchment area, km^2	Geological rocks
• midlands: over 800 • lowlands: 500 - 800 • upland: 200 - 500 • lowland: < 200	• small: 10 - 100 • average: >100 - 1000 • Large: >1 000 - 10 000 • very large: > 10 000	• limestone • silicate • organic

Table 106. Descriptors for lakes (system A)

Descriptors			
Catchment height, m	Average depth, m	Water mirror area, km^2	Geological breeds

• upland: 200 - 500 • lowland: < 200	• shallow: <3 • average in depth: 3 - 15 • deep: >15	• small: 0,5 - 1 • average: 1 - 10 • large: 10 - 100	• limestone • silicate • organic

The EU WFD system B is used for the typology of MNRs in the categories of "transitional waters" and "coastal waters".

For "transitional waters", in addition to ecoregion and salinity, an additional indicator is used among the mandatory descriptors - origin (Table 107). This indicator, as an additional descriptor, was included following the example of Romania and Bulgaria.

Table 107. Descriptors for transitional waters (system B)

Eco-region	Salinity, ‰	Origin.
• Black Sea	• oligohaline 0.5 to < 5 • mesogastric 5 to < 18 • polygamous 18 to < 30 • euryhaline < 40	• seaside • estuaries are open • estuaries are closed

For "coastal waters", in addition to the ecoregion and salinity, additional indicators are used - exposure (protection from waves and wind), the prevailing composition of bottom sediments (Table 108).

Table 108. Descriptors for coastal waters (system B)

Eco-region	Salinity, ‰	Exposition.	Bottom deposits
• Black Sea	• desalinated < 0.5 • oligohaline 0.5 to <5 • mesogastric 5 to <18 • polygamous 18 to <30 • euryhaline 30 to <40	• protected (bays, bays) • open (cape zones, direct coast)	• clay-silt • silty sandy • sandy

The Lower Danube sub-basin is located within two ecoregions:

- MNRs of the "rivers" and "lakes" categories belong to the ecoregion: Pontic Province (12);
- MPAs of the "transitional waters" and "coastal waters" categories are located in the Mediterranean ecoregion and belong to the sub-region: Black Sea.

The rivers of the sub-basin are classified as small (with a catchment area of less than 100 km^2), medium (from 100 to 1000 km^2) and very large (with a catchment area of more than 10,000 km^2) rivers.

According to the elevation of the catchment, the rivers of the basin are located in lowlands (less than 200).

The basin's geological rocks are of two types: organic (O) and silicate (Si).

Table 109. Types of IBAs in the "rivers" category

№	Type code	Type
1	UA_R_12_S_1_Si	a small river in the lowlands in silicate rocks
2	UA_R_12_M_1_Si	medium-sized river in the lowlands in silicate rocks
3	UA_R_12_XL_1_Si	a very large river in the lowlands in silicate rocks
4	UA_R_12_XL_1_O	very large river in the lowlands in organic rocks

In the category of "lakes", 7 types of MPAs were identified (Table 110).

Table 110. Type of MPA in the "lakes" category

№	Type code	Type
1	UA_L_12_L_1_SH_O	a large lake in the lowlands is shallow in organic rocks
2	UA_L_12_L_1_SH_Si	a large lake in the lowlands is shallow in silicate rocks
3	UA_L_12_M_1_SH_O	The middle lake in the lowlands is shallow in organic rocks
4	UA_L_12_M_1_SH_Si	The middle lake in the lowlands is shallow in silicate rocks
5	UA_L_12_S_1_SH_O	small lake in the lowlands shallow in organic rocks
6	UA_L_12_S_1_SH_Si	a small lake in the lowlands is shallow in silicate rocks
7	UA_L_12_XL_1_SH_Si	very large lake in the lowlands, shallow in silicate rocks

In the category of "transitional waters", 1 type of MWR is defined (Table 111):

Table 111. Types of IWPs in the "transitional waters" category

№	Type code	Type
1	UA_TW_M5_M_M	Mesohaline estuaries

One type of MPA of the "coastal waters" category was identified (Table 112):

Table 112. Types of MPAs in the "coastal waters" category

№	Type code	Type
1	UA_CW_M5_M_SH_D_SS	Mesogaline open deep silty-sandy

1.1.12 Reference conditions

The assessment of the ecological state of the MPA is based on a comparison of biological indicators (benthic macroinvertebrates, macrophytes, phytobenthos, phytoplankton and fish) with reference conditions that characterise the state of the MPA, which has not been subjected to anthropogenic impact or is minimal.

Reference conditions are determined on the basis of data obtained from reference sites, through modelling (predictive models or retrospective forecasting methods that take into account historical, paleogeographic and other available data that provide a sufficient level of confidence in the values for reference conditions for each type of MPE) or a combination of these methods or based on expert opinion.

In order to establish reference values for biological indicators based on data from reference sites, it is necessary to establish such sites for each type of MPA in all natural categories. The network should cover a sufficient number of sites to provide a sufficient level of confidence and to account for the variability of values for indicators that correspond to the different ecological status of the MPA type.

Key criteria for selecting reference sites:

- characterise the state of the MPA without anthropogenic impact or with minimal impact;
- There is no industry or intensive agriculture;
- concentrations of specific synthetic pollutants are zero or below the detection limits;
- no morphological changes;
- water intake and flow control cause only minor fluctuations in water levels and do not affect surface water quality;
- the vegetation of the coastal zone is appropriate for the type of MPA and geographical location;
- no invasive species;
- fishing and aquaculture do not affect the functioning of the ecosystem.

In accordance with subpara. 2, clause VII. of the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 dated 14.01.2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Conditions of a Surface Water Body, as well as Assigning an Artificial [...]", type-specific reference conditions may also be determined on the basis of existing reference sites in other countries for the same type of MWB or by combining the procedures described above.

Given that reference conditions for all types of MSPs are not currently defined in Ukraine, it was suggested to use the reference conditions established for the same or similar types in neighbouring EU countries, namely the Slovak Republic and Romania.

The methodology includes four hydrobiological indicators (benthic macroinvertebrates, phytoplankton, phytobenthos, macrophytes, macroalgae and eutrophication, respectively) for four natural categories of surface waters (rivers, lakes, transitional waters and coastal waters) that have been identified in Ukraine.

A draft order has been developed to approve environmental water quality standards for the MWR and to amend certain regulatory acts that establish reference conditions and type-specific classifications.

1.2 Defining arrays

1.2.1 Surface water

In the Lower Danube sub-basin, the WFD was assessed in 37 rivers and 16 lakes (according to the Water Resources of Ukraine geoportal of the State Agency of Water Resources of Ukraine).

Within the sub-basin, 106 MPAs have been identified. The identified MPAs belong to the following categories of surface water:

- rivers;
- lakes;
- artificial (AIU) and significantly modified (SMM);
- transitional waters;
- coastal waters.

Category "rivers"

According to the Methodology, 27 IAPs were identified. The number of identified IAPs by descriptors and types is shown in Tables 113 and 114.

Table 113. Distribution of IBAs in the "rivers" category by descriptors

Descriptor	Indicator.	Number of MWPs
by eco-region	Pontic Province (12)	27
by catchment area	small (S)	9
	average (M)	3
	very large (XL)	15
by the height of the catchment area	in the lowlands	27
by geological type	in silicate rocks	26
	in organic rocks	1

Table 114. Distribution of IBAs of the "rivers" category by type

№	Type code	Type	Number of designated MPAs
1	UA_R_12_S_1_Si	a small river in the lowlands in silicate rocks	9
2	UA_R_12_M_1_Si	medium-sized river in the lowlands in silicate rocks	3
3	UA_R_12_XL_1_Si	a very large river in the lowlands in silicate rocks	14
4	UA_R_12_XL_1_O	very large river in the lowlands in organic rocks	1

Category "lakes"

According to the Methodology, 16 MPAs were identified (Table 115).

Table 115. MPAs of the "lakes" category

№	Type code	Type	Quantity of the designated MPOs
		Ecoregion 12 Pontic Province	
1	UA_L_12_L_1_SH_O	a large lake in the lowlands is shallow in organic rocks	1
2	UA_L_12_L_1_SH_Si	a large lake in the lowlands is shallow in silicate rocks	3
3	UA_L_12_M_1_SH_O	The middle lake in the lowlands is shallow in organic rocks	4
4	UA_L_12_M_1_SH_Si	The middle lake in the lowlands is shallow in silicate rocks	4
5	UA_L_12_S_1_SH_O	small lake in the lowlands shallow in organic rocks	2
6	UA_L_12_S_1_SH_Si	a small lake in the lowlands is shallow in silicate rocks	1
7	UA_L_12_XL_1_SH_Si	very large lake in the lowlands, shallow in silicate rocks	1

Category "transitional waters"

1 MPA has been identified:

- TW - transitional waters;
- M5 - Black Sea - sub-ecological region;
- M - mesohaline: average annual salinity ranges from 5 to 18 ‰;
- M is for the seaside by origin.

Table 116. Types of IWPs in the "transitional waters" category

№	Type code	Type	Quantity of the designated MPOs
1	UA_TW_M5_M_M	Mesohaline estuaries	1

Category "coastal waters"

1 MPA has been identified:

- CW - coastal waters;
- M5 - Black Sea - sub-ecological region;
- M - mesohaline: average annual salinity ranges from 5 to 18 ‰;
- SH - open (cape zones, straight coast);
- D - deep: over 50 m.;
- SS - silty-sandy bottom sediments.

Table 117. Types of MPAs in the "coastal waters" category

№	Type code	Type	Quantity of the designated MPOs
1	UA_CW_M5_M_SH_D_SS	Mesogaline open deep silty-sandy	1

Category "significantly altered surface water bodies"

Fifty-seven IWMS have been identified in the sub-basin. The share of IWMSIs in the total number of MSBs in the sub-basin is 54%. Most of them (32 MSW) are classified as IZMV due to diversion.

19 MNEs are classified as MSMEs due to overregulation.

6 MWRs are classified as IWRM due to a combination of regulation and channel straightening (Figure 127).

Figure 127. Distribution of IHMW by causes of hydromorphological stress, %.

Category "artificial surface water bodies"

The sub-basin has 4 MWPs, 2 of which are canals and the other 2 are artificial reservoirs.

The percentage distribution of the identified WFDs in the Lower Danube sub-basin by category is shown in Figure 128.

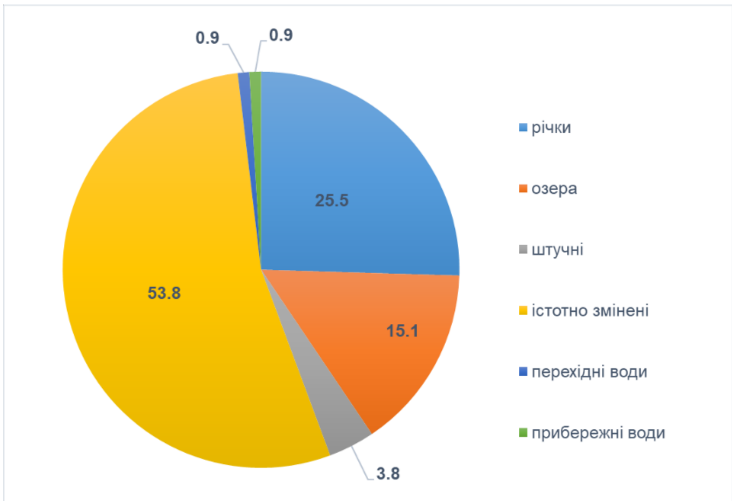


Figure 128. Breakdown of identified MSPs by category, %.

Each of the 106 MPAs has been assigned a unique code that looks like this:

UA_ M5.3.4_YYYY, where:

- *UA* - Ukraine;
- *M5.3.4* - code for the Lower Danube sub-basin (according to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 of 29 March 2017 "On Approval of the Boundaries of River Basin Areas, Sub-basins and Water Management Areas");
- *YYYY is the* unique number of the identified WFD in the sub-basin.

Each linear MPA (categories "rivers", "artificial or significantly modified MPAs") has a length (km). The length of the IBAs in the Lower Danube sub-basin ranges from 0.52 km (UA_M5.3.4_0069 - Valeperzha River) to 96.8 km (UA_M5.3.4_0003 - Danube River).

Figure 129 shows the distribution of the identified linear MFLs in the sub-basin by length.

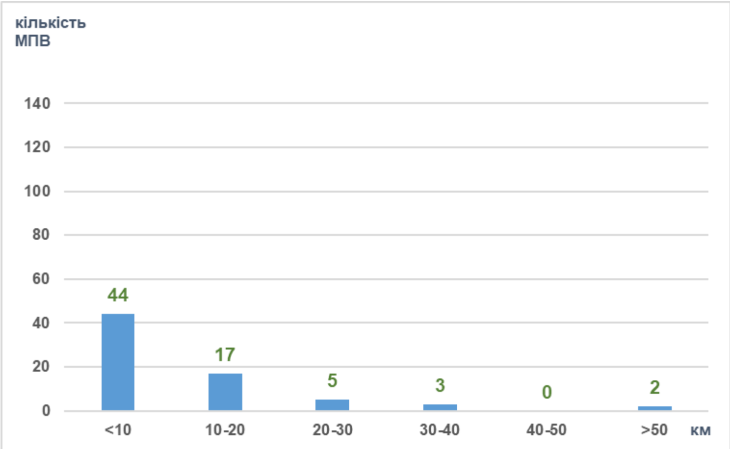


Figure 129. Distribution of the identified linear IPPs by length

Each polygonal MPA (categories "lakes", "artificial or significantly modified MPAs", "transitional waters", "coastal waters") has an area (km^2). The area of the MNR varies from 0.29 km^2 (UA_M5.3.4_0073 - Vynohradiv reservoir) to 242 km^2 (UA_M5.3.4_0105 - transitional waters of the Lower Danube sub-basin).

Figure 130 shows the distribution of the identified polygonal MPAs by area.

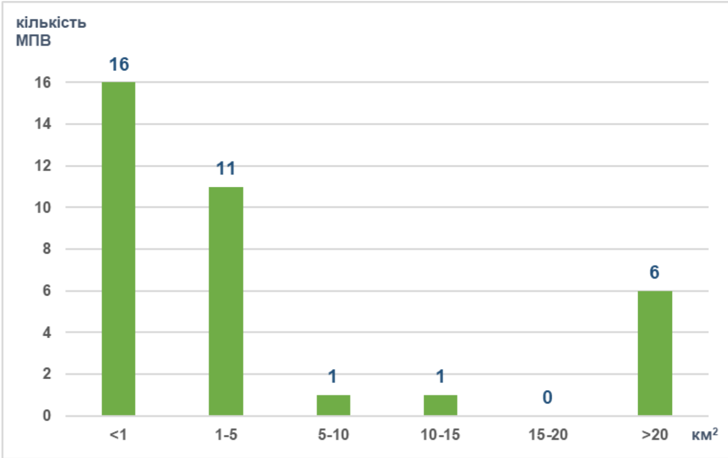


Figure 130. Distribution of identified polygonal MPAs depending on the area

1.2.2 Groundwater

MWP in the Upper Sarmatian sediments

The aquifer in the Upper Sarmatian sediments (N s_{13}) is represented in most cases by sub-horizons (up to 12) of different thickness and strike. The water-bearing rocks are layers and lenses of oolitic, shell limestone, sandstone, fine-grained sands, and shell accumulations occurring among clays of the same age. The thickness of the water-bearing rocks varies from 0.2-1.0 m to 3-5 m, and rarely up to 10-25 m. The total thickness of aquifers varies from 0.5-8 m to 20-45 m. The thickness of clays separating water-bearing rocks varies from 10 to 94 m. The depth of the aquifer cover is 60-150 m on the watershed plateau, 0-20 m in river valleys and deep gullies, and 25-50 m on the slopes of erosion cuts. There is a general submergence of sediments in the southern (towards the sea) and south-western directions, where the cover of aquifers is recorded at depths from -80 to -150. The head increases in the same direction (from 30-50 m to 100-140 m).

In terms of chemical composition and salinity, the waters are predominantly fresh and slightly brackish. Salinity increases towards the south, as water-bearing rocks sink and thus slow down free water exchange, but sometimes brackish water is found in the northern regions. In the coastal area, the water becomes brackish and salty. The chemical composition of the waters is very diverse: from calcium bicarbonate to sodium chloride-sulfate. Mineralisation ranges from 0.2-1.0 to 2.2-3.8 g/dm^3 , rarely up to 5-7 m.

The aquifer in the Upper Sarmatian sediments of the Upper Miocene subregion is characterised by various filtration rates, which depend mainly on the lithology, degree of fracturing, and thickness of water-bearing rocks. Thus, filtration rates vary from 0.2 to 153 m/day. Well flow rates are 0.1-3.6 dm^3 /s and more.

The aquifer in the Upper Sarmatian sediments of the Upper Miocene subregion is widely used for domestic and drinking water supply (both local and centralised) throughout the entire area of its distribution, and its high salinity water is used in seaside resorts as mineral drinking and therapeutic drinking water (Kuyalnik).

Table 118. MWC of the Lower Danube sub-basin

№	IPPC code	Aquifer (complex)	Geological index	Area of the MWP, km^2
1	UAM5340N100	MWP in the Upper Sarmatian sediments	N s_{13}	16478

The characteristics of the IPPC groups are given in Appendix 2 (M5.3.4).

2 MAJOR ANTHROPOGENIC IMPACTS ON THE QUANTITATIVE AND QUALITATIVE STATE OF SURFACE AND GROUNDWATER, INCLUDING POINT AND DIFFUSE SOURCES

2.1 Surface water

The Lower Danube sub-basin is located within one region - Odesa. The socio-economic structure of the basin creates preconditions for the formation of anthropogenic pressure that affects surface water ecosystems. The main factors of anthropogenic pressure include:

- population. The sub-basin is located in the Izmail and Bolhrad districts of Odesa region. The total population of the sub-basin, as of 2019, is 313116 people, which is 1% of the total population of Ukraine;
- enterprises in various sectors of the Ukrainian economy;
- Agriculture. Agriculture is one of the leading sectors that plays an important role in shaping the sub-basin's economic growth;
- Cross structures on small and medium-sized rivers prevent the free passage of water, sediments and migration of aquatic life, and change the transit mode of rivers to an accumulation one.

The characterisation of anthropogenic load and its impact was carried out on the basis of chemical, physicochemical and hydromorphological parameters that reflect the conditions of existence of the biotic component of aquatic ecosystems. Changes in these parameters under conditions of significant anthropogenic pressure can lead to the risk of not achieving a "good" ecological status of water.

The assessment of the anthropogenic load on the MWR was carried out in accordance with the Methodological Recommendations for the Analysis of the Main Anthropogenic Loads and Their Impacts on the Surface Water Status, which were approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources on 20 April 2023, Minutes No. 2.

The methodological basis of the assessment was the DPSIR model developed by the European Environment Agency (EEA)[25] and adapted to the conditions of Ukraine. The determination of anthropogenic pressure was based on a sequential analysis of Drivers/Activities → Pressures → State → Impact → Response (Fig. 131).

Figure 131. DPSIR conceptual model

Assessing the risk of not achieving "good" environmental status

[25] CIS Guidance #3 Pressure and Impact Analysis, EU, 2003

The analysis of anthropogenic load and related impacts is aimed at determining the probability of compliance/non-compliance of a water body with the objectives of environmental quality of the water environment.

Assessment of the risk of failure to achieve environmental goals from point sources of pollution

Based on the results of the assessment of anthropogenic loads from point sources of pollution and their impact on the sub-basin's MES, the risk of not achieving a "good" ecological status/potential was determined (Fig. 132) for

- 99 MPV - "no risk";
- 7 MWP - "at risk".

Figure 132. Risk assessment of failure to achieve "good" ecological status/potential based on the results of the assessment of anthropogenic pressures from point sources

Assessment of the risk of failure to achieve environmental goals from diffuse sources of pollution

Based on the results of the assessment of anthropogenic loads from diffuse sources of pollution and their impact on the sub-basin's MES, the risk of failure to achieve "good" ecological status/potential (Fig. 133) was established for

- 35 MPV - "no risk";
- 24 MPV - "possibly at risk";
- 47 MWP - "at risk".

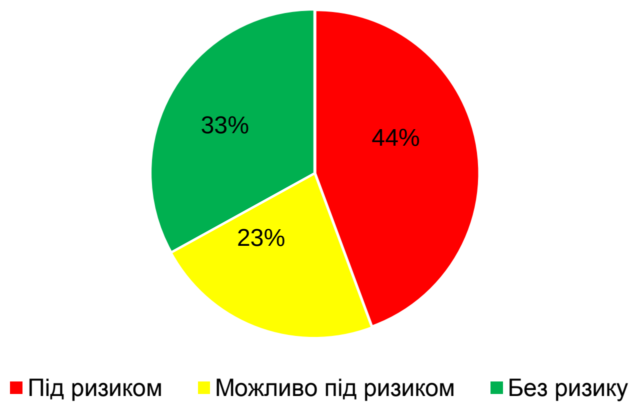


Figure 133. Risk assessment of failure to achieve "good" ecological status/potential based on the results of the assessment of anthropogenic pressures from diffuse sources

Assessing the risk of not achieving environmental goals: hydromorphological changes

Based on the results of the hydromorphological changes assessment, it was found that.[26]

- 45 MPV - "no risk";
- 57 MWP - "at risk".

[26] The risk of failure to achieve environmental objectives based on hydromorphological changes was not assessed for the SSSI

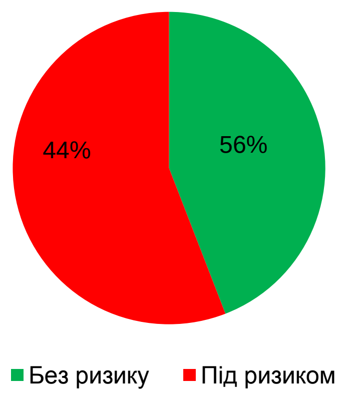


Figure 134. Risk assessment of failure to achieve good ecological status/potential based on anthropogenic pressure assessment: hydromorphological changes

Generalised risk assessment of failure to achieve 'good' environmental status/potential

The risk of not achieving a "good" environmental status/potential has been assessed as follows:

- 20 MPV - "no risk";
- 12 MPR - "possibly at risk";
- 74 IPVs are "at risk".

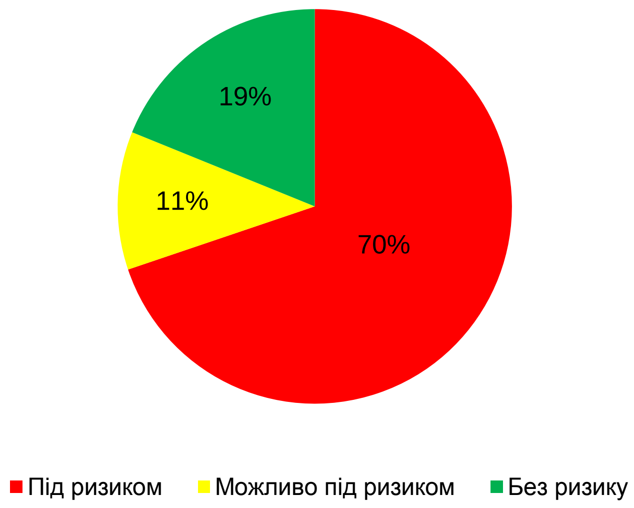


Figure 135. Summary assessment of the risk of not achieving "good" environmental status/potential of MNR

Impact of military operations on the state of surface water bodies

1. Pollution (organic, biogenic, hazardous) substances caused by:

1.1 destruction, suspension, disruption of the technological process of enterprises (including warehouses, oil product depots)

Data on the destruction, suspension or disruption of the technological process of enterprises as of September 2023 are presented in Annex 3 (M5.3.4).

1.2 by direct hit of pollutants from missiles, shells of military equipment, their washing, seepage in combat zones

Artillery shells, missiles and other munitions are basically composed of a metal shell filled with an explosive, propellant and a detonator.

Explosives are classified into primary explosives (mercury, lead azide, TNT) and secondary explosives (THE, hexogen, tetryl, TNT, picric acid, plastid-4, ammonites, dynamites, ammonals).

Metals are associated pollutants. The most common is lead, but also antimony, copper, cadmium, chromium, mercury, arsenic, nickel, bismuth and tungsten. As a rule, metals are concentrated in the sinkhole.

Flares burn at high altitude and disperse metals over large areas. Pyrotechnics can contain barium, antimony, strontium, copper, magnesium, manganese, chromium and lead. Unlike explosives and propellants, metals occur naturally in the environment, so their background concentrations need to be measured.

The detonation of rockets, artillery shells and mines produces a number of chemical compounds, including carbon monoxide and carbon dioxide, water vapour, nitrogen oxide, nitrogen, etc. A number of toxic elements, including sulphur and nitrogen oxide, also evaporate.

Monitoring of surface water in the area of active hostilities and recently liberated territories is not currently carried out for security reasons.

2. Impossibility of water monitoring or reduction of its programme (spatially and temporally) in the temporarily occupied territories.

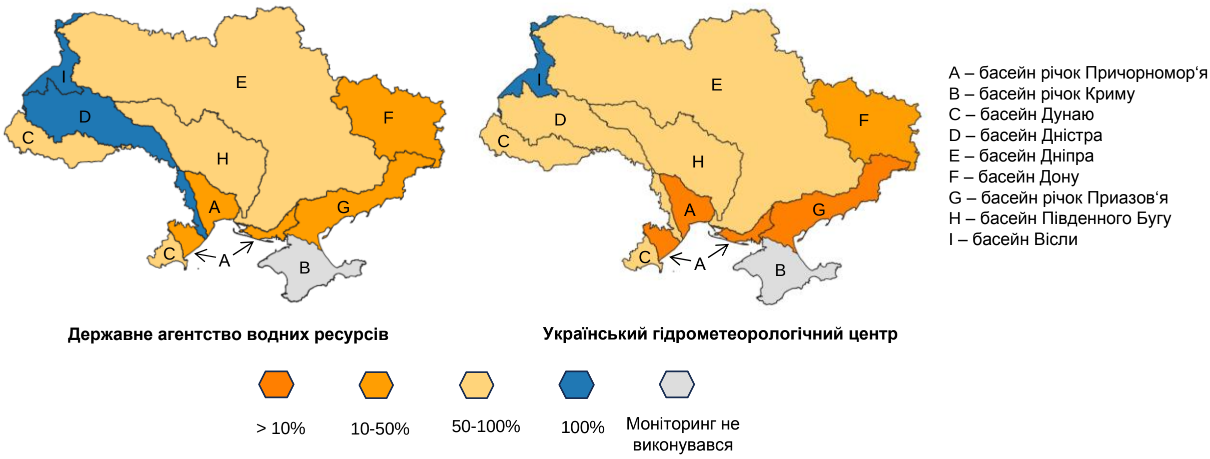


Figure 136. Surface water monitoring by river basin, 2022[27]

3. 3. Impossibility or restrictions on water management in the temporarily occupied territories.

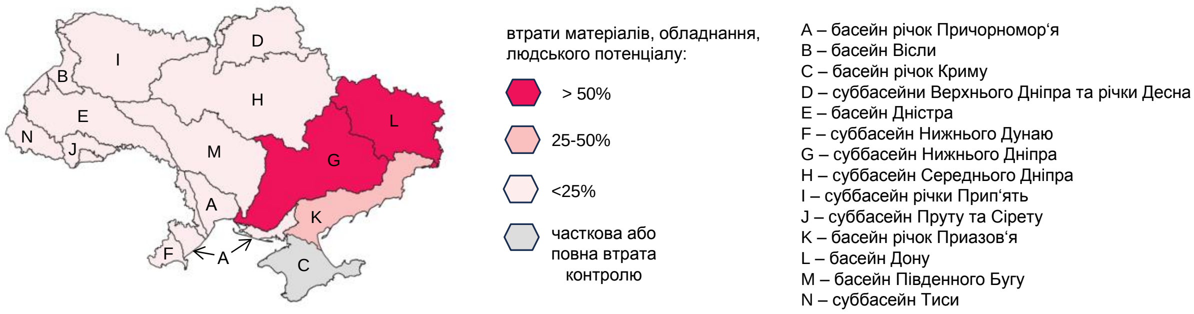


Figure 137. Impact of military operations on the ability to manage water resources[28]

2.1.1 Organic pollution

The analysis of anthropogenic load is formed by point and diffuse sources. While the impact of point sources can be determined on the basis of information obtained from water use reports in the form 2TP-vodkhoz (annual), the impact of diffuse sources is assessed on the basis of mathematical modelling. This is due to the fact that diffuse sources of pollution do not have constant coordinates and are characterised by a heterogeneous spatial distribution within the river basin. Another feature of diffuse sources of pollution is the variability of quantitative indicators of inflow and high dependence on hydrometeorological parameters.

Diffuse sources

[27] Information prepared by the Zoy Environmental Network for the OSCE Project Co-ordinator in Ukraine
[28] Information prepared by the Zoy Environmental Network for the OSCE Project Co-ordinator in Ukraine

The basic principles for determining the impact of anthropogenic load are set out in Guideline 3 of the General Implementation Strategy "Analysis of Anthropogenic Load". Based on the above-mentioned document, the national Methodology for Determining the Main Anthropogenic Pressures and Their Impacts on Surface Water Status was developed and approved by Order No. 4 of the State Agency of Ukraine for Water Resources dated 27 November 2018.

The indicators for determining the impact of diffuse sources in these documents include the following: the share of agricultural land and the share of livestock (Table 119).

Table 119. Indicators for determining the impact of diffuse sources

Share of agricultural land, I_{cr}			Share of livestock production, I_{TB}		
Category.	**Title. categories**	**Criterion.**	**Category.**	**Title. categories**	**Criterion.**
3	At risk	AND_{cr} > 0.3	3	At risk	AND_{TB} > 1.0
2	Possibly at risk	0.1 < AND_{cr} < 0.3	2	Possible at risk	0.3 < AND_{TB} < 1
1	No risk	AND_{cr} < 0.1	1	No risk	AND_{TB} < 0.3

A characteristic feature is that the level of diffuse pollution depends not only on the anthropogenic load in the river basin, but in many cases is determined by local climatic and hydrological conditions, and the properties of the underlying surface and soil.

The main factor in the anthropogenic load from diffuse sources is the type of land surface, which in turn depends on the population density in the catchment area of a particular WSP.

The main source of organic compounds is the households of the predominantly rural population, which are not served by the sewerage network. Wastewater disposal in such individual households is carried out on the terrain by accumulating in lagoons.

The load from the rural population was assessed using the calculation method. For this purpose, we used the coefficients of organic matter intake due to the vital activity of 1 person, the load from the population is calculated by the following indicators: BOD_5 - 60 g/day per person, COD - 110 g/day per person.

Taking into account changes in protein consumption by the population of Ukraine, a reduction factor of K = 78.9/105.2=0.75 was calculated. Accordingly, the value of BOD_5 per person should decrease from the physiological norm of 60 g/day to 45 g/day per person. The Intergovernmental Panel on Climate Change (IPCC) for the preparation of the Greenhouse Gas Inventory recommended a level of BOD_5 generation in municipal wastewater of 50 g of O_2 /day per person.

To calculate the value of BOD_5 , we used the figure of 50 g of O_2 /day per person. The COD level was calculated taking into account the conversion factor of BOD_5 to COD equal to 1.7. Accordingly, the figure of 85 g/day per person was used to calculate the COD load. Based on the changes in BOD_5 (50/60), the reduction in N_{total} will be 8.8 (50/60) = 7.3 g/day per person. The value of P_{total} was not changed due to the determining influence of detergents in the wastewater.

In rural settlements and small towns, wastewater is discharged into lagoons built into the ground, from where pollutants easily enter groundwater and are transported to the riverbed. Microbial and sorption processes in the soil cover contribute to the utilisation of 70% of organic matter. At the same time, a significant number of settlements without wastewater collection and treatment systems lead to surface water pollution.

Point sources

The main cause of organic pollution is inadequate or non-existent wastewater treatment after use by settlements, industrial and agricultural point sources. Such pollution can affect the composition of aquatic species and ecological status. The decomposition of organic matter consumes a lot of oxygen, which decreases the water's oxygen content and causes aquatic organisms to die. Organic pollution generated from these sources is assessed by BOD_5 and COD.

According to water use reports in the form No. 2TP-Vodkhoz (annual), in 2021, the total volume of wastewater discharged into surface water bodies of the Danube River basin was 44.011 million m^3 , including 28.492 million m^3 , polluted without treatment and insufficiently treated, 13.035 million m^3 , and 2.484 million m^3 .

Table 120. Water users discharging wastewater into surface water bodies in the Lower Danube sub-basin

Water user	EDRPOU code/water user code	Discharge volume, million m³	Degree of water treatment
PJSC Pulp and Paper Mill	00278818 / 510045	2,488 including: – 0,004 – 2,484	– regulatory clean without cleaning – normatively cleared (BIO)
PJSC "UDP Kilia Shipyard"	33113076 / 510144	0,036 including: – 0,024 – 0,012	– regulatory clean without cleaning – contaminated without cleaning
Titan LLC	25415133 / 510367	0,001	regulatory clean without cleaning
KP Svetlo	32319458 / 510747	0,126	contaminated insufficiently cleaned
Kamolino Holding LLC	37905021 / 512437	1,896	contaminated without cleaning
PJSC "Izmail-Navasco"	24769509 / 512480	0,402	regulatory clean without cleaning
Pivden Agro Holding LLC	39688078 / 512500	1,879	contamination without cleaning
Debut-2005 LLC	33757219 / 512495	4,908	regulatory clean without cleaning
FOP "Krivenko"	3062116515 / 512523	0,077	regulatory clean without cleaning
Mayak agricultural company	30704515 / 510838	12,327	contaminated without cleaning
GTS Operator of Ukraine LLC	42795490 / 511031	0,001	normatively cleared (BIO)
Crocus Farming Group	22505261 / 511819	0,160	regulatory clean without cleaning
Dunay Agricultural Company	32443875 / 511840	1,587	contaminated without cleaning
LLC JV "Danube-Agro"	30819680 / 511842	2,565	contaminated without cleaning
Rice of Bessarabia LLC	36837333 / 511846	5,625 – 2,236 – 3,388	– regulatory clean without cleaning – contaminated without cleaning
IC Natalka	30800397 / 511821	4,184 – 2,519 – 1,665	– regulatory clean without cleaning – contaminated without cleaning
Rice Group LLC	42914195 / 512661	4,830	contaminated without cleaning
State Enterprise "Ukrainian Sea Ports Authority", Reni branch	38727770 / 511959	0,114	The DFOs are not sufficiently cleaned
Kiliya branch of the State Enterprise "Centre for Certification and Expertise of Seeds and Seed Material"	37884028 / 512499	0,807	regulatory clean without cleaning

Table 121. Organic matter discharges to the sub-basin in 2021

Name of the company	BOD_5 , tonnes	COD, tonnes
PJSC "Pulp and Cardboard Mill", code 510045	6,0	93,6

KP Svetlo	1,6	8,0
SE USPA Reni branch, code 511959	2,3	-
Pivden Agroholding, code 512500	0,2	-

2.1.2 Pollution by nutrients

The supply of biogenic elements to water is the driving force behind eutrophication, which leads to an increase in primary production and accumulation of organic matter. The enrichment of water with nutrients that stimulate the development of autotrophic aquatic organisms, resulting in an undesirable imbalance of organisms in the aquatic environment and a decrease in water quality.

Among the biogenic elements, phosphorus and nitrogen compounds play a dominant role, and in some cases, ferrous, silicon and molybdenum can have an impact. Of the first two, phosphorus plays a greater role, while nitrogen is much less likely to limit the development of autotrophic organisms, due to the ability of many bacteria and cyanobacteria to fix it.

Diffuse sources

Land cover type is a dominant factor in the anthropogenic load on groundwater pollution from diffuse sources.

Another important indicator of the anthropogenic load from diffuse sources of pollution is the intensity of agriculture, which is expressed primarily in the amount of fertiliser used.

The majority of mineral fertilisers applied to various crops were nitrogen fertilisers. The current application of mineral fertilisers averaged 125 kg/ha.

The organic fertiliser load is not provided in the statistical information. This indicator is calculated on the basis of data on the number of livestock, manure yields and nitrogen and phosphorus compounds in their composition.

Despite the fact that the livestock industry in Ukraine has shrunk significantly since the change in the economic system and is recovering slowly, there are still a large number of domestic animals, especially birds, in the Lower Danube sub-basin.

Based on the official statistical reporting at the district level, we calculated the manure output within the basin for one year. Manure production was calculated by animal type and averaged yield factors (Table 122).

Table 122. Coefficients for calculating manure production from different types of animals

Type of animal, head	Manure production, tonnes per year
CATTLE	11,4
Pigs	4,3
Sheep, goats	1,05
Poultry, 100 heads	5,45

Based on the calculated manure yield from livestock and data on the content of nitrogen and phosphorus compounds in it (Table 123), the theoretical yield of nutrients from livestock activities was obtained.

Table 123. Content of nitrogen and phosphorus compounds in manure of domestic animals

Animal type	Nutrient content	
	N, kg/t	P O_{25} , kg/t
Cattle, heads	4,19	1,47
Pigs, heads	6,1	1,43
Poultry, 100 heads	11,83	9,8
Sheep, goats, heads	6,2	1,6

Land use indicators (namely, the share of agricultural land) were used as one of the indicators to assess the impact of diffuse sources.

To assess the possibility of nutrients entering surface waters, direct quantitative indicators should provide more accurate results, including fertiliser application parameters and the overall balance of nitrogen and phosphorus in soils. Given that fertilisers in soils can not only be consumed by plants and washed out with water runoff, but also be affected by microbial processes and released into the air, we concluded that calculating the local balance between the supply of nitrogen and phosphorus compounds to the agroecosystem and their consumption would avoid overestimating the impact of diffuse sources. In addition, in this case, not only the applied ameliorants are taken into account, but also the organic fertilisers accumulated within the basin.

To solve the problem of assessing the impact of diffuse sources, the best results can be obtained using data at the level of individual fields or farms. On the one hand, the initial information for such spatial resolution is not readily available, requiring the use of satellite technologies, and on the other hand, such work entails large and often unjustified expenditures of resources and time. For the purposes of developing the RBMP, it was decided to focus on the level of administrative districts.

Methodology for calculating the balance of nitrogen and phosphorus in the soil cover

The gross nutrient balance formed during the year in the topsoil characterises the potential amount of nutrients that can enter the channel network during runoff formation. The value of this balance is calculated as the difference between the amount of nutrients entering and leaving the agricultural system.

In agricultural practice in Ukraine, the balance of nutrients has so far been calculated only at the regional level.

The balance of nitrogen and phosphorus in soils is defined as the difference between the total supply of these compounds with fertilisers and their removal with crop yields. The latter is calculated by multiplying the crop yield data by the amount of nutrients consumed by the crop during maturation.

The indicators of nitrogen supply with precipitation are regionalised by physical and geographical zones and calculated on the basis of precipitation monitoring data for 2000-2017. Thus, the average annual precipitation for the mixed forest zone was 606 mm, forest-steppe - 571 mm and steppe - 488 mm. The amount of nitrogen supplied by precipitation was 4.5 kg/ha, 5.7 kg/ha and 4.0 kg/ha, respectively.

Determination of risk category thresholds for the Soil Balance indicator

The screening of the monitoring data revealed only 2 points where the threshold value of 50 mg/dm was exceeded^3 , which in terms of nitrogen is 11.3 mgN/dm^3 . The waters of both sites were under the influence of point sources of pollution.

Experimental studies carried out at specially equipped small runoff sites to model water exchange within homogeneous hydrological areas have shown that in the absence of fertilisation, nitrate concentrations in water runoff are low.

In the case of mineral fertilisers, the removal of nitrogen compounds from the catchment area increases dramatically. At the same time, nitrogen in the surface runoff was mostly supplied by storm precipitation, and the total concentration of Nmin in the surface runoff water did not exceed 2 mgN/dm^3 . In the waters of lateral runoff formed in the vadose zone, due to a much longer retention time, the concentration of nitrogen compounds exceeded 60 mgN/dm.

The ecological classification of terrestrial surface waters based on the ecosystem principle was used as a criterion base for determining the pollution of surface waters by nitrate compounds from agricultural sources. In the classification based on tropho-saprobiological criteria, the values of both biotic and abiotic parameters were agreed upon. Thus, the limit of deviation from the good condition of waters, at which they reach a polytrophic state, is the concentration of nitrate ions of more than 1 mg/dm^3 .

The entire available surface water monitoring database was sorted according to the above criterion. As a result, it was established that there were 25 observation points where $N\text{-}NO_3$ concentrations were above the limit of 1 mg/dm^3 . At the relevant points, the soil Nitrogen Balance was also determined. The average value was 35 kg/ha, and this value was used to determine the limit of surface water pollution. It should be noted that this value compares well with the risk limit adopted in EU countries, where it is 25 kg/ha.

Rivers in "good" ecological condition, fairly clean, mesotrophic, have a limit value of nitrate nitrogen concentrations of 0.5 mgN/dm^3 .

The average value of the Soil Balance at the sites where nitrate nitrogen concentrations of 0.5 mgN/dm^3 were observed was 10 kg/ha, which was taken as the limit for the absence of water pollution risk.

Table 124. Limit values of categories for the criterion for assessing the risk of failure to achieve environmental objectives from diffuse sources "Soil balance"

Category.	Category name	Limit value
1	"without risk"	BH<10
2	"possibly at risk"	10<BG<35
3	"at risk"	BH >35

Calculation of soil nitrogen balance at the level of administrative districts

The initial information for calculating the balance of nutrients in soils was based on statistical data on sown areas, crops and their yields, fertiliser application and livestock indicators at the level of administrative districts of the oblasts within the Lower Danube sub-basin.

Table 125. Nitrogen and phosphorus balance calculation results for the sub-basin

№	District	Area.	Nitrogen balance, kgN/ha	Phosphorus balance, kgP_2 O /ha_5
1	Artsyzky	Odesa	45,6	-31,1
2	Bolgradsky	Odesa	48,8	-19,5
3	Izmail	Odesa	73,7	-22,4
4	Kiliysky	Odesa	21,0	-22,2
5	Reni	Odesa	24,7	-24,9
6	Tarutinsky	Odesa	27,9	-28,7
7	Tatarbunary	Odesa	32,8	-34,3

In the next step, the calculated nitrogen balance was converted to the MRL of the Lower Danube sub-basin as a weighted average value. The value of the balance varies widely, from 21 to 73.7 kgN/ha in the sub-basin soils, with an average value of 44.7 kgN/ha.

The phosphorus balance was in deficit, and therefore phosphorus was not used to determine the anthropogenic impact from diffuse sources in the future.

Calculation of the livestock load at the level of administrative districts

In order to estimate the livestock load, it was necessary to convert all animal species to one conventional unit. For this purpose, standard coefficients calculated on the basis of the value of the feed base were used. The basic unit was 1 head of cattle. For pigs, total sheep and goats, the conversion factors were 0.3 and 0.1, respectively. Poultry was converted by a factor of 0.014.

Based on the results, the weighted average livestock unit and the share of livestock for each MNE were calculated.

In general, the share of livestock is low and ranges from 0.0035 to 0.052. The average value was 0.029 heads/ha.

The main factor that determines the anthropogenic load on the MPA from diffuse sources is land use indicators. Disturbance of the soil cover due to ploughing and fertiliser application leads to significant losses of organic and nutrients due to deflation and water runoff.

The Lower Danube sub-basin summarises the impact of all the countries through which the Danube flows. At present, the concentrations of nitrogen and phosphorus compounds in the Danube estuary remain the highest in the north-western part of the Black Sea.

Based on the results of calculations with the Danube waters, an average of 653.4 thousand tonnes of $N_{заг}$ and 38.4 thousand tonnes of $P_{заг}$ are annually discharged to the Black Sea. The Lower Danube sub-basin emits an average of 2792 tonnes/year of nitrogen compounds and 127 tonnes/year of phosphorus compounds . Among the various sources, the main share of nutrients comes from agriculture (Table 126). For nitrogen, the role of this factor is 66%, and for phosphorus - 74%.

Table 126. Inputs of nitrogen and phosphorus compounds from the sub-basin catchment area

	Nitrogen, tonnes per year	Phosphorus, tonnes per year
Settlements	185,7	10,9
Agriculture	1878,1	94,0
Other sources	309,6	4,5
Natural background	410,1	17,7
Total	2792	127

The greatest risk of diffuse pollution of surface water will be observed in spring, when runoff rates reach their highest levels. At this time, fertilisers and plant protection products should be applied to crops with the utmost responsibility.

During the period of minimum runoff (summer low water), the role of diffuse sources will sharply decrease due to the reduction of the water flow carrier. At this time, the role of point sources will be maximised. Given the low water content of most rivers, this will pose a great danger due to the reduced dilution capacity of water runoff. Some rivers may even dry up.

Assessment of risks of failure to achieve "good" environmental status from diffuse sources

The risks of not achieving "good" environmental status were assessed based on the risk category thresholds for the Soil Balance and Livestock Share indicators.

Soil balance, BG			Share of livestock production, I_{TB}		
Category.	**Category name**	**Criterion.**	**Category.**	**Category name**	**Criterion.**
3	At risk	BG > 0.3	3	At risk	AND_{TB} > 1.0
2	Possible at risk	10 < BG < 35	2	Possible at risk	0.3 < AND_{TB} < 1
1	No risk	BG < 10	1	No risk	AND_{TB} < 0.3

Point sources

Pollution by nutrients from point sources is caused mainly by the discharge of insufficiently treated or untreated wastewater into surface water sources (after use by settlements, industry and agriculture), which significantly increases their concentration in water bodies.

Nutrient discharges to water bodies of the sub-basin and the impact from point sources were measured and determined by the following indicators: ammonium nitrogen, nitrite ion, nitrate ion, phosphate (Table 127).

Table 127. Results of nutrient discharge into water bodies of the Lower Danube sub-basin

Name of the company	**Ammonium nitrogen,** tonnes	**Nitrites,** tonnes	**Nitrates,** tonnes	**Phosphates,** tonnes
PJSC "Pulp and Cardboard Mill", code 510045	1,6	1,8	81,4	0,008
Municipal enterprise "Svitlo", code 510747	2,7	-	-	0,170
Mayak, code 510838	--	-	6,6	-
Natalka agricultural group, code 511821	0,1	-	-	-
SPC "Dunay", code 511840	1,1	-	-	-
SE USPA Reni branch, code 511959	0,2	-	1,3	0,032
Rice Group LLC, code 512661	-	--	5,5	-
Total	**5,7**	**1,8**	**100,5**	**0,210**

2.1.3 Pollution by hazardous substances

Diffuse sources

The risk of pollution by hazardous substances from diffuse sources was not assessed due to the lack of data on pesticide use.

Therefore, the overall assessment of pollution from diffuse sources will be determined by the impact of crop production.

Just over 60% of the lower Danube MPA is at risk. After the first cycle of monitoring surveys is conducted and data on the content of priority substances is obtained, the methodology can be further developed in terms of the Pesticides indicator.

Point sources

The sources of hazardous substance pollution in the Lower Danube sub-basin include industrial wastewater, domestic and household wastewater, surface runoff from territories, pesticides, oil products, heavy metals and other chemicals used in agriculture, and accidental discharges.

Name of the company	Iron is common, tonnes	Petroleum products, tonnes
State Enterprise "Kilia Shipyard", code 510144	-	0,0001
Municipal enterprise "Svitlo", code 510747	-	0,0061
SE USPA Reni branch, code 511959	-	0,0135
Total	**-**	**0,0197**

2.1.4 Accidental pollution and impact of contaminated areas (landfills, sites, zones, etc.)

No accidental pollution was observed in the Lower Danube sub-basin by district in 2021.

The mechanism for preventing and minimising the risk of accidental pollution is established in the EU member states through the implementation of the Seveso-III Directive (Directive 2012/18/EU), the Industrial Waste from Mining Directive (2006/21/EC)10 and the Industrial Emissions Directive-IED (2010/75/EU)11 and for non-EU countries through the implementation of the recommendations of the UNECE Convention on the Transboundary Effects of Industrial Accidents.

At the level of the Lower Danube sub-basin, a list of potential accident risk sites should be developed, including operating industrial facilities with a high risk of accidental pollution due to the nature of the chemicals stored or used at industrial facilities, contaminated sites, including landfills and dumpsites located in flood zones. Such a register should first include facilities in the Lower Danube sub-basin that pose a risk of accidental pollution, primarily sludge ponds and tailings ponds, municipal wastewater treatment plants, and sites where industrial waste is stored.

The Ministry of Environmental Protection and Natural Resources of Ukraine has launched an electronic service that also contains the Register of Waste Disposal Sites and the List of Facilities that are the largest polluters of the environment in terms of discharging pollutants into water bodies.

Table 128. Register of facilities in the Lower Danube sub-basin that are at risk of accidental pollution

№	Name of the object
1	PJSC "ICCC", IZMAIL
2	MUNICIPAL ENTERPRISE "SVITLO", KILIA

2.1.5 Hydromorphological changes

Hydromorphological changes are one of the main water-environmental problems (WEPs) that impede the achievement of environmental objectives set out in the River Basin Management Plan (RBMP). Hydromorphological changes as a result of economic activity affect the habitats of aquatic communities. The presence of hydromorphological changes in surface water bodies (SWBs) leads to a deterioration in the ecological status of many SWBs in the Lower Danube sub-basin.

Hydromorphological changes are divided into types:

- disruption of the continuity of water flow and habitats - longitudinal disruption of the continuity of rivers and habitats (transverse artificial structures in the river channel, interruption of water flow, disruption of the free flow of rivers, movement of sediments, migration of fish and other aquatic life);
- disruption of the hydraulic connection between river channels and their floodplains;
- hydrological changes (water abstraction, hydropicking / fluctuations in water levels of artificial origin);
- Morphological changes (modification of the morphology of the riverbed, banks, and adjacent parts of the floodplain, e.g. straightening).

Dams and other artificial cross structures located in the riverbeds were built primarily to accumulate water, with its subsequent use for agricultural, public and industrial purposes. In the Lower Danube sub-basin, 19 MPAs have been identified where the continuity of water flow and habitats is disturbed (regulated).

The accumulation of water in ponds and reservoirs upstream of dams also provides flood protection for areas downstream of dams. According to the State Agency of Water Resources of Ukraine, a significant number of ponds are in poor technical condition. Most of them were built in 1960-1980 according to simplified design documentation. The dams are earthen, with loose slopes, and many of them are eroded. Spillway structures usually do not meet modern requirements in terms of their technical condition.

The presence of dams and other structures across the river channel disrupts the continuity of water flow and sediment movement, as well as the migration of fish and other aquatic life.

Fish passages were not built in the cross structures and, as a result, the populations of various fish species decreased or disappeared. To date, the construction of fish passages on existing dams seems to be quite problematic due to the lack of not only funds, but also the very assessment of the economic feasibility of building a fish passage.

Disruption of the hydraulic connection between river channels and floodplains. The hydraulic connection between the riverbed and the floodplain plays an important role in the functioning of aquatic ecosystems, providing water for important habitats for fish and aquatic life, and has a positive impact on the condition of surface and groundwater.

The assessment of this type of hydromorphological changes is included in the hydromorphological protocol for assessing the MWP used by the SES in the course of state monitoring of surface waters (indicators No. 10: "Interaction between the channel and the floodplain: 10a - Possibility of floodplain inundation, 10b - Limiting factor for the development of horizontal deformations of the channel").

Hydrological changes. Hydrological changes affect water bodies through water abstractions and fluctuations in water levels below dams, and, as a result, lead to changes in the regime and distribution of river flows. Discharges, water abstractions and artificial periodic fluctuations in water levels (hydroelectricity) are key pressures that require compensatory measures to be implemented on a river basin-wide scale.

In the Lower Danube sub-basin, there are no MPAs with hydrological changes.

Decreased natural flows in the context of global warming and natural water shortages, reduced flow velocities and the formation of stagnant zones contribute to eutrophication processes, and, as a result, lead to a deterioration in biodiversity and degradation of aquatic ecosystems.

Morphological changes. *The* main factors that adversely affect the natural morphology of the sub-basin's river channels, banks and floodplains are urbanisation, flood protection, agriculture and shipping. As a result of these activities, rivers in certain areas are straightened, dredged, and banked, the floodplain is ploughed up almost to the channel, and its natural vegetation is changed.

Within the sub-basin, rivers are straightened (morphological changes) at 32 MPAs.

Reduced variability in channel depth and width, disruption of the natural balance of erosion and accumulation, narrowing of the inter-dam space and restriction of free river meandering lead to an impoverishment of the composition and reduction in the number of biological indicators, such as fish, benthic invertebrates, higher aquatic vegetation, and phytoplankton.

In the Lower Danube sub-basin, 106 MPVs have been identified (71 in linear and 35 in polygonal water bodies). Based on data on existing cross structures in the channel, water intake locations and level fluctuations, as well as using satellite imagery, topographic and cadastral maps, half of the identified BWCs - 57 BWCs (55% of all identified BWCs) were identified as significantly modified (SMM) and 4 BWCs (3.7% of all identified BWCs) were identified as artificial. Of these:

- 32 IBAs are classified as significantly altered due to modification of river morphology (straightening of river channels);
- 19 MPAs - due to disruption of the free flow of rivers (overregulation);
- 6 MPV - due to a combination of overregulation and directionality;
- 4 IEDs are artificial IEDs (Fig. 138, Table 129).

Table 129. Hydromorphological changes in the MPA of the Lower Danube sub-basin

№	Hydromorphological changes	Load	Quantity IHRM	% of the total number of MPAs
1	disruption of the continuity of water and media flow	regulation (water accumulation)	19	18
2	morphological changes	straightening	32	30
3	disruption of the continuity of water and media flow and morphological changes	regulation (water accumulation) and directivity	6	6
4	artificial MPVs	water storage	4	4

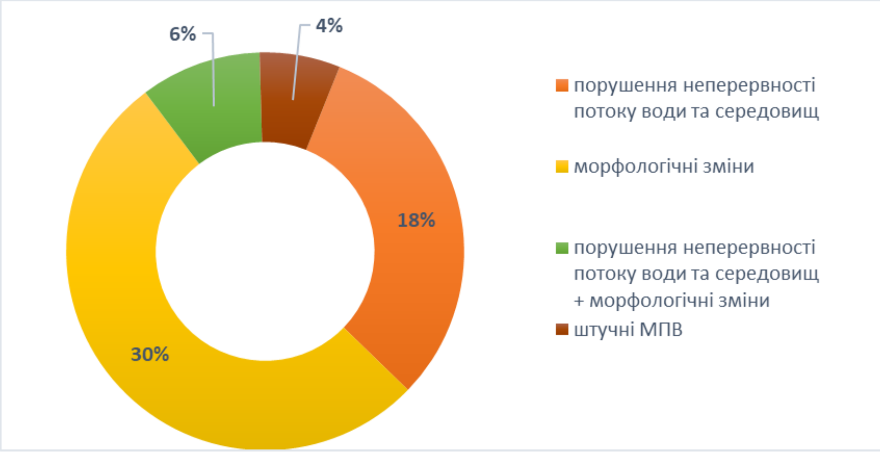


Figure 138. Distribution of IHMW by types of hydromorphological loads

All of these MEAs should be considered as having a risk of not achieving "good" environmental potential.

The criteria for assessing the failure to achieve "good" environmental potential are as follows:

- disruption of the continuity of water flow and environments (transverse artificial structures in the riverbed, disruption of the continuity of water flow and sediment movement and migration of fish and other aquatic life);
- water withdrawals (small and medium-sized rivers - water withdrawals exceeding 75% of the supply; large and very large rivers - water withdrawals exceeding 90% of the supply);
- water accumulation (ponds with a ponding area of more than 1 km or several ponds with a ponding area of less than 1 km, but their total length is more than 30% of the length of the MPA, as well as reservoirs with a volume of more than 1 million m);[3]
- fluctuations in water levels below the dam (water level fluctuations exceeding 0.5 m per day for most of the year);
- disturbance of natural morphological characteristics of rivers (hydromorphological class below the third according to the monitoring results, or straightening of more than 70% of the length of the main river channel in the absence of monitoring data).

Based on the analysis of the main water and environmental problems associated with hydromorphological loads in the sub-basin, it can be concluded that 57 MPAs identified as IWMPAs require restoration (revitalisation).

2.2 Groundwater

2.2.1 Pollution

The main anthropogenic factors affecting the state of the underground hydrosphere include groundwater abstraction for water supply, use of surface water for reclamation purposes, use of mineral fertilisers and pesticides in agricultural production, and discharge of industrial and municipal wastewater. In terms of territory, this impact can be conditionally classified as local (discharge of municipal and industrial wastewater into the geological environment, formation and operation of household and industrial waste dumps, etc.) and regional (irrigation reclamation, groundwater extraction, use of agrochemicals). At the same time, a number of anthropogenic factors associated with additional water load on the geological environment (irrigation water, various wastewater) can affect both the level and chemical regime of groundwater. The use of mineral fertilisers and pesticides as an anthropogenic factor differs from other factors in that it has virtually no effect on the level regime, but under certain conditions may affect the hydrochemical regime.

Groundwater resources in non-pressure horizons within the sub-basin are conditionally protected. The groundwater cover consists of loams and clays with a total thickness of 20-40 m. Contamination of the aquifers is possible through defective production wells and irrigation areas. There is spotty contamination of groundwater with nitrogen compounds within settlements. The presence of synthetic surfactants, oil products, and pesticides in aquifers is also recorded in concentrations that do not exceed the maximum permissible levels. In the areas of intensive exploitation, the impact of technogenesis affects the level regime.

The impact of technogenesis on groundwater massifs in pressure aquifers is mainly reflected in the level regime. As a result of long-term intensive exploitation, depression sinkholes have formed. The reduction in groundwater extraction observed in recent years is contributing to the recovery of groundwater levels.

The groundwater reservoirs in the pressure horizons lie beneath a layer of water-resistant sediments, which significantly hinders their connection with surface ecosystems and provides a relatively high level of protection against surface pollution.

In the pressure aquifers in production wells, there is also spot pollution of groundwater with nitrogen compounds, and the presence of synthetic surfactants, oil products, and pesticides in concentrations that do not exceed the maximum permissible levels.

Table 130. Groundwater pressures in the Lower Danube sub-basin

IPPC code	MPZV	Usage.	Communication from the ecosystem	Technological pressure	Pollutants	Natural chemical elements, the content of which in water exceeds the standard values
UAM5340N100	MWP in the Upper Sarmatian sediments	For centralised and non-centralised water supply	None	Groundwater extraction	Point source pollution by nitrogen compounds	In the southern part of the basin area, the natural content of SO^4 , Cl, Na is increased, dry residue, hydrogen sulphide content

2.3 Other significant anthropogenic impacts

2.3.1 Climate change

One of the main manifestations of regional climate change against the backdrop of global warming is a significant increase in air temperature, changes in the thermal regime and precipitation patterns, an increase in the number of dangerous meteorological events and extreme weather conditions, and the damage they cause to various sectors of the economy and the population. These trends are typical for Ukraine in general and the Lower Danube sub-basin in particular. The greatest changes have been observed over the past thirty years, which have been the warmest for the period of instrumental weather observations.

The rise in air temperature is observed not only near the Earth's surface but also in the lower troposphere, accompanied by an increase in tropospheric moisture content, and causes an increase in atmospheric instability and convection intensity. Such changes have led to an increase in the frequency and intensity of convective weather phenomena: thunderstorms, showers, hail, squalls, and an increase in the maximum intensity of precipitation and its storm component.

A characteristic feature of the changing moisture regime in Ukraine is a change in the structure of precipitation. In the warm period, this is manifested in an increase in the intensity of precipitation and an increase in its storm component. The increase in precipitation intensity has led to an increase in daily precipitation, although the number of rainy days has decreased and the maximum duration of the rain-free period has increased. These trends are also typical for the Lower Danube sub-basin.

The rise in air temperature and uneven distribution of precipitation, which is localised and heavy in the warm season and does not ensure effective soil moisture accumulation, has led to an increase in the number and intensity of drought events.

During the cold period, a significant increase in air temperature led to a change in the precipitation pattern by increasing the frequency of rain and decreasing the frequency of snowfall, resulting in an increase in sleet, sleet and ice.

In 2021, a study[29] was published to assess future climate change in Ukraine based on an analysis of climate projections for the 21st century using modern RTC scenarios and data from global and regional numerical climate models.

Water-balance modelling of water flow based on UkrNDGMI data using the regional REMO model and data from the CRU World Climate Centre under the A1B scenario has shown that from 2041, local surface runoff may cease in low-water years in the southern regions of Ukraine, including Odesa Oblast.

By 2050, the average annual air temperature will increase by 1-1.5°C (1.8°C in summer and 1.3°C in winter). This will lead to a reduction in the period with temperatures below 0°C, a lengthening of the warm dry season, increased evaporation, an increase in the number of extremely hot days and a reduction in the period with permanent snow cover. A more rapid change of seasons is likely.

Long-term precipitation forecasts are characterised by significant uncertainty. The average annual precipitation is forecast to decrease by 5-15%, but there may also be a slight (up to 6%) increase in precipitation due to heavy rainfall in the warm season. Extreme and hazardous weather events, such as storms, squalls, hurricanes, heavy rainfall and snowfall, thunderstorms and hail, will become more frequent and will be more destructive.

The average annual water flow in the Danube will not change significantly by 2050, but the redistribution of flow over the seasons may lead to a decrease in flow in summer and an increase in flow in winter. Small rivers are experiencing severe water stress as a result of a reduction in surface runoff (by 5-25%) and its redistribution over the seasons.

2.3.2 Pollution of water bodies with solid waste, including plastic

The pollution of water bodies by solid waste, primarily plastic, is one of the pressures that leads to the deterioration of the ecological and chemical state of surface waters. This problem is not specific to the Lower Danube river sub-basin, but to the whole country and reflects the problem of waste management at both national and local levels.

Gaps in national legislation, an inefficient system of waste collection, transport and disposal, and a low culture of waste management are manifested in a large number of unauthorised and spontaneous landfills, including on river banks. Some of the waste ends up directly in rivers and water bodies, which is not only an aesthetic problem, but also leads to chemical pollution of water, poisoning of living organisms and deterioration of their living conditions.

Over time, plastic breaks down and turns into microplastics, which get into living aquatic organisms, contributing to the accumulation of toxins.

Microplastics are less than 5 mm in size and fall into two groups: primary and secondary. Primary microplastics are part of cosmetics (toothpastes, scrubs, shower gels, etc.), industrial cleaning products, and are also formed as a result of wear and tear on car tyres and when washing synthetic products.

Recycled plastic is produced by shredding large plastic waste such as bottles, disposable tableware, packaging, etc.

No special studies have been conducted on the amount of waste on the banks and directly in rivers and water bodies in the Danube basin, nor on its direct impact on the ecological and chemical state of water bodies.

2.3.3 Invasive species

Invasions of alien species outside their "native" habitats are global in nature. The naturalisation and further spread of invaders can cause irreversible environmental damage and undesirable economic and social consequences.

Currently, biological invasions are considered to be biological pollution, but unlike most pollutants that can decompose in natural ecosystems through self-purification processes and whose content is controlled by

[29] ANALYSIS OF THE IMPACT OF CLIMATE CHANGE ON THE WATER RESOURCES OF UKRAINE (research summary) / Snizhko S., Shevchenko O., Didovets Y. // Edited by Sadogurska S. Centre for Environmental Initiatives "Ecoaction", 2021, 32 p.

humans, alien organisms that have successfully invaded begin to multiply uncontrollably and spread rapidly in the environment. This phenomenon can have unpredictable and irreversible consequences.

In addition, the introduction of alien species leads to irreparable losses of biodiversity, both through direct destruction of native species by predators, food and spatial competition, and as a result of displacement of native species, changes in their habitats and hybridisation. The emergence of any alien species is an indicator and, at the same time, a cause of the deterioration of the ecological state of a water body. All this causes a special danger of invasions and determines the specifics of control measures in terms of the risks of not achieving a "good" ecological state of MPAs where the process of invasion of adventive species is carried out. It is possible that alien species that pose a threat as agents of biological barriers or are intermediate hosts of human and domestic animal diseases can be used for sabotage. Therefore, this problem is becoming increasingly urgent in terms of ensuring the environmental safety of the river basin, part of which is located in the temporarily occupied territory.

According to the Convention on Biological Diversity (The Hague, 2002), measures aimed at mitigating the effects of invasions by alien species should be mainly preventive, but it is usually not possible to effectively control the process of invasions, primarily due to the lack of a biodiversity monitoring system.

Therefore, after mandatory special studies of alien aquatic species in the Danube basin and determination of the list of species and their locations, the first and most important control measure is the creation of a basin-wide monitoring system for invasions in the IWR.

Monitoring should be focused on identifying and analysing the species composition of alien species, invasive corridors, vectors, geography and dynamics of invasions; population dynamics of the most significant invasions from emergence to naturalisation, as well as of invasive species that have already been naturalised and the consequences of their impact on habitats, native species, communities and ecosystems; geographical location of invasive sub-corridors and ecosystems vulnerable to invasions. The most likely centres for the penetration, naturalisation and spread of alien species are places in the area of municipal wastewater outflows from large cities, where the aquarium services market is developed, as well as discharges of heated water from thermal power plants and large industrial enterprises. Therefore, an inventory of such possible entry points and their survey should be the first step in implementing a monitoring system.

The analysis of the monitoring data will make it possible to develop new ecological methods of preventing invasions and limiting the number of certain invasive species that can cause significant damage to natural and artificial ecosystems, public health and the region's economy.

3 ZONES (TERRITORIES) TO BE PROTECTED AND THEIR MAPPING

3.1 Emerald Network facilities

The Emerald Network is an ecological network consisting of special areas for the conservation of biological diversity created (designated) in accordance with the Convention on the Conservation of Wild Flora and Fauna and Natural Habitats in Europe (Bern Convention). Its goal is to ensure the long-term survival of species and habitats listed in the Bern Convention that require special protection.

On 30 November 2018, six countries: Belarus, Georgia, the Republic of Moldova, Norway, Switzerland and Ukraine have officially approved the lists of Emerald Network sites on their territories. The full list of Ukraine's Emerald Network includes 271 sites[30] , and the network covers about 8% of Ukraine's territory.

There are 5 Emerald Network sites in the Lower Danube sub-basin, covering approximately 17% (1,199 km^2) of the sub-basin area.

By category (Fig. 139), the sub-basin's Emerald Network facilities are divided into:

- a nature reserve - 3;
- Biosphere Reserve - 1;
- protected area - 1.

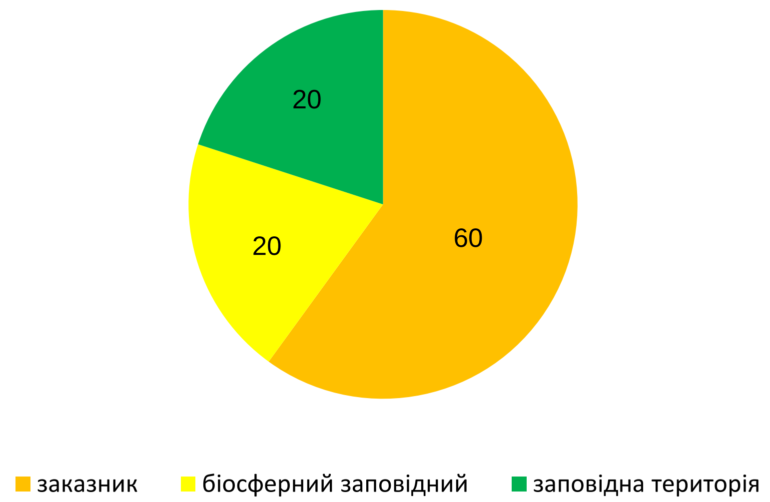


Figure 139. Breakdown of Emerald Network facilities by category, %.

None of the facilities has a management and development plan in place.

3.2 Sanitary protection zones

Sanitary protection zones include the areas where water intakes for drinking water supply are located. According to the Resolution of the Cabinet of Ministers of Ukraine on the Legal Regime of Sanitary Protection Zones of Water Bodies No. 2024 of 18 December 1998, these zones are classified as the so-called first zone (strict regime) of compliance with the use regime. The Resolution provides for a number of permitted and prohibited activities within drinking water intakes.

Member States should identify in each RBI:

- All surface/groundwater bodies used for abstraction of water intended for human consumption, providing an average of more than 10 m³ of water per day or providing water consumption for more than 50 people and

30 UPDATED LIST OF OFFICIALLY ADOPTED EMERALD SITES (NOVEMBER 2018) Document prepared by the Directorate of Democratic Participation and Marc Roekaerts (EUREKO) **https://rm.coe.int/updated-list-of-officially-adopted-emerald-sites-november-2018-/16808f184d**

- Water bodies intended for future use for the same purpose.

There are 9 water intakes in the Lower Danube sub-basin that withdraw more than 10 m³ per day. Of these, 6 are groundwater intakes and 3 are surface water intakes (Figure 140).

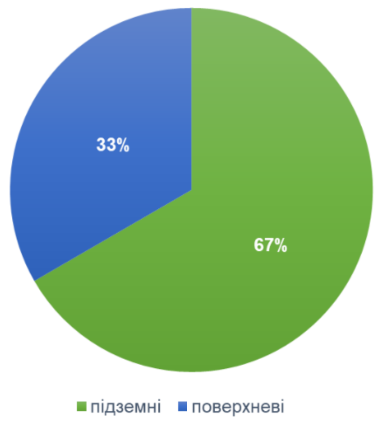


Figure 140. Distribution of drinking water intakes by type , %.

The State Agency of Water Resources of Ukraine is responsible for maintaining state water accounting.

3.3 Protection zones for valuable aquatic bioresources

Areas designated for the protection of economically important aquatic species or areas for the protection of valuable aquatic bioresources include those areas where such aquatic resources of significant economic value are found or cultivated.

Depending on the specifics of the protection zone for valuable aquatic bioresources, the monitoring programme may include additional indicators or sampling frequency.

According to the Resolution of the Cabinet of Ministers of Ukraine No. 1209 "On Approval of Tariffs for Calculating the Amount of Compensation for Damage Caused by Illegal Harvesting (Collection) or Destruction of Valuable Aquatic Bioresources" dated 21 November 2011 (as amended by the Resolution of the Cabinet of Ministers of Ukraine No. 1039 dated 6 October 2021), the list of valuable bioresources includes both rare and common fish species throughout Ukraine.

At the same time, according to Article 1 of the Law of Ukraine "On Fisheries, Commercial Fishing and Protection of Aquatic Bioresources", a fishery water body (or part thereof) is a water body (or part thereof) that is used or may be used for fisheries purposes.

Thus, taking into account the above, as well as the lack of an appropriate legislative and regulatory framework, the protection zones for valuable bioresources in Ukraine have not been defined.

3.4 Arrays of surface/ground water used for recreational, medical, resort and health purposes, as well as water intended for bathing

Recreation areas of water bodies are land plots with adjacent water space intended for organised recreation of the population on the coastal protective strips of water bodies. Places of mass recreation are determined by local governments in accordance with the powers vested in them every year before the start of the summer swimming season. Water protection zones are established along rivers, around lakes, reservoirs and other water bodies, within which land plots are allocated for coastal protection strips.

It is prohibited in water protection zones and coastal protection zones:

- storage and use of pesticides and fertilisers;
- construction of cemeteries, summer camps for livestock, manure storage facilities, cattle cemeteries, waste dumps, filtration fields, liquid and solid waste storage facilities, etc;
- discharge of untreated wastewater;
- construction of any structures (except for hydrotechnical, hydrometric and linear structures), including recreation centres, summer cottages, garages and car parks;
- Washing and maintenance of vehicles and equipment.

Requirements for the location and organisation of water body recreation areas:

- To organise recreational areas on water bodies, their owners or lessees are required to agree the operation of the beach with the State Service of Ukraine for Food Safety and Consumer Protection before the start of each swimming season;
- the recreation area should be located outside the sanitary protection zones of industrial enterprises. The recreation area should be located at the maximum possible distance (at least 500 m) from sluices, hydroelectric power plants, wastewater discharge sites, stables, livestock watering places and other sources of pollution;
- beaches should not be located within the first zone of the sanitary protection belt of drinking water sources.

Environmental goals for recreational areas:

- The water quality of reservoirs and rivers used in recreational areas must meet the requirements of sanitary legislation;
- the composition and properties of water in the area of recreational water use must meet the requirements for physical, chemical and sanitary-microbiological indicators.

Requirements for water monitoring in recreational areas:

- water sampling for departmental control in water bodies should be carried out annually by local self-government bodies at least 2 times before the start of the swimming season (at a distance of 1 km upstream from the swimming area on watercourses and at a distance of 0.1-1.0 km in both directions from it on water bodies, as well as within the swimming area);
- during the swimming season, such water sampling shall be carried out at least twice a month at at least two points selected in accordance with the nature, length and intensity of use of swimming areas.

Pursuant to CMU Resolution No. 264 of 06.03.2002 "On Approval of the Procedure for Registration of Places of Mass Recreation on Water Bodies", local executive authorities and territorial fishery protection authorities are required to identify on maps and schemes land plots and water areas suitable for the organisation of beaches, boat rental facilities, water attractions, as well as places for water sports and places for amateur and sport fishing in winter.

Approved copies of the maps are submitted to the emergency rescue services that serve water bodies in their area of responsibility and to the regional coordination emergency rescue centres of the State Specialised Emergency Rescue Service on Water Bodies of the Ministry of Emergencies (currently the State Emergency Service).

Information on places of mass recreation is submitted annually by 1 April by local governments, and information on places of recreational and sport fishing is submitted on 10 February and 30 October by territorial fish protection authorities to regional coordination emergency rescue centres of the SES.

According to the SES in Odesa region, due to martial law, recreation and leisure areas were not used in 2022-2023 (Annex 5 (M.5.3.4)).

3.5 Areas vulnerable to (accumulation of) nitrate

Ukraine has approved a methodology for determining nitrate vulnerable zones (Order of the Ministry of Ecology No. 244 dated 15.04.2021), as required by the EU Nitrate Directive. The methodological approach relies heavily on a large amount of high-resolution spatial and temporal data, mainly surface and groundwater monitoring data, but statistical data such as livestock numbers, fertiliser application and nitrogen surplus calculations should also be used to identify these zones. All of this information is needed to identify nitrate vulnerable areas, and it needs to be of high quality and with a sufficient level of confidence. At the moment, the existing surface water monitoring network is not sufficient in its continuity and spatial coverage to apply the developed method, and groundwater monitoring is not carried out at all.

Therefore, and taking into account the fact that in Ukraine

- the highest percentage of ploughed land in the world (53.9%, 2021 data), while the rate of ploughed agricultural land is 78.2%;
- There is a lack of representative and reliable information on the content of nutrients in surface and groundwater;
- Eutrophication of water bodies is a widespread phenomenon;
- the initial level of implementation of the Nitrate Directive,

for the period 2025-2030, it is proposed to define the entire territory of Ukraine as a nitrate vulnerable zone. This is in line with the requirements of the EU WFD, which provides for the "protection of seas and coastal waters" and the prevention of deterioration of MPAs and MEAs (it is more appropriate to classify more MPAs as vulnerable than to change their status from "good" to "poor"). This "whole country" approach is also used in many EU countries. Areas vulnerable to nitrate accumulation can be refined or defined in subsequent river basin management plan cycles based on improved, more accurate information.

This approach makes it possible to extend the main measures to the entire territory of the country and plan more specific measures for surface and groundwater bodies where there is a risk of not achieving environmental objectives due to the impact of agriculture based on confirmed data.

During the period 2025-2030, the focus should be on improving the monitoring network (both groundwater and surface water) and the database to ensure a more detailed approach to zone designation and monitoring and thus achieve full compliance with the EU WFD during the 2nd cycle of the river basin management plan (2031-2036).

3.6 Vulnerable and less vulnerable zones identified in accordance with the criteria approved by the Ministry of Environment

As of 2023, no vulnerable or less vulnerable zones have been identified in Ukraine.

The regulatory document governing this issue is the Order of the Ministry of Ecology and Natural Resources of 14 January 2019 No. 6 (registered with the Ministry of Justice of Ukraine on 5 February 2019 under No. 125/33096) "On Approval of the Procedure for Determining the Population Equivalent of a Settlement and the Criteria for Determining Vulnerable and Less Vulnerable Zones".

Also, in accordance with the Law of Ukraine "On Water Disposal and Wastewater Treatment" of 12 January 2023 (to enter into force on 07 August 2023), Article 12. *Powers of Local Self-Government Bodies*, the powers of local self-government bodies in the field of water disposal include:

- upon the submission of the central executive body implementing the state policy in the field of water sector development, identification of vulnerable and less vulnerable zones in accordance with the criteria approved by the central executive body ensuring the formation of the state policy in the field of environmental protection.

The State Agency of Ukraine for Water Resources has prepared and sent submissions to local authorities. The process of making relevant decisions by the competent authorities is ongoing.

4 MAPPING OF THE MONITORING SYSTEM, RESULTS OF MONITORING PROGRAMMES IMPLEMENTED FOR SURFACE WATER (ECOLOGICAL AND CHEMICAL), GROUNDWATER (CHEMICAL AND QUANTITATIVE), AREAS (TERRITORIES) SUBJECT TO PROTECTION

4.1 Surface water

Surface water monitoring is carried out in accordance with the Procedure for State Water Monitoring approved by the Cabinet of Ministers of Ukraine on 19 September 2018, No. 758. The Ministry of Ecology, the State Agency of Water Resources and the State Emergency Service are the subjects of state water monitoring.

Every year, starting from 2020, surface water monitoring programmes are approved by the relevant orders of the Ministry of Ecology (Order No. 410 of 31.12.2020 "On Approval of State Water Monitoring Programmes", Order No. 3 of 05.01.2022 "On Approval of the State Water Monitoring Programme", Order No. 27 of 17.01.2023 "On Approval of the State Water Monitoring Programme").

4.1.1 Monitoring system

In the Lower Danube sub-basin, monitoring is carried out at 21 monitoring sites at 15 WMSs, including:

- at transboundary IBAs identified in accordance with intergovernmental cooperation agreements - 4;
- at the IWPs from which water is abstracted to meet the drinking and household needs of the population - 3.

4.1.2 Hydromorphological assessment/status

Hydromorphological monitoring was carried out at 4 MPVs. According to the monitoring results, 4 MPVs belong to the first class (high status) (Fig. 141).

Figure 141. Hydromorphological state of the Lower Danube sub-basin MPA

4.1.3 Assessment of the chemical state

The assessment of the chemical state of the MSW is based on determining the concentrations of priority substances specified in Directive 2008/105/EC, taking into account Directive 2013/39/EU250, which sets the limit values of environmental quality standards. In Ukraine, the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 45 of 6 February 2017, registered with the Ministry of Justice of Ukraine on 20 February 2017 under No. 235/30103, defines a list of indicators for which environmental quality standards are set in Annex 8 of the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 5 of 14.01.2019 No. 5 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Status of a Surface Water Body, as well as Assigning an Artificial or Significantly Modified Surface Water Body to One of the Classes of Ecological Potential of an Artificial or Significantly Modified Surface Water Body".

Directive 2009/90/EC (Article 5) sets out technical requirements/criteria for the processing of monitoring data, which were also taken into account when assessing the chemical state of the WTG:

- If the measured value was below the limit of quantification (LOQ), the calculation uses the value of half the LOQ for that indicator;
- When summarising the results of individual isomers or mixtures (e.g. polycyclic aromatic hydrocarbons, cyclodiene pesticides, DDT), in the case of values measured below the LOQ, zero "0" should be used to calculate the average concentrations.

In addition, Article 4 of Directive 2009/90/EC stipulates that the methods for measuring the content of indicators must meet the minimum criteria: have a measurement uncertainty value below 50% (k=2) and a quantification limit equal to or below 30% of the relevant environmental quality standard.

Valuation reliability

The reliability of the chemical state assessment was performed using the criteria for establishing the reliability of the correct determination of the environmental and chemical states of the MSW specified in Annex 11 of the Order of the Ministry of Ecology and Natural Resources of 14.01.2019 No. 5.

According to the established criteria, a three-stage scheme was used to assess the reliability of the correct determination of the chemical state of the MPV:

- A high level of assessment reliability means that most of the requirements have been met, namely: measurement data are available for all indicators specified in the List of Pollutants for Determining the Chemical State of Surface and Groundwater Massifs and the Environmental Potential of an Artificial or Significantly Modified Surface Water Massif in accordance with the Order of the Ministry of Environment No. 45 dated 6 February 2017, hereinafter referred to as the List, that meet the requirements of the Procedure (almost all relevant requirements for the list of indicators, methods and frequency have been met); the aggregation of MPEs demonstrates reliable results;
- The medium level of reliability of the assessment of the state of the IAP is established in the absence of sufficient monitoring data, frequency and measurement of all indicators identified in the List;
- The low level of reliability of the assessment of the state of IWM means that the assessment of the state of IWM was based on risk assessment, transfer of monitoring data through aggregation of IWM according to certain criteria.

To assess the chemical state of the MPAs, statistically processed data of measurements of pollutants in surface waters conducted at 21 monitoring points (15 MPAs) in 2022 were used, namely, the average and maximum values.

Background concentrations for non-synthetic substances (mercury, lead, cadmium, nickel) were not taken into account when assessing the chemical state of the MPW.

Compliance of the measurement results with the environmental quality standards set for the annual average and maximum permissible concentrations is considered to be compliance with the requirements set for good chemical condition of the MPW.

For the MPEs that were not monitored in 2022, the chemical state was assessed by interpolating (transferring) the assessment results from the monitored MPEs according to the MPE aggregation.

The following parameters were not measured: brominated diphenyl ethers (esters), chloralkanes, C $_{,10-13}$ di-(2-ethylhexyl)-phthalate, diuron, isoproturon, pentachlorophenol, tributyltin compounds (tributyltin cation), perfluorooctane sulfonate and its derivatives (PFOS), dioxins and dioxin-like compounds, hexabromocyclo-dodecane (HBCDD).

For the indicators fluoranthene, hexachlorobenzene, hexachlorobutadiene, mercury and its compounds, dicofol, heptachlor and heptachloroepoxide, for which the recommended object of control is biota, due to the lack of technical capabilities and measurement methods, concentrations were determined only in surface water samples.

The chemical state was assessed on the basis of monitoring data obtained as part of the diagnostic and operational monitoring of the WIPPs in 2022 for 14 WIPPs (Annex 8 (M5.3.4)).

The following conclusions can be drawn from the results of the assessment of the chemical state of the WFD in the Lower Danube sub-basin in 2021-2022 based on monitoring data (Table 131):

- chemical condition "good": not determined;
- chemical status of "failure to achieve good": 9 linear MPAs (13% of the total number of linear MPAs), by MPA length this amounts to 212.75 km (25% of the total length of linear MPAs); 5 polygonal MPAs (14% of the total number of polygonal MPAs), by MPA area this amounts to 439.03 km^2 (60% of the total area of polygonal MPAs).

Table 131. Chemical state of the WRF for the period 2021-2022 (according to monitoring data)

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	total area of the MWP, km^2
"good"	-	-	-	-
"underachievement good"	9	212,75	5	439,03

The following substances have been found to exceed the MAC_{MAX} - maximum permissible concentration and/or MAC_{CP} - average annual concentration:

- nickel and its compounds (for 3 MPAs);
- fluoranthene (for 5 MPV);
- benzo(a)pyrene (for 14 MPV);
- benzo(b)fluoranthene (for 2 MPV);
- benzo(k)fluoranthene (for 2 MPV);
- benzo(g,h,i) perylene (for 3 MPV);
- Cypermethrin (for 14 MPV);
- dicofol (for 10 MPV);
- of lucitrins (for 8 MPVs);
- anthracene (for 1 MPE).

Based on interpolation of the monitoring results according to the aggregation of IAPs (low level of reliability of the IAPs assessment) (Table 132), the following was established:

- chemical condition "good": not determined;
- chemical condition "not achieving good": 52 linear MPEs (73% of the total number of linear MPEs), by MPE length this amounts to 518.75 km (61% of the total length of linear MPEs); polygonal MPEs - without interpolation (according to MPE aggregation).

Table 132. Chemical state of the WRF based on interpolation of monitoring data

Chemical state	number of linear MPVs	total length of the pipeline, km	number of polygonal MPAs	is the total area of the MPA, km^2
"good"	-	-	-	-
"underachievement good"	52	518,75	-	-

A general assessment of the chemical state of the WFD in the Lower Danube sub-basin (based on monitoring and interpolation data) leads to the following conclusions:

- chemical condition "good": not determined;
- chemical condition "not achieving good": 61 linear MPAs (86% of the total number of linear MPAs), by MPA length this amounts to 731.5 km (86.2% of the total length of linear MPAs); 5 polygonal MPAs

(14% of the total number of polygonal MPAs), by MPA area this amounts to 439.03 km² (60% of the total area of polygonal MPAs).

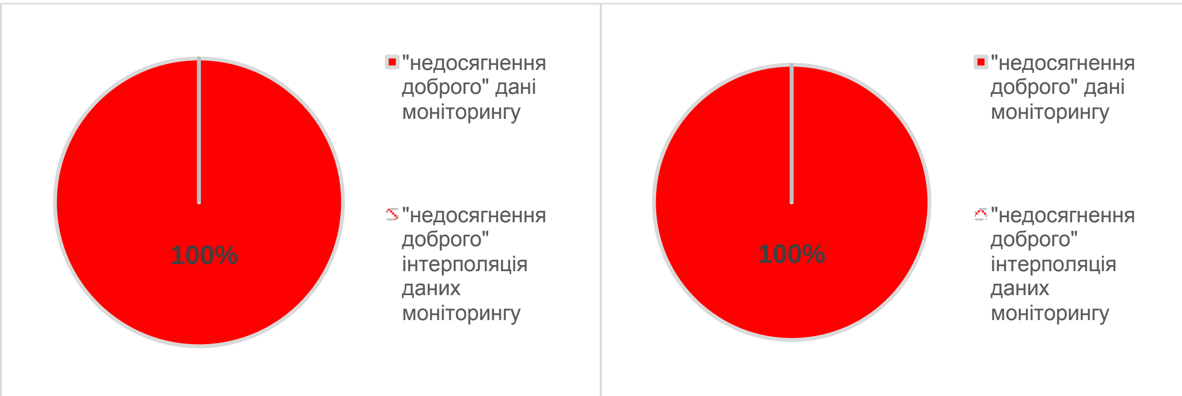
The general assessment of the chemical state of the WBF for the period 2021-2022 (monitoring data and interpolation of monitoring data) is presented in Table 133, Annex 9 (M5.3.4) and Figures 142 - 143.

Table 133. General assessment of the chemical state of the WRF for the period 2021-2022 (monitoring data and interpolation of monitoring data)

Chemical state	number of linear MPVs	total length of linear IPPs, km	number of polygonal MPAs	is the total area of polygonal MPAs, km²
"good"	-	-	-	-
"underachievement good"	61	731,5	5	439,03

a) by the number of IPAs b) by the length of IPAs

Figure 142. Chemical status of linear MPAs in the Lower Danube sub-basin (monitoring data and interpolation)



a) by the number of IPPs b) by the area of IPPs

Figure 143. Summary assessment of the chemical state of polygonal WMSs in the Lower Danube sub-basin (monitoring data and interpolation)

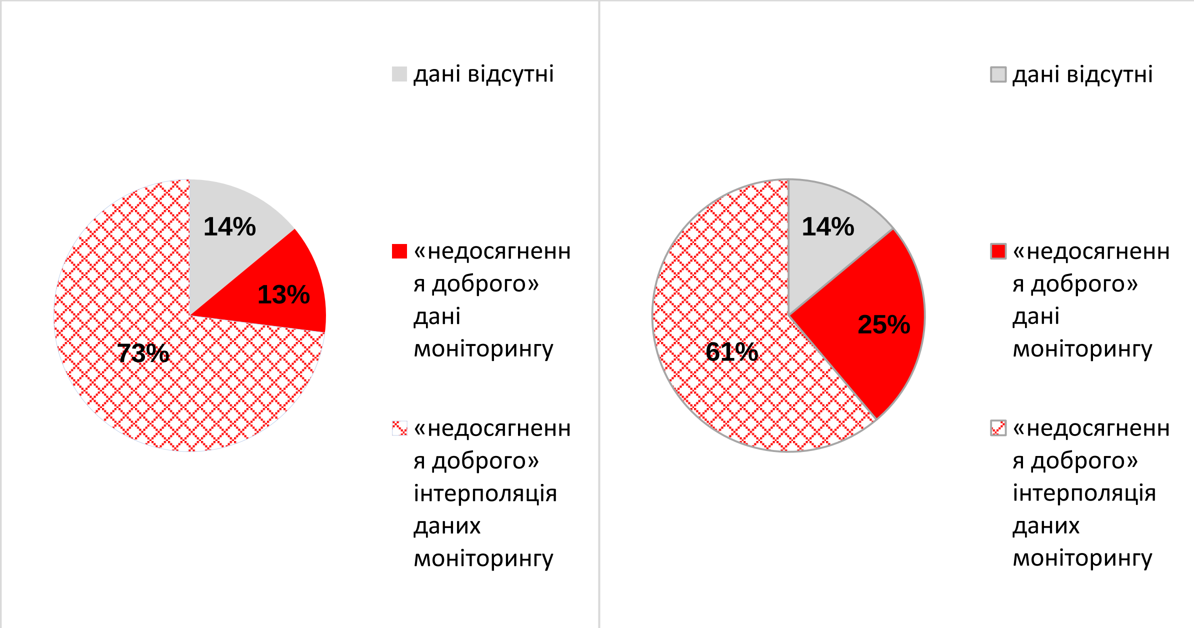
For the 14 MPAs of the Lower Danube sub-basin, the reliability of the assessment of the correct chemical status corresponds to an average level of reliability.

For one WFD (UA_M5.3.4_0034), the chemical state of the WFD was not determined (1 water sample was taken at Lake Safiany in 2022).

52 MPUs were assessed with a low level of reliability based on the transfer of results obtained within the framework of the surface water quality monitoring programme to MPUs where monitoring was not conducted in the specified period, according to the aggregation of MPUs.

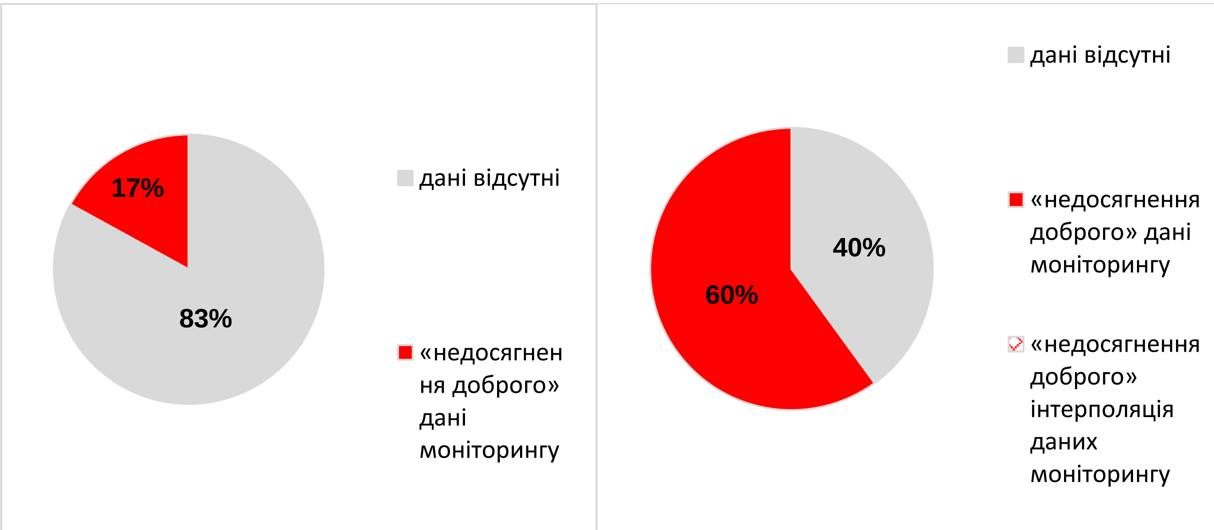
Taking into account the interpolation of monitoring data, the chemical state was assessed for 61 linear MPAs, which is 731.5 km long, and 5 polygonal MPAs, which is 439.03 km in area[2] .

A summary assessment of the chemical state of the linear MPAs and polygonal MPAs in the Lower Danube sub-basin is shown in Figure 144 and Figure 145.



a) by the number of IPAs b) by the length of IPAs

Figure 144. Overall assessment of the chemical status of the linear MPAs in the Lower Danube sub-basin



a) by the number of IPPs b) by the area of IPPs

Figure 145. Summary assessment of the chemical state of polygonal WMSs in the Lower Danube sub-basin

4.1.4 Environmental assessment

The assessment of the ecological state of the WFD is carried out in accordance with the criteria and list set out in the Order of the Ministry of Ecology and Natural Resources No. 5 dated 14.01.2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical States of a Surface Water Body, as well as Assigning an Artificial [...]" (hereinafter - the Order).

Five classes are used to classify the ecological status of a surface water body: "excellent", indicated in blue, "good", indicated in green, "satisfactory", indicated in yellow, "poor", indicated in orange, and "very poor", indicated in red.

In 2022, the biological indicators of the Lower Danube sub-basin were monitored at 10 MPL (14 sites) (Annex 7 (M.5.3.4)):

- phytoplankton;
- microphytobenthos;
- vascular plants;
- bottom macroinvertebrates.

No fish monitoring was carried out.

The assessment of the status of the MNR by biological indicators (except fish) is presented in Figure 146.

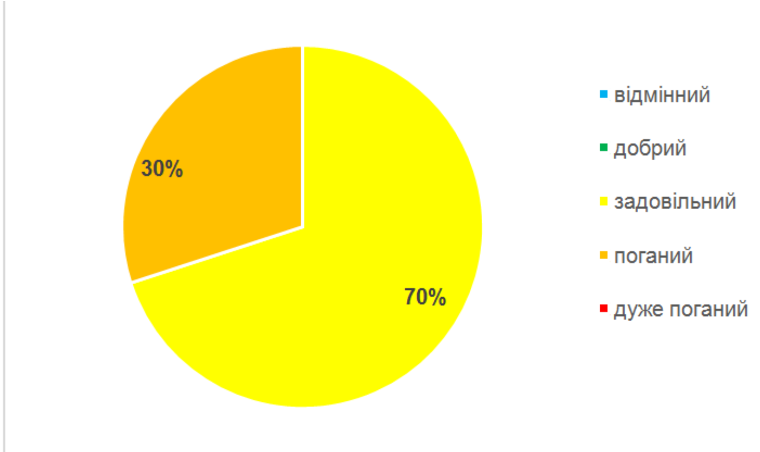


Figure 146. Evaluation of MWP by biological indicators

4.1.5 Assessment of environmental potential

The assessment of the environmental potential of the WFD is carried out in accordance with the criteria and the list of indicators set out in the Order of the Ministry of Ecology and Natural Resources No. 5 dated 14.01.2019 "On Approval of the Methodology for Assigning a Surface Water Body to One of the Classes of Ecological and Chemical Conditions of a Surface Water Body, as well as Assigning an Artificial [...]" (hereinafter - the Order).

For an artificial or significantly modified surface water body, the ecological potential is determined, for which four classes are used: "good", indicated by parallel green and grey bars, "satisfactory", indicated by parallel yellow and grey bars, "poor", indicated by parallel orange and grey bars, and "very poor", indicated by parallel red and grey bars.

No assessment of the ecological potential of significantly altered and artificial MPAs has been carried out.

4.2 Groundwater

4.2.1 Monitoring system

The quantitative and chemical state of groundwater is monitored within the framework of the state groundwater monitoring system and changes in the state are predicted both under natural conditions and under the influence of human activity. Quantitative and chemical monitoring is carried out in the same observation wells. The monitoring is carried out in both non-pressure and pressure aquifers under natural, slightly disturbed and disturbed conditions. The disturbed conditions are investigated within the operational water intakes.

The state groundwater monitoring includes diagnostic and operational monitoring, the indicators and frequency of which are defined in accordance with the WFD and are set out in Annex 2 of the Procedure for State Water Monitoring. The components of state monitoring of groundwater bodies include monitoring of quantitative, chemical and physico-chemical indicators. The Procedure for State Water Monitoring does not define the monitoring network (in particular, the number of monitoring points), but establishes the frequency and indicators to be monitored.

Table 134. Procedure for state water monitoring - Indicators and frequency of state monitoring of the MWP

Subject of monitoring	Name of the indicator	Frequency.	Notes.
Diagnostic monitoring*.**			
State Geological Survey	levels	one to three times a month	amount of water
	Temperature, redox potential permanganate oxidisability, mineralisation	at least twice a year	
	macro components: - Calcium, magnesium, sodium, potassium, hydrocarbonate ions, total ferric iron, - fluoride	four times a year	
	microcomponents	once a year	the list is determined taking into account the specifics of land use and indicators given in the State Sanitary Rules and Regulations 2.2.4-171-10
	Pollutants according to the list approved by the Ministry of Environment	four times a year	
	Specific synthetic pollutants (pesticides, pharmaceuticals and other substances)	once every two to six years	the list is determined taking into account the specifics of land use
	Specific non-synthetic pollutants (uranium, radium, radon and other substances)		
Operational monitoring***.			
State Geological Survey	Hydrogeological regime: groundwater levels	one to five times a month	
	total hardness, carbonate, non-carbonate mineralisation	quarterly, at least twice a year	
	phenols oil products synthetic surfactants	once every one to two years	
	macro components: hydrogen carbonate ions, calcium, potassium, magnesium sodium, silicon, total ferric, fluorine	quarterly, at least twice a year	
	microcomponents: aluminium, argentum, beryllium, cobalt, copper, manganese, molybdenum, nickel, selenium, strontium, chromium, zinc	once a year	The list of micro-components is determined taking into account the specifics of land use
	pollutants according to the list of pollutants for determining the chemical state of surface and groundwater bodies and the environmental potential of artificial or significantly altered surface water bodies approved by the Ministry of Ecology and Natural Resources	quarterly, at least twice a year	

Subject of monitoring	Name of the indicator	Frequency.	Notes.
	Specific synthetic pollutants (pesticides, pharmaceuticals and other substances);	once every six years	the list is determined taking into account the specifics of the array
	Specific non-synthetic pollutants (uranium, radium, radon and other substances)		

*** Data are updated and supplemented taking into account the specifics of the array.*

**** Data are updated and supplemented taking into account the specifics of the array and based on the results of diagnostic monitoring*

As of 01.01.2018, the groundwater monitoring network in Ukraine consisted of 892 observation points: 288 wells in non-pressure aquifers, 214 wells in pressure aquifers and 390 wells at production water intakes. Observations of groundwater levels in Ukraine in 2018 were carried out at 179 observation points, and chemical composition at 103 observation points *(State of Groundwater 2021)*. These data show that after the Head of the State Geological Service of Ukraine approved the state groundwater monitoring network in 2002, the number of observation wells decreased again from 1148 to 892 wells - by more than 20%.

Since the beginning of the Russian military aggression in 2022, the monitoring has been permanently suspended, as the implementation of the State Programme for the Development of Ukraine's Mineral Resources Base until 2030, which included monitoring and funding, was suspended.

The observation network for groundwater monitoring is currently in a dilapidated state. Observations conducted in 2018-2020 did not meet the requirements of the current Procedure for State Water Monitoring in terms of either quantitative or qualitative indicators.

4.2.2 Chemical assessment/risk assessment

The frequency of observations and the list of monitored indicators are defined in Annex 2 of the State Water Monitoring Procedure.

Due to the long period of absence of monitoring, as well as the limited number of observation points, it is necessary to conduct diagnostic monitoring of groundwater quality indicators of all identified MHWs at all observation wells.

The frequency and list of controlled indicators of operational monitoring are planned to be determined based on the results of diagnostic monitoring.

As of the end of 2023, no chemical assessment and/or risk assessment was available.

4.2.3 Estimation of groundwater volumes/reserves

Monitoring of quantitative and chemical indicators of the MWR condition will be carried out at joint observation points.
In accordance with the current Procedure for State Water Monitoring, diagnostic monitoring requires level measurements once or three times a month. Taking into account the long period of absence of monitoring, in order to obtain reliable data, levels should be measured three times a month.
In the course of operational monitoring, level measurements are carried out one to five times a month. The frequency of level measurements during operational monitoring will be specified based on the results of diagnostic monitoring.

As of the end of 2023, there is no estimate of the MNRP in terms of groundwater volumes and/or reserves.

5 A LIST OF ENVIRONMENTAL OBJECTIVES FOR SURFACE WATERS, GROUNDWATER AND PROTECTED AREAS (TERRITORIES) AND DEADLINES FOR THEIR ACHIEVEMENT (IF NECESSARY, JUSTIFICATION FOR SETTING LESS STRINGENT OBJECTIVES AND/OR POSTPONEMENT OF THEIR ACHIEVEMENT)

Environmental targets for surface water, groundwater and protected areas (territories) are set separately.

Surface water:

- Prevent deterioration of all arrays;
- Achievement/maintenance of "good" ecological and chemical status of all natural MPAs (rivers, lakes, transitional and coastal waters);
- Achievement/maintenance of "good" ecological potential and chemical state of significantly altered and artificial MPAs;
- Gradual reduction of pollution by hazardous substances to zero.

Groundwater:

- Prevent deterioration of all arrays;
- Achievement/maintenance of "good" quantitative and qualitative condition of all MNRPs;
- Preventing and limiting groundwater pollution.

Areas (territories) to be protected:

Achieving standards and targets as required by applicable law for:

- Emerald Network facilities;
- sanitary protection zones;
- protection zones for valuable aquatic bioresources;
- surface/ground water bodies used for recreational, medical, resort and health purposes, as well as water intended for bathing;
- areas vulnerable to (accumulation of) nitrates**;**
- vulnerable and less vulnerable areas identified in accordance with the criteria approved by the Ministry of Environment.

In cases where several objectives are set for a particular MEA or MEA, the most stringent should be applied, while all other objectives should also be met.

In some cases, the deadlines for achieving environmental targets or the targets themselves may be postponed as an exception.

It is allowed to postpone the date of achievement of the target for a period of 6 years (until 2036), but not longer than 12 years (until the end of 2042) from the end of the implementation of the first cycle of the RBMP (2030).

An exemption applied to a particular MNR or MNR should not create a risk of not achieving the environmental objectives of the upstream (for MNRs) or downstream (for MNRs) and adjacent (for MNRs) massif or massifs.

The exceptions include:

- **Achievement of less stringent targets or postponement of the date of** its achievement due to technical reasons (e.g. lack of a technical solution, technical impracticality or impracticability), disproportionately high cost or the existing natural state of the water body that does not allow for its improvement in time. The presence or absence of disproportionality is determined by the results of an economic assessment of costs and benefits;

– **Temporary deterioration of the state (goals) as a result of an unforeseen force majeure of** natural origin (e.g. extreme flood, drought) or anthropogenic (accident);

– **New physical modifications of a water body as a result of new infrastructure projects** aimed at economic development (e.g., a road or railway, a hydroelectric power station). In other words, hydromorphological changes to the MPA are allowed (up to the point of classifying it as "significantly altered"), but any water pollution from point or diffuse sources is not allowed. New physical modifications of a water body are allowed when the benefits to society outweigh the environmental ones, and there is no other option to avoid these modifications for technical and/or financial reasons.

All exceptions should be carefully justified and written in the RBMP in the form of text in section 5 and tables in a separate annex. The reason for postponing or setting less stringent targets (one or more of the three), as well as the timeframe for postponement (first or second cycle of the RBMP update) should be clearly stated.

For transboundary river basins (primarily those shared with EU countries), the application of exemptions to a particular water body should be coordinated and agreed upon.

5.1 Environmental targets for surface water

The RBMP is aimed at achieving/maintaining "good" ecological status by all designated MNRs. For surface waters, it is defined as "good" ecological status and "good" chemical status. For substantially modified and artificial MEAs, the main environmental objective is to achieve "good" ecological potential.

In the Lower Danube sub-basin, 45 naturally occurring MPAs have been identified, i.e. those classified as Rivers, Lakes, Coastal Waters and Transitional Waters; 57 significantly modified MPAs and 4 artificial MPAs.

For those MNRs that have a "good" ecological status based on the analysis of anthropogenic impacts, the main environmental objective is to preserve and prevent deterioration in the future. In those MNRs where "excellent" ecological status is established after the first year of monitoring, measures for their protection should be provided.

The MNR ecosystems that are at possible risk of not achieving "good" ecological status have a low anthropogenic load or the available data were insufficient to determine it accurately. As a result of the implementation of a set of measures aimed at improving the current state, the main environmental objective can be expected to be achieved by the end of the first planning cycle, i.e. in 2030.

The greatest anthropogenic impact has been noted on MNRs that are at risk of not achieving "good" ecological status. For these MPAs, it is necessary to use operational monitoring and confirm the ecological status using biological indicators. In accordance with the identified loads and their factors, develop and implement practical measures that will contribute to the restoration of the state of surface water bodies to achieve the set target and ensure sustainable water use.

Achievement of the main environmental objective for such MPAs should be ensured within 1-3 planning cycles. The time required to achieve the environmental objective depends on the nature of the anthropogenic load and the financial needs for measures aimed at achieving it.

An important component of the environmental goals is the gradual reduction of pollution with priority substances to a level below the environmental quality standard and strict control over their content in wastewater discharged into surface water bodies. It should be noted that the existing database used to analyse the anthropogenic load contained significant gaps in the content of priority substances. In the course of implementing the first management plan, one of the important environmental objectives should be to fully characterise water pollution by a group of hazardous and priority substances. Due to the above, it is currently impossible to predict the time of achieving a "good" chemical state.

The Lower Danube sub-basin contains 57 substantially modified MPAs and 4 artificial MPAs, the ecological objective of which is to achieve "good" ecological potential. To date, the parameters of this potential have not yet been established, and this brings to the fore the task of determining its specific parameters.

Based on the results of the assessment of anthropogenic pressure on the MPA of the Lower Danube sub-basin:

- 20 MNEs are "at no risk" of failing to achieve "good" environmental status/potential, 12 MNEs are "possibly at risk", and 74 MNEs are "at risk";

- 35 IPPs are "without risk" of not achieving "good" chemical status, 21 IPPs are "possibly at risk", and 50 are "at risk".

By 2030, 36 Municipalities will have achieved "good" environmental status/potential, of which 3 Municipalities are 5% of Municipalities that are "at risk" or "possibly at risk" of not achieving environmental targets based on the results of the anthropogenic impact assessment, and will achieve environmental targets through the implementation of PA measures.

The remaining 'at risk' or 'possibly at risk' MPSs in the basin (70 MPSs) could achieve 'good' ecological status/potential by 2036 or 2042, subject to the implementation of remedial measures.

By 2030, 106 MPAs will have reached "good" chemical status, including 35 MPAs that are currently "no risk" (they need to maintain this status), and 71 MPAs that are "possibly at risk" or "at risk" according to the results of an assessment of anthropogenic pressure.

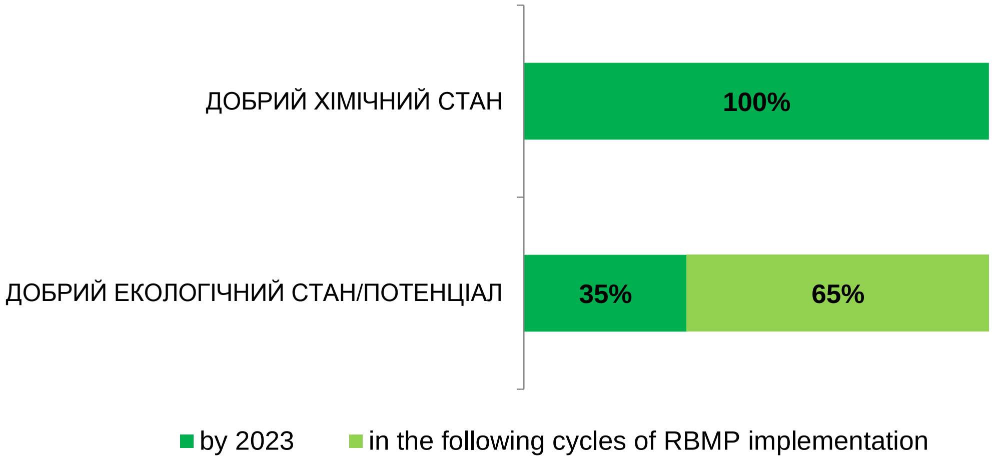


Figure 147. Timeframe for achieving the environmental objectives of the MNR

Annex 10 (M5.3.4) contains the environmental targets of the MIP, the timeframe for achieving them, reasons for postponement and setting less stringent targets.

5.2 Environmental objectives for groundwater

Environmental targets are set for each MPZ, both in terms of their quantitative and qualitative (chemical) status. According to the WFD, the main objective is to achieve a "good" groundwater status.

Additional targets for each individual IWR are defined depending on the existing quantitative and qualitative state of IWR, their use or potential use for water supply to the population, anthropogenic pressure and possible impact on surface ecosystems.

The main criterion for the "good" quantitative state of the MWR should be the absence of groundwater depletion.

Depletion is the state of aquifers in which, under the influence of artificial drainage, the decline in groundwater levels has reached such indicators that exclude the possibility of further use of the horizon to meet the needs of society using traditional technical means.

The assessment of the depletion of the ASGM is based on information on the level regime, data on groundwater extraction volumes and their comparison with the resources and approved operational reserves.

In addition, the criterion of "good" condition for non-pressure IWRMs is the appropriate condition of the associated surface water bodies and the absence of negative impact on surface ecosystems, primarily vegetation suppression.

The criteria for the "good" quality (chemical) state of the MPW are the natural background content of chemical elements and compounds, as well as the standards set for drinking water by the State Sanitary

Norms and Rules "Hygienic Requirements for Drinking Water Intended for Human Consumption" (SanPiN 2.2.4-171-10).

Quantitative state of pressure vessels

The quantitative state of the pressure IWRs is assessed by comparing the volumes of water withdrawal from these IWRs at water intakes with the volumes of projected groundwater resources (PGR).

The environmental objective is the stability of the quantitative state and the absence of groundwater depletion. At groundwater abstractions, the volume of water withdrawal should not exceed the estimated operational reserves (within groundwater deposits).

High-quality (chemical) pressure vessel MPZV

Since groundwater from all the pressure WTPs is used for centralised drinking water supply to the population, the criteria for "good" chemical condition was the compliance of groundwater chemical parameters with the State Sanitary Norms and Rules "Hygienic Requirements for Drinking Water Intended for Human Consumption" (SanPiN 2.2.4-171-10).

This document is mandatory for executive authorities, local governments, enterprises, institutions, organisations, regardless of ownership and subordination, whose activities are related to the design, construction and operation of drinking water supply systems, production and circulation of drinking water, supervision and control over the supply of drinking water to the population and citizens.

The Sanitary and Epidemiological Norms and Regulations 2.2.4-171-10 sets standards for drinking water, including tap water, water from bottling sites and pump rooms, as well as water from wells and springs, in terms of sanitary, chemical and epidemiological safety of drinking water.

Exceptions are indicators exceeded in groundwater due to natural factors.

An additional environmental objective is to avoid deterioration in the quality of the discharge boundary water, but conclusions on trends in chemical composition should be based on reliable monitoring data, as the content of components in water is subject to natural fluctuations, which is especially typical for those underground storage tanks that are located closer to the surface. Therefore, information on the interval of fluctuations in the content of components of the chemical composition of water should be available for each MPZV.

For operational water intakes, the absence of adverse changes in water quality is determined by comparing current indicators with those at the time of approval of reserves.

Given the current state of groundwater use and the problems with water supply, which have been significantly exacerbated by the hostilities, especially in the southern regions, it is advisable to set an additional goal to ensure that the optimal balance of surface and groundwater use for drinking water supply is maintained in accordance with Article 6 of the Law of Ukraine "On Drinking Water, Drinking Water Supply and Sewerage".

The primary goal should be the resumption of groundwater monitoring, which was virtually suspended in recent years and finally destroyed during the war. In the absence of groundwater monitoring, achieving all of these goals is unrealistic.

The poor state of groundwater monitoring over the past decades and, consequently, insufficient information on the current state of the MPZs allows to define environmental objectives only in the most general form. In the course of monitoring, the environmental objectives for each MPZ will be specified.

Appendix 10 (M5.3.4) (Table 2) lists the environmental targets of the Mine Action Plan and its groups, the timeframe for achieving them, reasons for postponement and setting less stringent targets.

Among the currently identified IPPs and their groups, will achieve "good" quantitative status by 2030, and the only IPP will achieve "good" chemical status in 2042.

6 ECONOMIC ANALYSIS OF WATER USE

6.1 Economic development of the sub-basin

The economic development of the Lower Danube sub-basin is conditioned by its geographical, climatic, economic and socio-demographic situation. The Lower Danube sub-basin is located on the territory of Izmail and Bolhrad districts and part of Tatarbunary TG of Bilhorod-Dnistrovskyi district of Odesa region.

Geographically, the Lower Danube sub-basin is an integral area, consisting of the Danube River basin within Ukraine, transitional waters and coastal waters (the Black Sea water area between the coastline and a line in the territorial sea at a distance of one nautical mile from the baseline used to determine the width of the territorial sea). The total population of the sub-basin, as of 2019, is 313,116 people, which is 1% of the total population of Ukraine.

Table 135. Share of area and population of oblasts within the sub-basin[31] , %.

Areas.	Share of the region's area within the basin	Share of the region's population within the basin
Odesa	21	14

An analysis of the current situation in the region's socio-economic situation shows certain trends:

- Analysis of the demographic situation shows a negative migration process of the existing population;
- Total industrial production decreased by 25.5%, with the largest drop in manufacturing: mining and processing;
- agriculture is one of the leading sectors that plays an important role in shaping the pace of economic growth and, according to preliminary data, demonstrates the following trends - the growth rate of gross output was 80.23%, including: crop production - 88.0%, (wheat (88.4%), corn (81.8%), rapeseed (108.6%), fruits and berries (98.7%), barley (91.2%), vegetables (94.1%) and sunflower (80.5%), soybeans (78.8%)), with a slight decrease in production volumes compared to the previous year; and livestock production - 74.45% due to a decrease in meat, milk, eggs and wool production compared to the previous year.

The transport and road sector saw a decline in cargo turnover (by 1.3%) and passenger traffic (by 0.7%) compared to the same period last year. Foreign trade: in 2019, the volume decreased by 10%.

Analysis of the Lower Danube sub-basin WFD

In 2019, the sub-basin's GRP amounted to UAH 25958.26 million. The dynamics of this indicator over the entire study period of 2015-2019 demonstrates an upward trend, and its share in Ukraine's GDP is also growing. The growth rate of the sub-basin's GRP compared to the previous year was highest in 2016-2017 (19%-24%), while in 2019, the sub-basin's GRP growth decreased to 13% per annum. The share of the sub-basin's GRP in the country's total GDP in 2019 was 65%.

Table 136. Dynamics of GRP in the sub-basin, 2015-2019

Indicator.	2015	2016	2017	2018	2019
GRP in actual prices, UAH million	13350,91	15985,67	19873,08	22942,37	25958,26
The share of the Lower Danube sub-basin's GRP in Ukraine's total GDP, %.	0,67	0,67	0,67	0,64	0,65
GRP growth rate of the Lower Danube sub-basin, % compared to the previous year	100	119	124	115	113

The dynamics of the sub-basin's GRP reflects an increase in GRP from UAH 13 million to UAH 25 million in 2019.

[31] calculated on the basis of data from the State Statistics Service of Ukraine http://www.ukrstat.gov.ua/

The GRP per capita within the sub-basin is UAH 82.9 thousand, which is lower than the total for the whole of Ukraine (as of 2019, the GRP per capita is UAH 94.7 thousand).

Analysis of the Lower Danube **sub-basin WFD**

As of 2019, the sub-basin's GVA was UAH 32,804.12 million, and its share in the total GVA of Ukraine was 0.96%.

Table 137. GVA by economic sector, 2015-2019

Sectors of the economy	2015	2016	2017	2018	2019
Agriculture, forestry and fisheries, UAH million	2043,38	2647,97	2868,99	3184,75	2746,16
Share of agriculture, forestry and fisheries in the sub-basin in the total GVA of Ukraine, %.	0,85	0,95	0,94	0,88	0,77
Mining and quarrying, UAH million	2,29	4,58	7,26	6,88	12,03
Share of the mining industry and quarrying in the sub-basin in the total GVA of Ukraine, %.	0,00	0,00	0,00	0,00	0,01
Processing industry, UAH million	1861,34	2255,99	2563,54	2850,84	3163,35
Share of the sub-basin's processing industry in the total GVA of Ukraine,%.	0,79	0,77	0,71	0,69	0,74
Supply of electricity, gas, steam and air conditioning, UAH million	389,69	406,50	442,41	525,12	532,77
Share of electricity, gas, steam and conditioned air supply of the sub-basin in the total water supply of Ukraine, %.	0,73	0,55	0,51	0,47	0,43
Water supply, sewerage and waste management, UAH million	95,13	85,96	101,24	129,51	163,52
Share of water supply, sewerage, and waste management in the sub-basin in the total GVA of Ukraine, %.	1,20	1,01	1,02	1,14	1,13
Transport, warehousing, postal and courier activities, UAH million	3278,92	4013,60	4942,17	5328,42	6359,18
Share of transport, warehousing, postal and courier activities in the sub-basin in the total GVA of Ukraine,%.	2,43	2,56	2,58	2,34	2,40

In the overall structure of the GVA of Ukraine, among the water-dependent economic activities of the sub-basin in 2019, the largest percentage is accounted for by transport, warehousing, postal and courier activities (2.4%) and water supply and sewerage, Waste management - 1.13%, agriculture, forestry and fisheries - 0.7%, supply of electricity, gas, steam and air conditioning - 0.4%, mining and quarrying - 0.01%, and processing industry - 0.74%.

The total amount of GVA of water-dependent economic activities in the sub-basin in the total amount of GVA in the basin during 2014-2019 ranged from 39-46% (in 2019 - 127 million UAH, which is 39.5%).

6.2 Characteristics of modern water use

The current water use of the sub-basin was characterised based on the data of the state water cadastre in the section "Water use" for 2019.

Table 138. Dynamics of changes in the number of water users and water withdrawals

Years	2015	2016	2017	2018	2019
Number of water users, pcs.	246	244	239	234	225
Water intake, million m3[3]	546,6	777,7	464,0	571,4	627,5
Discharge to surface water bodies, million m3[3]	51,73	47,4	52,15	57,67	57,46

Polluting wastewater discharge, million m3^3	15,17	15,06	18,78	2,09	32,73

In 2019, 225 water users submitted reports on water use in the sub-basin in the form 2TP-water farm (annual) (including 25 reports with zero water withdrawals).

The general indicators of water intake, water use and wastewater discharge in the sub-basin within Tatarbunary, Izmail, Kiliya, Bolhrad, Artsyz, Tarutino and Reni districts of Odesa region by economic sectors according to the 2TP-Vodkhoz (annual) form are summarised in Table 139.

Table 139. Characteristics of water use in the sub-basin in 2019, million m3^3

Industry.	Water intake	Usage waters	Discharges of waste water into surface water bodies	Discharges of polluted wastewater
Public utilities	7,289	5,623	0,138	0,138
Industry	0,532	0,619	2,536	0,031
Agriculture, including irrigation	659, 04	126,72	32,644	32,556
Transport	0,022	0,102	0,001	0
Together:	**672,5**	**137,2**	**57,46**	**32,73**

Polluted wastewater is discharged into surface water bodies in the Danube River basin by water users:

Water user	EDRPOU code	Discharge volume, million m^3	Degree of water treatment
Industry:			
PJSC "UDP Kilia Shipyard"	33113076	0,031	contaminated without cleaning
Utilities:			
KP Svetlo	32319458	0,138	contaminated insufficiently cleaned (CIC)
Agriculture (irrigation):			
Debut-2005 LLC	33757219	11,93	contaminated without cleaning
Mayak agricultural company	30704515	15,01	contaminated without treatment (CTC)
LLC JV "Danube-Agro"	30819680	3,388	contaminated without treatment (CTC)
Druzhba agricultural collective farm	03769497	2,228	contaminated without treatment (CTC)

Table 140. Characteristics of water use in the Lower Danube sub-basin by economic sector

Name of economic sectors	Water intake, million m3^3	Volume of water used, million m3^3	Share of total water withdrawal within the sub-basin, %.
Industry	**0,532**	**0,619**	**0,08**
including energy ferrous metallurgy	- -	- -	

food industry coal industry forestry woodworking Busbuilding and construction. chemical and petrochemical chemical industry fuel industry oil refining industry gas industry	0,020 - 0,480 - 0,031 - - - -	0,065 - 0,481 - - - - - -	
Housing and utilities	**7,289**	**5,623**	**1,08**
Agriculture	**659,037**	**126,72**	**98**
including fisheries irrigation agricultural enterprises	1,482 656,3 1,255	0,292 124,9 1,528	
Transport	**0,022**	**0,102**	**0,003**
Forestry	**-**	**-**	**-**
Other	5,62	4,136	0,83
Total for the sub-basin	**672,5**	**137,2**	**100**

Table 141. Wastewater discharges to water bodies by categories of discharged water

Name of economic sec-tors	**Volume of water discharged, million m3**^{3}	**including**			**Share of the total discharge within the sub-basin, %.**
		contamina-ted	**normatively clean wit-hout treat-ment**	**normatively cleaned at facilities**	
Industry	**2,536**	**0,031**	**0,005**	**2,499**	**4,41**
including energy ferrous metallurgy food industry coal industry woodworking Mashinostroitelstvo i me-todb. chemical and petrochemi-cal chemical industry fuel industry oil refining industry gas industry	- - 0,001 - 2,503 0,031 - - - - -	- - - - - 0,031 - - - - -	- - 0,001 - - - - - - - -	- - - - 2,499 - - - - - -	
Housing and utilities	**0,138**	**0,138**	**-**	**-**	**0,24**
Agriculture	**32,644**	**32,556**	**0,088**		**0,15**
including fisheries irrigation agricultural enterprises	0,088 32,556 -	- 32,556 -	0,088 - -	- - -	
Transport	**0,001**	**-**	**-**	**0,001**	**0,002**
Forestry	**-**	**-**	**-**	**-**	**-**
Other	21,141	0,005	22,137	-	**95,19**
Total for the sub-basin	**57,46**	**32,73**	**22,23**	**2,5**	**100**

A detailed description of the sub-basin's water use by economic sector is presented in Figure 148.

Figure 148. Characteristics of water use in the Lower Danube sub-basin in 2019[32] , million m³

In total, the Lower Danube sub-basin withdrew a total of 672.5 million m3 of water³ , of which: surface water - 666.3 million m3³ (99.1%), groundwater - 6.229 million m3³ (0.9%); the volume of fresh water used totalled 137.2 million m3³ , including for drinking and sanitation - 6.103 million m³ (4.5%); industrial - 1.115 million m³ (0.8%); irrigation - 127.9 million m³ (93.2%); other - 2.125 million m³ (1.6%):

The most significant water user in the Lower Danube sub-basin is:

- *Agriculture, including irrigation (operation of irrigation systems):* 126.7 million m³ (more than 90% of the total fresh water used);

The following sectors of the national economy follow in the order of decreasing water use:

- *Housing and utilities:* 5.623 million m³ (4.1%);
- *Industry:* 0.619 million m³ (0.45%), in which the woodworking industry has the largest share in terms of water use: 0.481 million m³ (0.35%).

In the sub-basin, the total volume of water discharge is 58.16 million m³ , including total wastewater discharged into surface water bodies - 57.46 million m³ (98.79%), of which: contaminated - 32.73 million m³ (56.96%); normatively clean without treatment - 22.23 million m³ (38.69%); normatively treated at treatment plants - 2.5 million m³ (97.6%); transit water discharged - 507.3 million m³ (28.3% of total water discharge); recycling, reuse and sequential use amounted to 3.104 million m³ (0.17% of total water discharge).

In the sub-basin, water is mainly abstracted for economic needs from surface sources used for industrial, agricultural, and municipal water supply. A prerequisite for further socio-economic development is to provide water users with sufficient water in sufficient quantity and quality.

Forecast groundwater resources for the sub-basin in Odesa region are 88.67 million m³ /year, and the level of approved groundwater resources is 92.72 million m /year. ³

The socio-economic importance of water for economic sectors was assessed based on the European methodology for assessing the value of water. The ranking of economic sectors was applied based on the ranking of economic sectors by 5 indicators adapted to the recommendations of the methodology, namely

- GVA generated by an industry is an economic indicator of the sector's weight in the region's economy;
- the volume of water withdrawn by the industry;

[32] State water cadastre data on "Water use", 2019, State Agency of Water Resources of Ukraine

- water intensity of the industry compared to other industries;
- The industry's dependence on water quality;
- pollution of water bodies by the industry's waste water.

Table 142. Water use and water intensity of the sub-basin's economic sectors

Industry sector	Water intake, million m^3	Gross domestic product, UAH million	Water intensity of airborne troops, m^3 /1000 UAH
Industry	1,063	3175,38	0,33
Housing and utilities	7,289	163,52	44,57
Agriculture	659,037	2746,16	239,44
Transport	0,022	6359,18	0,034

The water-dependent sectors of the economy were assessed for each indicator and its socio-economic weight was determined as low, moderate or high.

Table 143. Socio-economic weight of major water users

Sectors economies	Scope of airborne forces creation	Water intake by the industry	Water intensity of the industry	Dependence on water quality	Waste water contamination
Electricity	low	low	low	low	low
Industry	moderate	moderate	low	low	moderate
Mechanical engineering and metalworking	moderate	moderate	low	low	moderate
Woodworking	moderate	moderate	low	low	moderate
Food industry	moderate	low	low	high	moderate
Housing and utilities	moderate	high	moderate	moderate	high
Agriculture	moderate	moderate	high	high	low
Fisheries	moderate	moderate	high	moderate	moderate
Operation of irrigation systems (including irrigation)	moderate	high	high	high	high
Transport	high	low	low	low	moderate

Based on the assessment results, the economic sectors are grouped into 5 groups according to their dependence on water resources and socio-economic importance.

Group 1 "Full dependence" includes water users that are highly dependent on 4 indicators - water quality, high water intensity, significant pressure on water resources and small volumes of GWP - irrigation (operation of irrigation systems).

Group 2 "Multiple dependence" - have high dependence on at least two indicators - agriculture and housing and communal services.

Group 3, "Specific dependence", includes the food industry, fisheries, and transport, which have high ***dependence*** on one indicator.

Group 4 "Moderate dependence" - have moderate dependence on at least 2 indicators - industry, machine building and metalworking, woodworking.

Group 5 "Dependence without water use" includes economic sectors that use water without abstraction from natural water bodies, generate low volumes of Gross Domestic Product (GDP) and are minor polluters.

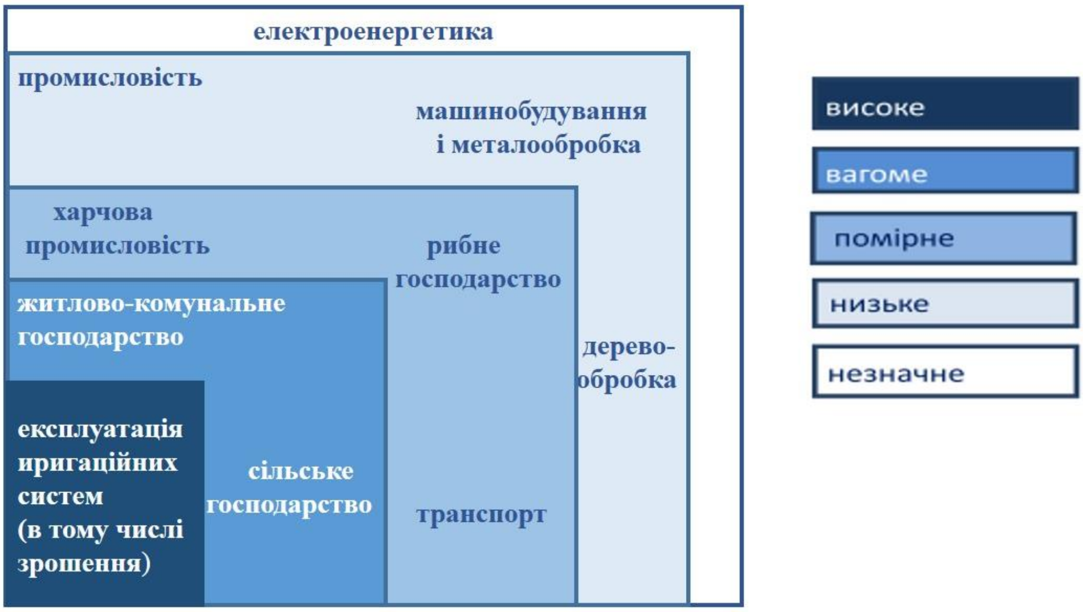


Figure 149. Socio-economic importance of economic sectors

6.2.1. Municipal water use

One of the main tasks of the water sector is to ensure municipal water consumption. This includes the water needs of the population, household and public utilities, public services, and industrial enterprises in settlements connected to local water supply systems. The amount of municipal water consumption depends on the number of residents, the degree of urbanisation and climatic conditions.

According to water use reports in the form 2TP-water farm (annual) for 2019, water users in the sub-basin withdrew 7.289 million m^3 of water from natural water bodies, including 1.731 million m^3 from surface water bodies and 5.559 million m^3 from underground water bodies. The total water used was 5.623 million m^3 , including: 5.347 million m^3 , for household drinking needs of the population, and 0.275 million m^3 .

The total drainage area is 0.637 million m^3 .

The discharge of return (waste) water into surface water bodies in the sub-basin is 0.138 million m^3 , and water losses during transportation for own needs in the municipal sector amount to 1.655 million m^3 (10.5% of total losses).

Major water users in the municipal sector:

– Municipal enterprise "Bolgradvodokanal" m. Bolgrad (USREOU code 37548545) - 0.141 million m^3 withdrawn from natural water bodies ;
– Municipal enterprise "Vilkovo city water supply" in Vilkovo. Vylkove (USREOU code 41819049) - 0.084 million m^3 of water withdrawn;
– Municipal enterprise "Izmail VUVKG" in Izmail. Izmail (EDRPOU code 03350137) - 1.862 million m^3 of water withdrawn;
– Municipal enterprise "Svitlo" in the city of Kilia (USREOU code 32319458) - 0.173 million m^3 of water withdrawn.

The rate of physical deterioration of water and sewerage facilities outstrips the dynamics of their renewal and development, which directly depends on the ability of the state and local budgets to finance these measures. The main problems of the housing and utilities sector are the deterioration of the water supply and sewerage network, inefficient operation of treatment facilities, which leads to the supply of water of inadequate quality to consumers and the discharge of polluted water into water bodies. The current increase in the quantitative indicators of sanitary standards for drinking water necessitates the re-equipment of existing water treatment plants with the introduction of the latest water treatment technologies and the construction of new ones.

6.2.2 Industrial water use (by major water users)

The industry in the sub-basin is represented by enterprises of various forms of ownership: woodworking, food processing, machine building and metal processing. The industrial enterprises in the sub-basin take water from surface sources.

According to water use reports in the form 2TP-water farm (annual) for 2019, the industry in the sub-basin withdrew 0.532 million m^3 of water from natural water bodies, including: 0.491 million m^3 , and 0.041 million m^3 . The volume of water intake by the food industry is 0.020 million m^3 , woodworking - 0.480 million m^3 . The total water used by the industry is 0.619 million m^3 , including: for domestic and drinking needs - 0.076 million m^3 , for production needs - 0.543 million m^3 .

The total drainage capacity is 2.548 million m^3 .

The discharge of waste water into surface water bodies amounted to 2.536 million m^3 , including: polluted water - 0.031 million m^3 , standard clean water without treatment - 0.005 million m^3 , standard treated water at treatment plants - 2.499 million m^3 .

There are no water losses during transportation for own needs in the industry.

The largest water user in the industry is PJSC Pulp and Paper Mill.

6.2.3 Water use in agriculture

Agriculture is one of the largest water consumers in the sub-basin. Non-returnable water consumption in agriculture accounts for 65-72% of total non-returnable water consumption in Ukraine.

The main areas of water use in agriculture are irrigation, watering, agricultural water supply and fisheries. Water use in agriculture is a very important and significant area in its socio-economic development. Unlike in industry, where it is sometimes possible to replace water in the technological process, in agriculture it cannot be replaced by anything, and irrigation of crops allows for good results.

According to state water use accounting data for 2019, agricultural entities in the sub-basin withdrew 659.037 million m^3 of water from natural water bodies, including 658.902 million m^3 from surface water bodies and 0.142 million m^3 from groundwater bodies. The total water used is 126.72 million m^3 , including: for domestic drinking needs - 0.279 million m^3 , for agricultural water supply - 1.275 million m^3 , for fisheries - 0.292 million m^3 , for irrigation - 124.851 million m^3 , for industrial needs - 0.238 million m^3 .

The total drainage area is 0.136 million m^3 .

The main water users are agriculture:

- Kamolino-Holding LLC (USREOU code 37905021) -11.206 million m^3 of water withdrawn;
- Debut-2005 LLC (USREOU code 33757219) -23.395 million m^3 of water withdrawn;
- Mayak SPC (USREOU code 30704515) - 30.166 million m^3 of water withdrawn;
- Danube-Agro JV LLC (USREOU code 30819680) - 6.842 million m^3 of water withdrawn;
- Rice of Bessarabia LLC (USREOU code 36837333) - 23.239 million m^3 of water withdrawn.

Agriculture is one of the leading industries that plays an important role in shaping economic growth and, according to preliminary data, demonstrates the following trends: gross output growth rate was 80.23%, including

I. Crop production - 88.0%, including: wheat (88.4%), corn (81.8%), rapeseed (108.6%), fruits and berries (98.7%), barley (91.2%), vegetables (94.1%) and sunflower (80.5%), soybeans (78.8%), with a slight decrease in production volumes compared to the previous year.

II. livestock - 74.45% due to a decrease in the production of meat, milk, eggs and wool compared to the previous year.

There is no water loss during transport.

6.2.4 Water use in transport

Water users in this sector of the economy in the sub-basin withdrew 0.022 million m^3 of water from natural water bodies, including 0.022 million m^3 . Water use by transport in the sub-basin amounts to 0.102 million m^3 , including: for domestic and drinking needs - 0.062 million m^3 , for industrial needs - 0.039 million m^3 .

The total drainage is 0.002 million m^3 .

The discharge of return (waste) water into surface water bodies in the sub-basin is 0.001 million m^3 , including 0.001 million m of normatively treated water at treatment plants^3 .

There is no water loss during transport.

6.2.5 Other types of water use

Other types of water use withdraw water in the amount of less than 0.83% of the total water withdrawal in the river basin.

These industries include trade and catering, logistics, construction, communications, healthcare and physical education, and public education.

6.3 Forecast of water demand by major economic sectors

The forecast of water demand by the main sectors of the economy is made for the period of the River Basin Management Plan (until 2030) under three scenarios: realistic, optimistic and pessimistic.

The forecast is based on the economic indicators of GDP/GDP for previous years and their forecast values. The increments of the optimistic and pessimistic scenarios are calculated by determining the average annual deviations from the forecast values for the previous years.

The deviation of the forecasted water withdrawal volumes under the pessimistic scenario ranges from 1.2-3.5% of the realistic scenario. The optimistic scenario shows a maximum increase in the projected demand for water resources by 0.1-1.8% compared to the realistic scenario.

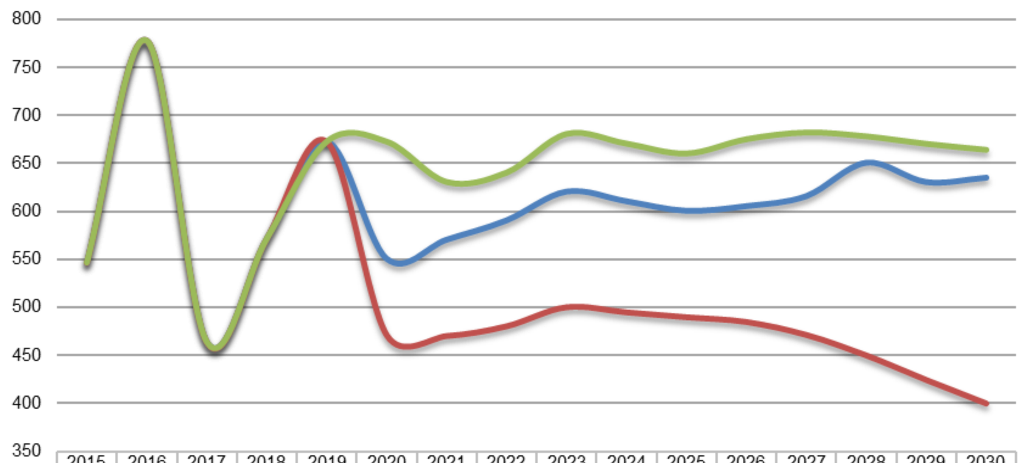
Since 2015, the economic profile of the sub-basin has been variable. Water abstraction increased in 2016 (777.7 million m3^{3}), and since 2017, water abstraction has been decreasing, with an increase in water abstraction starting in 2018.

The main factors affecting water use in the sub-basin include the following:

- the spread of the COVID-19 coronavirus infection and the introduction of restrictive measures;
- economic development - driver sectors: agriculture;
- natural: climate change → increased irrigation (the vast majority of water is abstracted in the sub-basin for the operation of irrigation systems (including irrigation)).

The forecast of water withdrawal for the short-term period - for 2021 - is based on the European Bank for Reconstruction and Development's forecast of Ukraine's GDP for 2021, which shows an increase of 3.5%.

For the medium-term period of 2021-2023, the forecast is based on the Forecast of Economic and Social Development of Ukraine for 2021-2023 of the Ministry of Economy, Trade and Agriculture of Ukraine, which envisages GDP growth of 4.2% in 2021, 3.8% in 2022 and 4.7% in 2023.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Реалістичний	546.6	777.7	464	571.4	672.5	550.6	570.4	590.5	620.5	610.4	600.5	605.4	615.8	650.5	630.4	635
Песимістичний	546.6	777.7	464	571.4	672.5	471.4	470.4	480.5	500.4	495	490	485	471.5	450.2	424.7	400.2
Оптимістичний	546.6	777.7	464	571.4	672.5	672.5	630.5	640.2	680.5	670.4	660.2	675	682	678	670.2	664

Figure 150. Forecast of water abstraction in the Lower Danube sub-basin until 2030

The long-term forecast period - 2024-2030 - was calculated based on data from USDA, World Bank, IMF, IHS, Oxford Economic Forecasting, which forecasts Ukraine's GDP growth by 3.2% annually.

In 2021, the Ministry of Economy predicted a slowdown in water withdrawals and a decline in economic performance due to the spread of the acute respiratory disease COVID-19 caused by the SARS-CoV-2 coronavirus.

The largest reduction was expected in the agricultural sector, which is the main water user in the Lower Danube sub-basin. Almost constant abstraction rates are observed in the industrial and transport sectors.

2021-2025 - growth is expected with slight fluctuations in water intake within 5%.

2025-2030 - a trend of intensive growth in water intake due to the projected economic growth of 3.1% annually.

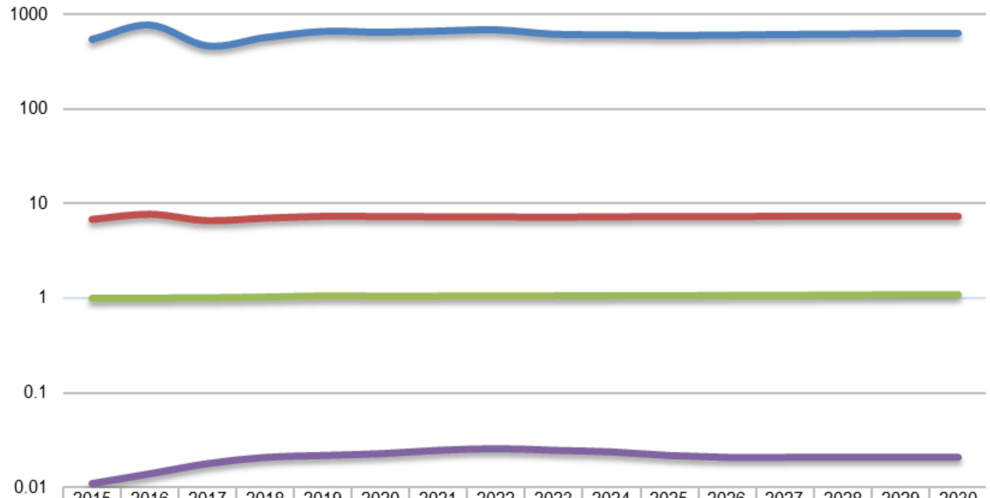
Water use was expected to decline in 2020 as a result of the COVID-19 pandemic.

Since 2021, there has been a stable trend of gradual growth in water intake.

In 2020, a total of 550.898 million m3 of water was withdrawn from the sub-basin[3] , of which 549.095 million m3 were surface water[3] , and 1.803 million m3 were groundwater[3] . Compared to 2019, when a total of 672.5 million m3 of water was withdrawn[3] , of which 666.3 million m3 were surface water[3] , and 6.229 million m3 were groundwater.[3]

Forecast groundwater resources in the sub-basin of the region are 88.67 million m^3 /year, and the level of approved groundwater resources is 92.72 million m /year.[3]

The forecast of water withdrawal in the sub-basin until 2030 by economic sectors was made on the basis of analysis of water use data series and their modelling in retrospect based on forecast values.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Сільське господарство	546.6	777.7	464	571.4	664.1	650.6	670.4	690.5	620.5	610.4	600.5	605.4	615.8	620.5	630.4	635
ЖКГ	6.776	7.68	6.56	6.99	7.29	7.27	7.22	7.18	7.15	7.22	7.25	7.26	7.29	7.29	7.29	7.29
Промисловість	1.002	1.01	1.02	1.04	1.06	1.06	1.06	1.06	1.07	1.07	1.08	1.08	1.08	1.09	1.10	1.10
Транспорт	0.011	0.014	0.018	0.021	0.022	0.023	0.025	0.026	0.025	0.024	0.022	0.021	0.021	0.021	0.021	0.021

Figure 151. Forecast of water withdrawals in the Lower Danube sub-basin by 2030 by economic sector

Within the sub-basin, agriculture (operation of irrigation systems) is the most developed sector, and this sector also abstracts the largest volumes of water, which affects the overall forecast of water abstraction in the sub-basin.

The housing and utilities sector is a significant water user in the sub-basin, which has responded more actively to the crisis caused by the spread of the COVID-19 pandemic. Thus, water withdrawals by this sector are projected to decrease by 2% in 2020. This indicator is expected to recover in 2025, which is reflected in the total water withdrawals in the sub-basin. In the subsequent period, this indicator is expected to fluctuate within 2-5%.

In the industrial sector of the sub-basin, no significant changes in water withdrawals are expected throughout the forecast period of 2021-2030. This trend is also evident in the retrospective period of 2015-2019.

No significant increase in water withdrawals by transport sector water users is forecast.

6.4 Tools of economic control

6.4.1 Payback of water resources use

The concept of "free" natural resources, which prevailed until the early 1980s, was accompanied by their irrational use, which eventually led to their pollution and shortage. The constant development of Ukraine's economy requires the involvement of more and more natural resources, including water, and thus the need to apply an economic assessment of this resource arises.

Conservation and rational use of water primarily involves improving the system of payment for its use.

Meeting the drinking needs of the population and the use of water by enterprises in their economic activities are referred to as special water use. Special water use is paid for and is carried out on the basis of a special water use permit. The permit for special water use is issued by the territorial bodies of the central executive body that implements the state policy in the field of water development.

The special water use permit sets out the water intake limit, the water use limit and the pollutant discharge limit. In the event of a water shortage, these limits may be reduced by the issuing authority without adjusting the special water use permit.

The terms of special water use are set by the authorities that issued the special water use permit. Special water use may be short-term (for three years) or long-term (from three to twenty-five years).

The legal, economic and organisational framework for the functioning of the drinking water supply system is defined by the Law of Ukraine "On Drinking Water and Drinking Water Supply" No. 2918-111 of 10.01.2002. According to this Law, centralised water supply services are provided by municipal enterprises of local communities (water utilities), which supply drinking water to all water users. Vodokanals have their own property and are financially independent, they have the right to set tariffs for water supply and sewerage independently. The activities of these enterprises are controlled by local governments and district state administrations.

In accordance with the "Procedure for setting tariffs for centralised water supply and sewerage services" approved by the Cabinet of Ministers of Ukraine by Resolution No. 302 dated 10 March 2016, the tariff for water supply and sewerage services should ensure reimbursement of operating expenses, financial expenses, expenses (or a share thereof) for capital investments, income tax expenses per unit of service and is determined by the company based on the indicators of the production programme for the base year. The tariffs for water supply and sewerage in different settlements of the region differ significantly.

Key regulators in the water and wastewater sector:

- the National Energy and Utilities Regulatory Commission (NEURC);
- local self-government bodies (LSG) (city, town and village councils).

Payback of water resources use is a comparison of funds received from the use of water resources to the funds spent on the provision of water services.

The description of water services and water use in the Lower Danube sub-basin is presented in accordance with the institutional structure of water services regulation:

I. Centralised water supply and sewerage services;
II. Special water use by economic sectors - payments and fees are paid to the budgets of all levels (rent, environmental tax for discharges into water bodies in Ukraine, lease of water bodies);
III. Water supply services for irrigation.

I. Payback of centralised water supply and sewerage services

In the sub-basin, centralised water supply and sewerage services are provided by more than 10 organisations licensed by local authorities.

According to the calculations, the licensees of local governments in the sub-basin received: UAH 76.6 million (including VAT) in 2018, UAH 91.13 million (including VAT) in 2019, and UAH 100.24 million (including VAT) in 2020, respectively.

The insufficient level of payments by consumers for services rendered, which amounted to 91% in 2020, creates a situation of insufficient coverage of water services by consumer payments and threatens the sustainability of water services, and hence the debts of water utilities for electricity and wages.

The condition of the water supply and sewerage networks in the sub-basin is unsatisfactory, which affects water quality. The cost of rehabilitating the networks is so high that it cannot be covered by depreciation alone.

In the sub-basin, the average profit in the tariffs was 2.8%, but none of the companies provided for the use of profit to form a reserve fund (capital) for modernisation, which should have been included in their business operations.

According to the NEURC, "the amount of production investments from profits is determined in the amount necessary for the gradual restoration of networks (improvement of the functioning of water and sewerage enterprises), and taking into account the needs to fulfil the financial obligations of licensees to international financial organisations". However, this level is extremely insufficient.

II. Payback of water resources use in the sub-basin (based on public finance calculations)

In accordance with the principles of "user pays" and "polluter pays" The Tax Code of Ukraine establishes a fee for special water use:

А. Rent for water intake for different types of water users;
Б. Environmental tax on discharges into water bodies.

In addition, there is a fee for the use of water bodies for aquaculture purposes:

В. Rent for water bodies;
Г. Payment for special use of aquatic bioresources.

A. Rent for special water use

The state budget received UAH 3.4 million from business entities in the sub-basin by administrative district in 2018, UAH 3.2 million in 2019, and UAH 3.02 million in 2020.

Revenues from rents for special water use to the budgets of the sub-basin regions are declining.

Б. Environmental tax on discharges of pollutants into water bodies

In the sub-basin, the state budget received tax revenues for pollutant discharges directly into water bodies in the amount of UAH 4.24 million in 2018, UAH 3.79 million in 2019, and UAH 3.23 million in 2020.

Environmental tax revenues from pollutant discharges into water bodies in the sub-basin are declining.

C. Payment for the lease of water bodies

The weighted average rent is unified for all water bodies in the sub-basin and is constantly increasing. Its dynamics is as follows: 2015 - 114.9 UAH/ha, 2016 - 153.2 UAH/ha, 2017 - 156.9 UAH/ha, 2018 - 162.7 UAH/ha, 2019 - 162.7 UAH/ha, 2020 - 162.7 UAH/ha.

According to estimates, local budgets in the sub-basin received rent for water bodies (parts thereof) in the amount of UAH 18.2-214.6 thousand in 2019-2020, including 2019 - 18.2 thousand UAH, 2020 - 214.6 thousand UAH.

The dynamics of water rent revenues to the budgets of the sub-basin regions is positive.

D. Payment for special use of water bioresources

The fee for the use of water bioresources is levied in accordance with a resolution of the Cabinet of Ministers of Ukraine. According to the report on local budgets, the fee for the special use of aquatic bioresources amounted to UAH 70.02 thousand in 2018, UAH 184.59 thousand in 2019, and UAH 1,574.5 thousand in 2020.

The dynamics of water bioresource use fees to local budgets in the Lower Danube sub-basin is positive.

Expenditures on water resources in the sub-basin

A. Capital and current expenditures from the state and local budgets for environmental programmes in the field of water resources protection

According to state statistical reports, capital investments and current expenditures are allocated to nine environmental areas, including those directly related to the reproduction and protection of water resources:

- treatment of waste water and protection and rehabilitation of soil, groundwater and surface water.

In 2018 and 2019, the percentage of the first and second directions together accounted for half of all expenditures of the total capital expenditures in all directions, but in 2020, the percentage of the first and second directions together decreased due to the growth of other areas of capital expenditures (Table 144).

Table 144. Dynamics of capital investments in the sub-basin, thousand UAH

Area.	2018			2019			2020		
	Total environmental programmes, including	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total environmental programmes, including	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total environmental programmes, including	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water
Odesa	12556,2	6333,4	100,4	12556,2	6333,4	100,4	23830,7	1970,2	4604,9
% of programmes from Total for the indicator		50,4	0,8		50,4	0,8		8,3	19,3
Total for 2 water protection programmes		6433,8			6433,8			6575,1	

In 2018-2019, the percentage of the first and second areas together accounted for almost a third of all expenditures from the total current expenditures in all areas, but in 2020, the percentage of the first and second areas together decreased due to the growth of total current expenditures due to the growth of other areas (Table 145).

Table 145. Dynamics of current investments in the sub-basin, thousand UAH

Area.	2018			2019			2020		
	Total environmental programmes, including	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total environmental programmes, including	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water	Total environmental programmes, including	Waste water treatment	Protection and rehabilitation of soil, groundwater and surface water
Odesa	75467,9	21217,4	109,3	75467,9	21217,4	109,3	152468,3	28665,0	1618,1
% of programmes from Total for the indicator		28,1	0,14		28,1	0,14		18,8	1,1
Total for 2 water protection programmes		21326,7			21326,7			30283,1	

B. State budget expenditures for the maintenance of water infrastructure under the management of the State Agency of Water Resources

In the sub-basin, water infrastructure maintenance activities are carried out by organisations under the management of the State Agency of Water Resources located in the respective areas of the sub-basin - the basin water resources management.

Expenditures for the operation of water infrastructure are made under the comprehensive programme "Operation of the State Water Management Complex and Water Resources Management"; in 2020, expenditures in the Lower Danube sub-basin amounted to UAH 10,086.4 thousand.

Determining the payback of water use in a sub-basin

If the payback ratio of water resources use, calculated using the formula "Revenues / Expenses * 100":

- is more than 100%, this means that all costs are reimbursed by paying tax and non-tax revenues for services to budgets of all levels or by tariffs; budget revenues, if used for their intended purpose, can be used for water resources restoration; enterprises receive profits that can be used for production development - production investments, formation of a reserve fund (capital), etc. (part of which will be used to pay income tax);
- if the indicator is less than 100%, this indicates a threat to the sustainability of the service, as the costs of budgets or enterprises are not covered by the revenues received.

The return on water use calculated using the formula is 6.1%, which means that costs are higher than tax revenues for water services (Table 146).

Table 146. Calculation of revenues and capital expenditures by 2020 indicators in the sub-basin

SOURCES.	Receipts, thousand UAH	EXPENSES	Expenses, thousand UAH
Rent for special water use (state and local budgets)	3024,7	Capital investments in water resources restoration and protection	30283,1
Environmental tax on discharges into the water bodies (state and local budgets)	3232,4	Expenditures from the state budget for the operation of the state water management complex	101086,4
Rent for water bodies (parts thereof) provided in use on a lease basis (local budgets)	214,6		
Payment for aquatic bioresources	1584,5		
TOTAL RECEIPTS	**8056,2**	**TOTAL EXPENSES**	**131369,5**
Payback	**6,1%**		

6.4.2 Water tariffs

Tariffs for centralised water supply and sewerage

According to the institutional structure in Ukraine, the NEURC and local governments set the following types of tariffs for centralised water supply and sewerage services:

1) Tariff for centralised supply (cold water, hot water separately) and sewerage (cold and hot water together);
2) Tariff for centralised supply (cold water, hot water separately) and sewerage (cold and hot water) using in-building systems.

There are no NEURC licensees in the sub-basin.

As of 2020, local governments have set tariffs for centralised water supply and sewerage for ten companies in the Lower Danube sub-basin.

In the sub-basin, only three WSP licensees have established tariffs for water supply and sewerage for consumers who are water supply and sewerage entities in the field of CWS: the enterprises VODOKANAL of the Reni City Council, Izmail Production Department of Water Supply and Sewerage Facilities and Municipal Enterprise Bolgradvodokanal, from which other water utilities buy water, the costs of which are included in the tariffs of these enterprises.

As of 01.01.2021, the weighted average tariffs (cumulatively for all licensees of the sub-basin) are as follows:

- for centralised water supply services - 16.83 UAH/m³,
- for centralised sewerage services - 14.72 UAH/m³.

Table 147. Tariffs for centralised water supply and wastewater disposal of the OMC licensees providing services in the Lower Danube sub-basin

Name of the company	Tariffs set by local governments, UAH/m³ / Cost price, UAH/m³ / Reimbursement, %.	
	Water supply for consumers who are business entities in the field of water supply and sanitation	Sewerage for consumers who are business entities in the field of water and wastewater treatment
Municipal enterprise "Primorske" in Kilia district	19,1/19,**1/100%**	
Izmail Production Department of Water Supply and Sewerage Services	10,96/10,91/100,**5%**	11,86/11,22/105,**7%**
KP Kommunalnyk	14,32/14,3/100,**1%**	
KP "Garant"	11,0/10,78/102,**0%**	
Municipal enterprise "Bolgradvodokanal"	15,48/15,**48/100%**	17,9/17,**9/100%**
Municipal enterprise "Glavanets"	23,1/23,**1/100%**	
KP "Comfort-16"	22,0/22,**0/100%**	
Municipal enterprise "Dmitrovka" in Tatarbunary district	18,7/18,**7/100%**	

The level of reimbursement of centralised water supply and sewerage costs for consumers who are business entities in the field of water and wastewater (tariff to cost) for all water utilities - licensees of the sub-basin's WSS is about 100% and varies from 100% to 105.7%.

The tariff structure of the licensees includes MLA:

– for centralised water supply: labour costs (38.4%); electricity (24.8%); fuel and lubricants (1.5%); repair costs (15.2%); reagents (0.9%); depreciation and amortisation (2.8%); (0.6%); financial expenses (0.8%); other expenses (13.8%);

– for wastewater disposal: labour costs (50%); fuel and lubricants (5%); repairs (2.8%); depreciation (4%); other costs (39%), etc.

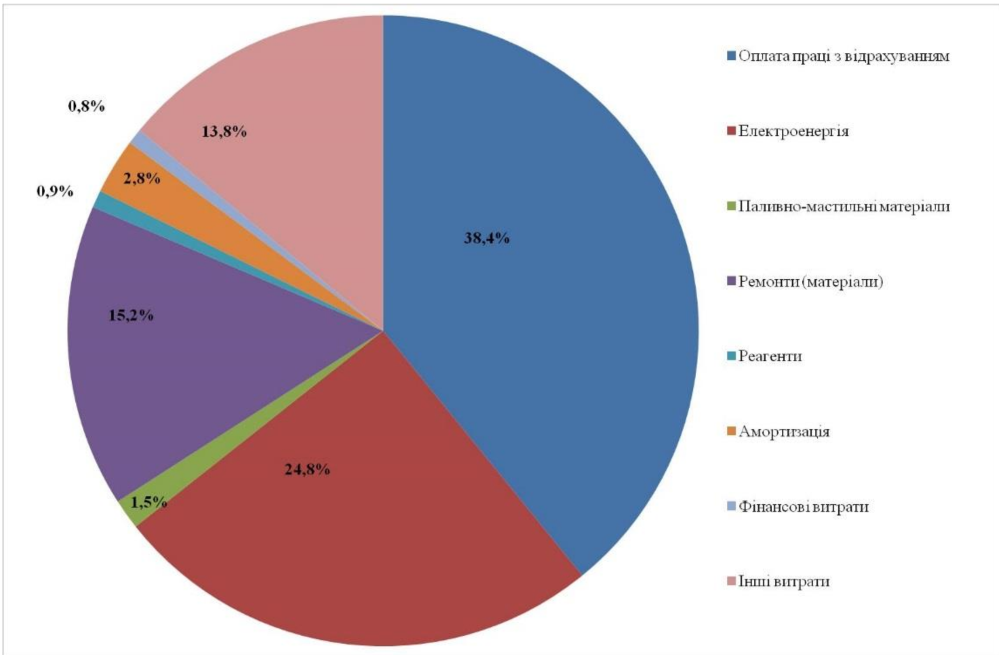


Figure 152. Weighted average tariff structure in the Lower Danube sub-basin

The cost of water for industrial enterprises

The cost of water is actually paid by industrial enterprises in the form of a mandatory payment for special water use - a rent, the amount of which depends on the type of water consumed, the purpose, place and region of consumption, and the actual volume of water used. No rent is paid if the volume of consumption is less than 5 m^3 per day and the water user does not have its own water intake facilities.

The rates of rent for special water use are set by the Tax Code of Ukraine and are differentiated according to regions. In the Lower Danube sub-basin, the rates are shown in Table 148.

Table 148. Rates of rent for special water use

Region.	Rate, UAH per 100 m^3
For the use of surface water	
Danube River Basin Region	29,96
For the use of groundwater	
Odesa	116,56

Charges for water pollution are received in the form of fines and environmental tax for discharges of pollutants into water bodies. The environmental tax is increased annually, with the last increase in environmental tax rates occurring in 2021. The tax rates for discharges of pollutants into water bodies are presented in Table 149.

Table 149. Environmental tax rates for discharges of certain pollutants into water bodies, UAH

Name of the pollutant	Tax rate per 1 tonne
Ammonium nitrogen	12883,84
Organic matter (based on biochemical oxygen demand (BOD)$_5$	5156,8
Suspended solids	369,52
Petroleum products	75792,4
Nitrates	1108,56
Nitrites	63278,16
Sulphates	369,52
Phosphates	10297,44
Chlorides	369,52

Cost of water supply services for irrigation

The state-owned operators of the irrigation water supply market are water management organisations of the State Agency of Water Resources.

The cost of such services is formed on the basis of a unified approach, which is defined by the order of the State Agency of Ukraine for Water Resources and is determined on the basis of economically justified costs directly related to their provision. The costs include direct labour costs, direct material costs and other direct costs, general and administrative expenses, including renewal and modernisation of fixed assets used in the amount of 10% of direct costs. These costs are differentiated according to technological characteristics.

The principle of pricing this service is not aimed at making a profit, as the state in the risky farming zone has committed itself to subsidising agricultural production. The service of water supply for irrigation is a kind of subsidy to agribusiness in the form of reducing the cost of irrigation through state maintenance (operation) of irrigation systems and service personnel.

The peculiarity of cost formation is that the calculation of the cost of this service includes the costs of water supply that are not covered by budget financing (including electricity, salaries, capital expenditures).

The cost of the service does not include the cost of water as a resource, as water management organisations are not primary water users.

The cost of water supply for irrigation as of 2020 varied from 1.08 to 3.51 UAH/m³ (Table 150).

Table 150. Cost of water supply for irrigation in the sub-basin, 2018-2020, UAH/m^3 (excluding VAT)

Area.	The cost of everything			Including the cost of	
	2018	2019	2020	electricity	own services
Odesa	**0,23-2,48**	**0,64-3,51**	**0,87-2,81**	**0,35-1,85**	**0,52-0,96**
Bolgrad district	1,29-2,48	1,71-3,51	0,87-2,81	0,42-1,85	0,45-0,96
Reni district	1,25-2,19	2,02-2,86	1,54-2,63	0,58-1,67	0,96-0,96
Izmail district	0,23-1,45	1,08-1,84	1,08-2,14	0,47-1,43	0,61-0,71
Kiliya district	0,58-1,22	0,64-1,86	0,87-0,95	0,35-0,42	0,52-0,53
Artsyz district	0,77-1,18	1,59-2,5	1,38-1,51	0,7-0,83	0,68-0,68

The proceeds from the provision of these services are used to replenish the special fund of the State Budget of Ukraine and are credited to the own revenues of water management organisations, which are used in accordance with the budget approved by the State Agency of Ukraine for Water Resources.

7 A REVIEW OF THE IMPLEMENTATION OF PROGRAMMES OR ACTIVITIES, INCLUDING HOW THE OBJECTIVES HAVE BEEN ACHIEVED

The section provides an overview of the implementation of environmental protection measures within the sub-basin, which were funded by national targeted programmes, the State Environmental Protection Fund, relevant regional and local programmes or funds, the State Regional Development Fund, state investment projects, international technical assistance projects, regional and local infrastructure projects, etc. (Annex 12 (M.5.3.4)).

The National Target Programme for the Development of the Water Sector and Environmental Rehabilitation of the Dnipro River Basin for the Period up to 2021 (Dnipro Programme)

Paragraph 4 of the CMU Resolution No. 336 of 18 May 2017 "On Approval of the Procedure for Developing RBMPs" states that the development of the first RBMPs for each RBM is carried out during the period of implementation of the Dnipro Programme. In accordance with clause 11 of the said Procedure, the measures to develop the first RBMPs for each RBF are financed from the state budget, which is provided for by the same Dnipro Programme within the expenditures envisaged by the State Budget of Ukraine for the respective year, as well as from other sources. The implementation of this programme is important both in the context of preparing the Lower Danube RBMP and for implementing measures to achieve environmental objectives for the Lower Danube RBM MOU.

The Dnipro Programme aims to define the main directions of state policy in the field of water management, conservation and restoration of water resources, implementation of an integrated water resources management system based on the basin principle, restoration of the role of reclaimed land in the food and resource supply of the state, optimisation of water consumption, prevention and elimination of the consequences of harmful water impact.

The main objectives of the Dnipro Programme are:

- harmonisation of Ukrainian legislation with international standards and improvement of the regulatory framework for innovation and investment development of the water sector - partially achieved;
- Implementation of an effective, justified and balanced mechanism for the use, protection and reproduction of water resources, ensuring sustainable development of the state water monitoring system in accordance with international standards - achieved;
- Implementation of the integrated water resources management system based on the basin principle, development and implementation of RBMPs, application of the economic model of targeted financing of activities in river basins, establishment of basin councils, and enhancement of the role of existing and creation of new basin water resource management agencies - partially achieved;
- Improving the technological level of water use, introducing low-water and waterless technologies, developing more rational water use standards, construction, reconstruction and modernisation of water supply and sewage systems - partially achieved;
- bank protection and regulation of river channels, construction and reconstruction of hydraulic structures, protective dams, polders, flood control reservoirs, clearing of river channels, improvement of water protection zones and coastal protection strips, development of schemes for comprehensive flood protection of territories from the harmful effects of water, improvement of methods and technical devices for hydrometeorological observations and flood forecasting - partially completed;
- Ensuring the development of land reclamation and improvement of the ecological condition of irrigated and drained lands, including restoration of the water management and reclamation complex, reconstruction and modernisation of reclamation systems and their facilities, engineering infrastructure of reclamation systems with the creation of integrated technological complexes, introduction of new methods of irrigation and land drainage, application of water and energy-saving environmentally safe irrigation and water regulation regimes - not fulfilled.

The estimated amount of funding for the Dnipro Programme was UAH 46478.46 million, including UAH 21029.03 million from the state budget, UAH 9294.2 million from the local budget, and UAH 16155.2 million from other sources not prohibited by law (in US dollar terms, this equates to USD 6.193 billion (as of

01.01.12), or an average of USD 688 million annually, or 0.4% of Ukraine's gross domestic product (GDP)). The amount of funding for the Dnipro Programme was determined annually during the drafting of the State Budget Law for the respective year, taking into account the real possibilities of the state budget. Since the start of the Dnipro Programme's activities, as of 1 January 2019, 26% of the envisaged need has been allocated from budgets of all levels and other sources, and as of 1 January 2020, 17% of the envisaged need, which has led to a significant failure to complete its tasks and activities on time.

The main implementer of the Dnipro Programme is the State Agency of Water Resources. If we analyse in detail the distribution of state budget expenditures on the TWA over the past 3 years, we can see the following trend. State funds are allocated mainly for the costs of consumption of the water sector, labour remuneration, utilities, the share of financing from the state budget, for example, in 2020 was 93.5% (UAH 2092158.5 thousand) from the general fund and 81.1% (UAH 2261343.4 thousand) from the special fund. Total state budget expenditures to finance the Dnipro Programme in 2020 amounted to UAH 5022671 thousand. The share of all funds used for the operation of the state water management complex and water resources management is UAH 4561352.5 thousand (90.8%).

Water infrastructure maintenance activities in the Lower Danube sub-basin are carried out by the BWR of the Black Sea and Lower Danube Rivers, which falls under the management of the DVA. Expenditures for the operation of water infrastructure are made within the framework of the comprehensive programme "Operation of the State Water Management Complex and Water Resources Management" for each separate division of the SAC, rather than on a basin basis.

The issue of extending the Dnipro Programme from 2022 to 2024 to the period of preparation of the RBMP has been resolved for the third year by reviewing the amount of funding for the measures and agreeing on their scope at the central and regional levels. Currently, the TWA has developed and submitted for interagency approval a draft Law of Ukraine "On Amendments to the National Target Programme for the Development of Water Management and Environmental Rehabilitation of the Dnipro River Basin for the Period up to 2021" to extend the Programme until 2024.

As of 8 June 2021, the Accounting Chamber of Ukraine conducted an audit of the effectiveness of the implementation of the Dnipro Programme activities for the period up to 2021. The purpose of the audit is to identify existing problems with the implementation of this Programme and to confirm or deny the need to extend its validity until 2024.

National Target Programme "Drinking Water of Ukraine for 2011-2020" (Drinking Water Programme)

"The National Target Programme "Drinking Water of Ukraine for 2011-2020", approved by the Law of Ukraine No. 2455-IV dated 03.03.2005 (hereinafter referred to as the Drinking Water Programme). Its main goal was to ensure the rights of citizens to an adequate standard of living and environmental safety guaranteed by the Constitution of Ukraine by providing drinking water in the required volumes and in accordance with the established standards. The Drinking Water Programme was intended to ensure the implementation of the state policy on:

- development and reconstruction of centralised water supply and sewage systems;
- protection of drinking water sources;
- Bringing the quality of drinking water to the requirements of regulatory acts;
- regulatory and legal support in the field of drinking water supply and sewerage;
- development and implementation of research and development projects using the latest materials, technologies, equipment and devices.

The estimated amount of funding for the Drinking Water Programme was UAH 9,471.7 million (in 2010 prices), of which UAH 3,004.3 million was allocated from the state budget and UAH 6,467.4 million from other sources. Due to the lack of adequate funding over the 10 years of the Drinking Water Programme in Ukraine, there have been no significant positive changes in the provision of drinking water in the required volumes and of the appropriate quality.

As of 1 January 2020, about 1% of cities, more than 10% of urban-type settlements and almost 70% of villages in Ukraine (8.934 million people) were not provided with centralised drinking water supply. Almost 1 in 4 citizens of the country is not provided with centralised water supply. The problem of using imported water covers at least 9 regions of the country, and directly affects at least 268,000 people living in 824 settlements.

According to global standards for water quantity and quality, Ukraine is classified as a low-water country. Ukraine ranks 37th out of 40 European countries in terms of drinking water quality. And over the past 10 years, our performance has only been deteriorating. And in terms of water per capita, Ukraine is 125th in the global ranking. At the same time, the national target programme Drinking Water of Ukraine is not being implemented or financed at all. The last time the Drinking Water Programme was financed was in 2018, when UAH 200 million was allocated from the State Budget of Ukraine, with water and sewerage companies alone submitting projects totalling UAH 1.3 billion. Such activity of the companies is caused by their unsatisfactory financial and economic condition, as well as the inability of local governments to provide the necessary support for the renewal of fixed assets from local budgets. In addition, it is worth noting that the procedures for obtaining grants and loans from international financial institutions are quite lengthy and involve significant risks, so obtaining state funds for the implementation of a particular infrastructure project was a desirable goal for each water utility. In 2019-2020, the Drinking Water Programme was not funded and ended in 2020.

In order to continue supporting water supply and wastewater treatment companies, in 2019, MinRegion of Ukraine developed and submitted to the central executive authorities and specialised associations a draft law "On Amendments to the Law of Ukraine "On the National Target Programme "Drinking Water of Ukraine" for 2011-2020", which provided for the extension of the Programme for another 5 years. Interagency approval, coordination, and consultations with the Ministry of Finance lasted for 2 years. The Resolution of the Verkhovna Rada of Ukraine No. 980-IX dated 5 November 2020 provides for the possibility and expediency of increasing/foreseeing expenditures and providing loans from the general fund of the draft state budget for 2021 under the budget programme "Implementation of the National Target Programme "Drinking Water of Ukraine" for the Ministry of Development of Communities and Territories of Ukraine (instead of MinRegion) (clause 2.17.68.). The Drinking Water of Ukraine programme will be extended until 2025.

The State Target Programme for the Development of Land Relations in Ukraine for the period up to 2020

The Programme was approved by the Cabinet of Ministers of Ukraine by its Resolution No. 743-r dated 17.06.2009.

The purpose of the Programme is to define and implement the main directions of state policy aimed at improving land relations and creating favourable conditions for sustainable development of land use in urban and rural areas, facilitating the solution of environmental and social problems in rural areas, developing highly efficient competitive agricultural production, and preserving the natural values of agricultural landscapes.

As a result of insufficient funding for the Programme, Ukraine is experiencing excessive ploughing of agricultural land, which leads to a disruption of the ecologically balanced ratio of agricultural, nature reserve and other environmental, health, recreational, historical, cultural, forestry, water fund lands, and an increase in the area of degraded, unproductive, and technologically polluted land (diffuse sources of pollution).

As of 1 January 2021, more than 500,000 hectares of degraded, underutilised and technologically contaminated land are subject to conservation, 143,000 hectares of disturbed land need reclamation, and 294,000 hectares of underutilised land need improvement.

A separate Ministry for Development of Economy, Trade and Agriculture of Ukraine has been established (Ministry of Economy, CMU Resolution No. 838 of 19.09.2019), which will implement the new State Target Programme for the Development of Land Relations and National Geospatial Data Infrastructure in Ukraine for the period up to 2030 (Land Programme, draft CMU Resolution of 13.04.2021).

The National Programme for the Development of Nature Reserves for the period up to 2020 (the NRF Programme)

One of the elements of the RBMP structure is Section 3 "Areas (territories) to be protected and their mapping: Emerald Network sites; sanitary protection zones; protection zones for valuable aquatic bioresources; surface/groundwater bodies used for recreational, medical, resort and health purposes, as well as bathing waters; zones vulnerable to (accumulation of) nitrates", vulnerable and less vulnerable zones identified in accordance with the criteria approved by the Ministry of Ecology, therefore, in the context of preparing and implementing the RBMP, it is very important to have information on the implementation of the "National Programme for the Development of Nature Reserves for the period up to 2020" approved by the Cabinet of Ministers of Ukraine on 8 February 2006. No. 70-r (hereinafter referred to as the NRF Programme).

According to the data on the registration of NRF territories and objects submitted by the executive authorities at the local level that ensure the implementation of the state policy in the field of environmental protection (hereinafter referred to as the "NRF"), as of 01.01.2020, the NRF of Ukraine comprises 8,512 territories and objects with a total area of 4.418 million hectares within the territory of Ukraine (actual area

4.085 million hectares) and 40,2500.0 hectares within the Black Sea. The ratio of the actual area of the nature reserve fund to the area of the state (the "reserve indicator") is 6.77%.

The NRF is managed by the Ministry of Ecology and is funded through the state budget programme "Conservation of Protected Areas". According to the passport of this programme for 2021, UAH 589326.7 thousand (state fund) and UAH 18289.8 thousand (special fund) were used for measures to preserve and expand the protected areas, for a total of UAH 607616.5 thousand. In general, the performance indicators under this budget programme were met.

In addition, according to the Regional Report on the State of the Environment in Odesa Region, in 2020, a number of environmental measures and programmes related to the restoration and conservation of water resources were implemented on the territories and objects of the nature reserve fund of Odesa region. For example, the Sturgeon Watch-3 campaign was held on the territory of the Danube Biosphere Reserve as part of the WWF project "Save the Danube Sturgeon" (2016-2020).

As part of the international project "Restoration of wetlands and steppes in the Danube Delta region" (2019-2023), an additional herd of wild tarpon horses, as well as European fallow deer and red deer, which perform an important ecological function, was introduced on Ermakov Island.

Also in 2020, the introduction of the eagle owl in the territory of the NRB within the framework of the project "Restoration of wetlands and steppes in the Danube Delta region" (2019-2023) was continued and 3 individuals of this species were released into the wild. In 2020, the implementation of the international project "Invasive Alien Species Observatory and Network. Development for the Assessment of Climate Change Impacts in Black Sea Deltaic Protected Areas", which aims to identify and study aggressive alien species of animals and plants that pose a threat to the ecosystem and economy of the region.

In 2020, as part of the Odesa Regional Comprehensive Environmental Protection Programme for 2020-2021, approved by the decision of the Odesa Regional Council dated 20.12.2019 No. 1165-VII, the Regional Scheme for the Formation of the Odesa Regional Environmental Network was detailed in Izmail, Reniia, Kiliya, Bolhrad, Shyriai, Ivanivka, and Velykomykhailiv districts of Odesa region.

Regional programme for **the development of the water sector in Odesa Oblast until 2021**

The programme was approved by the decision of the Odesa Regional Council of 18 September 2013 No. 882-VI, as amended on 15 May 2020 No. 304-VII.

The initiator, developer and responsible implementer of the Programme is the Black Sea and Lower Danube River Basin Water Resources Management Authority. The Programme has been developed in order to:

- Increase the efficiency of the state reclamation network and on-farm reclamation systems in the region, increase crop yields, improve the ecological state of rural areas and living conditions;
- implementation of the state and regional water policy, meeting the needs of the population for quality water and the region's economic sectors for water resources;
- Inventory and certification of water bodies, creation of a register of hydraulic structures and their owners in river basins, and the establishment of riverine protective strips;
- flood protection of the region's river basins and protection of rural settlements and agricultural land from the harmful effects of water.

Total financial resources required for the implementation of the Programme: UAH 2969160,698 thousand, including: state budget funds - UAH 1656100,698 thousand, local budget funds - UAH 450324 thousand, funds from other sources - UAH 862736 thousand.

The programme participants include the Regional State Administration's Agricultural Policy Department, the Regional State Administration's Department of Ecology and Natural Resources, the Main Directorate of the State Emergency Service of Ukraine in Odesa Oblast, the Odesa United Directorate for the Construction of Water Management Facilities, the Ukrainian State Regional Design and Survey Institute Ukrpivdendiprovodhosp, and local authorities.

The breakdown of funding by programme area is as follows:

1. Ensuring the development of land reclamation and improvement of the ecological condition of irrigated land - UAH 2240820 thousand;
2. Priority provision of centralised water supply to rural settlements that use imported water - UAH 582680,698 thousand;
3. Comprehensive flood protection - UAH 62670 thousand;
4. Protection of rural settlements and agricultural land from the harmful effects of water - UAH 82990 thousand.

Odesa Regional Integrated Environmental Protection Programme for 2020-2021

The Programme was approved by the decision of the Odesa Oblast Council of 20 December 2019 No. 1165-VII (as amended on 03 March 2020 No. 1240-VII and 10 August 2020 No. 1384-VII). The initiator, developer and responsible executor of the Programme is the Department of Ecology and Natural Resources of the Oblast State Administration.

Total amount of financial resources required for the Programme implementation: total - UAH 237793.684 thousand, including: state budget funds - UAH 101358101, local budget funds - UAH 132785583 (including oblast budget - UAH 128778071, of which rayon, territorial communities, city budget - UAH 2100000, budgets of villages, settlements, cities of rayon significance - UAH 1907512), other sources - UAH 3650000.

The programme participants are the Department of Ecology and Natural Resources of the Oblast State Administration, local governments, the Tiligulsky Regional Landscape Park, and the I. I. Mechnikov Odesa National University.

The main activities of the Programme are:

- protection and rational use of water resources;
- protection and rational use of land and mineral resources;
- preservation of the nature reserve fund and ecological network, protection and rational use of flora and fauna;
- Rational use and storage of production and household waste;
- science, information and education, personnel training, environmental impact assessment, strategic environmental assessment, labour organisation, participation in international environmental organisations, and implementation of an economic mechanism for environmental protection.

According to the Programme implementation report for 2020, only 8 out of 33 planned tasks have been completed, and two tasks are still in progress.

In 2020, the Odesa Regional Comprehensive Environmental Protection Programme for 2020-2021 envisaged the following environmental protection measures, namely:

- item 1.2.1 "Priority measures for cleaning the Gromadsky Canal to improve water exchange between Katlabukh and Saf'yany Lakes" - the regional budget, in terms of Article 85 of the Budget Code of Ukraine - UAH 5,880.0 thousand;
- item 1.2.3 "Development of project documentation for improving the hydrological condition of the Karasulak River (engineering surveys, development of project documentation, environmental impact assessment of the planned activities, expert evaluation, approval of project documentation)" - regional budget, in accordance with Article 85 of the Budget Code of Ukraine - UAH 2000.0 thousand and the budget of villages, towns, cities of district significance - UAH 520.0 thousand;
- item 1.2.4 "Development of project documentation for improving the hydrological condition of the Kyrgyz-Chinese River (engineering surveys, development of project documentation, environmental impact assessment of the planned activities, expert evaluation, approval (endorsement) of project documentation)" - the regional budget, in accordance with Article 85 of the Budget Code of Ukraine - UAH 3200.0 thousand and the budget of villages, towns, cities of district significance - UAH 400.0 thousand;
- item 1.2.5 "Clearing and reconstruction of the complex of culverts and barrier structures along the Malyi Taimenchuk River (KSC SRZ backwater) on the territory of Kiliya ATC" oblast budget - UAH 2000.0 thousand.

The decision of the Odesa Regional Council of 20 December 2019 No. 1199-VII "On the Regional Budget of Odesa Region for 2020" (as amended) provided UAH 1360.0 thousand for clearing riverbeds and flood protection, including

- clearing and reconstruction of a complex of culverts and barrier structures along the Malyi Taimenchuk River (KSS SRZ bay) in the territory of Kiliya ATC - UAH 860.0 thousand.

As of 01.01.2021, UAH 185,941 thousand was allocated from the regional budget for the clearing and reconstruction of a complex of culverts and barrier structures along the Malyi Taimenchuk River (KSS SRZ backwater) in the territory of Kiliya ATC.

Regional Programme "Drinking Water of Odesa Region" for 2021-2024

Approved by the decision of the Odesa Regional Council of 16 April 2021 No. 141-VIII. The programme is aimed at solving the problems with drinking water supply and sewerage in settlements and at developing the water supply and sewerage system, improving its efficiency and reliability.

The objective of the Programme is to provide the population of the region with drinking water of standard quality, develop the water supply and sewerage sector, and improve its efficiency and reliability.

The initiator, developer and responsible executor of the Programme is the Department of Life Support Systems and Energy Efficiency of the Odesa Oblast State Administration.

The Programme participants are district state administrations, local governments, and the Department of Life Support Systems and Energy Efficiency of the Odesa Oblast State Administration.

The total amount of funding is UAH 136,7010 thousand, including UAH 384,000 thousand from the state budget, UAH 326,200 thousand from district and city budgets, UAH 385,200 thousand from village, town, city of district subordination and territorial communities budgets, and UAH 27,610 thousand from other sources.

Areas of activity of the Programme:

- protection of drinking water sources;
- bringing the quality of drinking water to the established standards;
- improving the provision of centralised water supply and sewerage.

Within the framework of the Facility Design Programme: "Construction of the main drinking water pipeline Matroska - Izmail - Bolhrad with engineering structures for water supply to the city of Bolhrad and settlements of Bolhrad and Izmail districts of Odesa region with the reconstruction of water supply facilities from underground sources in the area of Matroska village, Izmail district, Odesa region" was not completed due to lack of funding.

Of the four existing surface water intakes where water is treated to drinking quality, one in Kilia requires a complete reconstruction of its water treatment facilities (the chlorination plant needs to be repaired).

Of the total number of sewage treatment facilities in Odesa Oblast, about 28.6% are in unsatisfactory sanitary and technical condition, namely the sewage treatment facilities in Bolharskyi, Berezivskyi, Bilhorod-Dnistrovskyi districts (Artsyzskyi, Berezivskyi, Saratskyi, Ananivskyi, Oknyanskyi, Tatarbunarskyi districts).

Sewage treatment plants in Odesa, Podilsk and Rozdilnyansky districts need reconstruction. Centralised sewerage systems with wastewater treatment at their own treatment facilities are available in the cities of Odesa, Bilhorod-Dnistrovskyi, Kodyma, Podilsk, Reni, Ananiev, Artsyz, Tatarbunary, Rozdilna, Berezivka, Kilia, Teplodar, and the villages of Zatoka and Ivanivka. Wastewater from the towns of Izmail, Chornomorsk, Balta, Yuzhne and Tarutino is treated at the departmental sewage treatment plants. The settlements of Savran, Zakharivka, Shiryaevo, Velykomykhailivka, Mykolaivka do not have any sewage treatment facilities.

As for the availability of drinking water supply, in 53 settlements of the region, water is supplied according to the schedule, including in the cities of Bilhorod-Dnistrovskyi, water is supplied for 17 hours in the spring and summer, Vilkovo - 20 hours, Tatarbunary - up to 9 hours.

There is no drinking water supply in 182 settlements in the region, which use imported water and mine wells.

Imported drinking water is partially or fully used in the water supply system of the region in 56 settlements, including 1 settlement (Suvorove) and 5 villages, where the population consuming imported water is 32.98 thousand people.

A total of ten activities are planned under the Programme, with two years left to complete and finalise them. In each of the Programme's areas, the activities are implemented in stages, and as of today, most of the planned activities have not yet been implemented or have not been fully implemented. Sufficient funding and active work of the executors will allow completing the planned actions by the end of the deadline.

Programme to improve the environmental situation in Kilia for 2018-2022

The programme was approved by the decision of the Kilia City Council dated 31.01.2018 No. 637-VII-30.

The initiator and developer of the Programme is the Department for the Development of Housing and Communal Services, Humanitarian and Social Work of the Executive Committee of the Kilia City Council. The responsible executor is the Executive Committee of the Kiliia City Council, and the Programme participants are the Executive Committee of the Kiliia City Council, public authorities and other business entities.

The Programme will be implemented in 2018-2022. The sources of funding include the state budget, regional, district budgets, city, village budgets and other sources not prohibited by law. The total amount of financial resources required to implement the Programme is UAH 156444.0 thousand.

The purpose of the Programme is to improve the environmental situation and prevent negative impacts from the poor state of the environment in Kilia. The Programme provides for measures to restore and maintain favourable hydrological conditions and sanitary condition of water bodies. The proximity of surface waters has a negative impact on the livelihoods of the city's population. Outdated, worn-out sewage systems used by Svitlo also have a negative impact on water bodies (surface and underground) in the city of Kilia and the state of the environment in general.

Implementation of the Programme's activities will help achieve the following results:

- preserve the existing water balance and resources;
- maintain the hydrological regime and sanitary condition of the Danube River;
- Ensure the elimination of illegal solid waste dumps;
- to ensure the preservation of green spaces on the council's territory by planting young trees, controlling weeds and ragweed, and landscaping streets;
- Ensuring trouble-free operation of sewerage networks in the local community;
- Involvement of the public in the implementation of environmental protection measures.

Programme for the implementation of the EU Strategy for the Danube Region in Odesa Oblast for 2020-2022

The programme was approved by the decision of the Regional Council on 10.08.2020 No. 1379-VII, as amended on 18.06.2021 No. 209-VIII.

The implementation of the Programme is coordinated by the Department of Economic Policy and Strategic Planning of the Oblast State Administration and the local Association of Local Governments "EU Strategy for the Danube Region".

The Programme's implementation is monitored by the Odesa Oblast Council's Standing Committee on Interregional and International Cooperation.

The Programme will be financed from the state and local budgets, investors' funds, international technical assistance programmes and other sources not prohibited by the current legislation.

The total amount of financial resources required for the implementation of the Programme is UAH 16790086 thousand, including: state budget funds - UAH 2688593 thousand, local budgets (budgets of territorial communities of villages, their associations, towns, cities (including districts in cities), budgets of amalgamated territorial communities) - UAH 301905 thousand, other - 11866796 thousand.

The top priority issues for Odesa Oblast, which the Programme is aimed at addressing, are:

- development of all types of transport links, modernisation of transport infrastructure, and environmental friendliness of transport;
- development of port infrastructure and shipping;
- development of tourism with a focus on domestic tourism, preservation of historical, archaeological, ethno-cultural heritage and their integration into the tourism sector; development of ecological and rural green tourism;
- Reducing energy consumption by increasing energy efficiency of enterprises and modernising the housing stock; increasing the share of renewable energy; and reducing CO_2 emissions;
- Improving the quality of water resources, reducing their pollution, providing the population with high-quality drinking water, protecting and restoring small rivers;
- Establishing an effective natural risk management system, especially in view of climate change and the resulting increase in the frequency and intensity of extreme natural events (floods, droughts, forest and reed fires);
- Increasing the percentage of protected areas, protecting valuable natural sites and territories from destruction, and restoring valuable natural landscapes and ecosystems.

The purpose of the Programme is to ensure proper coordination of individual activities and projects implemented in the Odesa Oblast in the context of the EU Strategy for the Danube Region, to increase the efficiency of the use of funds for these activities and projects, as well as to provide conditions for cooperation between the authorities and local self-government bodies, business entities, scientific and expert community, civil society at both the regional and the Danube macro-region levels for closer integration.

The implementation of the Programme will allow:

- to significantly improve the state of the region's transport infrastructure, which will provide an additional incentive for economic development;

- improve the quality of life of the population, in particular by providing them with quality water supply and sewerage, electricity, and improving the environmental situation;
- improve the quality of the environment, increase the percentage of nature reserves;
- develop the region's tourism potential, including by attracting foreign partners.

Each administrative region develops an environmental development programme based on the specifics of the region. Odesa oblast, which includes the Lower Danube basin, pays more attention to water resources and the protection and conservation of biological and landscape diversity in its environmental target programmes.

Given the economic situation in the country, the state budget is unable to finance significant expenditures on water management and reclamation, housing and communal services, or environmental protection, so at present and in the near future, some new administrative units (NUs) have begun to focus on their own investments, to seek internal reserves of enterprises and funds in the regional, district and amalgamated territorial community budgets, and to attract international assistance.

And the Danube RBMP (Lower Danube sub-basin) with specific measures for each identified sub-basin MOU should be the first to help local communities lay the foundation for future action planning.

8 FULL LIST OF PROGRAMMES (PLANS) FOR THE LOWER DANUBE RIVER SUB-BASIN, THEIR CONTENTS AND PROBLEMS TO BE SOLVED

The RBMP was developed in accordance with the "Methodological Recommendations for Setting Environmental Objectives, Developing a Programme of Measures and Performing a Cost-Effectiveness Analysis of the River Basin Management Plan" (Methodological Recommendations), approved at the meeting of the Scientific and Technical Council of the State Agency of Ukraine for Water Resources on 12 July 2023. The RBMP was developed by the Black Sea and Lower Danube RBMOs in accordance with the Guidelines and the Procedure for Developing RBMPs in cooperation with local executive authorities, local governments, non-governmental organisations (NGOs), scientific and educational institutions (SEIs) and other stakeholders, taking into account the proposals and decisions of the Lower Danube Basin Council.

The development of the software took into account the chemical state of the transboundary IBAs (Danube River - UA_M5.3.4_0001; Yalpukh River - UA_M5.3.4_0023; Kirgiz-China River - UA_M5.3.4_0063) based on monitoring data for 2022-2023. The Programme is developed for a period of 6 years, starting with the first cycle of the plan for 2025-2030. The start of the measure implementation should be no later than the third year from the beginning of the cycle (no later than 1 January 2028). During the implementation, it is allowed to make additions and changes to the approved programme.

A total of 25 main and 6 additional measures are proposed for the RBMP. A full list of measures in the Lower Danube River Sub-basin and their content is provided in Annex 13 (M5.3.4).

8.1 Surface water

For surface waters, the RMP includes the following key measures:

- measures aimed at reducing organic pollution (diffuse and point sources);
- measures aimed at reducing pollution by nutrients (diffuse and point sources);
- measures aimed at reducing pollution by hazardous substances (diffuse and point sources);
- measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of the free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, and modification of river morphology;
- measures aimed at reducing the impact of planned infrastructure projects on water conditions.

In addition to these measures, the RP also includes other measures aimed at addressing other WFD GWPs in the Lower Danube River Basin, identified in view of the specifics and transboundary nature of the sub-basin.

8.1.1 Measures to reduce pollution by organic matter, nutrients and hazardous substances (diffuse and point sources)

Anthropogenic loads and their impacts on the state of the IWM include pollution with organic, biogenic and hazardous substances from the main sources of pollution - sewage treatment plants (STPs) of agglomerations (point pollution) and deterioration/damage/absence of drainage systems (diffuse pollution). The same measure for the construction/reconstruction/modernisation of the agglomeration's SSS and sewerage networks (hereinafter referred to as the "S&S"), including stormwater networks (melt and rainwater), combines the reduction of pollution of the MSW with organic, nutrient and hazardous substances from point and diffuse sources. Anthropogenic loads and their impacts on the state of the IWM allow establishing reasonable correlations between them and developing a software package to achieve certain environmental goals.

The proposed measures aimed at reducing pollution of the Lower Danube sub-basin's IWR fall into three groups:

- measures aimed at reducing organic pollution (diffuse and point sources) - 4 measures;
- measures aimed at reducing pollution by nutrients (diffuse and point sources) - 5 measures;
- measures aimed at reducing pollution by hazardous substances (diffuse and point sources) - 5 measures.

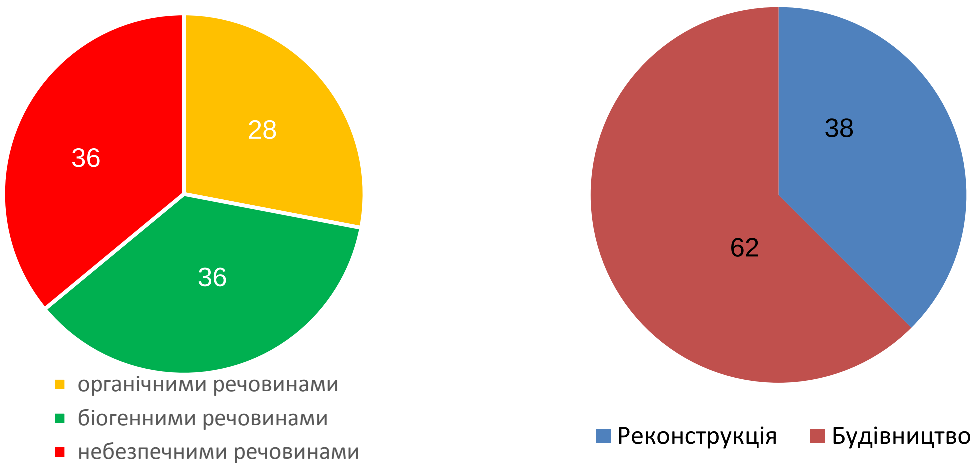


Figure 153. The ratio of measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources and the method of their implementation (reconstruction or construction of CWS and CM), %.

In order to reduce pollution with organic, biogenic and hazardous substances (point and diffuse sources), the following measure is envisaged: "Creation of wastewater treatment and solid waste disposal complexes in the waters of the Danube seaports of five territorial communities of Izmail district, Odesa region" (No. 3). This measure is a pilot project that is planned to be implemented in the CBA to achieve/maintain the "good" status of the Lower Danube MSP.

Measures aimed at reducing pollution by nutrients (diffuse sources) include: "Establishment of water protection zones and coastal protection strips of water bodies" (No. 5 of the list of measures. Measures aimed at reducing pollution by hazardous substances (diffuse sources) include the measure: "Rehabilitation of the territory of the former oil storage facility and prevention of pollution by oil products in the border area of Reniisky TG, Izmail district, Odesa region" (measure No. 2). The project envisages a set of measures to prevent oil pollution of the Danube River bank, with an estimated area of 0.35 hectares and a volume of 6.5 thousand cubic metres of contaminated soil.

In accordance with the requirements of the Law of Ukraine "On Wastewater Disposal and Treatment" dated 12 January 2023 No. 2887-IX, in order to ensure high-quality centralised wastewater disposal while reducing the impact of wastewater on the IBA, 5 settlements (31%) of the Lower Danube sub-basin, with a population equivalent (PE) of 2,000 or more, plan to build/reconstruct Sewage Treatment Plants and KMs. The proposed measures to reduce pollution by organic, biogenic and hazardous substances and their implementation in terms of new construction or reconstruction/modernisation indicate the following: 3 TSs (Izmail, Kiliya and Reni) require reconstruction/modernisation of the SPSs and CMs. The construction of new CS and CM is envisaged for 2 TS (Safianivska and Vylkivska).

Among the measures aimed at reducing pollution by organic, biogenic and hazardous substances (diffuse and point sources): 4 measures are classified as "at risk", 1 measure is classified as "possibly at risk", and none of the measures are classified as "no risk". The share of the proposed measures aimed at reducing pollution by organic, biogenic and hazardous substances from point sources of pollution depending on the risk assessment is presented in Figure 154.

Figure 154. Distribution of measures aimed at reducing pollution by organic, biogenic and hazardous substances, depending on the risk assessment of IWR, %.

All proposed measures aimed at reducing pollution by organic, biogenic and hazardous substances relate to the category of "rivers" and only one measure relates to the category of "lakes" in order to achieve/maintain "good" ecological status of the MNR.

8.1.2 Measures aimed at improving/restoring hydrological regime and morphological indicators

The number of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of impaired free flow of rivers in the Lower Danube sub-basin is 19. When developing the measures, it was taken into account that the environmental objectives for the MSPs are to achieve "good" status for 7 MSPs and 11 IZMVPs (the Kirgiz River is included in two measures, which are listed under Nos. 19 and 20).

Measures aimed at improving/restoring the hydrological regime and morphological indicators depending on the risk assessment are presented in Figure 155.

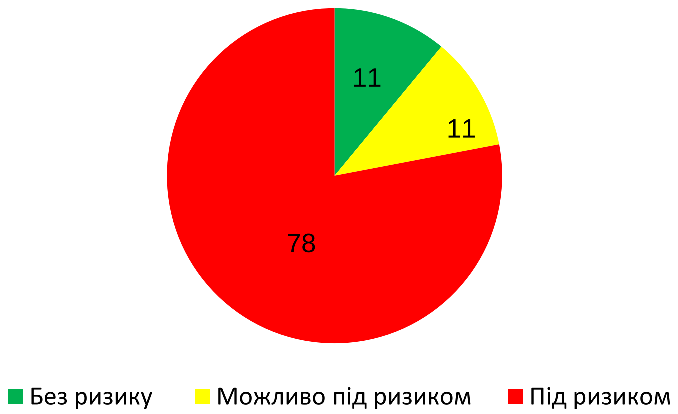


Figure 155. Distribution of measures aimed at improving/restoring the hydrological regime and morphological indicators in case of disruption of free flow of rivers, hydraulic connection between river channels and their floodplains, hydrological changes, modification of river morphology, depending on the assessment of IWR risks, %.

8.2 Groundwater

For groundwater, the RMP includes the following key measures:

- measures aimed at reducing pollution (diffuse and point sources);
- measures aimed at preventing groundwater depletion;
- measures aimed at reducing the impact of planned infrastructure projects on water conditions.

In order to achieve/maintain a "good" quantitative and qualitative state of the IWZs, the following two measures are to be implemented first of all: "Establishing the boundaries of sanitary protection zones for groundwater intakes used for centralised water supply to the population, medical and recreational needs, indicating them in land management documentation, urban planning documentation at the local and regional level, entering information on relevant restrictions on land use into the State Land Cadastre and marking these boundaries on the ground with information signs" and "Mandatory equipping of all water intake wells with water regulating and controlling devices. These measures cover all the subbasin's WUAs and will be implemented at the expense of water users and local TGs.

8.3 Other measures

Other measures include the following additional measures: legislative, administrative, fiscal, research, educational, aimed at introducing new technologies, environmental and communication, design, and others.

The additional activities include such research activities as "Economic and environmental certification of water users in the Lower Danube sub-basin on the basis of digitalisation 16 TG Bilhorod-Dnistrovskyi rayon, Bolhradskyi rayon, Izmailskyi rayon, Odesa oblast", "Development of the Strategy for the greening of water management activities in the context of sustainable development of the Lower Danube sub-basin" 16 TG Bilhorod-Dnistrovskyi rayon, Bolhradskyi rayon, Izmailskyi rayon, Odesa oblast", "Modernisation of the hydrological infrastructure management system and hydrological monitoring of water management systems "Kyslytskyi arm of the Stepovyi arm - floodplain of the Stepovyi arm - Lake China" Safianivska TG, Izmail district, Odesa region", "Modernisation of the hydrological infrastructure management system and hydrological monitoring of the water management systems "Safiany - Katlabukh" Safianivska TG, Izmail district, Odesa region", "Modernisation of the hydrological infrastructure management system and hydrological monitoring of the Kyslytskyi Rukav - Staronekrasivski Plains - Lung Lakes", Izmail TG, Izmail district, Odesa region, and "Modelling of water and salt balance and water quality in the Danube Lake Katlabukh, Safianivka TG, Izmail district, Odesa region". Five activities are planned for the Lower Danube, aimed at improving hydromorphological characteristics and creating wastewater treatment facilities.

8.4 Overall assessment of the effectiveness of the proposed measures for the LIP

The RP includes measures aimed at reducing pollution by organic, biogenic and hazardous substances from point and diffuse sources, measures to improve/restore the hydrological regime and morphological indicators, hydrological changes, modification of river morphology, and other additional measures aimed at achieving and/or maintaining the "good" status/potential of the MNR. Some measures belong to several WEAs. The largest share of measures is aimed at improving/restoring the hydrological regime and morphological indicators (44%), pollution of the IWR (40%) and other measures (16%). The overall structure of the PAs in terms of proposed measures for surface waters in the Lower Danube sub-basin is presented in Figure 156.

Figure 156. Main and additional measures for the Lower Danube sub-basin MEA

The vast majority of measures relate to hromadas/settlements with a population of 10.0 to 100.0 thousand. There are 24 (77%) of such measures, while there are only 3 (10%) for hromadas with a population of 2.0 to 10.0 thousand. There are only 4 (13%) measures for agglomerations with a population of more than 100,000.

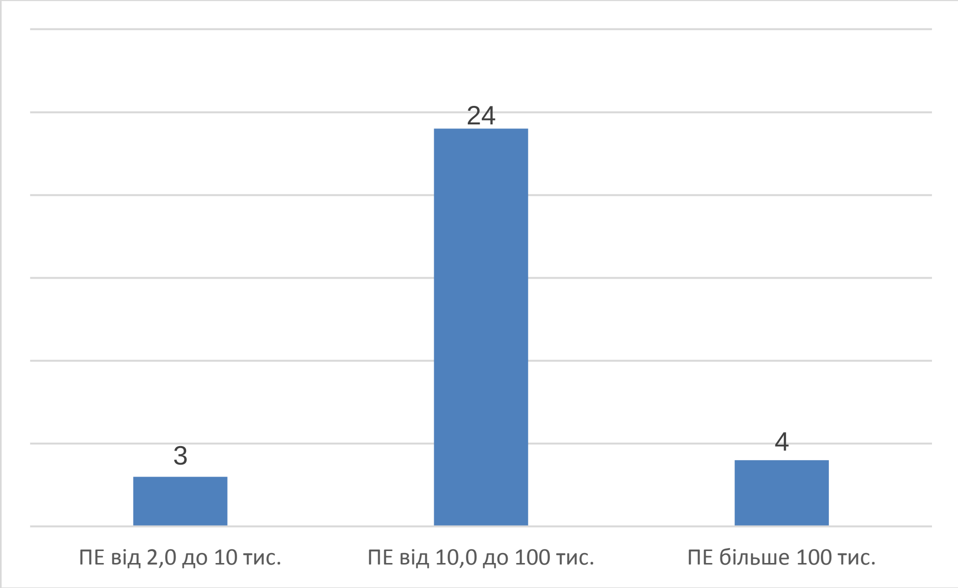


Figure 157. Number of measures by PE in the Lower Danube sub-basin

In accordance with the RBMP Development Procedure, the measures envisaged in the RBMP are financed from the state and local budgets, as well as other sources not prohibited by law. These measures are financed from the state budget within the limits of expenditures envisaged by the State Budget of Ukraine for the respective year.

The cost-effectiveness analysis was carried out for 25 key measures with a total cost of UAH 2632.901 million (Annex 14 (M.5.3.4)).

The scale of social impact is 539.86 thousand people.

The implementation period is 6 years (2025-2030).

The number of WUAs covered by the measures is 27 WUAs (25.5% of all WUAs in the sub-basin).

Table 151. Matrix for assessing the cost-effectiveness of the Lower Danube River Sub-basin Action Programme

Criteria.	**Level of efficiency**				
	Very high *(mean value 5)*	**High** *(mean value 4)*	**Medium** *(mean value 3)*	**Low** *(mean value 2)*	**Very low** *(mean value 1)*
Balance of event cost/event value	1		7	15	2
Success rate		1	3		21
Social efficiency		1	1	19	4
Pressure from the water sector	4		1		20

The total cost of all the proposed measures for the period 2025-2030 is UAH 2,639.3 million, with a cost per TS (16) of UAH 164.9 million. The most costly measures are those related to the reconstruction/modernisation of the KWS and KM. For example, up to UAH 1,269.8 million is needed to implement such measures in Izmail.

The analysis of the cost-effectiveness of the RBMP programme of measures did not identify any measures with a very high level of efficiency.

One measure with a total cost of UAH 1,269.8 million (48% of the total cost of all measures) was included in the group with a high level of efficiency, namely "Reconstruction of sewage treatment facilities in Izmail, Izmail TG, Izmail district, Odesa region". The social effect is 70.5 thousand people.

The group of medium efficiency includes 3 measures with a total cost of UAH 778.866 million (29% of the total cost of all measures). The measures are mainly aimed at addressing the main HAPs: reducing pollution by organic, nutrient and hazardous substances from small towns and villages in the sub-basin. The social impact is 274.1 thousand people.

The group with a low level of effectiveness includes 17 measures with a total cost of UAH 513.775 million and a social effect for 181.26 thousand people. 16 measures in this group are aimed at addressing hydro-morphological changes by implementing measures to revitalise and clean up the Kyrgyz-China, Aliyaga, Kyrgyz, Dunayets, Maly Katlabukh and other rivers. This group also includes the establishment of water protection zones and coastal protection strips for water bodies in 16 TGs in Bilhorod-Dnistrovskyi, Bolhrad-skyi and Izmailskyi districts of Odesa Oblast.

The group with a very low level of efficiency includes 4 measures aimed at improving hydromorphological indicators. These are measures to revitalise and clean up water bodies within the administrative boundaries of Krynychne TG, Bolhrad district. UAH 70.432 million is envisaged for the implementation of these measures, which will achieve a social effect for 42.3 thousand people, which corresponds to a very low level according to the criteria being assessed.

The action programme also includes 6 additional measures with a total cost of UAH 120.1 million. These measures include economic and environmental certification of water users, modernisation of the hydrolog-ical infrastructure management system and hydrological monitoring of water management systems, mod-elling of water and salt balance and water quality in the Danube Lake Katlabuh. These activities do not have a direct social impact.

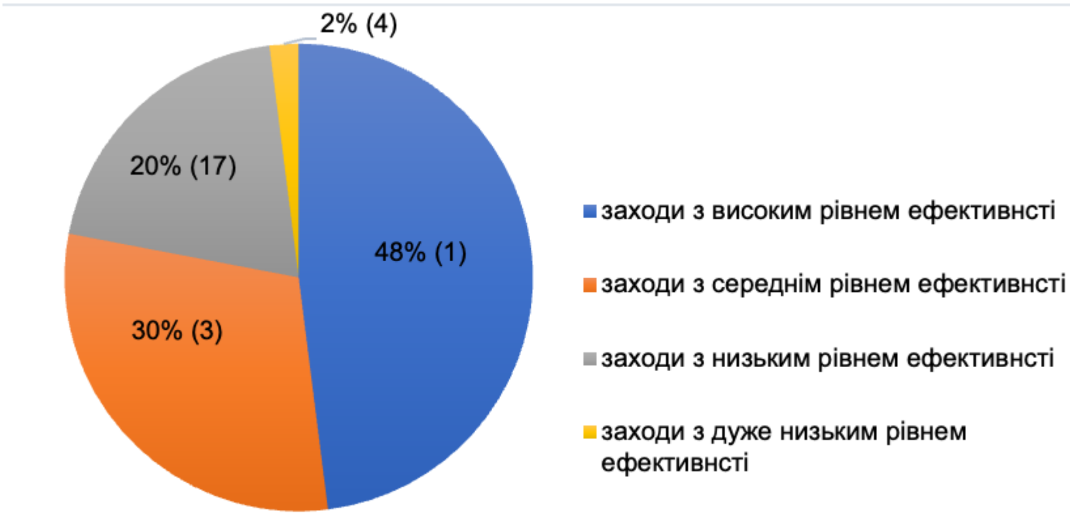


Figure 158. Distribution of measures with different levels of efficiency by total cost of measures

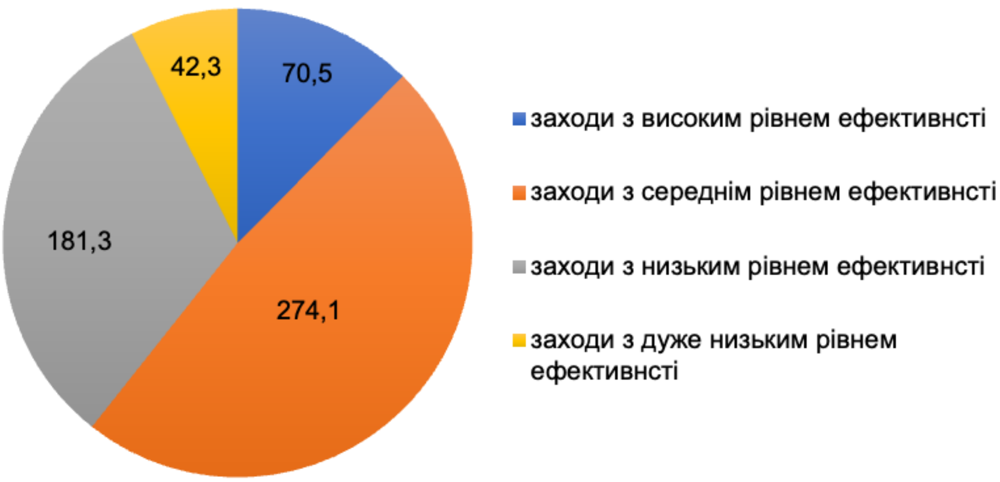


Figure 159. Distribution of measures with different levels of effectiveness by social component, thousand people

9 REPORT ON PUBLIC INFORMATION AND PUBLIC DISCUSSION OF THE DRAFT RIVER BASIN MANAGEMENT PLAN

During 2022-2023, the Black Sea and Lower Danube River Basin Water Management Authority (hereinafter referred to as the BSRBWMA) held consultations with the public of Odesa Oblast on the main water and environmental issues (hereinafter referred to as the WEA) of the Lower Danube sub-basin, development of a complete list of programmes (plans) for the Lower Danube sub-basin, their content and problems to be solved (hereinafter referred to as "the Programmes"), and preparation of a draft management plan for the Lower Danube River Sub-basin for 2025-2030.

In order to timely prepare the Lower Danube Sub-basin RBMP approved by the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 313 of 27 November 2020 "Schedule for the Process of Developing the Draft Lower Danube River Sub-basin Management Plan", to implement the Orders of the State Agency of Water Resources of Ukraine No. 44 "On Approval of the Action Plan" of 16 May 2022, and No. No. 1105 "On the Development of Draft River Basin Management Plans", the RBMOs of the Black Sea and Lower Danube Rivers held online meetings for three days (10-12 August) in 2022, and offline meetings with representatives of district state administrations, territorial communities and water users in April-May 2023 to ensure the preparation of the RBMP for the Lower Danube Sub-basin for the period 2025-2030, taking into account the need to plan measures during the military and reconstruction periods.

Additionally, in order to ensure the preparation of the RMP for the development of the RBMP for the Lower Danube Sub-basin for the period 2025-2030, the Black Sea and Lower Danube Rivers Authority prepared and sent letters to business entities providing water supply and sewerage services (water utilities), industrial enterprises, agricultural enterprises, hotel and tourist facilities, and health resorts in the region that discharge wastewater into surface water bodies (SWBs) of the Lower Danube sub-basin with a request to submit their proposals to the RMP aimed at addressing the GWP of the Lower Danube sub-basin.

At the regular meeting of the Black Sea Rivers Basin Council, the positions aimed at addressing the GWP of the Lower Danube River Sub-basin were considered and approved. The section will be updated after public consultations in 2024.

In accordance with the Law of Ukraine "On Strategic Environmental Assessment" dated 20.03.2018 No. 2354-VIII, river basin (sub-basin) management plans are subject to strategic environmental assessment (SEA) prior to their approval. According to Art. 2 of the Law of Ukraine "On Strategic Environmental Assessment", SEA is mandatory for projects of the BDS that meet two criteria at the same time: related to agriculture, forestry, fisheries, energy, industry, transport, waste management, water resources, environmental protection, telecommunications, tourism, urban planning or land management (scheme) and the implementation of which will involve the implementation of activities (or contain activities and objects) for which the legislation

SEA allows to focus on a comprehensive analysis of the possible environmental impact of planned activities, which allows to reasonably assess strategic documents in terms of environmental and public health impact, coordinate them with each other and use the results of this analysis to prevent or mitigate environmental impacts in the strategic planning process. SEA contributes to the overall transparency of strategic decision-making and enables the opinions and suggestions of key stakeholders to be taken into account at an early stage of planning and development of the SEA. The SEA provides for clear procedures for consultation and communication between key government authorities, business and civil society representatives, which contributes to more informed and balanced decision-making.

The section will be supplemented after public consultations in 2024 and the completion of the SEA procedure.

10 LIST OF COMPETENT STATE AUTHORITIES RESPONSIBLE FOR IMPLEMENTING THE RIVER BASIN MANAGEMENT PLAN

According to part two of Article 13 of the Water Code of Ukraine, the Cabinet of Ministers of Ukraine, the Council of Ministers of the Autonomous Republic of Crimea, village, town and city councils and their executive bodies, district and regional councils, executive authorities and other state bodies are responsible for public administration in the field of water use and protection and water resources restoration in accordance with the legislation of Ukraine.

The executive authorities in the field of water use and protection and water resources reproduction are the Ministry of Ecology, the State Water Agency, the State Geological Survey, the State Ecological Inspectorate and other bodies in accordance with the law.

Table 153. Executive authorities in the field of water use and protection and water resources reproduction

Title.	Address.	Address of the official website
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	35, Metropolyt Vasyl Lypkivskyi St., Kyiv, 03035 tel.: (044) 206-31-00, (044) 206-31-15, fax: (044) 206-31-07, E-mail: info@mepr.gov.ua	www.mepr.gov.ua
State Agency of Water Resources of Ukraine (SAWR)	8 Velyka Vasylkivska St., Kyiv, 01024 tel./fax: (044) 235-31-92, tel. (044) 235-61-46 E-mail: davr@davr.gov.ua	www.davr.gov.ua
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	16 Anton Tsedik St., Kyiv, 03057 tel: (044) 536-13-18 E-mail: office@geo.gov.ua	www.geo.gov.ua
State Environmental Inspectorate of Ukraine (SEI)	3, building 2, Novopecherskyi lane, Kyiv, 01042 tel./fax +38 (044) 521-20-40 tel: (044) 521-20-38 E-mail: info@dei.gov.ua	www.dei.gov.ua

Table 154. Main regulatory acts that define the powers of executive authorities in the field of water use and protection and water resources reproduction

Name of the body	Legal act	Link on the official website of the Parliament of Ukraine
Ministry of Environmental Protection and Natural Resources of Ukraine (MEPNR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Articles 15 and 15^1	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text

Name of the body	Legal act	Link on the official website of the Parliament of Ukraine
	Regulation on the Ministry of Environmental Protection and Natural Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 25 June 2020, No. 614 (Official Gazette of Ukraine, 2020, No. 59, p. 32, Article 1853)	https://zakon.rada.gov.ua/laws/show/614-2020-%D0%BF#Text
State Agency of Water Resources of Ukraine (SAWR)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 16	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Agency of Water Resources of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 20 August 2014, No. 393 (Official Gazette of Ukraine, 2014, No. 71, p. 34, Article 1995)	https://zakon.rada.gov.ua/laws/show/393-2014-%D0%BF#Text
State Service of Geology and Mineral Resources of Ukraine (Derzhgeonadra)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 17	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text
	Regulation on the State Service of Geology and Subsoil of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 30 December 2015 No. 1174 (Official Gazette of Ukraine, 2016, No. 3, p. 284, Article 192)	https://zakon.rada.gov.ua/laws/show/1174-2015-%D0%BF#Text
State Environmental Inspectorate of Ukraine (SEI)	The Water Code of Ukraine of 6 June 1995, No. 213/95-BP (Bulletin of the Verkhovna Rada of Ukraine (VVR), 1995, No. 24, p. 189) - Article 15^2	https://zakon.rada.gov.ua/laws/show/213/95-%D0%B2%D1%80#Text

Name of the body	Legal act	Link on the official website of the Parliament of Ukraine
	Regulation on the State Environmental Inspectorate of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 19 April 2017 No. 275 (Official Gazette of Ukraine, 2017, No. 36, p. 73, Article 1131)	https://zakon.rada.gov.ua/laws/show/275-2017-%D0%BF#Text
	Regulation on Territorial and Interregional Territorial Bodies of the State Environmental Inspectorate, approved by the Order of the Ministry of Energy and Environmental Protection of Ukraine dated 07 April 2020 No. 230, registered with the Ministry of Justice of Ukraine on 16 April 2020 under No. 350/34633 (Official Gazette of Ukraine, 2020, No. 33, p. 25, Article 1116)	https://zakon.rada.gov.ua/laws/show/z0350-20#Text

In order to ensure the implementation of the state policy in the field of management, use and reproduction of surface water resources within the Lower Danube River Sub-basin, to direct and coordinate the activities of organisations under the management of the State Agency of Ukraine for Water Resources on management, use and reproduction of surface water resources within the Lower Danube River Sub-basin, as well as to ensure the implementation of the state policy in the field of water management within Odesa region, the State Agency of Ukraine for Water Resources created the

Name of the organisation	Address.	Telephone/fax	Email.	Website.
The Black Sea and Lower Danube River Basin Water Manage-ment Authority (Black Sea and Lower Danube Rivers)	13, Ivan and Yurii Lypiv Str., Odesa, 65078	(048)766-91-02	buvr_odesa@oouvr.gov.ua	www.oouvr.gov.ua

The names of sub-basins and water management areas within river basin districts are given in the Annex to the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 25 "On the Allocation of Sub-Basins and Water Management Areas within Established River Basin Districts" dated 26 January 2017, registered with the Ministry of Justice of Ukraine on 14 February 2017 under No. 208/30076 (https://zakon.rada.gov.ua/laws/show/z0208-17#Text).

The boundaries of river basin districts, sub-basins and water management areas were approved by the Order of the Ministry of Ecology and Natural Resources of Ukraine No. 103 dated 03.03.2017, registered with the Ministry of Justice of Ukraine on 29 March 2017 under No. 421/30289 (https://zakon.rada.gov.ua/laws/show/z0421-17#Text).

The Black Sea and Lower Danube Rivers Basin Water Management Authority is a budgetary non-profit organisation that falls under the management of the State Agency of Ukraine for Water Resources. The Regulation on the Black Sea and Lower Danube Rivers Basin Water Management Authority was approved by the Order of the State Agency of Ukraine for Water Resources dated 06.07.2023 No. 80.

The Lower Danube Basin Council is a consultative and advisory body of the State Agency for Water Resources Management of the Lower Danube Sub-basin in order to develop proposals and ensure coordination of interests of enterprises, institutions and organisations in the field of water use and protection and water resources restoration within the Lower Danube Sub-basin area, to promote integrated water resources management within the Lower Danube Sub-basin area, to ensure coordination of interests and coordination of actions of stakeholders in water resources management within the Lower Danube Sub-basin area, to facilitate cooperation between central and local executive authorities, bodies The Lower Danube Basin Council is an advisory body to the State Agency of Water Resources of Ukraine within the Lower Danube Sub-basin area. The Regulation on the Lower Danube Basin Council was approved by the Order of the State Agency of Water Resources of Ukraine No. 972 dated 22.12.2018.

According to the List approved by Resolution of the Cabinet of Ministers of Ukraine No. 1371 dated 13 September 2002 (as amended by Resolution of the Cabinet of Ministers of Ukraine No. 1276 dated 30 November 2011) (https://zakon.rada.gov.ua/laws/show/1371-2002-%D0%BF#n38), the Ministry of Ecology and/or the State Agency of Water Resources of Ukraine are responsible for fulfilling international obligations in the field of water protection arising from Ukraine's membership in international organisations or in accordance with international treaties concluded by Ukraine.

In addition, pursuant to Article 9 of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (https://zakon.rada.gov.ua/laws/show/801-14#Text), the Government of Ukraine has concluded bilateral agreements on the protection of border/boundary waters, the responsibility for which lies with the State Agency of Water Resources:

- Agreement between the Government of Ukraine and the Government of Romania on Cooperation in the Field of Water Management on Boundary Waters of 30 September 1997 (https://zakon.rada.gov.ua/laws/show/642_059#Text)

- Agreement between the Government of Ukraine and the Government of the Republic of Moldova on the Joint Use and Protection of Boundary Waters of 23 November 1994 (https://zakon.rada.gov.ua/laws/show/498_051#Text).

11 PROCEDURE FOR OBTAINING INFORMATION, INCLUDING PRIMARY INFORMATION, ON THE STATE OF SURFACE AND GROUNDWATER

In order to ensure proper organisation of access to public information, implementation of the Law of Ukraine "On Access to Public Information", Presidential Decree No. 547 of 05 May 2011 "Issues of Ensuring Access to Public Information by Executive Authorities", resolutions of the Cabinet of Ministers of Ukraine No. 583 of 25 May 2011 "Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the Secretariat of the Cabinet of Ministers of Ukraine, Central and Local Executive Authorities", No. 835 of 21 October 2015 "On Approval of the Regulation on

To regulate the procedure for access to public information, the State Agency of Ukraine for Water Resources adopted Order No. 163 dated 08.12.2023 "On Certain Issues of Implementation of the Law of Ukraine "On Access to Public Information" in the State Agency of Ukraine for Water Resources".

In accordance with paragraphs 16-18 of the Procedure for State Water Monitoring, approved by Resolution of the Cabinet of Ministers of Ukraine No. 758 of 19 September 2018, the results of state water monitoring are:

- Primary information (observation data) provided by the subjects of state water monitoring;
- generalised data relating to a certain period of time or a certain territory;
- Assessment of the ecological and chemical state of surface water bodies, the ecological potential of artificial or significantly altered surface water bodies, the quantitative and chemical state of groundwater bodies, the ecological state of marine waters and identification of sources of negative impact on them;
- forecasts of water conditions and their changes;
- scientifically based recommendations necessary for making management decisions in the field of water use and protection and water resources reproduction.

Subjects of state water monitoring are obliged to store primary information (observation data) obtained as a result of state water monitoring for an indefinite period of time.

The information obtained and processed by the state water monitoring bodies is official.

Primary information (observation data), generalised data, assessment results, forecasts and recommendations resulting from the state water monitoring are provided free of charge:

- for MNR (including coastal waters) - to the State Water Agency and the Ministry of Environment;
- for the Mine Reserves - to the State Service of Geology and Mineral Resources and the Ministry of Environment, as well as to the State Water Agency in terms of generalised data, assessment results and forecasts;
- for marine waters - the Ministry of Environment.

The subjects of state water monitoring shall exchange information with each other on the data and results of state water monitoring on a free-of-charge basis.

The State Agency of Ukraine for Water Resources collects and publishes information on the state of surface waters in the public domain by maintaining the following information resources:

- Water Resources of Ukraine geoportal (http://geoportal.davr.gov.ua:81/);
- the web-based system "Monitoring and Environmental Assessment of Water Resources of Ukraine" (http://monitoring.davr.gov.ua/EcoWaterMon/GDKMap/Index).

Automatic data exchange has been set up between these information resources and the Ministry of Ecology's EcoThreat resource.