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Air pollution and hydromorphological description of the river

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ABSTRACT

Hydromorphological assessment of surface water status not only takes into account biological and physicochemical components, but also structural characteristics of surface waters including among others: hydrological regime, river continuity and morphological conditions. It should be borne in mind that the quality of surface water is also influenced by atmospheric conditions and the type of pollution that occurs in the areas surrounding the catchment area. Because harmful substances can get into the tanks both as a result of precipitation that can absorb atmospheric pollutants and by leaching from neighboring areas of solid contaminants there. It is therefore important to conduct surface water analysis in conjunction with air quality monitoring.

Keywords: hydromorphological status, RHS, atmospheric air, pollutant emissions

1. INTRODUCTION

The River, along with the adjacent Valley are some of the most valuable habitat items. Because due to human activity are followed by all kinds of transformations, therefore one the most important tasks of water management is monitoring and hydromorphological assessment of surface waters. This introduces Directive 2000/60/EC of the European Parliament of 23 October 2000 [1], establishing a framework for Community action in the field of water policy, which is called The Water Framework Directive (WFD). It was designed to prevent deterioration in the status of bodies of water and was reaching "good status" of all waters in the period up to the end of 2015. For surface waters "good status" designated by the "good ecological status". In order to fully meet the guidelines of the WFD, to assess the quality of surface waters enter the original hydromorphological assessment, which, alongside the component biological and physicochemical will take into account the structural characteristics of surface water in the hydrological regime, among others, the continuity of the River, the morphological conditions [2].

The hydromorphological state depends on the abundance of natural and anthropogenic elements, as well as on their relative proportions (the greater the predominance of natural elements, the better the ecological status of a particular river). Domination of anthropogenic component shows a clear transformation river environment by man [1]. This method is used to monitor the effects of physical changes in order to determine the usefulness of the settlement of certain plant species [3]. It is most commonly used in the United Kingdom, Germany, Sweden, Denmark, the Czech Republic and Latvia [4-7]. However, in a modified version in Italy, Greece and Portugal [8]. Method of River Habitat Survey (RHS) is used primarily for the purpose of monitoring the rivers as well, very often serves as a reference method for other research methods (for example SERCON- System for Evaluating Rivers for Conservation [9]). In Poland the RHS method is used from the late 90 's of the 20th century. On the other hand, the form of the textbook has been adopted since 2007 [10].

This method has become particularly popular in recent years because it allows for a precise description of the hydromorphological conditions for the 500-metre stretch of the representative. According to the RHS methodology, research is carried out in two stages in the field, compiling a field form [11]. In the first stage the characteristics of the morphological traits and troughs in the 10 control profiles, located every 50 m, are taken into account and the structure of the water and shore vegetation is taken into account, as well as the use of the river valley area. In the second stage of the method of the RHS allows synthetic description of the research section, which shall take into account the different morphological forms and transformations that were not recorded in the earlier stage of the research [12-13].

This method allows you to collect about 400 parameters characterizing the hydromorphological condition of the river and allows for the calculation of the indicators of the HQA and HMS, which are made up of many individual basic parameters. Index HQA (Habitat Quality Assessment) is a pointer to the naturalness, which enables the assessment of the diversity of the natural elements and the valley. Conversely, the habitat conversion index HMS (Habitat Modification Score) allows you to calculate on the basis of the information about the type and number of buildings, information such as: the strengthening of the banks, changes in water relations disorder trough profiles valley. Individual elements are assigned points, the sum of which allows for the classification of the test section of the watercourse to

a specific category (watercourse has the best conditions for hydromorphological for high values of the indicator HQA and low values of HMS).

In addition to assessing the hydromorphological an important element influencing the quality of surface waters is the state of the air and the nature of impurities that appear in areas surrounding the analyzed area. For this reason, it is essential to carry out the monitoring of air quality. The consequence of air pollution among other things are acid rain containing absorbed in drops of water sulphur dioxide, nitrogen oxides and their reaction products in the atmosphere: diluted solutions of sulfuric acid, mainly sulfuric acid (sulfuric acid (IV) according to the new nomenclature) and the most harmful sulfuric acid (otherwise sulfuric acid (VI), as well as nitric acid (otherwise nitric acid (V)). Acid rain, as well as other acidic precipitation get into lakes, rivers and the like tanks, causing their acidification and making them not suitable for humans and animals. Harmful substances can get into the tanks in two ways: either directly or through leaching from the neighboring areas. An example is aluminium, which will leach from the soil becomes especially dangerous for fish, as they accumulated in their gills by preventing breathing. In freshwater ecosystems background form the granite rocks that are resistant to weathering and acid rain is not neutralized in the soil causing high acidification of lakes and watercourses. Consequently, fish, especially trout and salmon can no longer reproduce, and this can lead to their extinction, and it is due to their being in the acid water.

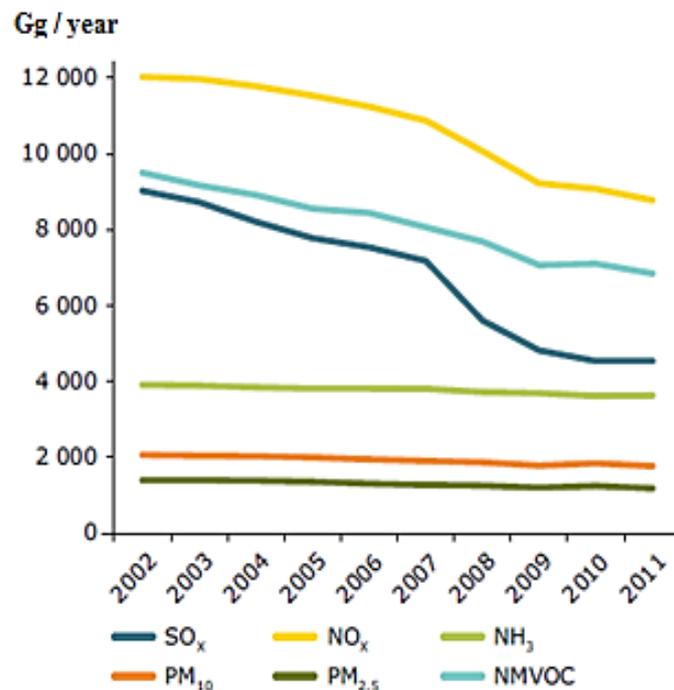


Figure 1. The emission of pollutants over the years 2002-2011 [18].

Atmospheric air is an element of the environment, and the atmosphere is made up of five layers, the most important thing for man is the troposphere, i.e. a layer from one side of the adherent to the surface of the Earth, and the other up to the contractually to the height of an average of 11-13 km above the surface of the land [14]. Therefore, in ambient air, you

cannot extract any natural barriers, and it becomes the recipient of large amounts of different types of pollution that impact both on human organisms, and the environment around them. Consequently, the necessary becomes monitoring system and air protection, so you can try to control and analyze the impact of specific pollutants not only globally, but also in scale continental, national and local [15].

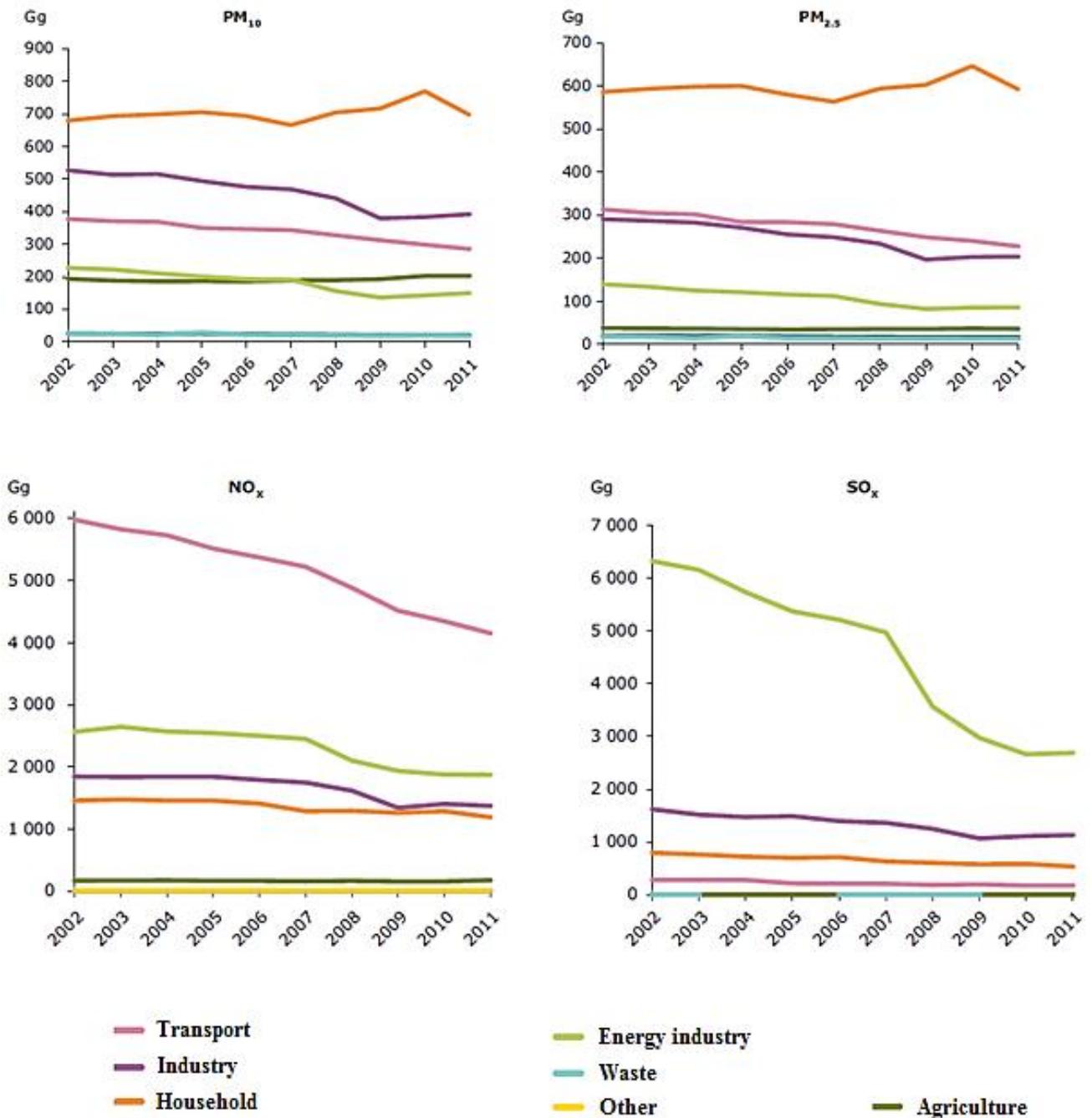


Figure 2. A summary of pollutant emissions in different sectors of emission sources.

In Poland air quality is controlled within the provincial air quality assessment systems, which are supervised by the Regional Inspectorate for Environmental Protection [15].

Useful are also any periodic or constantly change analysis of the field current immission of contamination on the site, because you can improve existing methods for improving the system of monitoring the atmosphere [16].

The most important act of the law setting out the requirements in the field of air protection for all Member States of the European Union is the European Directive of the Parliament and of the Council of 21 May 2008 (2008/50/WE) on ambient air quality and cleaner air for Europe. The directive was introduced to the process CAFE (Clean Air For Europe) and aims to improve air quality and protect against the harmful effects of pollutants on the environment. The Directive sets and defines the basic and common strategy as:

- combating or reducing the harmful effects of pollution on human health and the environment as a whole;
- assessment of ambient air quality;
- maintain ambient air quality where it is good and it is recommended that improvements in other areas.

In the last decade, emissions of major pollutants in Europe have decreased (for the years 2002-2011), improving air quality throughout the area. However, in some sectors are shown some increases in emissions. An example is here dust emissions from the combustion of fuel in the commercial sector, institutions and households whose values have increased by about 7% since 2002. This sector is currently the most important factor contributing to the increase of the total particulate matter (PM) in the European Union. However, in the case of emissions of SO₂, CO, and Pb have noticed a significant reduction, which unfortunately did not bring a decline in concentrations of pollutants in the atmosphere for PM and O₃ (Fig.1 and Fig. 2).

2. RESULT

The subject of this analysis is the Jasien river, which is the right tributary of Ner river. Currently the river begins at the outlet of the canal in Giewont Street below Pomorska Street, and its total length is 12,6 km, with a total catchment area of 79,57 km².

Jasien River flows through the center of Lodz (a city in central Poland) and is located within the administrative boundaries of the city. To this situation, the only small sections of preserved natural character, and its greater part flows among residential and industrial of Lodz (Fig. 3).

The following analysis covers the entire river Jasien on her outdoor sections (Fig. 4), because it allows you to present: various types of transformations of anthropogenic and natural elements of the river. On the exposed sections of the river were made 12 profiles 500 meters, and in each of them 10 control profiles. Outdoor sections of the Jasien River are located from the estuary to the Ner River after Lazurowa Street (A) and from Przedzalniana Street to Tymienieckiego Street (B) (Jasien River flows through areas of dense urban building) at the outlet of the culvert on Giewont Street (C) (this is a source section of the Jasien River flowing a few kilometers through areas slightly covered with urban and industrial buildings).



Figure 3. A view of the fragment of the river Jasien.

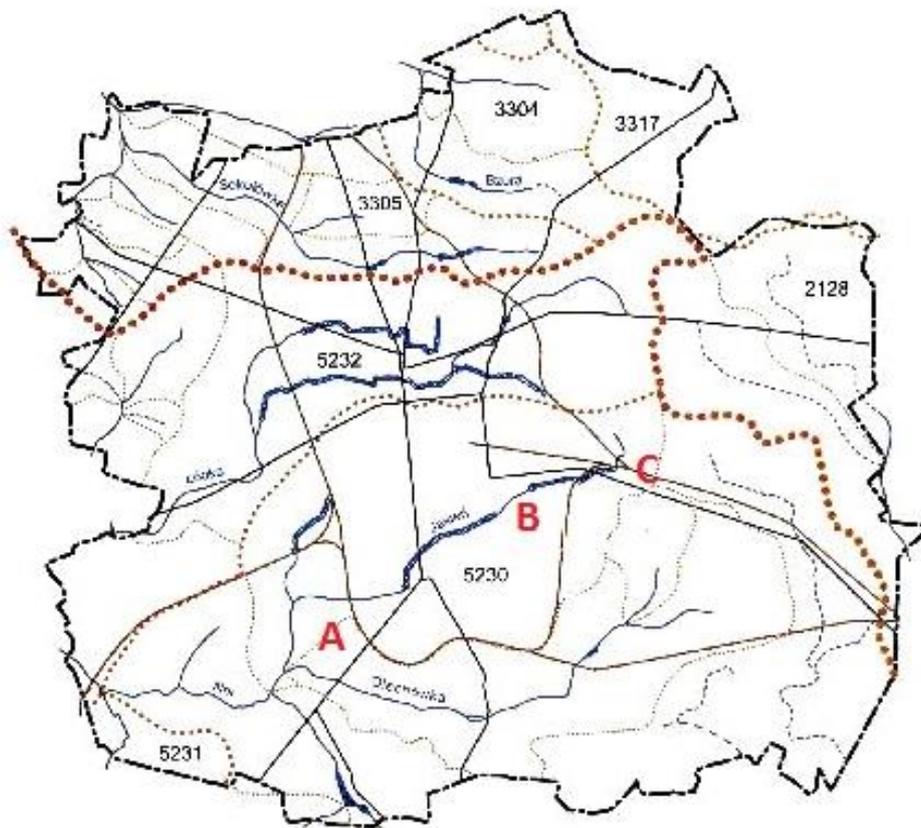


Figure 4. Map of the distribution of research points.

Portion of the river from the mouth of the river Ner to Lazurowa Street is the estuary section of Jasien river. This part is dominated by a river valley with an invisible slope of the valley, and the height of the right and left bank is similar. During the measurements, the river water in this section was cloudy. Along the length of the section, the bottom was sand and the banks were covered with earth [11]. The flow of classified as smooth, and sometimes fast. Almost every control profiles observed modifications Bank of the trough (Table 1) to strengthen and profiling. Natural morphological elements, recorded on the source section, are intersections and coastlines not covered by vegetation. The structure of the vegetation on the slopes and tops of the banks of the [11] for the most part was uniform, and sometimes in some of the profiles there is no vegetation. In the strip of 5 m from the shore there were meadows and pastures, on the edge of the right and left were used extensively. Trees and bushes were found throughout the profile on the right and left bank but were only dispersed. Water plants were observed in large numbers in narrow-leaved plants and structural algae were observed. in the lane of 50 m from the top of the bank in scattered sections, mainly pastures, meadows and suburban buildings were observed. In this section there were invasive plants: American ticks, Himalayan impatiens, tuberous sunflower and hard-boiled rhizome. The representatives of the fauna were dragonflies and ducks. Anthropogenic changes have also been observed namely deepening the valley and the so-called “rubbish” (according to the nomenclature RHS) [11].

Table 1. Excerpt from field for the section of the estuary (A) river Jasien.

PAGE 2			
E. Physical attributes			
Left bank			
Material - Profile 1	BE	BE	BE
Material - Profile 2	BE	BE	BE
Material - Profile 3	BE	BE	BE
Material - Profile 4	BE	BE	ZI
Material - Profile 5	BE	BE	ZI
Material - Profile 6	BE	BE	ZI
Material - Profile 7	BE	BE	ZI
Material - Profile 8	BE	BE	ZI
Material - Profile 9	BE	BE	ZI
Material - Profile 10	BE	BE	ZI

Modifications I - Profile 1	PR	PR	PR
Modifications I - Profile 2	PR	PR	PR
Modifications I - Profile 3	PR	PR	PR
Modifications I - Profile 4	PR	PR	NW
Modifications I - Profile 5	PR	PR	NW
Modifications I - Profile 6	PR	PR	NW
Modifications I - Profile 7	PR	PR	NW
Modifications I - Profile 8	PR	PR	NW
Modifications I - Profile 9	PR	PR	NW
Modifications I - Profile 10	PR	PR	NW

Section from Przedzalniana Street to Tymienieckiego Street in contrast to the source section has a bit more depth and is approximately 0,5 m. Because there was more turbidity in the water there was no visible bottom of the trough, and it was difficult to determine the material that builds the bottom. Throughout the episode, you will notice to strengthen the base of banks, and sometimes and the bottom, which was made of concrete slabs. The whole stretch of the trough is profiled and deepened. At this stretch of the belt 5 m and 50 m from the top of the left and right bank dominate the extensive meadows, trees and urban development, which is connected with the occurrence of roads, buildings and trash [11].

The structure of the vegetation on both banks is mostly uniform and simple. In the analyzed section, water vegetation is primarily a narrow-leaved plant and in two profiles appeared liverworts. Just like in the estuary there are quite a lot of algae structural. On this section i.e. from Przedzalniana Street to Tymienieckiego Street were located the water buildings, that is water outlets, which is in the method RHS are classified because of their shoreline strengthening. Two of them were identified as large (shoreline ≥ 25 m in length) and the remaining ones as medium outlets (shoreline lengths of 10-25 m) and the presence of pedestrian bridges and medium bridges were noted. There is a park on the right bank and, like the esophagus, there are invasive plants, such as: Sosnowski borsch, osteophyta, smallwood flower and tuberous sunflower.

The source section of Jasien river is profiled and deepened. The structure of the vegetation on the slopes and the peaks of the shores [11] was generally considered to be uniform, while in some profiles there was no vegetation. At 5 m and 50 m from the top of the left and right bank, meadows and pastures were used extensively. In contrast, trees and bushes occurred throughout the profile both on the right and left bank but were distributed. The aquatic vegetation is similar to that of the analyzed section 1 and 2, which is dominated by narrow-leaved and structural algae. An additional element is the large number of shoreline shrews, the American hound and the sharpshooter, which are invasive plants. High water

marks were observed on the shore plants. This section, along with the estuary section, has quite a number of natural river elements.

A large number of parameters collected by the RHS method allows the assessment of the nature of the river environment and the extent to which they are modified. Therefore, in addition to several other elaborate components of the supplement, the specialists developed their own indexes. Synthetic indexes allow the assessment and classification of rivers as required on The Water Framework Directive [1]:

1. The natural habitat index indicates the extent to which the environment has features that are similar to or close to nature, so that the diversity of natural morphological features of the river and the river valley can be determined. To determine the rate HQA, you should sum up the numbers allocated in accordance with the requirements of the methodology RHS, and they are [11]: type of flow in the river bottom material trough, natural elements morphological trough and the banks, the structure of vegetation shoreline, a group of aquatic vegetation, plantings and elements the morphological associated with them, the use of the area at the waist to 50 m from the top of the shore, or the valuable natural elements of the environment. Unfortunately, the method of aggregation of these features is tedious and time-consuming. The values that the HQA can finally accept are in the range 0-136 (in Polish rivers the values are from 15 to 80). The maximum value of 136 indicates that the river is a natural stream in which there is a very large variation of natural morphological elements in the trough and its surroundings. The index is lower, the river has less natural hydromorphological characteristics. For the Jasien River, the natural habitat index (HQA), for successive episodes, was successively: HQA = 17, HQA = 21, HQA = 18 [11].

2. The conversion of habitat is characterized by the degree of anthropogenic changes in the river. All forms of transformations registered during off-site and off-site field surveys should be considered i.e. buildings of piling up, transit, shore strengthening, profiling of the edges or bottom, rampart, water piled up due to the presence of water structures, or blending the edges. HMS Takes values from 0 to 100, where 0 means no anthropogenic transformations, and values close to 100 indicate strong transformations. For the Jasien River, the natural habitat index (HMS) for successive episodes was consecutive: HMS = 50, HMS = 55, HMS = 30 [11].

Based on Table 2 it can be stated that the hydromorphological condition of the three sections is bad because the anthropogenic elements dominate the natural. The RHS method meets the requirements of the WFD [1] because the scope of fieldwork is based on two of the three criteria of the directive, i.e. the morphological characteristics and the assessment of the continuity of the river. The third criterion is the hydrological regime understood as the mean flows accompanying the correct amplitude of the fluctuations of flows during the year and in the multiyear. Unfortunately, this element is not included in the RHS method, which should be considered a serious drawback. This is one of the most frequently mentioned disadvantages of the RHS system, that is, failure to take into account the hydrological regime and the connection to groundwater. Therefore, the RHS method should be complemented by such elements of assessment that would allow the hydrological regime to be characterized, including disturbances resulting from significant changes in the management of the catchment area, the impact of water management (mainly non-returnable water) and existing reservoirs on the hydrological regime. There is a drainage system as well as a combined sewage system in the area of the catchment area analyzed (a part of the sanitary channels is included

in the drainage system in the upper catchment area). These factors affect the hydrological calculations. It should also be noted that the Jasien catchment basin has an area of 2 735 ha, of which 1 205 ha is sealed (this gives the seal factor equal to 0,44). The cause of this unfavorable situation is the large share of urbanized and industrial areas, communication and high housing developments in the center of Lodz. Flow rate means the degree of sealing of the catchment area as a geometric value. The effective flow factor is the share of the flow volume in the volume of precipitation variable variable.

Table 2. Hydromorphological classification of the studied sections of Jasien on the background of the diagram RHS classification [4].

		Categories - HQA				
		109-136	82-108	55-81	28-54	0-27
Categories - HMS	0-2	I	II	II	III	III
	3-8	II	II	III	III	IV
	9-20	III	III	III	IV	IV
	21-44	III	IV	IV	IV	V
	45-100	IV	IV	V	V	V



Retention data are extremely important in the description of the river, but are not directly included in the RHS standard. On the other hand, the retention is closely related to the precipitation of rainwater into the water reservoirs, which in turn is related to deposition of pollutants. Therefore, an important element is determining the size of the charges of acidifying substances, heavy metals and biogens delivered to the surface water with precipitation. Such data are developed by the State Environmental Monitoring as part of air quality monitoring. The precipitation chemistry station for the Lodz province is located in Sulejow. For 2013, the annual precipitation was 671.8 mm, while the load deposited with the precipitation was 55.2 kg / ha and it was 12.9 % higher than the national average and the annual total load for the city of Lodz amounted to 52.68 kg / ha per year.

3. CONCLUSIONS

The assessment of the Jasien River using the British method of the River Habitat Survey allowed us to register the different elements both natural river and about anthropogenic transformations. Because the RHS method of recording defined environmental elements, the results are accurate and reproducible. And hydromorphological assessment is obtained in the form of synthetic indicators, and may be used for statistical analysis.

The hydromorphological condition of the Jasien river has been identified as very weak, since most of the banks and the river bed are reinforced by concrete lining, only the source and the escapement (but not strengthened) were profiled. In all 12 test profiles can point to human interference, which is associated primarily with revetments, the presence of a water development. Least according to the classification fell middle section of the river Jasien, which is related to the flow through the city center, where the prevailing density housing is characterized by the local and central heating system. The specifics of these two type of heating systems causes in the immediate vicinity of the float large amounts of air pollution, as a result of precipitation are going to get to the river. While the best condition has occurred in the source section of river where the superstructure is scattered, and we have to deal with less air pollution.

According to the authors, should be expanded standard RHS of the essential elements for the description of river transport. It appears that the extent of such enlargement should go beyond the standard adopted in the RHS (e.g., an important part of information on the proximity of large areas with particularly low water retention or information about the housing density). It should also include analyzes of both air quality monitoring and the combination of systems and types of heating used in a given area, as this may well be an important factor influencing the quality of surface water.

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