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Environmental Protection of International River Basins

DEVELOPMENT OF DRAFTRIVER BASIN MANAGEMENT PLAN FOR A SELECTED PILOTBASIN IN BELARUS (THE UPPER DNIEPER BASIN)

ECONOMIC ANALYSIS AND PRIORITY MEASURES

Prepared by

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With assistance of
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Republican Center on Analytical Control in the field of Environmental Protection, Belarus

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ABBREVIATIONS

BAT	Best available techniques
Belarus	Republic of Belarus
CRICUWR	Central Research Institute for Complex Use of Water Resources (MNREP, Belarus)
EU	European Union
GWB	Groundwater body
HCS	Housing and communal services
HMW	Heavily modified water bodies
HPP	Hydro power plant
IPCC	Intergovernmental Panel on Climate Change
MAC	Maximum allowable concentrations
MNREP	Ministry of Natural Resources and Environmental Protection of the Republic of Belarus
MSW	Municipal solid waste
MTP	Minsk treatment plant
NEMS	National Environmental Monitoring System of the Republic of Belarus
NPP	Nuclear power plant
PoM	Program of Measures
project	International project “Development of draft river basin management plan pilot basin of the upper Dnieper, Belarus"
RCACEP	Republican Center of Analytical Control in the field of Environmental Protection (MNREP, Belarus)
RCRCEM	Republican Center of Radiation Control and Environmental Monitoring (MNREP, Belarus)
SWC	State Water Cadastre of the Republic of Belarus
TCP	Technical Code of Common Practice (national regulations, Belarus
Water Convention	United Nations Economic Commission for Europe (UNECE) – Convention on the protection and use of transboundary watercourses and international lakes
WFD	Directive 2000/60/EC of the European Parliament and the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (EU Water Framework Directive)
WP и CS	Water protection zone and the coastal strip

INTRODUCTION

This report has been prepared by the experts of CRICUWR in association with the partners from RCRCEM and RCACEP in the frame of the contract for the development of the project management plan for the river basin of the selected pilot basin in Belarus (the Upper Dnieper basin).

The following experts participated in preparing the report,:

- Vladimir Korneev, Lubov Hertman, Vladimir Anufriev, Kanstantsin Tsitou, Aliaksandr Pakhomau, Ivan Bulak (CRICUWR).

In preparing the report, there has been considerable methodological assistance and cooperation from key expert of the project – Aliaksandr Stankevich.

In preparing the report, materials from the following reports of the project were used:

- "Pressures and impacts analysis on water bodies" (report prepared by CRICUWR);

- "Water bodies and risk analysis" (report prepared by CRICUWR);

- "Environmental objectives" (report prepared by CRICUWR);

- "Identification, characterization and delineation of groundwater bodies in the Dnieper basin, Belarus" (author – Bernardas Paukshtis);

- "Identification and typology of water bodies" in the Dnieper basin, Belarus "(authors - Tatiana Kol'tsova and Michael Jackman, with the assistance of Aliaksandr Stankevich and technical execution of CRICUWR);

- "Classification of groundwater bodies" (report prepared by Bernardas Paukshtis - KE5 expert on ground water);

- «Joint Field Survey Report: Surface Waters 2013: Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine, DRAFT v.1, 01 September 2013 (Author of report: Svetoslav Cheshmedjiev - KE3 Ecology & Biology Expert, Tatjana Kolcova - KE4 Hydromorphology , ZurabJincharadze KE2);

And other project materials.

Economic analysis and preparation of preliminary priority actions for the Upper Dnieper basin includes:

- economic analysis of the situation in the basin, including population, industry, agriculture, shipping, energy, affecting the condition of water bodies;
- features of water use;
- influence of water resources and their state on the economic activity;
- analysis of government programs for socio-economic development of the region;
- draft program of activities for Basin Management Plan of the Upper Dnieper.

The main guiding document when performing economic analysis is the Governing document №1 to the WFD "Economics and environment";

Additionally, the following regulations and other tools of water-environmental policy were used:

- Directive of the European Parliament and of the Council of the European Union number 2000/60 / EC of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive);

- Water Code of the Republic of Belarus (approved by Presidential Decree of April 30, 2014 N 149-Z);
- Water Strategy of the Republic of Belarus for the period up to 2020 (approved by the Council of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus 11.08.2011 № 72-P);

Economic analysis and preparation of preliminary priority measures to achieve and maintain good ecological status of water bodies in the Upper Dnieper basin are based on the experience:

- Danube River Basin District Management Plan 2009;
- National river Tisza basin management plan, 2012;
- International River Basin District Meuse - Analysis, Roof Report, International Meuse Commission, 2005;
- Internationally Coordinated Management Plan for the International River Basin District of the Rhine, in 2009;
- Plan of gradual improvement of the water system the Svisloch river – the Osipovichy reservoir for 2014-2020, 2013.
- Investigation of the water supply and sanitation sector in the Republic of Belarus. The World Bank Washington. 2013

Photo on the title page - the river Sozh, Gomel (Belarus) is presented by Lubov Hertman

1 ECONOMIC ANALYSIS

1.1 Features of the economic (business) activity in the basin

Identified in earlier phases of research water bodies at the risk of failing good ecological status represent only 11.5% of the total amount of the allocated water bodies. For them are identified the most important sources of exposure, it allows to identify the main activities to improve the ecological status of water bodies. Nevertheless, the development of measures to maintain a good ecological status of other water bodies in the basin is also important. Therefore, economic analysis of the situation in the basin and determination of the most characteristic effects in the whole basin are necessary for assessment of the long-term development in the basin, including hydro problems.

1.1.1 Population[1]

In the basin of the Upper Dnieper in Belarus are located 41 city, 26 small towns and of district type, over 15 large villages and many smaller settlements (hamlets, villages, etc.).
Population density (73.63 people per 1 km^2) is the largest compared to other basins of major rivers. The highest population density is in the Minsk region - 185.01 people per 1 km^2.
In large cities - Minsk, Gomel, Mogilev, Orsha, Zhodino and Bobruisk - population density exceeds 2,000 people per 1 km^2 (Minsk - 6,201.56 people per 1 km^2).
Water to the population in the basin is carried out mainly from centralized systems exploited by public utilities of settlements.
Provision of urban population with centralized water supply in Minsk – up to 99%, in the Minsk region - 93%, Mogilev region - 97.2%, Gomel region - 81.6%. Provision of rural population of Mogilev region - 69.9%, Gomel region - 50%. Public water supply is carried out with water from underground sources, with the exception of the city of Minsk, where the average daily intake is 535.3 thous.$m^3$and 150 thous.$m^3$from it are supplied from surface water sources Vileika-Minsk water system. Currently a phased transfer of water supply to the city of Minsk from underground sources is carried out.
Provision of the population with centralized wastewater disposal in Minsk - up to 95%, urban population in the Gomel region - 81.6%, in the Minsk region - 85%, Mogilev region - 90.9%.The provision of rural population with centralized and local systems for household wastewater in the Mogilev region – 45.3%, Gomel region - 50%.
The main problems in the field of water supply and sewerage in the basin are:

- Inadequate supply of the population with centralized water supply, especially in rural areas (for example, in the Gomel region is not provided about 272 thousand people, including 52 thousand of urban and 220 thousand of rural population), as well as centralized sewerage system;

- Ensuring the quality of drinking water sources in the non-centralized water supply systems (wells and boreholes);

- Inadequate drinking water supply standard quality of centralized water supply systems due to increased iron concentrations greater than 0.3 mg / l);

- High physical deterioration of sewage treatment facilities, lack of modern technology and equipment for waste water treatment, including of nutrients (nitrogen and phosphorus), and insufficient level of automation and scheduling processes;

[1]- preparing this chapter the materials of the report "Development of Scheme of complex use and protection of watersfor river Dnepr basin (2013)", CRICUWR- Minsk, 2013, 124 p. 82-92 were used.

- High physical deterioration of networks, equipment and facilities;

- Violation of the requirements of urban development in matters of sanitary protection zones of water intakes;

- Failure modes for sanitary protection zones of water intakes and norms of sanitary protection of sources of centralized water supply.

Problems exist also in the functioning of public utilities providing water and wastewater services to the population. In the period under review the level of reimbursement of operational costs is provided by the so-called "cross-subsidization" and the direction of subsidies from local budgets Reimbursement of depreciation costs, and the more income-providing development of water and wastewater systems at their own expense is yet unattainable in the short term. There is the goal of eliminating "cross-subsidization" and grants to ensure full recovery of operating costs. In this connection, the investment in the industry ensures the implementation of the state program "Clean Water" with funding from state and local budgets, borrowing the International Bank for Reconstruction and Development and other international and regional financial institutions.

Remains rather low level of sanitary arrangement of rural settlements. Simple and still widely used technical solutions in this area are raked and the well screen to divert domestic wastewater. Hygienic risk when using this kind of structures is quite high. Due to the filter waste water through the soil is an intensive flow of pollutants into groundwater. Especially, this problem is exacerbated at high elevations in groundwater levels. When water is taken from wells and wells drilled in the upper aquifer, the content of nutrients (especially nitrogen compounds - nitrate and ammonium nitrogen) in water may exceed the allowable concentrations for decentralized water supply several times.There have been cases of nitrate content in water abstracted from wells about 100-500 mg /dm^3 at MAC of 40 mg / dm^3. The use of such water for drinking is a serious danger, especially for children. The use of septic tanks instead of raking can only reduce the pollution intensity of pollutants, but does not fully solve the problem of environmental safety sanitation. Such traditional approaches to sanitation in rural areas and in the areas of individual building in cities also lead to contamination of surface water and groundwater. Furthermore uneasiness when placing buildings in the planning of individual building in areas adjacent to small rivers leads to intense discharges in river when snow melts, runoff of contaminated water generated during rainfall.

To a high risk of surface and groundwater contamination also leads the practice of allocating land for construction of a new individual buildings with a minimum level of engineering infrastructure (electrical networks, water and dirt roads or driveways), i.e. without equipping sewerage system. This approach leads to the widespread use of simple structures for sewage - septic tanks and raked, leading to an intense flow of contaminants during filtration.

Large communities are a powerful source of local pollution by nutrients, primarily due to receipt of sewage from wastewater treatment plants utilities.

Through intensive sampling of groundwater for water supply is noted formation of hydrodynamic funnels of different sizes. In the district of Minsk urban agglomeration as a result of intensive exploitation of groundwater has formed a mega funnel with a diameter up to 40-70 km down the center to 25-40 m.

Within settlements are formed the sources of water pollution with surface waste water containing a significant amount of oil.

The big problem is MSW landfills, which are a source of contamination of both surface and underground water bodies.

Another aspect is related to the right of the population on the use of water bodies for recreation. Eutrophication of water bodies leads to a sharp decrease in their recreational appeal. Branch does not have the resources to impact water bodies subject to eutrophication. The result is that for these purposes are starting to use less available water bodies with increasing anthropogenic impact on them.

1.1.2 Industry[2]

In the Dnieper River basin are concentrated the largest industrial centers of the country - Minsk, Zhodino, Gomel, Bobruisk, Mogilev, Zhlobin, Shklov, Svetlogorsk Dobrush, Orsha and others.
Minsk is the major industrial center of the country. Minsk enterprises produce 19.7% of the national volume of industrial production.
The presence of natural waters pollution sources with different pollutants, the content of which depends on the structure of production is characteristic for large industrial centers.
All selected in the basin of the Upper Dnieper water bodies at risk of failing good ecological status have large industrial towns within its catchment area, where the significant contamination forms with sewage from industrial and municipal wastewater treatment plants and with runoff of settlements.

For industrial water supply in the region is quite widely used groundwater removal industry which has remained stable over the last years, in contrast to the use of surface water, removal of which has considerably decreased.

At the industrial enterprises of the region is formed a substantial amount of contaminated wastewater that is discharged into sewerage system of settlements, water bodies, storages. Remains urgent problem of sewage treatment (food industry and others) on the local wastewater treatment plants before discharge into the sewerage system of settlements. A very common practice is wastewater from water treatment plants without city sewer systems, causing problems of municipal wastewater treatment plants operation. Requires to be solved the problem associated with disposal highly mineralized water salt-coating production of fish processing plants. Remains quite severe problem with recycling sludge formed after electroplating wastewater treatment plants. There is an ongoing practice of storing sediments containing heavy metals on the enterprises areas.

A serious problem is the pollution of surface waste water discharged from the areas of enterprises. The lack of rainwater drainage and sewage treatment plants of the surface wastewater at the part of enterprises leads to the contamination of ground and surface waters. In enterprises practically is no interest to use rain water in the technical water supply.

There are problems with the placement of certain industrial wastes. For example, Gomel chemical plant for the production of fertilizers is functioning for 45 years of the in the open area of more than 100 hectares, during this period is accumulated about 22 mn tons of phosphogypsum and the amount of waste continues to increase, requiring activities to protect surface water and groundwater.

The region has developed mining industry. Development of minerals is presented in the form of local building materials mining and mining of molding clay in open quarries, as well as the development of peat on the open areas. In the basin are presented a number of large peat enterprises "Osintorf", "Tatarka", "The Dnieper's". In the basin area is made sapropel mining from water bodies, accompanied by certain negative impact on aquatic ecosystems. There are located a number of significant developing deposits such as oil near Rechitsa town. Annual oil production is 1.6 mn tons. In 2014 is started producing oil from dense rocks using hydraulic fracturing technology, which improves the possibility to extract previously inaccessible oil deposits in the rocks. Also in the region are deposits of chalk and marl near the town of Krichev and Kostyukovichi and used for cement production.

Development and production of the above minerals is accompanied by intensive anthropogenic impacts on water bodies and groundwater. With the introduction of technology with hydraulic oil production risks associated with possible contamination of aquifers and surface water bodies are significantly increased.

[2]- preparing this chapter the materials of the report "Development of Scheme of complex use and protection of watersfor river Dnepr basin (2013)", CRICUWR- Minsk, 2013, 124 p. 92-96 were used.

1.1.3 Agriculture[3]

Agriculture in the Dnieper River basin specializes in growing traditional crops of temperate latitudes. Among crops are dominantly cereals, mainly barley, rye, wheat, potatoes, fodder crops. At the highest level is the flax.
In livestock is grown mainly cattle for milk and meat production, as well as pigs and poultry.
In the basin of the Dnieper major share in the structure of land in use is agricultural land, of which nearly 30% are arable land, nearly 15% is grassland. About 40% is covered by forests; under different water bodies and marshes is occupied 4.5%.

Table 1 – The structure of agricultural land in the basin

Type of land	Area, thous. km^2	% of total
Total agricultural land	29.2	45.8
- arable	18.7	29.4
- fallow	0.2	0.4
- used for permanent crops	0.4	0.7
- meadow	9.8	15.4
among them improved	5.9	9.2
There claimed farm land:		% of agricultural area
- irrigated land	0.5	1.7
- drained land	13.0	43

Enterprises for breeding and fattening animals are a powerful source of local water pollution. In the basin of the Upper Dnieper in Belarus operates 16 poultry farms, 20 complexes for breeding and fattening of cattle, 35 complexes for breeding and fattening pigs.

Most of the water bodies are at risk by the degree of agricultural development, and only two of them there are at risk of livestock.

The main problem associated with the impact of livestock facilities on water bodies is the handling of manure containing wastewater, because the volumes of wastewater generated in these enterprises and the amount of pollutants significantly exceed the number of pollutants in other types of wastewater. For example, in average in pig-breeding complex is formed 18-22 liter / day per animal manure containing waste water under the gravity system of manure removal and 27-37 dm^3 / day under hydro flushing, which are characterized by BOD_5 6000-12500 mg / dm^3, contain 700-1500 mg / dm^3 total nitrogen, 300-600 mg / dm^3 phosphorus P_2O_5.

The main methods of manure containing wastewater processing in accordance with the applicable technical regulations include:

- Removal manure containing wastewater into manure storages with further use as fertilizer with the export;

- Separation of wastewater by mechanical cleaning on fractions: liquid (clarified liquid) and solid (pellet) with further recycling as organic fertilizer.

- cleaning of manure containing waste water and removal them into water bodies, disposal of sewage sludge as an organic fertilizer.

[3]- preparing this chapter the materials of the report "Development of Scheme of complex use and protection of watersfor river Dnepr basin (2013)", CRICUWR- Minsk, 2013, 124 p. 100-102 were used.

Technological schemes with biological wastewater treatment are recommended for pig farms with 56000, 108000, 216000 pigs. It is regulated by design standards that the so-called biological treatment the liquid fraction of the manure pig farms is allowed in exceptional cases with a lack of suitable land areas and water for irrigation, as well as unfavorable climatic, geographical and hydrogeological conditions and in the case of transfer to the urban sewerage facilities. However, biological wastewater treatment and further removal to water bodies in some cases are a forced step associated with the inability of agricultural utilization considerable discharges of wastewater generated at the complex with a large amount of animals. Assuming the above concentrations of BOD_5 in manure containing wastewater, the requirement to remove nitrogen and phosphorus compounds is to be implemented on pig farms with livestock over 2000-2500 animals, i.e. much smaller than that of the complexes built on standard projects (12 000, 24 000 animals). Thus, on pig complexes when wastewater removing occurs is to be implemented technological purification scheme with the removal of nutrients, which leads to problems of an economic nature. This kind of wastewater treatment is very expensive and requires highly trained personnel to operate, making it unprofitable production at such facilities.

Industrial and agricultural facilities, widespread within the river basin of the Dnieper, the most significant negative impact have on shallow located unconfined aquifers (groundwater).

For the basin are typical highly transformed water bodies due to the drainage of land. Besides artificial reclamation networks, large areas of water bodies are canalized and have dams. With the use of hydro-morphological criteria river morphology change (channel straightening) are identified 26 water bodies at risk and 18 water bodies at possible risk (including 3 water bodies at risk and 1 at the possible risk from the 12 water bodies at risk, determined using the chemical and ecological status, as well as criteria for evaluating the risk of threats from point and diffuse sources).

Farmland with drainage are usually characterized by a high degree of plowed while canalized rivers are practically deprived the coastal strip. Removal of nutrients with melt and rain water in such areas is very intense. At the same opportunities to expand the coastal strip is very difficult, as they are connected with the reduction of the area of arable land. Significant amounts of nutrients enter the water bodies with the drainage flow. Possible measures to reduce such impacts, such as the construction of ponds, sumps, filter jumpers and dams on drainage collectors require cost and space to accommodate them.

1.1.4 Navigation[4], transport and transport infrastructure

The basin area is full of transport infrastructure. Major traffic flows on the rail and road are directed to the west and east. Orsha-Minsk-Russian border, as well as in northern and southern areas of Minsk-Gomel, Vitebsk-Orsha-Mogilev-Gomel. The railway network in the region is partly electrified. Impacts on water bodies due to the economic activities of enterprises operating railroads are associated with water use and discharge of industrial waste into the environment.

Roads in most parts are paved. Operation of road is associated with local impacts on water bodies at the intersections with watercourses due to flushing of contaminants, including anti ice reagents by melt and rain water. Also local centers of emission of pollutants exist in the road alignment on roadside infrastructure, as well as on the territory of enterprises making repair and maintenance of roads (RED industrial sites, storage area of sand and sand-soya blend, etc.).

In the region there are a number of airports: Minsk-1(Minsk-1), Machulishchy, Mogilev (Mogilev district, v. Nikitinichi), Minsk National Airport (Smolevichi district), Gomel Airport (Gomel district).The impacts are associated with air emissions of pollutants and their subsequent precipitation, water consumption and wastewater disposal.

[4]In preparing this chapter the materials of the report "Development of Scheme of complex use and protection of watersfor river Dnepr basin (2013)", CRICUWR- Minsk, 2013, 124 p. 102 were used

The region has a series of gas pipelines and associated infrastructure, including the gas pipeline "Yamal-Europe", and a network of pipelines for the distribution of gas in the gas supply to the region. In the basin area is built and operates underground gas storage "Osipovichskoye."

Also there is located oil pipeline (parts of pipeline "Druzhba") and pipelines for the transportation of petroleum products (diesel), a branch of the oil pipeline "Druzhba" Unecha-Polotsk and associated product pipelines for the transport of oil and oil products. Operation of this pipeline system is accompanied by the risk of leaks and accidents with a hit of oil into the environment.

The rivers Dnieper, Sozh, Berezina are navigable. The system of water transport includes 4 river ports (Bobruisk, Gomel, Mogilev, Rechitsa), 2 waterways enterprises (Gomel, Bobruisk) serving waterways on the rivers Dnieper, Berezina, Sozh.

Ship building is carried out on the specialized plants (Pinsk, Rechitsa, Gomel). Design of ships is carried at JSC "Belsudoproekt", Gomel.

Apart from the risk of contamination of surface water from the boats, with shipping is connected impact on river banks in the period of construction of quays and ports and coasts wave processing of moving boats.

1.1.5 Energetic[5]

The basin area has a number of large thermal power plants: Minsk TPP-4 capacity of 1035 MW, Gomel TPP -2540 MW, Mogilev TPP -2345 MW, Minsk TPP-3 – 320 MW, Minsk TPP-5 – 320 MW, Bobruisk TPP - 180 MW, SvetlogorskTPP – 155 MW, and TPP of medium and low power:OrshaTPP –72.96 MW, ZhodinoTPP – 54 MW, Minsk TPP-2 – 29 MW, Mogilev TPP-1 – 21.2 MW, Bobruisk TPP -1 – 12 MW. The functioning of a number of TPP required the construction of reservoirs for the abstraction of water for production and for removal of wastewater and heated wastewater. Most of these reservoirs are strongly eutrophic, and impact negative on aquatic ecosystems watercourses on which they are built.

Hydropower potential in the Dnieper River basin is currently used in very small amounts. The powerщathe largest hydro power plant in Belarus in the Dnieper basin is 2,175 MW (Osipovichskaya HPP, start of expluatation - 1953). The basin area is flat, that determines the development of hydropower using low-pressure streams. The greatest potential of hydropower in the Dnieper basin is concentrated in the Mogilev region directly in the river Dnieper. In accordance with the state program of construction hydroelectric power stations in 2011-2015 in the Republic of Belarus it is considered to construct a cascade of four hydroelectric power stations on the Dnieper river with the total capacity of 20.3 MW: Orsha (5.7 MW) - 2017; Rechitsa (4.6 MW) - 2018; Shklov (4.9 MW) - 2018; Mogilev (5.1 MW) - 2019.

One of clean energy sources - hydroelectric power plant, its construction and operation leads to significant hydro-morphological pressures on surface water bodies.

With the use of hydro-morphological criteria discontinuity of flow of rivers and reduction of aquatic habitats is identified in 35 water bodies at risk and 11 water bodies at possible risk (including 2 water bodies at risk and 1 at the possible risk of the 12 water bodies at risk determined using the chemical and ecological status, as well as criteria for assessing the risk of threats from point and diffuse sources).

1.2 Other possible loads and impacts on surface water bodies

Besides the basic loads and their effects on surface water bodies associated with existing human activities with current environmental conditions, characteristics of water bodies and their catchments areas, there

[5]In preparing this chapter the materials of the report "Development of Scheme of complex use and protection of watersfor river Dnepr basin (2013)", CRICUWR- Minsk, 2013, 124 p. 102 were used.

may be other possible loads. These possible loads and their effects are associated with possible changes in human activities on the basis of socio-economic development in the basin of the Upper Dnieper in Belarus, hydrometeorological hazards, as well as climate change (Table 2).

Table 2 – Analysis of other possible pressures and their impacts in the basin of the Upper Dnieper in Belarus

Pressure	Impact
Change of human activities related to the forecast of socio-economic development	Change of water use, including quantitative and qualitative characteristics of water consumption and wastewater. According to the program of socio-economic development of the Republic of Belarus for 2011-2015 and the national strategy for sustainable socio-economic development of the Republic of Belarus for the period up to 2020 the index of industrial production for the period up to 2020 may be 109 - 110%, agricultural products - 107- 108%. Maybe a slight increase in the removal of surface water from surface water bodies for various needs, which on average can lead to immaterial reduce surface runoff in the Dnieper basin (not more than 1%), and in the utilities sector consumptive use can remain at the same level or decrease. Due to the implementation of programs of intensive development of livestock and poultry farming in the country and the region, it is planned significant increase in livestock and as a consequence – the increase in load on water bodies. Increase of fish production is also expected due to the implementation of development fish farming programs in the region, it is also associated with an increase in anthropogenic pressure on aquatic ecosystems. According to the State program of construction of hydroelectric power plants in 2011-2015 in Belarus further increase hydroelectric power generation will be implemented in the years 2016-2019 with a step input of large hydropower plants on the river Dnepr, which will be under the authority of "Belenergo": Rechitsa HPP (4.6 MW) - 2018; Shklov HPP (4.9 MW) - 2018; Mogilev HPP (5.1 MW) - 2019. Also is considered the possibility of increasing the power generation at the Dnieper river by entering additional HPP – Bykhov and Zhlobin. Until 2015 it is planned to put into operation 12 micro and mini hydropower plants in the Dnieper basin. Accommodation of HPPs on watercourses will impact on their hydrological regime, as well as on the hydrogeological regime of adjacent territories.

Hydrometeorological hazards: - spring floods - summer-autumn rain floods	Flooding and under flooding lead to economic damage. According to the Republican Centre for Management and Emergency Response (Ministry for Emergency Situations in the Republic of Belarus) and the Republican Hydrometeorological Center (Ministry of Natural Resources in the Republic of Belarus)[6] in the basin of the Upper Dnieper a number of areas have impacts of spring floods. Primarily, these include the following areas: - Gomel district, Gomel region - Sozh, Iputs; - Borisov district, Minsk region - Berezina, Sha, Plissa; - Rechitsa district, Gomel region - Dnieper, Berezina; - Bobruisk district, Mogilev region - Berezina, Ola; - Bragin district, Gomel region - Dnieper, Braginka; - Dobrush district, Gomel region - Iputs, Horoput. In these areas during spring floods is noted significant regular flooding of settlements, engineering infrastructure, as well as agricultural lands. It is desirable to develop and implement the pilot projects for the areas that are most prone to flooding with the aim to improve the management of flood risks, taking into account the recommendations of the relevant EU Directives[7]. Due to climatic changes over the last few years there have been changes in the amount of rainfall and its distribution. As a result, began to record events of rainfall with great intensity in the summer, leading to flooding of settlements. The consequences of such incidents involve significant material damage. To minimize the consequences of such events should review the relevance of climatic parameters (intensity, frequency of rain occurrence, etc.) and calculation methods of rainwater drainage for its design.
- drought periods	Significant reduction of surface runoff is noted in dry periods. This may lead to the deterioration of the ecological status of the recreational potential of surface water bodies (especially small rivers) and adjacent areas, changes in the hydrogeological regime of groundwater, depletion of the soil cover in the floodplain, and so on. In addition to economic damage (mainly agriculture), it can lead to the danger for safety of water supply in rural areas that have no centralized water supply systems (due to lowering of groundwater levels and swallowing wells)
Climate change	The data presented in 2013 in the materials of the fifth report of the Intergovernmental Panel on Climate Change (IPCC)[8] indicate that climate change is an indisputable fact that is confirmed by observations of increases in global average air and ocean temperatures, widespread melting of snow and ice , sea-level rise. It is predicted that in the basin of the Upper Dnieper in Belarus until 2035 the average basin air temperature increase as a function of climate change scenarios could reach in the winter from 1.5 to 2.0 ° C, in the summer - from 1.0 up to 1.5°C. Also are projected changes in precipitation, in the autumn and winter

[6]"Catalogue of dangerous hydrological phenomena indicators on the territory of Belarus," the Republican Hydrometeorological Center

[7] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks // Access to European Union law [Internet resource]. – http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007L0060:EN:NOT

[8]Climate Change, 2013. The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Summary for Policymakers]. - Geneva: IPCC, 2013. - 28 p. // Proceedings of the IPCC [electronic resource]. - Mode of access: http://www.ipcc.ch/report/ar5/wg1

	impossible slight increase (maximum - 10%); and in the spring and summer is possible reduction (maximum - 10%)[9]. Thus the average annual runoff in the basin of the Dnieper may decrease during the period from 2016 to 2035 in average on 10%[10], it greatly enhances the probability of occurrence and the negative effects of low-water periods. It is necessary to develop and implement measures to adapt the Dnieper basin water resources to climate change, including a more detailed forecast these changes to watercourses of the basin, vulnerability assessment of various types of water and other related natural resources and economic sectors to climate change, the implementation of pilot projects on adaptation

1.3 General characteristics of the water use

The use of water resources and (or) the impact on water bodies in the implementation of economic and other activities - water use - is an important characteristic for the development of measures to achieve good ecological status of water bodies. This is due to the fact that the use of water, including water abstraction and wastewater characteristics, determines the extent of the impact on water resources within a given water body.

According to the State Water Cadastre of the Republic of Belarus for the 2012 water intake (surface river waters) for the use in the basin of the Upper Dnieper was 125.05 million m^3/year, which is less than 0.6% of the total river flow for the year (22.6 billion m^3) [http://www.cricuwr.by/gvk/default.aspx]. Groundwater intake for use was 436.25 million m^3/year, which does not exceed 38.5% of the total of proven operational stocks constituting 1.1327 billion m^3/year (Figure 1). Consumptive use and losses amounted to 109.9 million m^3/year, which is less than 0.5% of the available water resources of the total stream flowin reporting 2012. In the basin of the Upper Dnieper use of groundwater is much greater than the use of surface waters that characterizes the use of water mainly from the underground water sources.

In general, the upper basin of the Dnieper River in the territory of Belarus is a zone of runoff formation, characterized by low levels of water use.

[9] Annex I: Atlas of Global and Regional Climate Projections // Proceedings of the IPCC, pp.1350-1353. [Electronic resource]. - Mode of access: http://www.ipcc.ch/report/ar5/wg1/docs/review/WG1AR5_FOD_AnnexI_Final.pdf

10 Chapter 11. Near-term Climate Change: Projections and Predictability // Proceedings of the IPCC, p.987 [electronic resource]. - Mode of access: https://www.ipcc.ch/report/ar5/wg1/docs/review/WG1AR5_SOD_Ch11_All_Final.pdf

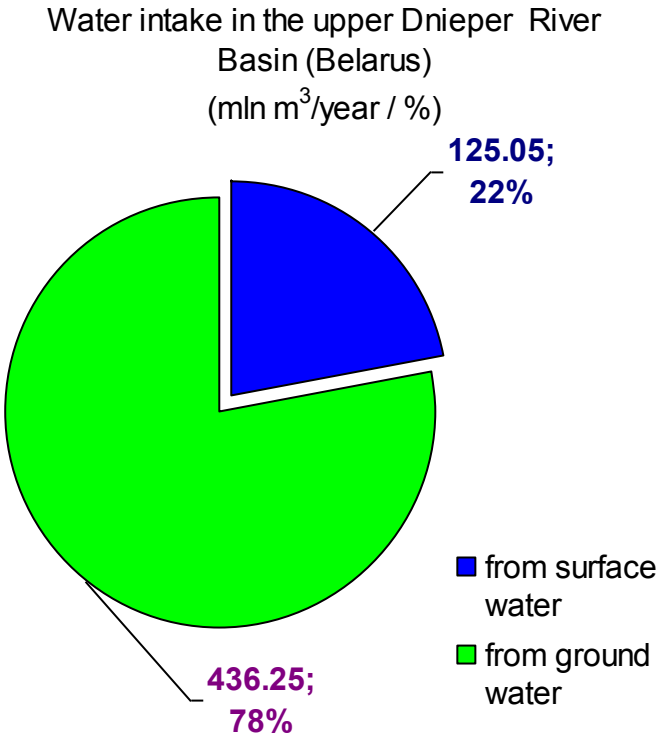

Figure 1 - Water intake in the basin of the Upper Dnieper (Belarus), million m^3/ year/%

Surface waters are mostly used for industry, fisheries (fish farms), agriculture (Figure 2).

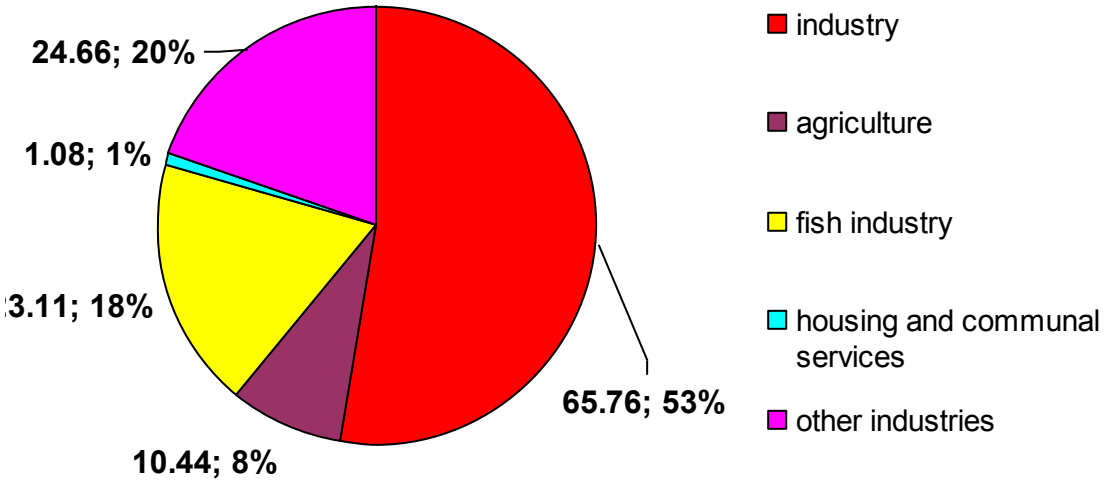

Figure 2 - Use of water from surface water bodies by activity (million m^3/year/%)

Ground waters are mainly used for housing and utilities, agriculture and industry (mainly for drinking water supply in these activities) (Figure 3).

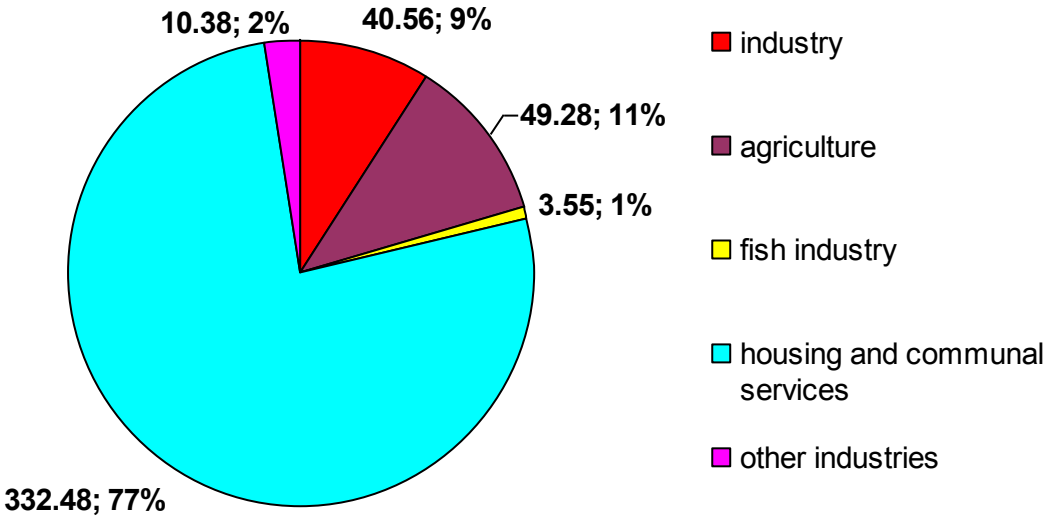

Figure 3 - Use of water from groundwater sources by activity (million m^3/year/%)

Especially the basin is the receiver of additional volumes of water about 137 million m^3 per year due to water transfer from Vileika-Minsk water system from the basin of theVilia river for water supply and irrigation of Minsk.
Total according to the statistical reporting of water use within the state water cadastre in the basin of the Upper Dnieper in the territory of Belarus is located 163 water users. Of these 23 enterprises discharged more than 90% of the total volume, which in 2012 amounted to 451 692 thousand m^3.

The main sources of pollutants in the wastewater are Orsha, Mogilev, Rechitsa, Borisov, Minsk, Gomel, Bobruysk and other industrialized towns. The largest contribution (about 40%) comes from Minsk treatment plant (MTP), on which is performed wastewater treatment from industry and population of Minsk. However, to assess the loads and impacts presented in the following sections, detailed information was used in all 163 water users (major point sources of pollution), including the volumes of waste water and the content of pollutants, as well as the quantitative and qualitative characteristics of the receiving water bodies.
Table 3 shows the data of wastewater removal in the Dnieper basin and the main receiver of wastewater – surface water bodies.

Table 3 – Removal of wastewaters and other waters by river basins for the year 2012, mn. m^3

River basin	Removal of wastewaters and mine waters						Capacity of treatment facilities
	total	In water bodies				in the subsoil, the groundwater by using filtration fields, drives, etc.	
		total	from them				
			Insufficiently treated	Without treatment	standard treated		
1. Dnieper	461.13	427.61	0.96	38.97	387.67	33.53	859.32
1.1. Berezina	299,79	289,03	0,64	35,66	252,73	10,76	569,75
1.1.1.Svisloch	208,35	203,04	0,04	18,72	184,28	5,32	359,95
1.2. Sozh	64,57	55,97	0,20	2,48	53,29	8,6	93,84

Despite the fact that insufficiently treated waste water in the drainage structure is less than 1%, the load on water bodies is a significant.
In this context, the question of protection water bodies from sewage pollution is primary.

1.4 The most significant factors of surface water and groundwater influence on the social development and the main sectors of the economy

The region is a developed in the industrial and agrarian relations, and therefore, the influence of surface water and groundwater on the social development and the main sectors of the economy is essential here. Table 4 below summarizes the characteristics of the impact of water resources as a factor of social and economic development, and assessment of their significance for the economy.

Table 4 - Assessment of the significance of natural waters for the economic and social spheres

Factors	General description of the problems	Assessment of the significance of water for economic and social development*
Impact on production (including mining, manufacturing)	Water intake in the region to the needs of industry is a significant share of the total consumption. Water resources are the important, but not the limiting factor in the placement of most industries, except for water-intensive.	2
Influence for placing	Influence of water on the placement of industrial facilities and settlements is estimated as significant, but not critical. For HPP, TPP, other water-intensive industries the impact of water resources is crucial. To accommodate settlements availability of water resources has less influence	2
The effect on the production of electricity (including hydropower, thermal energy production and nuclear stations)	Water consumption for energy needs is essential when using water as the heat transfer agent and coolant. Water resources determine impact on hydropower. However, the share of hydropower plants in the total energy production is relatively small	2
Impact on shipping	Currently shipping is carried out on sections of the rivers Dnieper, Berezina, Sozh. Effect of water resources on shipping is significant in terms of negative impact of aridity watercourses due to which water transport is underdeveloped	2
Impact on the cost of drinking water	Impact on the cost of drinking water is connected with the quality and availability of groundwater (the cost of	2

*the relative importance of the influence in the basinby the four-point scale: 1 - the local level and of moderate intensity, 2 - the local level, a significant intensity, 3 - a regional level, but moderate intensity, 4 - a regional level, and a significant intensity

	transport and treatment) and evaluated as significant	
Forestry	Water intake by forestry enterprises is relatively small in relation to total consumption, the impact of water availability on the productivity of forests is moderate due to very adequacy of moisture due to rainfall	1
Effects on soil quality and agriculture	The significance of water influence on the soil quality and agriculture is moderate. Influence is due to the use of water in agricultural water supply, irrigation, fish in ponds	1
Recreation and tourism	The significance for recreational water bodies is an average. State and quality of water in water bodies used for recreational purposes, the state of the adjacent coastal zones are meaningful	1
Impact on infrastructure	The level of impact on infrastructure (networks, pipelines, roads, communications and other) is a relatively small	-

The main human activities that impact on surface and ground water bodies are:

- wastewater discharge, including wastewater surface discharge to water bodies, wastewater disposal on the field of filtration, ground storages and similar facilities;
- point and diffuse sources of pollution from industrial and agricultural activities;
- radionuclide contamination flushed out from areas contaminated by the Chernobyl accident;
- the transfer of pollutants from the transboundary tributaries.

The main water-environmental problems in the basin are:

- inadequate treatment facilities in settlements, including lack of deep nutrient removal (nitrogen and phosphorus) in wastewater treatment plants with a capacity over 10 000 EN, lack and poor dissemination of modern designs of treatment facilities in rural areas, a significant spread of the use of filtration fields.
- absence and low technical level of treatment facilities for the local treatment of industrial wastewater before discharge into drains of settlements;
- overload of treatment plants by the volume of incoming wastewater and the amount of contaminants in them, which leads to discharges of inadequately treated waters to water bodies.
- insufficient security or absence rainwater drainage systems and surface treatment of sewage in urban areas;
- a significant inflow of nutrients into water bodies with drainage water from the reclaimed land, as a result of water and wind erosion, filtering into the soil soluble ingredients of fertilizers as well as removal of biogenic pollutants into water bodies from livestock facilities and other loads due to agricultural activities in the basin;
- noncompliance management regimes in the WZ and the PP;
- the presence of unauthorized dumps TCRs within settlements;
- hydromorphological changes of water bodies;
- flooding areas.

2 BASIN DEVELOPMENT PROGRAMMES

Currently within the basin of the Upper Dnieper operates a number of **Government programs**, their tasks in the field of use and protection of water resources are to ensure the protection of water bodies from biological and chemical contamination, depletion, as well as providing the population with drinking water of a high quality from centralized water systems.

In the field of environmental issues they focused on the implementation of measures to reduce the pollution of surface and groundwater bodies by sewage, as well as harmful substances coming from urban and agricultural areas with surface waste water; restrict cross-border transfers; provision of population with clean drinking water; creating favorable conditions for the development of water tourism and recreation on water bodies.

1. Water Strategy of the Republic of Belarus for the period until 2020, approved by the Collegium of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus 11.08.2011 № 72-P;

2. The program of socio-economic development of the city of Minsk in 2011-2015, approved by the Minsk City Council of Deputies of 23.12.2011 № 187;

3. The program of socio-economic development of the Mogilev region for 2011-2015, approved by the Mogilev Region Council of Deputies from 18.10.2011 № 11-1;

4. The program of socio-economic development of the Minsk region for 2011-2015, approved by the decision of the Minsk Region Council of Deputies of June 10, 2011 № 90;

5. The program of socio-economic development of the Gomel region in 2011- 2015, approved by the decision of the Gomel Region Council of Deputies from 26.07.2011 № 111;

6. The program of socio-economic development of Belarus for 2011 - 2015, approved by the Decree of the President of the Republic of Belarus of 11.04.2011, № 136;

7. The State Program on Water and Sanitation "Clean Water" for 2011 - 2015, approved by the Resolution of the Council of Ministers of the Republic of Belarus of 15.09.2011 № 1234.

The main expected *results* of the program in 2020:

- reduction of fresh groundwater withdrawals to 4%;
- ensuring 100% centralized sanitation in settlements with a population of over 10 thousand people;
- providing high-quality drinking water to the population of all regional and district centers, cities of regional subordination and townships;
- providing with a centralized water supply of standard water quality the urban population up to 95% and the rural population – up to 80%;
- 100-percent coverage by the centralized water supply ofhigh quality drinking water the rural population in agro-towns;
- improving the quality of wastewater treatment and the reliability of the sewerage system;
- an increase in the replacement of water and sewer pipelines and networks;
- reduction of specific water consumption by 15%;
- increase the reuse and recycling of water up to 97%;
- improving the reliability of the water supply and sanitation and reducing water wastage in its supply and distribution to 5%;
- ensuring efficient operation of existing treatment facilities;
- construction and reconstruction of local treatment facilities of industrial organizations;

- providing rainwater and meltwater treatment in settlements with a population of over 50 thousand people, in resort and industrial areas;
- reduction up to 45% of operating fields of filtration with subsequent reclamation, construction of local treatment facilities;
- reduction of pollutants discharges into water up to 50% and 30% of nitrogen and phosphorus;
- termination of wastewater into water bodies without treatment;
- complete termination of wastewater into lakes and reservoirs;
- creation of new recreational areas in water bodies not involved in recreational activities

In Belarus are developed and adopted **sectoral programs**, the implementation of their measures will affect the water bodies of the Upper Dnieper Basin:

1. Engineering water management measures to protect human settlements and agricultural lands from flooding in the most flood probable areas of Polesye for 2011 - 2015, approved by the Resolution of the Council of Ministers of the Republic of Belarus of 06.09.2010 № 1280
2. Poultry Development program in the Republic of Belarus for 2011-2015, approved by the Resolution of the Council of Ministers of 28 September 2010 № 1395
3. State program of development of fisheries activities for 2011-2015, approved by the Council of Ministers of 7 October 2010 № 1453
4. Republican program of reconstruction, technical re-equipment and the construction of a complex for growing pigs in 2011-2015, approved by the Resolution of the Council of Ministers on May 5, 2011 № 568
5. Republican program of development of the dairy industry in 2010-2015, approved by the Resolution of the Council of Ministers of 12 November 2010 № 1678
6. The Republican program for livestock breeding business in 2011 - 2015, approved by the Resolution of the Council of Ministers dated 31 December 2010 № 1917
7. State program of development of the Belarusian energy system for the period until 2016, approved by the Council of Ministers of the Republic of Belarus 29.02.2012 № 194
8. The development strategy of the energy potential of the Republic of Belarus, approved by the Resolution of the Council of Ministers of the Republic of Belarus 09.08.2010 № 1180
9. The state program of construction of hydroelectric power plants in 2011-2015 in the Republic of Belarus, approved by the Resolution of the Council of Ministers of the Republic of Belarus 17.12.2010 № 1838
10. The State program for the construction of energy sources on local fuels in 2010-2015, approved by the Council of Ministers of the Republic of Belarus 19.07.2010 № 1076
11. State program "Peat" for 2008-2010 and for the period until 2020, approved by the Council of Ministers of the Republic of Belarus 23.01.2008 № 94
12. Program of Forestry of the Republic of Belarus for 2011-2015, approved by the Resolution of the Council of Ministers 03.11. 2010 № 1626
13. The main directions of the state urban policy of the Republic of Belarus for 2011-2015, approved by Presidential Decree of 30.08.2011 № 385
14. The program "Roads of Belarus" for 2006-2015, approved by the Resolution of the Council of Ministers of the Republic of Belarus, April 6, 2006 № 468
15. State program of development of fisheries for 2011-2015, approved by the Council of Ministers of the Republic of Belarus 07.10.2010 № 1453
16. State program on overcoming the consequences of the Chernobyl disaster in 2011-2015 and for the period until 2020, approved by the Council of Ministers of the Republic of Belarus 31.12.2010 № 1922

17. State program of conservation and use of reclaimed lands for 2011-2015, approved by the Council of Ministers of the Republic of Belarus 31.08.2010 № 1262
18. State program for Development of Railway Transport of the Republic of Belarus for 2011-2015, approved by the Council of Ministers of the Republic of Belarus 20.12.2010 № 1851
19. State program of development of tourism in the Republic of Belarus for 2011-2015, approved by the Council of Ministers of the Republic of Belarus 24.03.2011 № 373
20. State program for sustainable rural development for 2011-2015, approved by Presidential Decree 01.08.2011 № 342
21. State program on the functioning and development of the National Environmental Monitoring System in the Republic of Belarus for 2011-2015, approved by Presidential Decree 13.06.2011 № 244
22. Programme of Housing and Utilities of the Republic of Belarus until 2015, approved by the Council of Ministers of the Republic of Belarus 08.02.2013 № 97
23. Republican program of development of the dairy industry in 2010-2015, approved by the Council of Ministers of the Republic of Belarus 12.11.2010 № 1678
24. The program of the industrial complex of the Republic of Belarus for the period until 2020, approved by the Council of Ministers of the Republic of Belarus 05.07.2012 № 622
25. The program of development of inland waterway and maritime transport the Republic of Belarus for 2011 - 2015, approved by the Resolution of the Council of Ministers of the Republic of Belarus of 24.12.2010 № 1895
26. State program of measures to mitigate climate change for 2013-2020, approved by the Council of Ministers of the Republic of Belarus 21.06.2013 № 510

The activities scheduled for implementation in the above program, include the water bodies in the basin of the Upper Dnieper. These programs are intended to achieve certain socio-economic effects in certain industries. Their implementation may have various implications for the water bodies, including the negative. This should be considered when designing the program of activities of the Management Plan of the Upper Dnieper.

Program provides the following *measures* that may impact on water bodies of the basin:

- Reconstruction, technical re-equipment, construction and conversion of enterprises to grow poultry.
- The creation of new and development of existing aquaculture systems for growing fish farming perspective objects, creating the conditions for the reproduction of fish resources, the development of aquaculture farming and recreational fishing.
- Construction of new facilities, breeders, breeding plants (cores) for breeding pigs.
- Conducting agromeliorative activities on drained farmland and fish ponds, the reconstruction and rehabilitation of drainage and drainage-watering reclamation systems, the reconstruction and rehabilitation of irrigation systems.
- Increasing the supply of the population with centralized water supply and drainage, including in rural areas and the agricultural settlements.
- Building energy sources operating on biogas resulting from the processing of sewage sludge and organic part of municipal waste.
- Providing planning and regular sanitary cleaning of villages and one hundred percent coverage of the multistory residential buildings in rural areas by separate collection of municipal solid waste.
- The development of engineering infrastructure of settlements, including artificialisation of villages with the missing types of equipment.

- Formation of the "green" economy based on energy conservation, implementation of environmental ("green") technologies, renewable and alternative energy sources, efficient waste processing technologies.
- Increasing navigable waterways.
- Modernization of the transport fleet of river ports.
- Reconstruction of berthing facilities.
- Development of the monitoring network on hydrological and hydromorphological regimes of water bodies in accordance with the requirements of the water legislation of the European Union.
- Technical re-equipment of the monitoring network of surface and groundwater.
- Assessment and forecast changes in runoff of the Dnieper based on adaptation to climate change.

3 PRIORITY ACTIVITIES IN THE BASIN OF THE UPPER DNIPER

In the draft TCP 1 / 17.06-XX-20XX (02120) The development of a management plan for the basin water resources, which is based on the WFD and Common implementation strategy for the Water Framework Directive (2000/60 / EC), are encouraged to develop activities in the Management Plan in the following areas.

The program of activities shall consist of two sections.

The first section should be submitted to water conservation measures to improve the ecological state (status) of water bodies at risk of not achieving good ecological status (status) to the end of the Plan, as well as measures to prevent or reduce the impact on the state of water, as well as measures to restoration of water bodies, the ecological state (status) of which is estimated as fourth or fifth class.

The second section should be submitted to water protection measures for the conservation and maintenance of the existing ecological condition (status) of all other water bodies.

The Plan shall be submitted to measures aimed at the reduction of pollutants into water bodies from point and diffuse sources of pollution, and measures aimed at the rational (sustainable) use of water resources and reduce the negative impact of other sources of environmental degradation (status) of water bodies.

In the basin of the Upper Dnieper in Belarus are allocated 12 water bodies at risk of failing good ecological status.

Including this following surface water bodies: Svisloch below Minsk WWTP, Berezina (below Borisov), Plissa, Udoga, Zhadunka, Uza, Gayna, Adrov, Dobysna.

For water body Svisloch Minsk WWTP is developed "Plan of gradual improvement of the water system Svisloch - Osipovichy reservoir for 2014-2020 "(Appendix B). This is water body, which has the most significant degree of influence. The risk of failing good ecological status is the greatest.

The main directions of the Plan of gradual improvement of the water system Svisloch:

1. Improving water resources management in enterprises.
2. The collection and treatment of surface wastewater from areas of human settlements.
3. Measures to maintain and restore the ecological status of water bodies.
4. Improving the regulatory framework and information systems in the field of water management.

Plan of gradual improvement of the water system Svisloch is developed on the base of long-term research of the water body under the State Scientific and Technical Program. Plan gradual improvement of the water system Svisloch contains recommendations for specific activities at the level of distressed enterprises. Similar plans should be developed and implemented for the rest of the water bodies at risk of failing good ecological status.

Below is a series of activities that must be performed *in the whole basin* and they reduce the load on water bodies at risk of failing good ecological status and also maintain a good ecological status of other water bodies.

Based on the existing problems in the basin of the Upper Dnieper in Belarus, it is previously proposed to develop activities for the whole basin in the following areas.

1. Water protection measures

Exclude allocating contaminated and inadequately treated sewage into water bodies. Necessary to carry out the expansion and renovation of municipal wastewater treatment plants. Establish a proper degree of local industrial wastewater treatment on enterprises (including agricultural), advanced treatment of urban wastewater after biological treatment facilities complete.

To prevent contamination of river water bodies with surface wastewater from urban areas is necessary to carry out their sewerage and purification. This concerns, first of all, the surface runoff from industrial areas, streets with heavy traffic, high-rise buildings and districts, etc.

Introduction of BAP in agriculture (Implementation of Best Agricultural Practice).To prevent or minimize contamination with surface runoff from agricultural land must comply with the rules and fertilizer application technology, the rules of storage, the choice of a rational structure of crops on the coastal slopes, creating along watercourses protective shelterbelts.

1. Water conservation measures

In industry, the main event in this category is the introduction of water conservation technologies and expand water reuse.

Development and implementation of small and waterless technology and support processes.

Saving water in the municipal economy is achieved due to reduction of water losses in the system due to leakage, accident prevention, rational use of water by consumers.

2. Fundamental measures

Record keeping water resources and their use.

Development of scientific-methodical base management and protection of water bodies.

Development of monitoring network of water bodies and water management systems.

Development of mathematical models of simulation.

Identification of areas prone to flooding, their classification and mapping.

Design and development of basin GIS.

Development and implementation of educational programs.

Public participation in the development and implementation of activities.

4. Institutional measures

Basin management organization for the use and protection of water.

The development of the regulatory framework of functioning water complex and water regulation.

Regulate the use of areas potentially subject to flooding.

Regulation of land use in riparian zones.

The development of regulatory instruments, improved economic and financial funding mechanism.

Necessary to provide economic incentives for reducing water consumption.

The development of insurance systems risks associated with the harmful effects of water.

5. Activities to improve the operational management

Integrated development of the monitoring of surface water and groundwater.

Development of state control and supervision systems over the use and protection of water bodies.

Optimizing hydrogeological regime supervision.

Ensuring the development and maintenance of the State Water Cadastre.

Development of the systems for informing and alerting public authorities, water users and the public.

Activities for the design and development of the basin geographic information systems.

6. Capital bank protection works

7. Activities on water adaptation to climate change

Detailed forecast of climate changes for the watercourses in the basin.

Assessment of possible development of severe weather events (spring floods and summer-autumn rain floods, drought periods).

Definition of flood zones and areas of flooding, causing economic damage due to flooding.

Vulnerability assessment of various types of water and other related natural resources and sectors of the economy to climate change.

Implementation of pilot projects on adaptation to climate change.

Proposed activities rather aimed at maintaining good status of water bodies in the basin. For water bodies at risk of failing good ecological status is necessary to elaborate the event because of the particular pressures on the water body.

Annex A shows the Program of activities for maintaining good ecological status of water bodies in the basin of the Upper Dnieper.

The Program sets out the general arrangements with the terms of their performance *in the whole basin of the Upper Dnieper.*

On the basis of it is need to develop specific activities for each water body at risk of failing good ecological status taking into account specific problems and this water body

CONCLUSION

The Upper Dnieper basin is characterized by the following economic characteristics:

Water bodies in the basin of which are large settlements – large industrial centers (Minsk, Gomel, Orsha, Zhodino and Bobruisk) are experiencing severe load from wastewater treatment facilities of utilities and industrial enterprises, as well as surface waste water load.

Through intensive sampling of groundwater for water supply is noted hydrodynamic formation of craters of different sizes (in the district of Minsk urban agglomeration is formed mega crater with the diameter up to 40-70 km down the center to 25-40 m).

MSW landfills are a source of contamination of both surface and underground water bodies.

Most of the water bodies at risk are because of the degree of agricultural development of the territory and only for the two of them there is a risk of livestock. Influence of diffuse sources of pollution on water quality throughout the basin of the Upper Dnieper can surpass the influence of point sources. Thus, in the total contribution of pollution from diffuse sources can be from 40% to 90%.

Industrial and agricultural facilities, widespread within the Dnieper basin, have the most significant negative impact on shallow unconfined aquifers (groundwater).

The basin is characterized by highly transformed water bodies due to the drainage reclamation of land (except artificial reclamation networks, large areas of water bodies have channel straightening).

On the rivers Dnieper and Sozh is developed river navigation, that associated not only with the risk of surface water pollution from watercraft, but also with impacts on river banks in the period of construction and operation of ports and shipping lanes.

During the construction and operation of hydroelectric plant there are significant hydromorphological pressures on surface water bodies.

Besides the basic loads and their effects on surface water bodies, associated with existing human activities in current environmental conditions, characteristics of water bodies and their catchments areas, there may be other possible loads. They are associated with severe weather events (spring floods and summer-autumn rain floods, drought periods), projected climate change. Especially in the southern part of the basin is actual to construct flood protection structures for the protection of agricultural land and settlements.

The main water-environmental problems in the basin are:

– imperfect structures and wastewater treatment technologies, low operating current local treatment facilities of industrial wastewater;

– overload treatment plants by the volume of incoming wastewater and the amount of contaminants in them, that leads to discharges in water bodies inadequately treated sewage;

– insufficient amount or lack of systems for surface wastewater collection, disposal and treatment in urban settlements;

– nutrients pollution of water bodies from agricultural production;

– noncompliance management regimes in the OT and the PP;

– the presence of unauthorized dumps MSWs within settlements;

– hydromorphological changes of water bodies;

– flooding and under flooding of areas.

The existing *State programs* provide protecting water bodies from biological and chemical contamination, depletion, and ensuring quality drinking water from centralized water systems.

The main attention in them is paid to the implementation of measures to reduce the pollution of surface and groundwater bodies by sewage, as well as harmful substances coming from urban and agricultural areas with surface wastewater; restrict cross-border transfers; provision of population with clean drinking water; creating favorable conditions for the development of water tourism and recreation on water bodies.

Based on the existing problems in the basin of the Upper Dnieper in Belarus, previously is proposed to develop activities for the whole basin in the following areas:

1.Water protection measures.

2.Measures on water conservation.

3. Fundamental measures.

4. Institutional measures.

5. Activities to improve operational management.

6. Capital bank protection and bank protection works.

7. Measures for the adaptation of water resources to climate change.

For water bodies at risk of failing good ecological status is required detailed elaboration of measures to stabilize and improve their status.

Annex A PROGRAM OF ACTIVITIES FOR MAINTAINING GOOD ECOLOGICAL STATUS OF WATER BODIESIN THE UPPER DNIEPER BASIN

Measure	Year						
	2016	2017	2018	2019	2020	2021	2022
Water protection measures							
Replacement of water and sewer pipelines and networks							
Construction of new water supply networks							
Construction iron removal stations							
Development of integrated environmental permits for enterprises							
Reconstruction of local treatment facilities							
The introduction of modern technologies for treatment of waste water from nutrients on objects							
Providing rainwater and melt water treatment in settlements with a population of over 50 thousand people, in resort and industrial areas							
Separate collection of MSW in rural settlements							
Reduce the exploitation of filtration fields with their subsequent rehabilitation							
Complete termination of wastewater removal into lakes and reservoirs							
Building energy sources operating on biogas							
Implementation of Best Agricultural Practice (BAP)							
Control of the management regime within the OT and PP							
Eliminating illegal dumping of MSW							
Create new recreation areas on water bodies, not involved in recreational activities							
Water conservation measures							
Introduction of water conservation technologies							
Reducing water losses during transportation and usage in enterprises							
Reducing the consumption of drinking water by production enterprises							
Development (adjustment) of the individual technological standards for water consumption and wastewater removal for industrial enterprises							
Equipment metering of water consumption and wastewater removal for enterprises							
Equipment metering of water consumption of the population							
Fundamental measures							
Development of scientific-methodical base for management and protection of water bodies							
Development of a program to monitor hydrological and hydromorphological regimes of water bodies							
Development of mathematical models of simulation							
Identification of areas prone to flooding, their classification and mapping							
Assessment and forecast changes in runoff based on adaptation to climate change							
Design and development of basin GIS							
Development and implementation of educational programs							

Public participation in the development and implementation of activities	■	■	■	■	■	■	■
Institutional measures							
Basin management organization for the use and protection of water	■						
Creating of the Basin Council		■					
The development of the regulatory framework of water resources use and water consumption regulation	■	■	■	■	■	■	■
Regulating the use of areas potentially subject to flooding			■				
Regulation of land use in riparian zones	■	■	■	■	■	■	■
The development of regulatory instruments, improved financial and economic mechanisms to encourage the introduction of BAT	■	■	■				
Activities to improve the operational management							
Organization the network for observation hydrological and hydromorphological regimes of water bodies			■	■	■	■	■
Optimizing of hydrogeological regime observations		■	■	■	■	■	
Technical re-equipment of the monitoring network for surface and groundwater	■	■	■	■	■		
Development of state control and supervision systems over the use and protection of water bodies	■	■	■	■	■	■	■
Ensuring the development and maintenance of the State Water Cadastre	■	■	■	■	■	■	■
Implementation of systems for informing and alerting public authorities, water users and the public	■	■					
Measures on development and implementation of basin GIS			■				
Capital bank protection and bank protection works	■	■	■	■	■	■	
Activities on water adaptation to climate change							
Detailed forecast of climate change in the basin	■						
Assessment of possible development of severe weather events on water bodies (spring floods and summer-autumn rain floods, drought periods)	■						
Definition of flooding and under flooding areas, causing economic damage due to floods		■					
Vulnerability assessment of various types of water and other related natural resources and economic sectors to climate change		■					
Implementation of pilot projects on adaptation to climate change			■	■	■		