



Evaluation of safety of hydraulic structures as part of the ecological monitoring of streams (for example, the Osetr river in the Moscow region) environmental aspects

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Abstract The article summarizes the results of a comprehensive environmental assessment of the Osetr river basin in 2018 based on the results of engineering and environmental surveys obtained in the framework of environmental monitoring. The current state of the dam on the Osetr river in Zaraisky district is assessed, the forecast of possible changes in the environment under the influence of anthropogenic load is presented in order to prevent, minimize or eliminate harmful and undesirable environmental and related social, economic and other consequences and preserve optimal living conditions of the population. The analysis of the current state of the problem has shown that the safety of small waterworks is reduced due to the receipt of unreliable initial data for the assessment of the environmental situation at the site, which leads to serious violations of the rules of operation, damage to dams and reservoirs and as a result has a significant impact on the environment with subsequent positive or negative effects.

Keywords: Environmental condition; Anthropogenic loads; Operation of hydraulic structures; Assessment, Environmental safety

1. Introduction

Hydraulic structures (next - GS) are specially prepared tanks, the bottom and slopes of which are equipped with anti-filtration devices to protect against pollution of underground and surface water sources (Federal law, 1997; Lyapichev, 2008).

As a result of the entry into the natural environment and migration of pollutants contained in the water of GS, their impact on the air, surface and groundwater, soil, the nature and magnitude of which are determined by the physical and chemical properties, weight and toxicity of waste ingredients accumulated in GS, as well as the geological structure and climatic and geographical features of the region.

According to the data obtained in the administration of Zaraisky district and LLC "Ryazanproekt", in 2017 on the dam of the Osetr river in Zaraisk in the Moscow region was carried out a complex of engineering and environmental surveys for the overhaul of the dam.

Within the framework of environmental monitoring, a reconnaissance survey of the dam was conducted, during which the main environmental indicators were determined, an assessment was made on radiation, chemical, sanitary-epidemiological and physical factors of environmental risk.

2. Research methodology

The analysis of the current state of the problem showed that the safety of waterworks, especially small ones, is reduced due to the receipt of unreliable initial data for the assessment of the environmental situation at the site of works: serious violations of the rules of operation, damage to dams and reservoirs, the lack or low efficiency of public safety, inadequate assessment of maximum flooding, insufficient engineering assessment during the construction of the dam, which predetermines the increased interest of specialists in the problem of ensuring safety., and also with the lack of the majority of owners of project documentation that prevents to estimate a condition and safety of hydraulic engineering constructions, to establish compliance of security of settlement expenses of spillages to a class of constructions (Moiseev; 2000, Malakhanov, 2000; Lyapichev, 2008)

The dam on the Osetr river was put into maintenance in 1966 on the site of the old wooden ridge dam and serves to create a support in the upstream pool at the lower retaining level of 113.50 m in order to create recreational areas in the Zaraisk district.

The dam is located below the bridge, draining occurs through the top across the width of the river. Within 250 m downstream of the dam in the bed of the Osetr river there is an island and a long small rocky roll. The general orientation of the dam: from North-West to South-East. The existing dam is overflow, with steps arranged below to extinguish the power of water. The relief of the left and right banks of the dam is transformed and formed as a result of construction works at the building of the dam.

On the left bank is arranged in a bypass channel, a length of about 180,0 m - at the time of survey was dry. Along the perimeter of the coastline can be traced soaking flat areas and their subsequent overgrowing with marsh vegetation (sedge). In the areas of water discharge, tree trunks were found stuck in the process of flooding, interfering with the normal flow of water.

Currently, the dam belongs to the construction of class IV, is a reinforced concrete sectional structure, separated by buttress type supports, filled with a mixture of soil and gravel. Pressure line made of concrete slabs, rendered from the stream. The water-fighting part-precast-monolithic reinforced concrete, on the basis of oak piles of the old dam and rubble stone and according to the technical specification in the structure of the hydroelectric complex on the river Osetr in Zaraysk consists of the following main

structural elements (LLC, 2017): upstream apron from clay loam and monolithic reinforced concrete pour - repair required; the weir part of the dam - in the form of inclined reinforced concrete, monolithic slabs, reinforced with a grid of flat steel. Slabs are supported and laid on inclined reinforced concrete buttresses, which transfer the load to the base of the structure. The fastening of the plates in some places is completely absent, in some places there are collapses and deformations of the surface of the spillway of the dam; water cooker - the water running part is destroyed, there is no apron, the mounting of the washout pit and the slopes of the diverting channel; abutments reinforced concrete.

On the left bank there is a bypass canal, with a length of about 180.0 m - at the time of the survey it was dry. Along the perimeter of the coastline, soaking of gentle areas and their subsequent overgrowing with marsh vegetation (sedge) can be traced. In the areas of water drainage, tree trunks stuck in the process of flood are found that interfere with the normal flow of water.

In connection with the reconstruction and operation of GS can have a significant impact on the environment with subsequent positive or negative effects.

3. Results and discussion

One of the significant results of the impact of the hydraulic structure on the environment is the change in the hydrological regime of rivers and the formation of conditions for the qualitative composition of water: the intensity of the processes of formation and melting of ice, evaporation and precipitation; anthropogenic load on the reservoir, the level of sanitary preparation of the possible flooding zone; characteristics of the flooded bed; economic development of the reservoir; as well as a consequence of the self-cleaning processes that develop under the influence of tributaries, lateral inflow, discharge regimes of water flow affects the state of the dam as a whole, and as a result the water quality of the Osetr river.

As a whole, according to the results of the reconnaissance survey, it can be noted that no critical violations were detected. The amount of research carried out meets the requirements of the normative-methodical literature and is sufficient to assess the current situation (LLC, 2017):

- the radiation situation at the site under study is satisfactory. Surface radiation anomalies on the shoreline of the Osetr river in the area of the dam were not detected;
- as a result of human activities, surface soil and soils from geological wells in the study area are not contaminated with heavy metal salts, their concentrations do not exceed the MAC;
- according to the content of petroleum products, the degree of contamination of the soil grounds of the work site can be qualified as “permissible” level of pollution;

- according to sanitary-microbiological, sanitary-parasitological and sanitary-entomological indicators, the soil can be classified as "clean".

The results of hydroecological studies of the water of the Osetriver indicate their satisfactory condition:

- the results of laboratory studies of the selected water samples at the site were compared with the standards of MPC established by the order of the Ministry of agriculture of 13.12.2016, № 552, "Maximum permissible concentrations (MPC) of chemicals in water of water bodies of fishery value" and SanPiN 2.1.5.980-00 "Hygienic requirements for the protection of surface water". Exceedances were found for a number of indicators: Nickel (1.5 MPC f-v), copper (10 MPC f-v), iron(4.1 MPC f-v), petroleum products (1.06 MPC f-v) as of 2017; suspended solids (1.02-2.6 MPC f-v), organic substances on BOD5 (2.14 MPC f-v), nitrite ions (1.51-2.28 MPC f-v), manganese (1.6-2.5 MPC f-v), copper (4.5 MPC f-v) (Order of the Ministry of Agriculture of the Russian Federation № 552, 2016);
- in groundwater the content of heavy metals, petroleum products does not exceed the MPC established by GN 2.1.5.1315-03, which indicates the absence of strong anthropogenic and man-made impact at the moment on this component of the environment (MPC, 2015);
- according to the water pollution index (WPI), the water of the Osetr river is estimated as "moderately polluted" (WPI=1.0-2.5) from the sett. Zaraysk to the confluence of the Oka (49.2 km) and is replaced by "dirty" (WPI =4.0-6.0) to the sett. Akatyevoye (2.09 km) (Temporary guidelines for the integrated assessment of the quality of surface and sea waters, 1986).
- less contaminated alignments №№1,2 (sett. Zaraysk, sett. Markino) and № 15 (sett. Spas-Doschatyi) SCWPI are 3.95; 4.26; 3.93; and the water quality belongs to class 4 and category "b", i.e. it is "dirty". In alignments №3 (sett. Radushino) and № 25 (sett. Akatyevoye - Oka river) water is a very "dirty" (4th class, a category "c"). The worst quality is observed for alignments, linked to the sett. Vlasyevoye. (№ 24) - the water is "very dirty" (4th class, a category "d"), and SCWPI is 5.4 (RD 52.24.643-2001).

The state of atmospheric air can be described as "satisfactory" (LLC, 2017):

- acoustic effects on the atmospheric air in the study area exceed the maximum permissible levels. The main contribution to the noise level is made by the noise of the dam falling water;
- the measured values of electric field intensity, magnetic field intensity and induction at the work site do not exceed the standard values.

During many years of operation, surface and underwater structures of the dam were worn by 70% or more. In order to accurately assess and avoid a hydrodynamic accident at a hydraulic structure causing significant damage to the area, it is necessary to carry out major repairs without changing the technical characteristics and existing parameters.

The organization of monitoring the interaction of GS with the environment is of great importance for taking urgent measures to prevent undesirable effects or mitigate them,

if necessary. The composition of monitoring studies is determined based on the analysis of specific aspects of the impact of GS on the environment (Federal law, 1997).

Reference

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