**Water quality**

Live in all its forms and human health are dependant on the availability of water of appropriate quality and in appropriate quantity. Water (in particular fresh water) resources, characterised by high quality, are an necessary element for the development of ecosystems, increase of tourist attractiveness of a region, which in turn is reflected in the development of some branches of the economy and affects the civilisation development of a country, being at the same time a factor that determines the standard of living of a society to a high extent.

Low water quality limits the possibility of its application for particular purposes, including for the needs of industry, tourism and supplying the population with water for consumption, which generates additional costs for the whole sectors of the national economy. It pertains both to inland and marine waters.

Poland is distinguished by relatively small water resources to ca. 1500 m\(^3\)/year/capita and a high population and varied state of urbanisation and management of the area. National water resources per capita are low and constitute just about 36% of the European average. The state of water resources results in difficulties with water supply in some areas of Poland. The mining and processing industries are concentrated in southern Poland and are characterised by a significant impact on water quality and water management of that region and the whole country. The water-intensive industry and development of demographic processes, as well as natural geographic and hydrographic conditions lead to the occurrence of serious water deficiencies. In the southern part of Poland, there also exists a significant variability of water flow in rivers during heavy rain and the movement of large volumes of flooding water constituting, among others, runoff from the mountains. All the factors make reasonable water management difficult, and the relatively small retention volume of artificial reservoirs does not allow artificial elimination of the problems arising from periodical surpluses and deficits of surface waters. What is the basic problem in the scope of supplying population with water is the small availability of water of high quality, whereas due to the clear decrease in consumption from industry and households, the problems with quantity have become much less important.

### Rivers, lakes and groundwater

The basic environmental objectives with reference to waters is maintenance or improvement of water quality, the biological relations in the water environment and on wetlands, so as to:

a) for surface water bodies, avoid adverse changes to their environmental and chemical status (or the environmental potential and the chemical status in the case of artificial and heavily modified water bodies) and achieve or maintain the good ecological status (or environmental potential) and chemical status;

b) for groundwater bodies, avoid adverse changes to their quantitative and chemical status, reverse significant and persistent upwards tendencies with reference to pollution caused by human activity, ensure the balance between the extraction and recharging of groundwater and maintain or achieve a good quantitative and chemical status.

Implementing the above objectives, one should ensure that the waters, depending on the needs, are fit in particular for:

1) supplying population with water for consumption;
2) recreation and water sports;
3) habitation of fish and other water organisms in natural conditions, enabling their migration.

**extract from Article 38 of the Water Law Act on 18 July 2001**

### Status of surface waters

The status of surface waters is assessed by comparison of the monitoring results with criteria expressed as threshold values of water quality indicators. The overall status incorporates the ecological status (which includes biological elements and physicochemical and hydromorphological elements as supporting indicators) and the chemical status (assessed on the basis of chemical indicators, characterised by the occurrence of hazardous substances to the water environment, including the so-called priority substances).

The ecological status is determined for water bodies, constituting the basic unit in water management, while the term ecological status is applied for natural water bodies, and in the case of artificial or heavily modified water bodies – ecological potential. Ecological status and ecological potential are classified by assigning a water body to one of five water quality classes.

Three types of monitoring of surface waters have been carried out since 2007: surveillance monitoring (aimed at
establishing the status of surface water bodies, determination of the types and assessment of the intensity of significant influence resulting from human activity, performing assessments of long-term changes in the status of surface water bodies in natural conditions and performing assessments of long-term changes in the status of surface waters bodies in the conditions of broadly understood influences resulting from human activity), operational monitoring (carried out to establish the status of surface water bodies, which has been identified as endangered with failure to meet the environmental objectives set for them and water bodies, for which a specific usage goal has been established, as well as making an assessment of the changes in the status of surface waters resulting from implementation of action plans) and investigative monitoring (undertaken on an ad hoc basis, among others, to determine the size and influences of accidental pollution or establish the causes of clear discrepancies between the results of the assessment of the ecological status on the basis of biological and physicochemical quality elements).

Due to the implementation of a new system of water status assessment, changing not only the method of assessment, but also the threshold values for particular indicators and introducing the principle of annual assessment of a different group of water bodies (so as to assess all water bodies in Poland during a six-year water management cycle), it is impossible to compare the assessments of the years 2007 and 2008 with prior assessments. It is also not possible, on the basis of the results from the two years, to make conclusions concerning tendencies in the changes in water quality, since different surface water bodies and groundwater bodies were evaluated.

In 2007, of 267 river water bodies covered by assessment, on the basis of the results of surveillance monitoring, only 6 (2.2%) achieved the very good status, thus met the requirements set of class II. Most of the assessed river water bodies (73.8%) were assigned to class III, thus their ecological status was moderate. Of the 181 river water bodies covered by surveillance monitoring in 2008, 23 (12.7%) were classified as parts, whose ecological status was good or very good (Fig. 5.2.1.).

![Fig. 5.2.1. Classification of the ecological status of river water bodies covered by surveillance monitoring in the years 2007-2008 (source: CIEP/SEM)](image)

The assessment of water bodies of flowing artificial waters and highly modified water bodies covered by diagnostic monitoring in the years 2007 and 2008 was very similar. In 2007, more than 66% of them were assigned to class III, thus were of moderate ecological potential, 30% – poor or bad potential and less than 4% achieved good potential and above. In 2008, 5.5% of the examined water bodies from that category met the environmental objective, thus represented good ecological potential and above.

In general, it can be concluded that the results of surveillance monitoring, after the first two years of functioning of the new monitoring system and water status classification indicate that 6.5% of bodies of flowing waters meet the identified environmental objective, thus achieve the good or very good ecological status (Table 5.2.1.). The assessment results of ecological potential of artificial and heavily modified water bodies are comparable: about 4.5% of water bodies covered by monitoring meet the environmental objectives (Table 5.2.2.).

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Table 5.2.1. Classification of the ecological status of river water bodies covered by diagnostic monitoring in 2007 and 2008 (source: CIEP/SEM)

Table 5.2.2. Classification of the ecological potential of artificial and highly modified river water bodies covered by diagnostic monitoring in 2007 and 2008 (source: CIEP/SEM)
Beside regular monitoring measurements and the results of classification of the status of waters, also the data concerning concentrations of pollutants transported by rivers from the territory of Poland to the Baltic Sea are a source of information on their quality (see: the part of this chapter concerning the Baltic). The results obtained for nitrogen suggest that its concentration in the last three years has remained at a relatively stable level, much lower than at the end of the 1990s, with simultaneous fall in the medium flows (Fig. 5.2.3.). Also the significant drop in the size of BOD5, phosphorus and nitrogen transported from Poland to the Baltic Sea in comparison to 1998 leads to the conclusion about an improvement of the status of the rivers in the scope of physicochemical elements. The value of the load of BOD5 decreased by 45% in 2008 compared to 1998.

In 2008, there was performed, based on the data from the years 2004-2007, the water eutrophication assessment. The assessment was carried out on the basis of results from monitoring obtained for biological elements (chlorophyll “a”, phytobenthos or macrophytes) and physicochemical elements (indicators characterising the nutrients conditions, oxygen conditions and organic pollutants), whereas the choice of biological indicators for eutrophication assessment depended on the abiotic type of the river, where the monitoring point was located. The assessment was carried out on the basis of the provisions of Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of the status of surface water bodies, and it was performed for monitoring point and not for a water bodies. A monitoring point was considered eutrophic if one or more indicators taken into account exceeded the threshold value determined for class II (good status).

The eutrophication assessment of flowing waters performed in this way indicates that the phenomenon concerns ca. 62% of watercourses (of 3268 monitoring points, from which data were included in the assessment, eutrophication was identified in 2016 points) (Fig. 5.2.4.).

Until the end of the process of intercalibration of methodologies of assessment of the status of waters (for biological elements) that is being carried out in the European Union, thanks to which the concept of “good status” shall be unified for the whole European Union, comparison of their quality at the international scale is possible only on the basis of the
indicators developed by the European Environment Agency (EEA). They include percentage listing of monitoring points in ranges of the identified nitrate concentrations (Fig. 5.2.5.). Poland, where concentrations exceeding the threshold value, above which eutrophication occurs (according to the Regulation of the Minister of the Environment the value is 10 mg NO₃/l), were recorded at only 5% of monitoring points examined in 2005 (results from which are transferred to the EEA), occupies a position in the middle of the list.

![Fig. 5.2.5. Share of monitoring points on rivers in 2005 in the ranges of concentrations of NO₃ (mg/l) (data for Denmark of 2004; Bosnia and Herzegovina - 33 mp) (source: EEA, CSI 020)](image)

Polish lakes are generally eutrophic. About half of them are characterised by morphometric and hydrographic features and geomorphological conditions that contribute to the natural aging process of lakes. It means that the eutrophic state is a natural state for many Polish lakes. The state of purity of lake waters is obviously determined not only by natural features, but also the diverse anthropogenic pressure, and, most of all, the delivery of biogenes from point and area sources, deepening and speeding up water eutrophication (also natural eutrophication). In addition, degradation of lakes and related ecosystems may be a result of implementation of improper environmental policy.

In total, 208 lakes were tested and assessed in the years 2007-2008, biological indicators were mostly taken into consideration during the assessment. Lakes with very good and good status, of which there were 98, accounted for 47.1% of the total number of lakes covered by monitoring in the period under consideration (Fig. 5.2.6.). However, with reference to the total surface area of the lakes and the volume of their water, there were much less of them, that is 32.1% and 35.3% respectively. In terms of the number of lakes, the greatest share was accounted for by lakes with good status, which account for 31.7% of the number of tested bodies of water and 24.5% of the volume of their water. It should be remembered, however, that the above assessment was carried out according to the expert judgement, in some cases diverting from the criteria determined in the Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of the status of surface water bodies.

![Fig. 5.2.6. Collective results of classification of lakes covered by monitoring in the years 2007-2008 by ecological status (source: CIEP/SEM)](image)

The lakes in the Vistula river basin are characterised by a much better status. Almost 56% of lakes were assigned the good and very good ecological status there. In the Odra river basin, such bodies accounted for just 31%. Lakes in the drainage basin of Pregoła were characterised by varied status, but the general number of lakes covered by monitoring was too small there to make a reliable comparison. The same applies to the examined lakes in the Niemen river basin, although all monitored lakes represent very good and good status.

The observed diversity of the quality of lake water between the drainage basins results to a high extent (but not exclusively)
from natural conditions. Water bodies may represent a wide range of background (referential) concentrations of nutrients, which depend mostly on the geological conditions of the basin. And so, for example, high concentrations of nutrients compounds, which are not related to adverse changes to biological elements, do not have to testify to moderate or worse ecological status. Thus, assessment of the ecological status focuses on biological effects of the pressure, and the thresholds defined for particular status account for the natural conditions characteristic for a given lake (its type).

An analysis of long-term trends could be carried out only for lakes tested for more than two years, that is 9 lakes of the former fundamental monitoring network (covering lakes subject to slight pressure), examined since 1999. For the lakes, there were performed analyses of the changes to the state of their waters in the years 1999-2008. On that ground, it was established that the values of the basic eutrophication parameters (phosphorus and total nitrogen concentrations, concentration of chlorophyll and water transparency), although they show some variability from year to year, remain at a constant level (whereas in the case of chlorophyll, while the data for 2007 and 2008 are not comparable with the previous data due to the implemented new sampling methodology).

Fig. 5.2.7. Changes to the concentration of total phosphorus in the water of lakes covered by monitoring in the years 1999-2008 (source: CIEP/SEM)

Fig. 5.2.8. Changes to the concentration of total nitrogen in the water of lakes covered by monitoring in the years 1999-2008 (source: CIEP/SEM)

Fig. 5.2.9. Changes to the concentration of chlorophyll “a” in the water of lakes covered by monitoring in the years 1999-2008 (source: CIEP/SEM)

Fig. 5.2.10. Changes of transparency of the water of lakes covered by monitoring in the years 1999-2008 (source: CIEP/SEM)

In 2008, there was performed the lake water eutrophication assessment on the basis of data from the years 2004-2007. What was the basis for determination of eutrophication of waters were average values of the results of examinations of the following indicators – chlorophyll “a”, total phosphorus, total nitrogen, visibility of the Secchi disk and the result of the examination of macrophytes (the Ecological State Macrophyte Index – ESMI). The assessment was carried out on the basis of the provisions of the Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of the status of surface water bodies., whereas if several posts were located on a lake, one average value for the whole lake was calculated. If, in the period under analysis, a lake was tested more than once, the results coming from various years was also averaged. A lake was deemed as eutrophic if one or more indicators taken into consideration exceeded the threshold value determined for class II (good status), although in some cases exceedance of the thresholds of one indicator was not the determining factor in the general assessment, there was also taken into account the general character of the natural conditions of the lake, anthropogenic and biological factors. Assessment of eutrophication of the lake waters indicated the occurrence of that phenomenon in 268 of 432 water bodies, thus a percentage similar to that in the case of flowing waters, which amounts to ca. 62% (Fig. 5.2.11.).

Fig. 5.2.11. Results of lakes eutrophication assessment in the basis of data from the years 2004-2007 (source: CIEP/SEM)

**Status of groundwater**

The assessment of the groundwater quality, carried out on the basis of the results of studies performed in 2007, presents a
slightly different picture in comparison to the results of previous assessments due to the fact that the national measurement network of the groundwater monitoring has been modified in 2006 with the view to adjust it to the requirements of the Water Framework Directive and owing to the method of the groundwater quality classification. In relation to the implementation of the new water monitoring and classification system, it is not possible to make comparisons to the results from previous years.

It results from the examination of the groundwater quality carried out in 2007 in the measurement points that good chemical status of groundwater (classes I, II, III) was established in ca. 80% of the examined points, whereas ca. 20% points were characterised by poor chemical status (class IV, V) (Table 5.2.3.) (Fig. 5.2.12.).

Tab. 5.2.3. Results of the examination of the groundwater quality at measurement points of the national groundwater monitoring network under operational monitoring and diagnostic monitoring in 2007, according to the classification defined by the Regulation of the Minister of the Environment of 23 July 2008 on the criteria and method of assessment of the groundwater status (source: CIEP/SEM)

Furthermore, beside the assessment of the quality classes at particular measurement points, assessment in terms of the chemical and quantitative status was performed for the first time with reference to 161 groundwater bodies designated in Poland.

The results of the assessment of the chemical status of groundwater bodies (GWB) indicate that the chemical status is poor only in the case of 11 (out of 161), the area of which equals 11 687 km² (accounting for ca. 9.5% of the area of the country) (Fig. 5.2.13.). As regards quantitative assessment, it showed that 15 GWBs (occupying the area of 6 960.1 km², accounting for ca. 4.2% of Poland) are characterised by poor quantitative status (Fig. 5.2.14.).

Fig. 5.2.12. Groundwater quality at measurement points (source: CIEP/SEM)

Fig. 5.2.13. Assessment of the chemical status of groundwater bodies in 2007 (source: CIEP/SEM)
The quality of waters in Poland depends significantly on the way of managing their drainage basins. For example, sewage from neighbouring holiday resorts, tourist cabins, camping sites and other nearby buildings, whose sewage management has not been properly arranged, may get to lakes used for recreational purposes. Recreational use of lakes is often accompanied by the process of deterioration of the shores and waterside vegetation, which contributes to soil erosion and impoverishment of the vegetation and, as a consequence, enhances the inflow of substances from the drainage basin to the lake.

The volume of substances transferred from the drainage area to surface water is the lowest from forests, the highest, on the other hand, from industrial and urban areas.

The state of rivers is mostly determined by the drainage of and improperly treated municipal and industrial waste water, including discharge of saline water from coal mines (Fig. 5.2.15.).

Rearing animals and agriculture still are a source of pollutants. It often happens that fields are adjacent to the shores of rivers or lakes, and there are no protective barriers in the form of belts of trees or shrubs along the shoreline, which is conducive to the transfer of agricultural pollutants to the water. According to the data of the CSO of 2009, the total area of agricultural land in Poland amounts to 189.8 thousand km$^2$, thus covering 60.7% of the area of Poland. Consumption of phosphorus mineral fertilisers in the economic year 2007/2008 calculated per P$_2$O$_5$ amounted to 462.30 thousand tonnes and was more than 12% higher than in the economic year 2006/2007 and as much as 42.6% higher than in the year 2004/2005. On average, more than 28.6 kg of phosphorus fertilisers fell on one hectare of agricultural land in the years 2007/2008.

In the case of mineral nitrogen fertilisers, consumption in the economic year 2007/2008 amounted to 1 142.30 thousand tonnes (N). In comparison to the economic year 2004/2005, consumption of mineral nitrogen fertilisers grew by 31%. On average, more than 70 kg of nitrogen fertilisers fell on one hectare of agricultural land in the economic year 2007/2008 (see chapter: Land and soil).

High concentration of industry, in particular on areas located in the upper courses of Odra and Vistula, causes significant changes to the relief and changes to the water relations, as well as the necessity to discharge sewage to the surface river network transporting small volumes of water.

Also in the case of groundwater, abstraction of water through large municipal and industrial intakes, as well as mine drainage were the main causes of its poor quantitative status, which caused adverse changes to the location of the groundwater level (Fig. 5.2.16.).

As regards the main factors determining poor chemical status of groundwater, they included total iron, the presence of which exceeded the threshold value established for good chemical status in ca. 10% of examined water samples (according to the results from 2007). The problem of the presence of iron in groundwater is a national one, and is related to the natural presence of iron in numerous minerals of both igneous and sedimentary rocks. Of the remaining physicochemical indicators, the factor that was of the greatest importance for classifying the tested water as water of poor chemical status was the presence of ammonia and nitrates, whose presence in unconfined groundwater is related mostly to anthropogenic activities, while they may be present in confined groundwater also as a result of geochemical processes. It should be noted, however, that it results from the tests carried out in 2007 that the concentrations of nitrates did not exceed the permissible threshold of 50 mg/dm$^3$ in most measurement points, and, importantly, low concentrations of nitrates were found in ca. 95% of points.
(under 25 mg/dm$^3$). Furthermore, a gradual fall of the number of measurement points, where pollution with nitrates was found was observed in the subsequent years (concentration of over 50 mg/dm$^3$). For lakes, pressures such as: extraction of water for municipal and industrial purposes, transport, morphological changes, changes in the hydrological regime are of local importance and concern a small group of them. What is the main manifestation of degradation of lakes is the process of eutrophication. Eutrophication consists in the growth of fertility of water bodies through increased inflow of biogenes, that is phosphorus and nitrogen compounds. The concentrations of biogenic compounds found in lakes in the recent years, although lower than a dozen years ago, still are high enough to stimulate intensive water bloom.

**The Baltic Sea**

The marine environment is a precious heritage, which must be protected, preserved and, as far as possible, recovered in a way enabling, in the end, maintenance of biodiversity and preservation of diversified and dynamic character of oceans and seas, which are clear, healthy and fertile.

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The basic environmental objective with reference to marine waters is preservation or improvement of their quality, in particular through:

a) protection and preservation of the marine environment, prevention of its deterioration or, where practicable, recovery of marine ecosystems in areas where they have been adversely affected;

b) prevention and phasing out of pollution of the marine environment, so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health, or legitimate uses of the sea.


The Baltic is called the Mediterranean Sea of Northern Europe, as it is surrounded by land from all sides and connected to the Northern Sea only by a few shallow straits. Being about 12 000 years old, it is one of the youngest seas of the Atlantic Ocean. The Baltic Sea belongs to the largest brackish seas in the world, whose characteristics make them particularly vulnerable to pollution and eutrophication. It is a relatively shallow regional sea with an average depth of 50 metres (for comparison, the average depth of the Mediterranean Sea is 1500 m). The Baltic Sea is almost entirely closed (only 3% of the volume of water is exchanged during each year). The very long period of total exchange of water in the sea (25-30 years) is one of the factors making the Baltic one of the most polluted seas in the world.

The Polish Baltic monitoring programme covers with regular control (6 times a year) the state of the marine environment in the Polish zone of the southern Baltic at stations located in the deep-sea zone – in the area of the Gdańsk Deep (station P1=BMP L1), the Bornholm Deep (station PS=BMPK2), at the south-eastern slope of the Gotland Deep (station P140=BMP K1) and at stations located in the coastal zone (Fig. 5.2.17.).

*Fig. 5.2.17. Measurement stations and measurement frequency in 2008 within monitoring of the Baltic (source: CIEP/SEM)*

Classification of the state of the Polish areas of the southern Baltic was carried out on the basis of measurement data obtained during implementation of the monitoring programme for the following areas/regions: the Puck Lagoon (station ZP6), the internal Bay of Gdańsk (except for the area of the estuary of Vistula; stations P110, P116, P104), high seas zone:
the Gdańsk Deep (station P1), the south-eastern Gotland Basin (station P140), the shallow-water zone (up to 20 m) of the middle coast (stations: L7, P16, K6) and the open Bay of Pomerania (beside the are of the estuary of Odra/Swin; stations B13 and B15) (Fig. 5.2.18. - 5.2.22.). Preliminary classification of the state was carried out on the basis of the following quality elements and indicators[1]:
- biological quality elements – phytoplankton:
  1) average concentrations of chlorophyll a in the summer months (V-IX) or annual average in the case of the Bay of Puck and the Vistula Lagoon,
- physicochemical quality elements:
  1) winter concentration of dissolved phosphates (average concentration from layer 0-10 m in the deep water zone or 0-bottom in the lagoons),
  2) winter concentrations of mineral nitrogen (NO₃+NO₂+NH₄),
  3) water transparency in the summer months (V-IX) or annual average in the case of the Vistula Lagoon,
  4) oxygen saturation in bottom water (average concentration of oxygen in the bottom layer) in the summer months (V-IX).

![Fig.5.2.18.](image)

*Fig.5.2.18. Classification of the state of marine waters of the Polish zone of the Southern Baltic in 2008 in terms of concentration of chlorophyll a; colour code: yellow – moderate state, orange – poor state, red – bad state (source: CIEP/SEM)*

![Fig. 5.2.19.](image)

*Fig. 5.2.19. Classification of the state of marine waters of the Polish zone of the Southern Baltic in 2008 in terms of winter concentration of dissolved phosphates; colour code: green – good state, yellow – moderate state, orange – poor state; note – there are no data for the Bay of Pomerania (source: CIEP/SEM)*
Pursuant to the above-mentioned Regulation (see footnote 26), the final result of assessment is determined by the biological element, which was previously assigned the least advantageous class, thus the ecological state of marine waters of the Polish zone of Southern Baltic is determined by the concentrations of chlorophyll "a", as the measurement of the biomass of phytoplankton. In the presented classification, the state changes from moderate to bad. Good ecological state was identified
in none of the classified basins in terms of chlorophyll a, which means that no significant improvements have been observed with respect to eutrophication of the Polish areas of the Baltic Sea.

Within the research and measurement works performed during the cruises of ship RV Baltica in the years 1998-2008, there were carried out measurements \textit{in situ} and samples of sea water were collected for determination of the amount of chemicals in a laboratory located on the ship and water samples for tests in an onshore laboratory to perform determinations of chemical factors, biological factors and long-living radionuclides, analysis of the content of toxic substances in bottom organisms.

Seasonal changes to the production of phytoplankton took place exceptionally early for the Baltic, that is there took place strong blooming of cyanoses by the end of May and in June. Already in May, in the waters of practically the whole area of the Proper Baltic, there were identified high values of fluorescence, corresponding to high concentrations of chlorophyll “a”, while the presence of numerous toxic species of \textit{Aphanizomenon flos aquae} and \textit{Nodularia spumigena} was recorded in July. An analagous situation took place in the Polish part of the Baltic, where the measured concentrations of chlorophyll a sometimes significantly exceeded the average results from the period of 1999-2007 (Fig. 5.2.23 - 5.2.25).

Fig. 5.2.23. Long-term (1998-2007) seasonal changes in thermohaline conditions, the content of biogenic substances and chlorophyll a in the surface layer of the Gdańsk Deep (station P1);

Analysis of oxygen saturation of bottom layers in the period of late summer in the Polish coastal zone in the years 2000-2007 was carried out for the purposes of the all-Baltic workshops “Baltic Sea 2020 – hypoxia in the coastal zone” showed that oxygen deficiencies of various severity occur each year (Fig. 5.2.26.).

Fig. 5.2.26. Number of oxygen deficits in the Polish coastal zone in the years 2000-2007 at selected monitoring stations (colour markers determine the occurrence of minimum oxygen concentration in a year, the numbers in brackets represent the depth of the station) (source: CIEP/SEM)

In the years 2000-2007, threshold concentration of oxygen, classified as deficit, was established incidentally also in the zone of middle coast, where the dynamic conditions – strong rip currents and the phenomenon of upwelling – should definitely counteract the occurrence of oxygen deficits. The minimum value of oxygen was recorded in 2008 confirms the growth of the risk of hypoxia also in the area of the Polish Baltic zone.

The issue of pollution of the Baltic Sea with hazardous substances is, most of all, the problem of the enormous number of various substances of anthropogenic origin flowing to it through rivers. Despite the fact that monitoring shows that the loads of some hazardous substances flowing to the Baltic have been significantly reduced in the last 20-30 years, the problem still exists, whereas the concentrations of some new substances in the marine environment even increased (e.g. compounds including fluorine, Fig. 5.2.27).
Comparing the results of persistent organic pollutants POP (carried out in 2008 in fish from both locations) to the analogous results obtained in 2004 for ΣPCB and ΣDDT, there was recorded a fall in the average concentrations. The content of HCB and ΣHCH in the case of herrings from the Kołobrzesko-Darłowskie fishery was close to the level from 2004, whereas the content of HCB and ΣHCH in the organisms from the Władysławowo fishery was higher than in 2004, while the growth was slight in the case of HCB (Fig. 5.2.28.).

Since 1986, after the Chernobyl nuclear plant disaster, the radioactivity level in the waters of the Baltic Sea has been shaped mainly by the presence of two radionuclides of anthropogenic origin: caesium 137 (137Cs) and strontium 90 (90Sr). Both isotopes are characterised by relatively long periods of half life amounting to 30 and 28 years respectively, which, among other things, are responsible for the still elevated activity of the said isotopes in relation to the time before the Chernobyl disaster. After 1986, the activity of 137Cs in the Baltic waters was growing to maximum values, which were recorded in 1991. From that time, there has been observed a virtually uninterrupted fall in the concentrations of the said isotopes in the Baltic waters. The fall is related most of all with the radioactive decay of isotopes, the processes of bioaccumulation in animated elements of the marine environment, the processes of sedimentation and exchange of the waters between the Baltic and the Northern Sea (Fig. 5.2.29.). A one-off increase, recorded in 2004, in the average concentration of strontium 90 was the result of smaller, in terms of volume, inflow from the Northern Sea.
The catchment area of the Baltic Sea is four times larger than the Sea itself and is inhabited by about 85 million people. Of the 14 countries of the catchment area of the Baltic, nine have direct access to the Sea. Eight of 9 coastal countries are members of the European Union. During the last century, there was recorded a significant negative impact on the environment of the Baltic Sea due to the growth in population and urbanisation, industrialisation and increase in the activity in agriculture. What is optimistic is the fact that there was recorded at the same time a constant downwards tendency in the total loads of nutrient substances from 1990 (according to the data of the Helsinki Commission HELCOM).

In comparison to the year 1998, the load of BOD5 transported through the rivers to the Baltic Sea from the territory of Poland fell by 49%, reaching in 2008 the level of ca. 137 thousand tonnes/year (Fig. 5.2.30.). At the same time, there was recorded a fall in total nitrogen by ca. 70% (from 260.5 thousand to 77.9 thousand tonnes/year) (Fig. 5.2.31.), and in total phosphorus by ca. 52% (from 15.5 thousand to 7.4 thousand tonnes/year). It is, above all, the result of significant investments in the scope of treatment of municipal waste water, removal of various sources of industrial “hot-spot” sources and implementation of the Code of Good Agricultural Practice. However, it must be remembered that the last years have been characterised by relatively small flows (Fig. 5.2.3.) the downwards trend in the loads transported to the Baltic Sea may change in the subsequent years depending on hydro-meteorological conditions.
Fig. 5.2.30. Load of BOD5 transported through rivers from the territory of Poland to the Baltic Sea in the years 1995-2008 (source: CIEP/SEM)

Fig. 5.2.31. Load of total nitrogen transported through rivers from the territory of Poland to the Baltic Sea in the years 1995-2008 (source: CIEP/SEM)
Nevertheless, eutrophication is the greatest problem in the context of protection of the Baltic. The environment of the sea has changed over the last century from oligotrophic (with transparent waters) to strongly eutrophic (Fig. 5.2.33.).

Excessive loads of nitrogen and phosphorus originating from land sources, located on the area of the catchment area of the Baltic Sea and from outside of that area are the main cause of eutrophication. About 75% of the load of nitrogen, as well as at least 95% of the load of phosphorus, is introduced to the Baltic through rivers and direct point discharges from municipal installations. About 25% of the load of nitrogen originates from atmospheric deposition which, beside pressure from the land, is the second important source of pollution (Fig. 5.2.34.).
Actions aimed at improvement of water quality

In December 2003, the Government of Poland adopted the National Programme for Municipal Waste Water Treatment. The Programme was prepared to build, extend and modernise the collective sewage systems and municipal sewage treatment plants, as well as to define the deadlines for implementation of them, necessary for implementation of the provisions of the Treaty of Accession, referring to Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment. It means, among other things, achievement of the quality standards of sewage discharged to the water environment from sewage treatment plants required by the EU and ensuring 75% reduction of the total load of nitrogen and phosphorus in municipal wastewater from the territory of the whole country to protect surface waters, including sea waters from eutrophication.

The actions determined in the National Programme for Municipal Waste Water Treatment shall also contribute to the improvement of the investment attractiveness of Poland and its regions by the development of technical infrastructure, with simultaneous protection and improvement of the state of the environment, health, preservation of cultural identity and development of territorial cohesion.

In the period from 1995 to 2008, the efficiency of municipal sewage treatment plants increased in Poland by more than 35%. In the same period of time, according to the data from the statistical yearbook of the CSO, the share of population covered by the services of municipal sewage treatment plants increased from 42% to 63.1% (Fig. 5.2.35.), assuming a value of 86.9% for urban areas, and 25.7% for rural areas. The number of wastewater treatment plants servicing rural areas increased from 433 to 2213. In 2008, 98.6% of cities were serviced by wastewater treatment plants.
Since 1995, the length of the combined character of the sewage network in rural areas has grown almost 9-fold, reaching the total length of 43,943 km, thanks to which, 22.6% of population in rural areas used the sewage network in 2008 (compared to 5.9% in 1995). In the same period, the indicator for urban areas increased from 65.1% to 86.9%, which means a rise by over 33% (Fig. 5.2.36 and 5.2.37).

As regards the share of total population serviced by sewage treatment plants, Poland, against other EU Member States, comes in the middle of the list, ahead of Belgium, for example, but at the same time being behind its neighbours (the Czech Republic or Lithuania) (Fig. 5.2.38).

The Baltic Sea Action Plan (BSAP) is another project meant to contribute to improvement of the state of inland and sea waters. It was adopted in 2007 at a Ministry Conference under the Convention on the Protection of the Marine Environment of the Baltic Sea Area, called the Helsinki Convention (HELCOM). Its basic aim is to obtain good ecological status by the waters of the Baltic through gradual reduction of the discharge of nutrients, that is the loads of nitrogen and phosphorus from land sources, getting to it through the catchment area or as a result of wet and dry atmospheric deposition. According to the preliminary allocation of discharges of nutrients to the waters of the Baltic, as expressed in the BSAP, based, inter alia, on the use of physico-biogeochemical models (NEST), Poland has to limit the discharge of nitrogen by at least 63,400 tonnes and phosphorus by about 8,760 tonnes by 2021 in relation to the average discharges from the years 1997-2003 (adopted as base data for 2000), amounting to 191,170 tonnes and 12,650 tonnes respectively.

The Baltic Sea Action Plan is a project consistent with other projects and programmes aimed at water protection.
Implementation of the provisions of the National Water-Environment Programme, water management plans or the National Programme for Municipal Waste Water Treatment shall contribute to improvement of the quality of inland waters, and thus it shall have a positive impact on the state of the ecosystem of the Baltic Sea, as the recipient of the pollutants flowing down rivers or directly from the land.

Improvement of marine environment and coastline protection is one of priorities of national marine policy directions until 2020, as was indicated in the governmental document „Assumptions for marine policy of the Republic of Poland until 2020”.

Water quality, especially the quality of water dedicated to supplying people with drinking water, has a great impact on the health of the society, as well as proper functioning of ecosystems. Despite the significant improvement of water quality recorded in recent years, which is the effect of limitation of production in many industries, modernisation of processes and building industrial and municipal sewage treatment plants, the state of purity of surface flowing waters and lakes is still insufficient.

Achievement and maintenance of a good status of waters and reasonable management of water resources requires undertaking and implementing a series of actions in the scope of: industry, agriculture, wastewater management, spatial management, formation of water relations and protection of the water environment, as well as organisational, legal, and educational actions.

The main middle-term objective, to be achieved until 2016, is to increase the self-financing of water management and rationalise the management of surface water and groundwater resources in order to protect the national economy from water deficiencies and secure against the effects of floods. What shall be the main task is striving at maximisation of saving water resources for industrial and consumption purposes, as well as increasing retention of water.

As regards protection of waters against pollution until the end of 2015, Poland shall ensure 75% reduction of the total loads of nitrogen and phosphorus in municipal sewage, continuing the process of modernisation, extension and building new sewage treatment plants within the National Programme for Municipal Waste Water Treatment, as well as implementation of the Baltic Sea Action Plan concerning fight against eutrophication of the waters of the Baltic. There shall also be undertaken further actions aimed at protection of waters against pollution caused by nitrates originating from agricultural sources in compliance with Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment.

It is the overall goal of the environmental policy of Poland in the scope of protection of water resources to maintain or achieve good state of all waters, including also maintenance and recovery of ecological continuity of watercourses.

Implementation of the goal shall be ensured by development and implementation, for each separated river basin area in Poland, a water management plan and a water-environmental programme for Poland. The plans (now being developed for the years 2010-2015) shall include a description of the measures that shall be undertaken to enable achievement of the assumed environmental goals.

[1] In the classification, there were used threshold values laid down in Regulation of the Minister of the Environment of 20 August 2008 on the method of classification of surface water bodies and developed for the needs of project HELCOM EUTRO PRO (http://meeting.helcom.fi/c/document_library/get_file?p_l_id=79889&folderId=377779&name=DLFE-36818.pdf).