Water Quality in Slovenia

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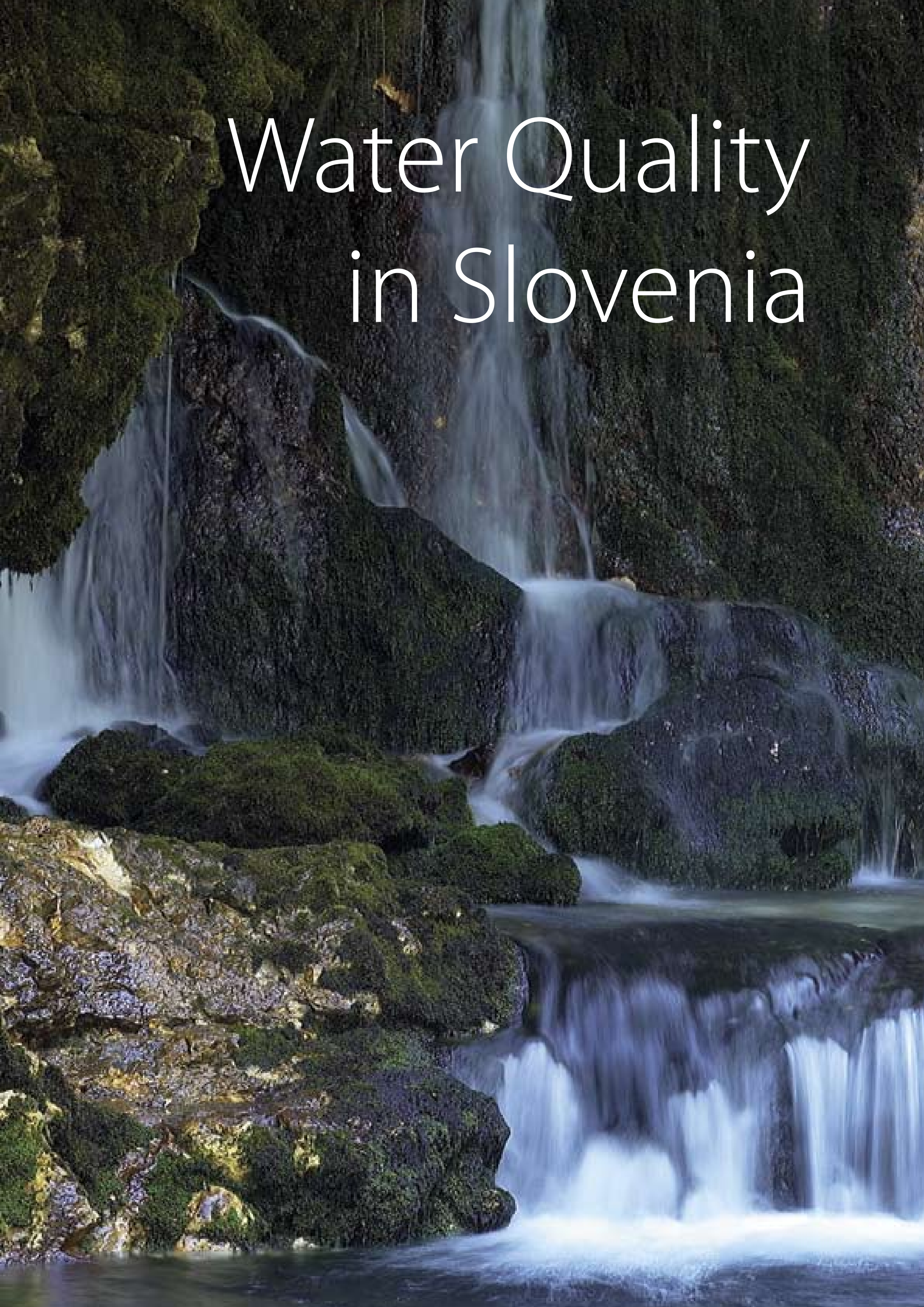


Preface

In recent years, people often ask about water quality. In most cases, they think of the taste, scent and look of water we drink every day. But the answer to the question "What is the quality of water?" is much more complex, since water quality is not just the quality of drinking water, and, moreover, water quality cannot be described merely by the words 'good' or 'bad'.

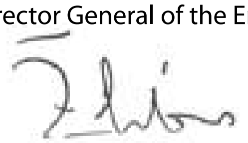
Water quality is a term used to describe the physical, chemical and biological characteristics of water, usually in respect to its suitability for a particular purpose. Different water characteristics are essential for different purposes. Industrial water, for example, must not be corrosive and must not contain substances that result in the formation of residue on the appliance surface. Drinking water must not contain any toxic substances and hazardous microorganisms. Furthermore, bathing water must not contain microorganisms either, since they can cause numerous diseases. With the objective of water protection, various regulations prescribing the limit values of concentrations of various substances in water have been issued in the last thirty years in Europe, as well at a national level.

With the intent of sustainable use, prevention of deterioration, protection and the improvement of the existing water status, reduction of hazardous substance pollution and provision of sufficient quality surface and groundwater supplies, in 2000 the European Union adopted the Water Framework Directive, which gives the Member States a legal and professional basis for an integrated approach to water protection and management. The main objective of the Water Framework Directive is to achieve a good chemical and ecological status of all waters by 2015. The Water Framework Directive does not prescribe limit values for individual water parameters; it provides a new approach to an integrated evaluation of both the chemical and ecological status of water. The new approach is based on the conditions of the aquatic environment where the impact of human activity is either not present or is insignificant. This means that, according to the requirements of the Water Framework Directive, water quality is evaluated comprehensively and the natural status is defined as a state without hazardous substances or other major loads, a state that supports the life of all aquatic organisms as it would be in the case of insignificant human impact. At the same time, it provides a comparability of methodologies and standards and thus, for the first time, comparability of the assessments of water quality status among individual Member States.

For the evaluation of water quality, the Water Framework Directive in Article 8 requests the introduction of surface and groundwater monitoring programmes. Monitoring and water quality status evaluation is one of the key tasks of the Environmental Agency of the Republic of Slovenia. The monitoring of water quality in Slovenia has a long tradition, but in 2007, it was carried out according to the requirements of the Water Framework Directive for the first time. The first assessments of the chemical and ecological status in accordance with the requirements of the Water Framework Directive will, for the purpose of river basin management plans, be carried out by 2009.

The present publication is a brief overview of the water quality status in Slovenia and a trend evaluation in relation to the situation in previous years. The assessments have been made in accordance with the currently applicable regulations that have already been partially adapted to the requirements of the Water Framework Directive. With this publication, we wish to contribute to the understanding of the water quality issue and to the conservation of our precious water resources for future generations.

Silvo Žlebir, Ph.D.
Director General of the Environmental Agency of the Republic of Slovenia



Lake Bohinj, Ribčev Laz

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1 Introduction

Slovenia is one of the smallest countries in Europe, but with regard to water resources, it is one of the richest European countries. The average annual precipitation that supplies surface waters and groundwater amounts approximately 1500 mm. The greatest annual amount of precipitation is received by the mountainous western region, and the smallest amount occurs in the eastern part of Slovenia. Running waters in Slovenia form a dense river network. Due to a highly varied relief and rock structure, the rivers are mostly short, with only 22% of rivers being longer than 25 km. Additionally, geological strata that transmit and store groundwater contain large quantities of dynamic supplies, which represent the main source of drinking water in Slovenia.

Pure water has neither scent nor taste. A water molecule contains only two elements, hydrogen and oxygen. But in the natural environment, nowhere can water be found in its pure form; it contains various substances like dissolved gases, both inorganic and organic substances, and microorganisms, which can be of natural origin or as a result of human activity. The composition of water changes during its circulation in nature.

In the modern world, we hear way too often that water is over-polluted. Drinking water contains toxic substances and undesirable microorganisms, which can cause various diseases. Animals and plants in rivers are endangered by chemical pollutants. The agricultural activity uses large quantities of fertilizers, pesticides and herbicides that are washed into groundwater, and hazardous chemicals are washed from roads and urban areas as well. The rapid growth of population, urbanisation and development are endangering water quality. Unfortunately, the existence of man is also endangered by these processes.

But nature has its own defensive mechanism - water in nature has a self-purification capacity. Energy from sunlight drives the process of photosynthesis in aquatic plants, which produce oxygen as one of the end-products; oxygen is necessary for the decomposition of organic substances in water. The decomposition results in the formation of carbon dioxide, nutrients (nitrogen and phosphorus compounds) and other substances necessary for the development of aquatic plants and animals. The purification cycle continues when these plants and animals die and the bacteria decompose them, providing new generations of organisms with nourishment. Unfortunately there are many toxic substances which are decomposed only slowly, or not at all. They present a great environmental concern.

And what is the water quality like in Slovenia? In comparison with developed countries, water quality in Slovenia is among the highest in Europe. One of the reasons is undoubtedly that most of the rivers rise on the territory of Slovenia. But this does not mean that Slovenia has no problems with surface water and groundwater quality. Some river sections are still loaded with excessive amounts of industrial and municipal waste waters and are therefore substantially polluted or even over-polluted. Problems are also present in groundwater, which represents the main source of drinking water in Slovenia. Groundwater is polluted with nitrates and pesticides, and, on a local level, additionally with chlorinated organic solvents. The highest level of pollution is registered in the north-eastern part of Slovenia and in the vicinity of Celje.

In 2000, with the intention of effective water management, the European Union adopted the Water Framework Directive (1), which has already been entirely transposed into the Slovenian legislation. In 2003, two basic administrative units were designated for the purpose of the Water Framework Directive and river basin management: the Danube river basin district and the Adriatic river basin district. According to ecological characteristics, the territory of Slovenia was classified into four hydroecoregions, and additionally divided more precisely into bioregions and types. The implementation of the Water Framework Directive was continued by the analysis of data on the natural characteristic of water and on the impacts of human activity. These data represented the basis for the definition of surface and groundwater bodies defined in 2005. Water bodies are base units for the assessment of water status according to environmental objectives. In the case of surface water streams, for example, the water body is a continuous section of the river, measuring from a few to tens of kilometres, with similar natural characteristics as well as similar impacts of human activity (agriculture, industry, urbanisation). The groundwater body is a distinctive volume of groundwater in one or more aquifers. In surface waters, 155 water bodies were determined in Slovenia, and 21 water bodies in groundwater. In 2007, monitoring was established in all the above mentioned water bodies, as required by the Water Framework Directive. A new monitoring approach, introduced by the Water Framework Directive, should above all be emphasised. Programmes are based on the analyses of pressures. These are data on the emission of substances into waters from point sources, data on land use, surpluses of nitrogen, the use of phytopharmaceutical products etc. According to the analysis of these data, the monitoring programme is problem oriented and involves predominantly problematic water bodies. Other water bodies are less frequently involved in the programme. An essential novelty of the monitoring is evaluation of the ecological status. The assessment of the ecological status is based on biological quality elements (phytoplankton, phytobenthos and macrophytes, fish and benthic invertebrate fauna) and on hydromorphological, chemical and physico-chemical elements supporting the biological elements. The ecological status is divided into five quality classes. The starting point of the assessment of the ecological status is measuring the alteration of the ecosystem's structure and functioning of the natural state, i.e. the state where there is no human activity impact or it is insignificant.

Piran

Lake Bled

According to the Environment Protection Act (2), the Environmental Agency of the Republic of Slovenia is responsible for the water quality monitoring and evaluation of water quality status in Slovenia. Monitoring programmes (3) are drawn up in accordance with regulations that summarise the provisions of European directives, and in accordance with the status assessment and pressure analysis of each individual water body. They include quality monitoring of rivers, lakes, sea, groundwater, and water in protected areas.

The publication presents a brief overview of the water quality assessment in Slovenia, based on the national monitoring results. The assessments of water quality have been made in accordance with the currently applicable regulations that have already been partially adapted to the requirements of the Water Framework Directive. On surface waters, the assessment of the chemical status has been made; the methodology for the evaluation of the ecological status for all surface waters is still in the course of preparation. Methods for the evaluation of status on the basis of some biological quality elements and for certain pressures have already been elaborated. It should be emphasised that the situation is similar in other European countries where methodologies for the evaluation of ecological status are still being developed as well. Parallel to the development of methodologies, Member States are conducting a process of intercalibration to ensure a comparable evaluation of ecological status. For groundwater, the publication provides the evaluation of chemical status for 14 water bodies. The evaluations of the remaining seven water bodies will be based on data from 2007 when the monitoring network was expanded to include those water bodies for which monitoring had not yet been established.

The full range of data and evaluations of the quality of rivers, lakes, sea and groundwater, as well as water in protected areas, is published in annual reports available in the library and on the website of the Environmental Agency of the Republic of Slovenia (4).

2 Surface Waters

2.1 Quality of Rivers

The monitoring of river water quality (5, 6) is carried out on the basis of laws and regulations (2, 7, 8) in accordance with the requirements of the Water Framework Directive (1) and other guidelines and professional instructions for the establishment and implementation of the monitoring (9, 10, 11, 12, 13, 14). In rivers, a total of 135 water bodies were determined in 2005, 110 of them in the Danube river basin district and 25 in the Adriatic river basin district (15). In some of these water bodies, monitoring had already been carried out in the past, and in the others, the monitoring and status evaluation for the purpose of the first river basin management plan will be carried out for the first time in the period 2007-2009. The chemical and ecological status will have to be evaluated in accordance with the Water Framework Directive.

In Slovenia, the chemical status of rivers has been evaluated in accordance with the Regulation on the chemical status of surface waters (7) since 2002. The Regulation determines the limit values of parameters and criteria for the assessment of the chemical status. In the future, this regulation will have to be changed as a directive (16), which will in the course of preparation, determine environmental quality standards for the substances that have, at a European level, been classified as hazardous (priority list of hazardous substances).

In past years the assessment of river water quality was based on biological analyses of phytobenthos and benthic invertebrate fauna, and carried out according to the saprobic system which, above all, indicates the influences of organic pollution in waters. For the period from 1996 to 2005, the status of Slovenian rivers in relation to biological analyses is presented according to this system. The ecological status assessment methods are still under development. Sampling and analyses for some biological quality elements are carried out in compliance with ready-prepared expert groundwork (17, 18, 19, 20, 21, 22). For the year 2006, the first results of organic pollution evaluation on the basis of benthic invertebrate fauna and phytobenthos have already been presented.

All evaluations are stated for a monitoring site and not for the water body, as required by the Water Framework Directive, since not all evaluations of the chemical status for all water bodies are available at the moment, and neither is the methodology for the evaluation of the ecological status for all biological elements and pressures.

2.1.1 Evaluation of Chemical Status of Rivers

The chemical status must be determined:

- for any river or its part where the catchment area reaches 2500 km^2,
- for any water body that is substantially polluted by one or more parameters from the priority or indicative list of parameters,
- for any water body into which waste waters containing priority substances are discharged,
- for water bodies crossed by the state border.

According to the Regulation on the chemical status of surface waters (7), physico-chemical parameters must be measured at all monitoring sites. In addition, priority substances are regularly measured at all basic monitoring sites; and at all basic and additional monitoring sites, those parameters are measured for which increased pollution has been established on the basis of results obtained in the monitoring of river water quality or on the basis of the data published in annual reports on emission monitoring of sources of pollution.

The chemical status of a surface water body is determined on the basis of the calculation of the average annual value of parameters for which the limit values listed in Table 1 are defined in the Regulation (7).

A surface water body has a good chemical status if:

- any annual average value of parameters at a monitoring site does not exceed the prescribed limit value,
- the time series of annual average values of any of the parameters whose concentration in the sediments has not had an upward trend in the last five-year period.

Table 1: *Limit values of parameters for the evaluation of the chemical status as listed in the Regulation on the chemical status of surface waters (7)*

GENERAL PHYSICO-CHEMICAL PARAMETERS			
PARAMETER	UNIT	LIMIT VALUE	
		water	sediment analysis
Nitrate	mg NO_3/L	25	
Sulphate	mg SO_4/L	150	

PRIORITY LIST OF CHEMICAL STATUS PARAMETERS			
PARAMETER	UNIT	LIMIT VALUE	
		water	sediment analysis
Cadmium	µg Cd/L	1	yes
1,2 dichloroethane	µg/L	10	
Hexachlorobenzene	µg/L	0.03	yes
Hexachlorobutadiene	µg/L	0.1	yes
Hexachlorocyclohexane	µg/L	0.05	yes
Pentachlorophenol	µg/L	1	yes
Mercury	µg Hg/L	1	yes
Tetrachloroethene	µg/L	10	
Trichlorobenzene	µg/L	0.4	yes
Trichloroethene	µg/L	10	
Trichloromethane	µg/L	12	

INDICATIVE LIST OF PARAMETERS			
PARAMETER	UNIT	LIMIT VALUE	
		water	sediment analysis
Copper	µg Cu/L	5	
Boron	µg B/L	100	
Zinc	µg Zn/L	100	
Chromium	µg Cr/L	10	
Nickel	µg Ni/L	10	
Lead	µg Pb/L	10	
Dichloromethane	µg/L	10	
Alachlor	µg/L	0.1	
Metolachlor	µg/L	0.1	
Atrazine	µg/L	0.1	
Simazine	µg/L	0.1	
Total pesticides	µg/L	0.5	
Anthracene	µg/L	0.05	
Naphthalene	µg/L	1	
PAH	µg/L	0.1	
Fluoranthene	µg/L	0.025	
Benzene	µg/L	3.0	
PCB	µg/L	0.01	
AOX	µg Cl/L	20	
EOX	mg Cl/kg	-	yes
Phenol substances (phenol index)	µg/L	10	
Mineral oils	mg /L	0.05	
Anion active detergents	mg MBAS/L	0.10	

PAH: Polycyclic aromatic hydrocarbons
PCB: Polychlorinated biphenyls
AOX: Adsorbable organic halogen compounds
EOX: Extractable organic halogen compounds

Ledava, Čentiba

Mura, Mota

Based on the results of the monitoring of river water quality in 2006, the chemical status of rivers was evaluated at 76 monitoring sites. A good chemical status was determined for 64 monitoring sites, and a bad chemical status was determined for 12 monitoring sites. The chemical status of rivers at individual monitoring sites in 2006 is shown in Map 1.

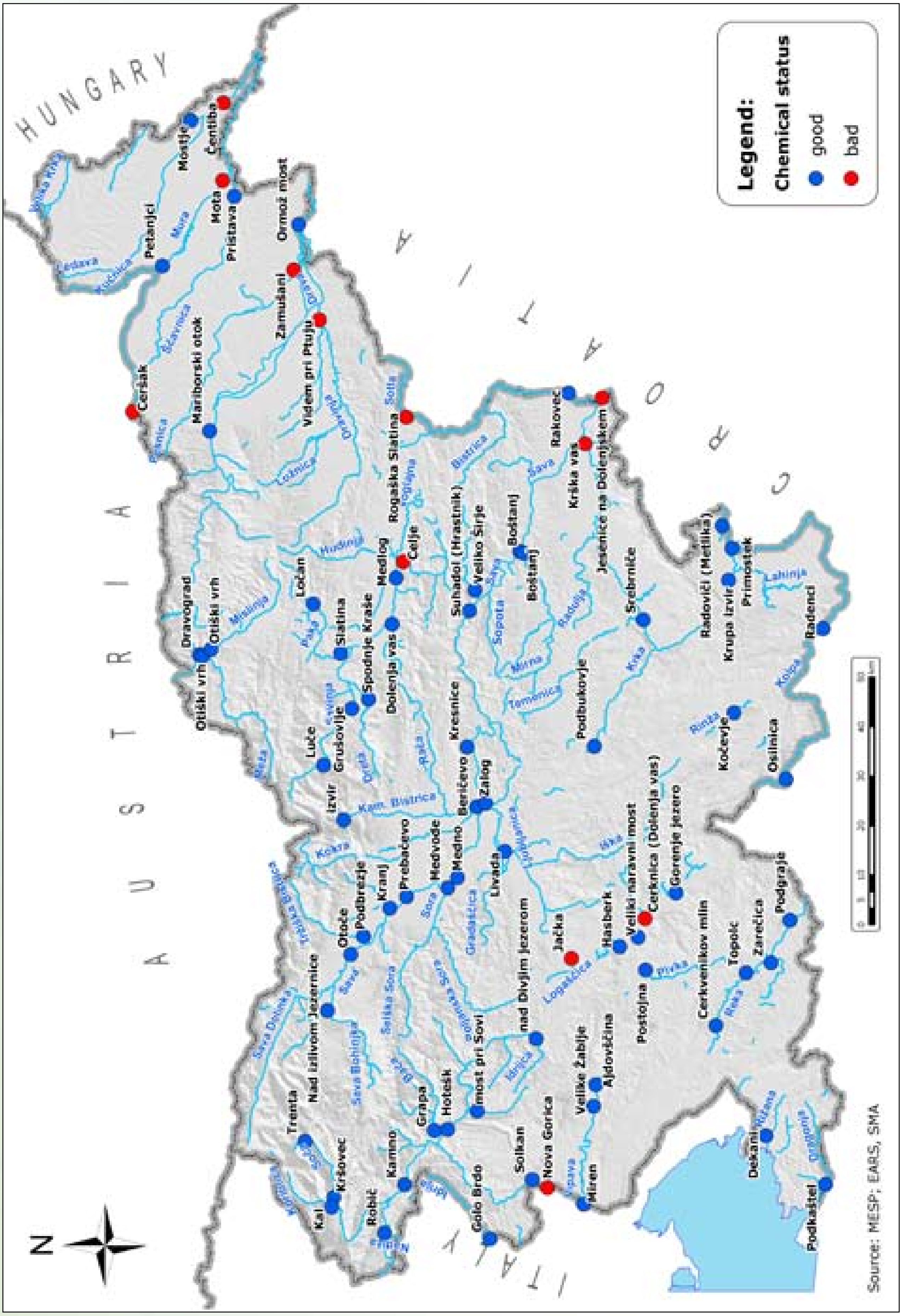
A bad chemical status was determined on account of exceeding the limit values for adsorbable organic halogen compounds (AOX), metolachlor, atrazine, total pesticides, anion active detergents, mineral oils, boron and zinc. Monitoring sites for which a bad chemical status was determined in 2006 and the parameters exceeding the limit values are shown in Table 2. No characteristic trend was determined for concentrations of priority substances in sediments.

Table 2: *Monitoring sites for which a bad chemical status was determined in 2006, with an indication of the parameters that exceeded limit values*

RIVER	Monitoring Site	Parameter	Annual Average Value	Limit Value
MURA	Ceršak	AOX (µg Cl/L)	24	20
	Mota	AOX (µg Cl/L)	24	20
LEDAVA	Čentiba	AOX (µg Cl/L)	24	20
DRAVINJA	Videm pri Ptuju	Metolachlor (µg/L)	0.24	0.1
PESNICA	Zamušani	Metolachlor (µg/L)	0.43	0.1
		Total pesticides (µg/L)	1	0.5
SAVA	Jesenice na Dolenjskem	AOX (µg Cl/L)	57	20
SOTLA	Rogaška Slatina	Boron (µg/L)	177	100
CERKNIŠČICA	Cerknica (Dolenja vas)	Detergents (mg MBAS/L)	0.13	0.10
LOGAŠČICA	Jačka	AOX (µg Cl/L)	21	20
VOGLAJNA	Celje	Zink (µg Zn/L)	493	100
KRKA	Krška vas	Atrazine (µg/L)	0.11	0.1
KOREN	Nova Gorica	Detergents (mg MBAS/L)	3.05	0.10
		Mineral oils (mg/L)	0.75	0.05

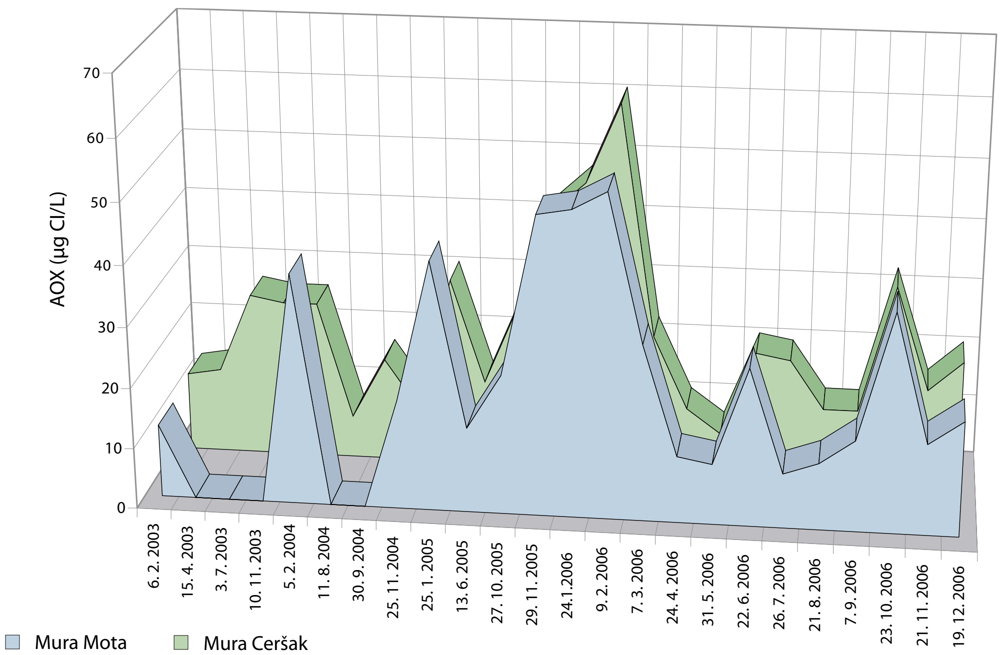
AOX: Adsorbable organic halogen compounds
Detergents (mg MBAS/L): Anion active detergents (mg MBAS/L)

Map 1: *The chemical status of rivers in 2006*



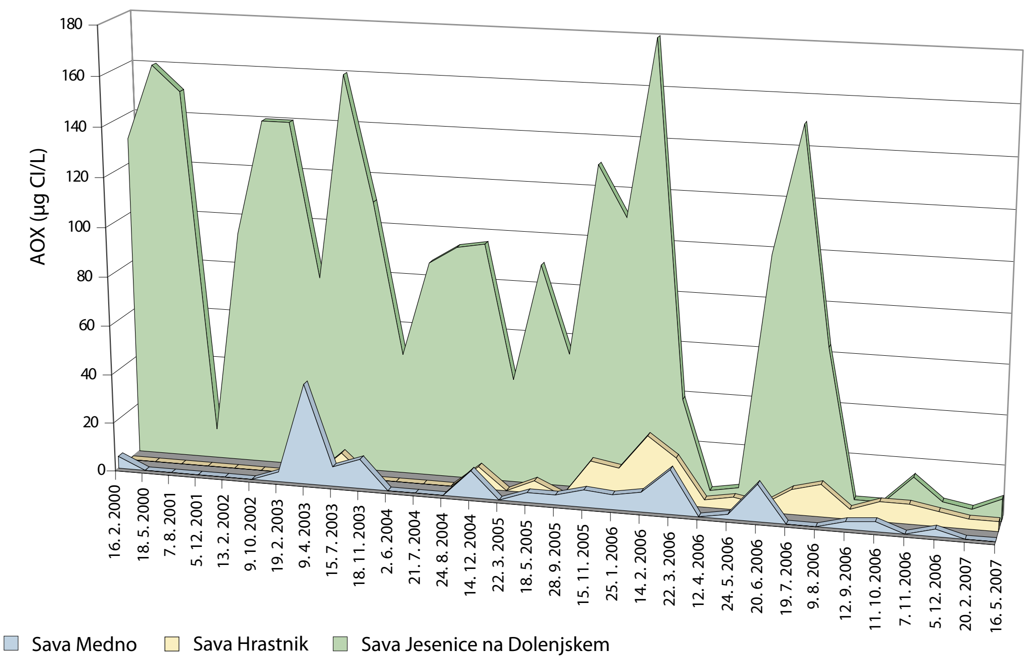
Exceeded values of adsorbable organic halogen compounds (AOX) were measured in the water bodies into which wastewaters with a large annual amount of AOX are discharged (23), or high concentrations are brought in by their tributaries (24). Despite the data on the reduction of AOX emissions into waters in 2006 in relation to 2005 (24), an exceedance of the limit values was determined in the Mura (Chart 1), the Ledava and the Logaščica.

***Chart 1:** AOX concentrations in the Mura river in the years 2003 to 2006*



The water bodies with the highest amount of AOX content were determined on the lower Sava, where the main source was the direct industrial outflow from the VIPAP Videm Krško factory. In the last four months of 2006, the measured AOX concentrations at the monitoring site Jesenice na Dolenjskem were below the limit value of 20 µg/L, which was the result of the closing down of the pulp production plant in the mentioned factory in September 2006 (Chart 2). It is a case which clearly demonstrates the reduction of AOX concentration to a permissible level immediately after a cessation of direct discharges. It is also evident from the Chart that there are no excessive AOX loads in the upper and middle Sava.

***Chart 2:** AOX concentrations in the Sava river in the years 2000 to 2007*



Sava, Medno

Ljubljanica, Ljubljana

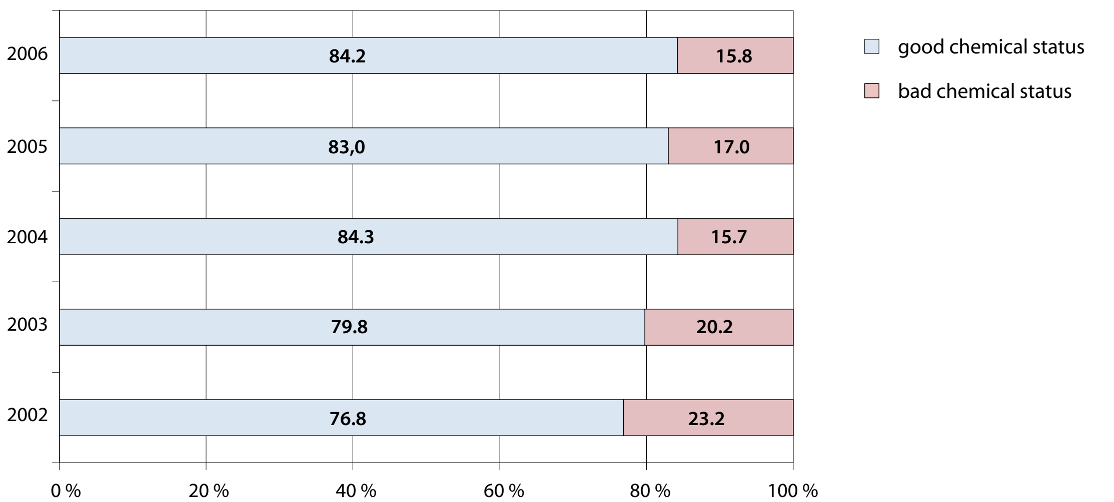
In the Dravinja and the Pesnica, a bad chemical status was determined because of an exceeding amount of metolachlor. Metolachlor is a herbicide used for weed control in agriculture, at the roadside and in ornamental plant growing. It is frequently used after the sowing or germination of corn. The share of agricultural areas in the hinterlands of the Dravinja and the Pesnica is substantial (more than 50%), so it can be concluded that their bad chemical status is caused by the use of herbicides in agricultural areas. There are also herbicide problems present in the Krka, where a bad chemical status was determined on account of exceeding amounts of atrazine. Atrazine is a triazine non-selective organic herbicide used in the past for the control of most broadleaf weeds and grasses in agriculture, afforestation and other non-agricultural activities. The presence of atrazine in water shows an illegal use of the mentioned herbicide as there have not been any registered herbicides containing atrazine in Slovenia since 2003.

The Koren is a short river flowing to Italy and is therefore a border river. It is classified as one of the most polluted rivers included in the national water quality monitoring. It is heavily polluted by the municipal wastewaters of Nova Gorica. In the Koren, the measured values of chemical and biochemical oxygen demand, orthophosphates, ammonium and nitrites are the highest in Slovenia. In 2006, a bad chemical status was determined on account of exceeding the limit values for detergents and mineral oils.

The bad chemical status of the Voglajna in Celje was determined on account of exceeding amounts of zinc, although, according to the data from 2006, the emissions of zinc have been reduced. An excessive zinc pollution is the result of the discharge of the industrial wastewaters from Cinkarna Celje.

The chemical status of rivers was improving in the years 2002 to 2006. In 2002, 23.2% of monitoring sites were classified to have a bad chemical status, and in 2006, 15.8% of monitoring sites had bad chemical status (Chart 3).

Chart 3: *Percentage of monitoring sites in good and bad chemical status in the years 2002 to 2006*



In Table 3, the chemical status at individual monitoring sites in the years 2002 to 2006 is shown. A good status is coloured blue and a bad status is coloured red. In the case of a bad status, the parameters that caused the status to be evaluated as bad are also stated. White fields indicate that monitoring was not carried out at the particular monitoring site.

Table 3: *The chemical status of rivers in the years 2002 to 2006*

RIVER	Monitoring Site	2002	2003	2004	2005	2006
MURA	Ceršak	AOX	Cd in sed.	good	AOX	AOX
MURA	Petanjci	good	good	good	good	good
MURA	Mota	good	good	AOX	AOX, FS	AOX
ŠČAVNICA	Pristava	det.	det., FS	FS	metol., pest.	good
LEDAVA	Čentiba	good	good	AOX	AOX	AOX
KOBILJSKI POTOK	Mostje	good	good	good		good
DRAVA	Dravograd	good	good	good	good	good
DRAVA	Brezno	good	good	good	good	
DRAVA	Mariborski otok	good	good	good	good	good
DRAVA	Duplek	good	good	good	good	
DRAVA	Ptuj	good	good			
DRAVA	Borl	good	good	good	good	
DRAVA	Ormož	Hg, Cd in sed.	Hg in sed.	good	good	good
MEŽA	Podklanc	good	good	good	good	
MEŽA	Otiški vrh	good	good	good	good	good
MISLINJA	Otiški vrh	good	good	good	good	good
DRAVINJA	Videm pri Ptuju	Hg, Cd in sed.	good	metol.	metol., pest.	metol.
PESNICA	Zamušani	good	good	good	good	metol., pest.
SAVA DOLINKA	Podkoren	good	good	good	good	
SAVA BOHINJKA	Sv. Janez	good				
SAVA BOHINJKA	above the outfall of the Jezernica			good	good	good
JEZERNICA	Mlino	good				
SAVA	Otoče	good	good	good	good	good
SAVA	Prebačevo	good	good	good	good	good
SAVA	Medno	Hg in sed.	good	good	good	good
SAVA	Šentjakob	good	good	good	good	
SAVA	Dolsko	good	AOX	good	good	
SAVA	Litija	good	good	good	good	
SAVA	Kresnice					good
SAVA	Suhadol (Hrastnik)	Hg in sed.	good	good	good	good
SAVA	Radeče nad Sopoto	good	good			
SAVA	Boštanj	good	good	good	good	good
SAVA	Brežice	AOX, atrazine, metol., FS	FS, AOX	FS, AOX	AOX, FS	
SAVA	Jesenice na Dolenjskem	AOX, atrazine, metol.	AOX, Cd in sed.	AOX	AOX	AOX
TRŽIŠKA BISTRICA	Podbrezje	Cu	good	good	FS	good
KOKRA	Kranj	good	good	good	good	good
SORA	Medvode	good	good	good	good	good
KAMNIŠKA BISTRICA	source	good	good	good	good	good
KAMNIŠKA BISTRICA	Beričevo	AOX, FS, Cd, Hg in sed.	Cu, FS, AOX	FS, AOX	metol.	good
MIRNA	Boštanj	good	good	good	good	good
SOTLA	Rogaška Slatina	Pb	Pb, AOX, Cd in sed.	Pb	metol., FS	B
SOTLA	Rakovec	good	AOX	good	FS	good
KOLPA	Osilnica	good	good	good	good	good
KOLPA	Petrina	good	good			
KOLPA	Fara	good	good	good	good	

RIVER	Monitoring Site	2002	2003	2004	2005	2006
KOLPA	Radenci	good	good	good	good	good
KOLPA	Radoviči (Metlika)	good	good	good	good	good
KOLPA	Kamanje		good			
RINŽA	Kočevje	good	det.	good	good	good
BILPA	Spodnja Bilpa	good	good			
LAHINJA	Primostek	good	good	good	good	good
KRUPA	source	PCB	good	PCB	PCB	good
LJUBLJANICA	Livada	good	good	good	good	good
LJUBLJANICA	Zalog	AOX, det., MO, Hg in sed.	Hg in sed.	good	good	good
VELIKA LJUBLJANICA	Mirke	Cu	good	good	good	
VELIKI MOČILNIK	Vrhnika	good	good	good	good	
GRAJSKI IZVIRI	Bistra	good	good	good	good	
CERKNIŠKO JEZERO (STRŽEN)	Dolenje jezero		good	good	good	
CERKNIŠČICA	Cerknica (Dolenja vas)	good	good	good	good	det.
PIVKA	Postojna	FS	good	good	good	good
UNICA	Hasberk	good	good	good	good	good
LOGAŠČICA	Jačka	AOX, Cu, MO	FS, AOX	FS, AOX, det.	good	AOX
SAVINJA	Luče		good	good	good	good
SAVINJA	Letuš	good				
SAVINJA	Braslovče	good	good	good	good	
SAVINJA	Grušovlje					good
SAVINJA	Medlog	good	good	good	good	good
SAVINJA	Tremerje	good	good	good	good	
SAVINJA	Rimske Toplice	good	good			
SAVINJA	Veliko Širje	good	AOX	good	good	good
PAKA	Rečica	det.	good	det.	det.	good
PAKA	Ločan					good
PAKA	Slatina					good
BOLSKA	Dolenja vas	good	good	good	good	good
VOGLAJNA	Celje	Zn, Cd	Cd, Cu, Zn, Ni, sulphate	Cu, Zn	good	Zn
KRKA	Podbukovje	good	good	good	good	good
KRKA	Srebrniče	good	good	good	good	good
KRKA	Gornja Gomila	good	good	good	good	
KRKA	Krška vas	good	good	good	good	atrazine
IZVIR KRKE POLTARICA	Gradiček	good	good	good	good	
SOČA	Trenta	good	good	good	good	good
SOČA	Kršovec					good
SOČA	Kamno					good
SOČA	pod Tolminom	good	good	good	good	
SOČA	Plave	good	Hg in sed.	good	good	
SOČA	Solkan	Hg in sed.	good	Cd in sed.	Cd in sed.	good
KORITNICA	Kal	good	good	good	good	good
TOLMINKA	outfall	good	good	good	good	
PODROTEJA	Karst source Podroteja	good		good	good	
IDRIJCA	Podroteja	good	good	good	good	
IDRIJCA	above the Divje jezero					good
IDRIJCA	Hotešk	good	good	good	good	good
KOREN	Nova Gorica	Cu, det., FS	Cd, Cu, Zn, Pb, FS, MO, det.	Cu, FS, MO, det.	FS, MO, det.	MO, det.
VIPAVA	source	good		good	good	

RIVER	Monitoring Site	2002	2003	2004	2005	2006
VIPAVA	Velike Žablje					good
VIPAVA	Miren	good	Cd in sed.	good	good	good
HUBELJ	source	good		good	good	
HUBELJ	Ajdovščina	good	good	good	good	good
NADIŽA	Potoki	good	good			
NADIŽA	Robič			good	good	good
REKA	Podgraje					good
REKA	Topolc	FS	FS	good	good	good
REKA	Cerkvenikov mlin (the mill)	good	good	good	good	good
REKA	Matavun	good	good	good	good	
MOLJA	Zarečica					good
RIŽANA	source	good		good	good	
RIŽANA	Dekani	Cu, Ni, MO	good	good	good	good
DRAGONJA	Podkaštel	good	good	good	good	good
MALENŠČICA	Malni	good		good	good	
RAK	Veliki naravni most (the Great Natural Bridge)					good
JEZERSKI OBRH	Gorenje jezero					good
TREBUŠČICA	most pri Sovi					good
BAČA	Grapa					good
IDRIJA	Golo Brdo					good
RIŽANA	Bertoki	good				

Bad chemical status
Good chemical status
The monitoring site was not included in the monitoring programme

AOX: Adsorbable organic halogen compounds
FS: Phenol substances
MO: Mineral oils
PCB: Polychlorinated biphenyls
det.: Anion active detergents
metol.: Metolachlor
pest.: Pesticides
Cu: Copper
Ni: Nickel
Zn: Zinc
Pb: Lead
Cd: Cadmium
Hg: Mercury
B: Boron
in sed.: Upward trend in sediment

In 2006, the monitoring of priority and nationally relevant substances was also carried out at 23 monitoring sites. The entire list of priority substances was monitored at a frequency of once a month, and nationally relevant substances were monitored four times a year. The analysis of the results for priority substances shows that, in relation to the European Commission's last proposal of environmental quality standards (16), the annual average values do not exceed the proposed environmental quality standards and therefore do not indicate a bad chemical status.

Soča, Kanal

Dragonja, border crossing point Dragonja

2.1.2 River Quality Assessment Using Saprobic Index and Beginnings of Ecological Status Evaluation

In Slovenia, as well as in other European countries, the methodology for the assessment of the ecological status of the rivers according to the Water Framework Directive is currently in preparation.

Until 2005, the biological quality of rivers was evaluated using the saprobic index, which primarily shows the organic pollution. The Pantle and Buck method was used, with a modification according to the Zelinka and Marvan method (25, 26) using calculation of the saprobic index (SI) value of the biocenoses of benthic invertebrates and phytobenthos. The saprobic index (SI) value increases from one to four with the deterioration of living conditions. For every analysed sample, the saprobic index (SI) is calculated using the saprobic value, frequency and indicative weight of taxon.

According to the index value, each monitoring site is classified into an appropriate quality class (Table 4).

Table 4: *Quality classes according to the saprobic index value*

Quality class	SI value	Saprobic level	River quality description
1	1.0 - 1.5	oligosaprobic	uncharged to very little charged
1-2	1.51- 1.8	oligosaprobic to betamesosaprobic	little charged
2	1.81- 2.3	betamesosaprobic	moderately charged
2-3	2.31- 2.7	betamesosaprobic to alfamesosaprobic	critically charged
3	2.71- 3.2	alfamesosaprobic	heavily polluted
3-4	3.21- 3.5	alfamesosaprobic to polysaprobic	very heavily polluted
4	3.51- 4.0	polysaprobic	excessively polluted

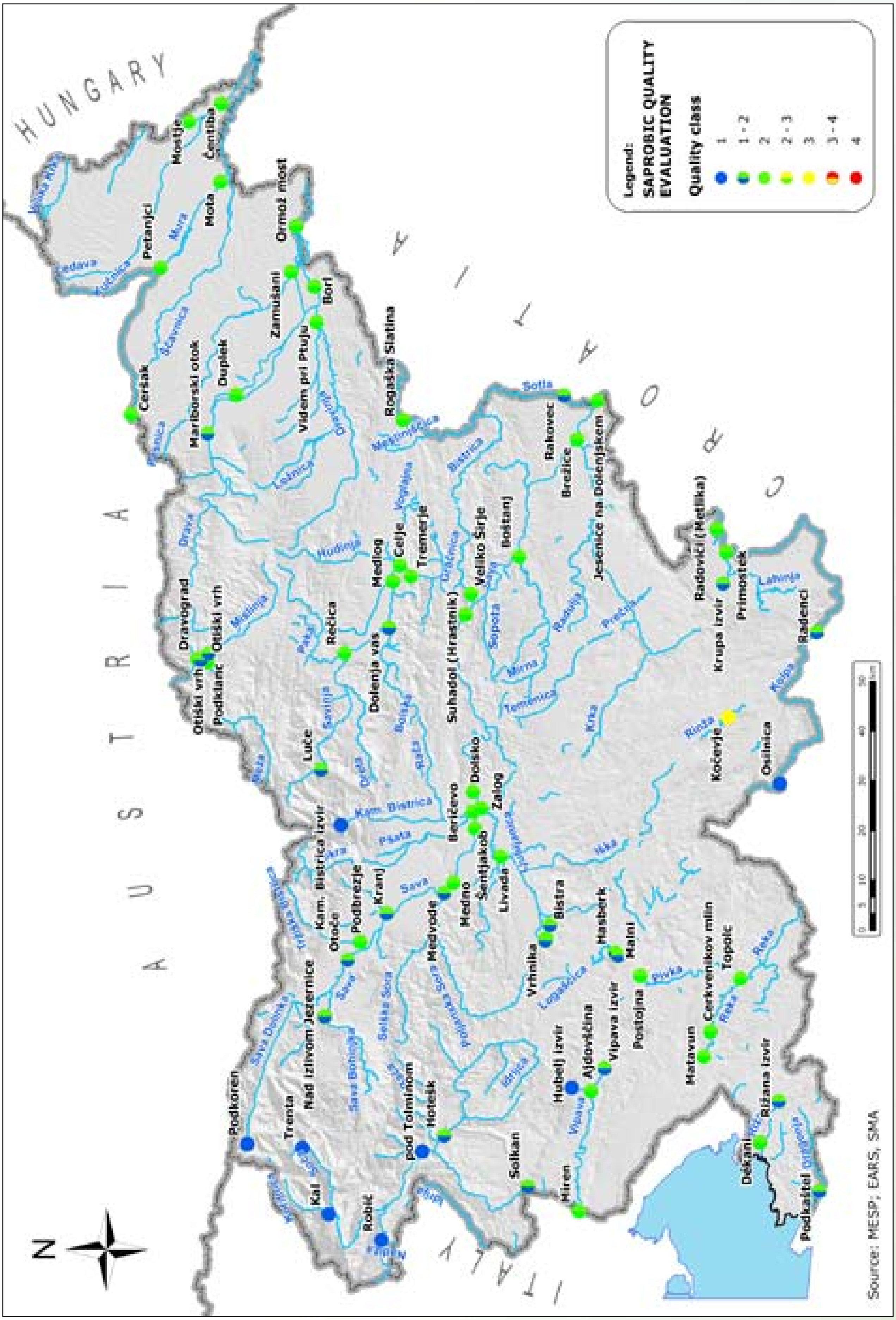
The saprobic quality evaluation at selected monitoring sites in 2005 is shown in Map 2.

In comparison with 2004, the saprobic quality of rivers was improved in 2005. Based on the results of saprobic analyses conducted in 42 rivers and at 69 different monitoring sites, most of the monitoring sites are classified as uncharged to very little charged, and only one monitoring site is classified as heavily polluted (the Rinža in Kočevje). There were neither very heavily polluted nor excessively polluted rivers in 2005.

Sampling

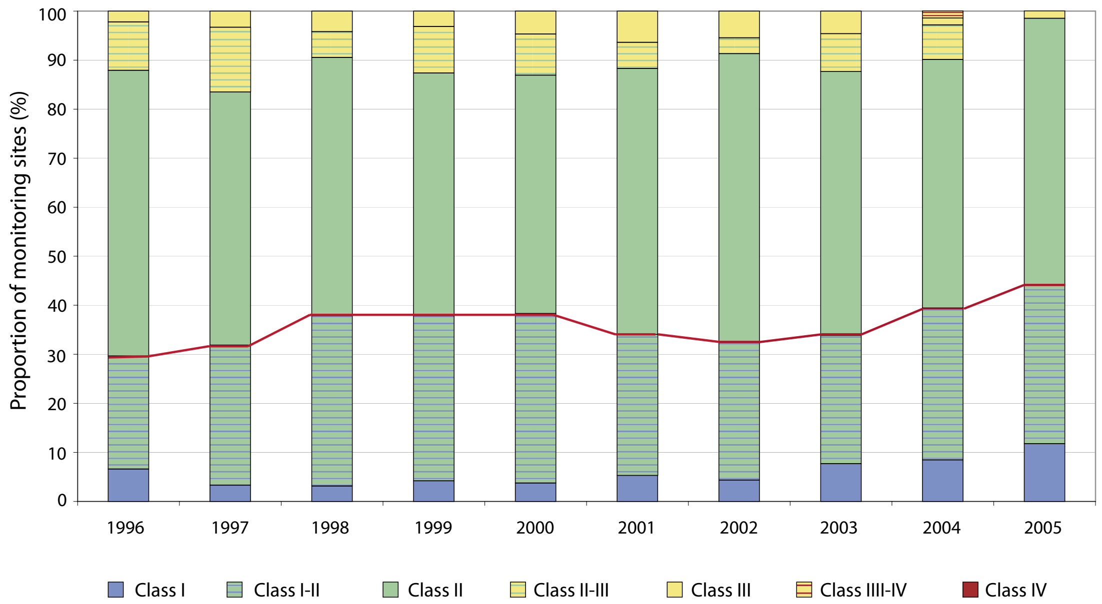
A dragonfly

***Map 2:** Saprobic quality evaluation of rivers in 2005*



The improvement of the saprobic quality of rivers is indicated throughout the entire period from 1996 to 2005. The number of monitoring sites in quality classes 1 and 2 is increasing, and the number of monitoring sites in lower quality classes is decreasing (Chart 4).

***Chart 4:** The saprobic status of rivers – the proportion of monitoring sites in a specific quality class in the years 1996 to 2005*



An improvement in the Ljubljanica at the monitoring site Zalog, following the activation of the central wastewater treatment plant in Ljubljana in July 2005, should be noted. The improvement is indicated by the results of saprobic analyses of benthic invertebrates that primarily show the impacts of organic pollution (Chart 5). The findings are supported by the results indicating the biochemical and chemical oxygen demand, which also reflect the organic pollution (Chart 6).

***Chart 5:** Water quality of the Ljubljanica in Zalog in the years 1991 to 2006 according to the saprobic index based on benthic invertebrates*

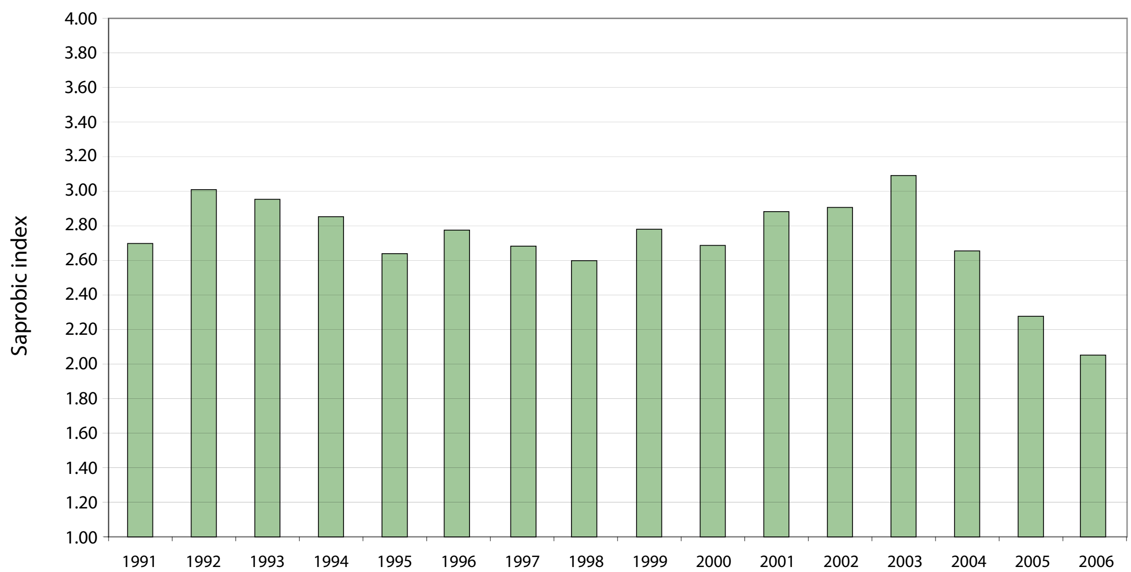
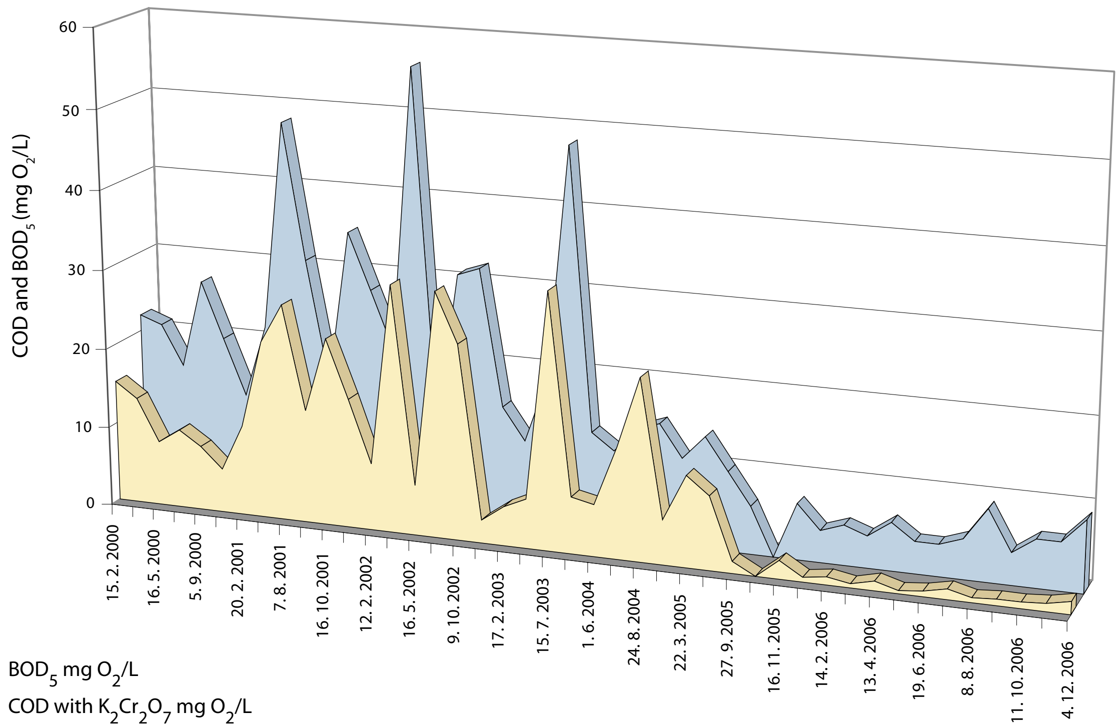


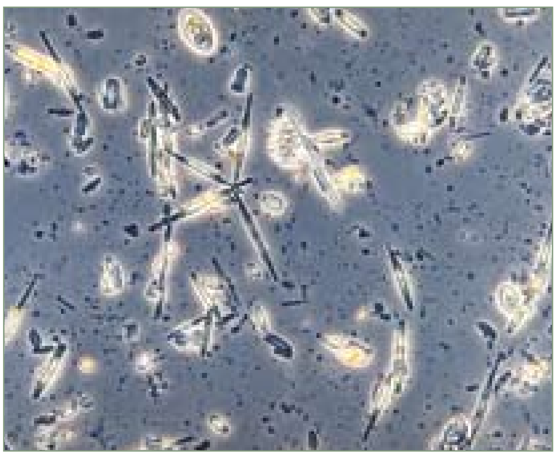
Chart 6: *Water quality of the Ljubljanica in Zalog in the years 2000 to 2006 according to the biochemical and chemical oxygen demand*



Caddisflies - larvae

A dragonfly larva

Various algae



Shellfish-Bivalve

In 2006, the quantitative sampling of benthic invertebrates and phytobenthos, carried out by sampling multimicrohabitat types in selected water bodies, was carried out in Slovenia for the first time. The samples were laboratory proceeded (sub-sample sorting and determination to required level) using new national methodology (18, 19, 20). They were evaluated according to the expert groundwork for the assessment of the organic pollution of rivers by using an adapted saprobic index based on of benthic invertebrates and phytobenthos (21, 22). Only 22 selected rivers were analysed. Sampling and further laboratory proceedings of 37 monitoring sites showed that, according to quality assessment based on phytobenthos, 43% of monitoring sites had a high status, 32% a good status, 22% a moderate status and 3% had a poor quality status. The results of benthic invertebrates sampling and analysis, however, showed that 57% of monitoring sites had a high status, 27% a good status, 11% a moderate status, 3% a poor status and 3% had a bad quality status. It should be emphasized that this assessment has been made based on only two biological quality elements, for only one pressure (organic pollution) and at selected monitoring sites.

In the following years, a classification of the ecological status will be presented, representing the measurement of the alteration of the ecosystem's structure and functioning from the natural state, i.e. the state where there are no, or only very minor human impact. The assessment of the ecological status is based on biological quality elements (phytoplankton, phytobenthos and macrophytes, fish and benthic invertebrates) and on hydromorphological, chemical and physico-chemical elements supporting the biological elements. The assessment system will enable a distinction between five classes of ecological status: "high", "good", "moderate", "poor" and "bad". Since the starting points or reference conditions of water bodies are different, a type-specific approach will be used whereby the waters are classified into types according to their natural characteristics and then reference conditions are defined for each type (27, 28, 29, 30). The evaluation of the ecological status of rivers in Slovenia will be possible only when assessment methods for all biological quality elements and different pressures are prepared.

2.2 Quality of Lakes

With Slovenia's association with the European Union, the Water Framework Directive (1) has become the binding and key document in the field of water management and has also influenced changes in the monitoring of lake quality. The period from 2003 to 2006 was actually a transitional period for the implementation of the Water Framework Directive, which has brought important changes in lake sampling and, most of all, a new, integrated approach for the assessment of ecological status, which could not be used in that period due to the assessment methods still in the course of preparation.

Until 2002, national monitoring of lake quality was carried out only on Lake Bled, Lake Bohinj and Cerknica Lake. Since 2003, due to the requirements of the Water Framework Directive, the monitoring has also included artificial lake, reservoirs and river accumulations of an area larger than 0.5 km^2 (31, 32), which are according to the Rules of identification and classification of surface water bodies (15) defined as water bodies (Map 3, Table 5). These are the following: Lake Bled, Lake Bohinj, Velenje Lake, Šmartinsko Lake, Slivniško Lake, Perniško Lake, Gajševsko Lake and Ledavsko Lake, the reservoirs of Klivnik, Molja and Vogrščček, as well as the river accumulations of Moste, Mavčiče, Vrhovo and Ptuj Lake. Monitoring was due to a high rate of flow not carried out only in Ormož Lake, but it was nevertheless performed as part of the monitoring programme of rivers. In the river accumulations of Mavčiče, Vrhovo and Ptuj Lake, monitoring was carried out only in the event of the 'blooming' of phytoplankton, which is characteristic of the dry season when the rate of flow in river accumulation is at its lowest and the accumulations are given the status of standing water bodies.

The intermittent Cerknica Lake, which does not have any common characteristics with permanent lakes, was included in monitoring of lakes in the years 1993 to 2005. Since there are Karst Rivers, which during high waters tend to flood the Cerknica field, the sampling and assessing the lake were carried out in accordance with the criteria for rivers, and the status of Cerknica Lake is also presented in the data for rivers.

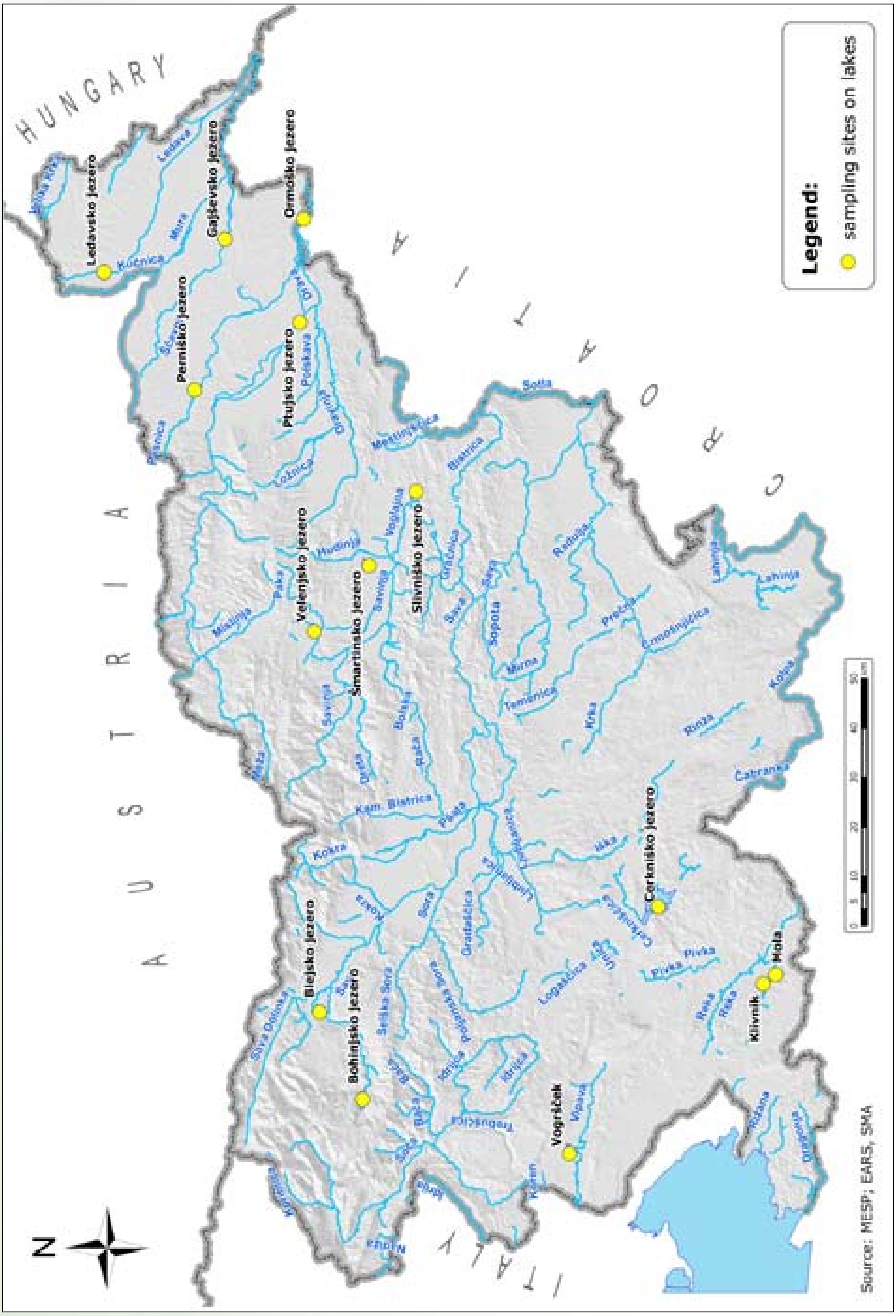
Lake Bohinj

Table 5: *List of water bodies in Slovenia where monitoring of lakes is carried out*

Name	Water body type	Sub - basin	Surface area (km^2)	Volume ($m^3 10^6$)	Depth (m)
Lake Bled	J	Sava	1.43	25.7	31 max.
Lake Bohinj	J	Sava	3.28	92.5	45 max.
Cerknica Lake	V	Sava	> 24	do 76	>3 mean.
Šmartinsko Lake	kMPVT	Savinja	1.07	6.5	6 mean.
Slivniško Lake	kMPVT	Voglajna	0.84	4.0	5 mean.
Ledavsko Lake	kMPVT	Mura	2.18	5.7	>3 mean.
Perniško Lake	kMPVT	Pesnica	1.23	3.4	<3 mean.
Gajševsko Lake	kMPVT	Mura	0.77	2.6	<3 mean.
Vogršček	kMPVT	Vipava	0.82	8.5	20 max.
Klivnik	kMPVT	Reka	0.38	4.3	12 mean.
Molja	kMPVT	Reka	0.68	4.3	6 mean.
Velenje Lake	UVT	Paka	1.35	25	55 max.
Moste	kMPVT	Sava Dolinka	0.69	8	12 mean.
Mavčiče	kMPVT	Sava	<1.0	-	12 max.
Vrhovo	kMPVT	Sava	1.43	8.65	6 mean.
Ptuj Lake	kMPVT	Drava	3.5	19.8	6 mean.
Ormož Lake	kMPVT	Drava	1.5	9	6 mean.

J: Natural lake
V: River
VT: Water body
kMPVT: Candidate for heavily modified water body
UVT: Artificial water body

Map 3: *Lakes included in the monitoring programme in the years 2003 to 2006*



In the years 2003 to 2006, the monitoring network consisted of monitoring sites in lakes and monitoring sites at the lakes' inflows and outflows. The sampling of lakes was carried out at selected depths along the water column. The monitoring programme was primarily adjusted to monitor eutrophication, which is the main problem in most natural and artificial lakes of the Temperate Zone on a carbonate geological layer, to which all lakes and reservoirs in Slovenia also belong. In the lakes and their inflows, the status of nutrients and general physico-chemical parameters were primarily monitored. Analyses of pollutants, heavy metals and pesticides were only carried out in some inflows and outflows where, taking into account the pressures in the catchment area, an increased concentration of individual pollutants in water was to be expected. The lakes were evaluated according to OECD criteria (33), which classify the lakes into five trophic categories, based on the average annual concentration of total phosphorus and nitrogen, the average annual and minimum transparency, and the average annual and maximum concentration of chlorophyll-a. Other pressures that have to be taken into consideration in the ecological status classification of lakes or the ecological potential of artificial reservoirs as required by the Water Framework Directive, were not evaluated while an appropriate methodology is still in the course of preparation. Among biological quality elements, the status of phytoplankton, macrophytes, phytobenthos and benthic invertebrates was monitored. In the years 2003 to 2006 the final assessment of lake status was made according to the status of phytoplankton (one of the OECD criteria), which is expressed by the average and maximum annual concentration of chlorophyll-a. The sampling of macrophytes, phytobenthos and benthic invertebrates was carried out at selected sites in the shore zone according to new methodology, adapted for the assessment of the ecological status of lakes. A detailed programme outlining the monitoring of water quality for each individual lake is presented in the annual Programme for monitoring the quality of lakes (32).

Lake Bled

The trophic status of lakes and reservoirs evaluated on the basis of OECD criteria (**O**rganisation for **E**conomic **C**o-operation and **D**evelopment) (33) is presented in Table 6. The same criteria were used in the evaluation of the status of river in the blooming period, and the presented values are the average measured values at individual depths. The exception is the Moste reservoir where sampling was carried out four times a year.

***Table 6**: OECD criteria for the evaluation of the trophic status (33) and the evaluation of lakes/reservoirs in the years 2003 to 2006*

OECD CRITERIA						
Trophic level	**Total phosphorus (average)**	**Nitrogen inorganic (average)**	**Transparency (average)**	**Transparency (minimum)**	**Chlorophyll-a (average)**	**Chlorophyll-a (maksimum)**
STATUS of the lake	**(µg P/L)**	**(µg N/L)**	**(m)**	**(m)**	**(µg/L)**	**(µg/L)**
Ultraoligotrophic	< 4	< 200	> 12	> 6	< 1	< 2.5
Oligotrophic	< 10	200 - 400	> 6	> 3	< 2.5	< 8
Mesotrophic	10 - 35	300 - 650	6 - 3	3 - 1.5	2.5 - 8	8 - 25
Eutrophic	35 - 100	500 - 1500	3 - 1.5	1.5 - 0.7	8 - 25	25 -75
Hypereutrophic	> 100	> 1500	< 1.5	< 0.7	> 25	> 75
Lake and period of status evaluation	Total phosporous	Nitrogen inorganic	Transparency	Transparency	Chlorophyll-a	Chlorophyll-a
	(µg P/L)	(µg N/L)	(m)	(m)	(µg/L)	(µg/L)
NATURAL LAKES						
Lake Bled 1979 - 1981	72	650	1.9	1.2	17	> 75
Lake Bled 2003 - 2006	13	287	6.7	3.6	5.0	18.2
Lake Bohinj 2003 - 2006	4	456	9.5	6.2	1.1	3.4
ARTIFICIAL LAKE						
Velenje Lake 2006	120	1500	7.4	6.5	1.4	7.6
RESERVOIRS						
Šmartinsko Lake 2003 - 2006	63	758	1.2	0.8	17.3	46.4
Slivniško Lake 2004 - 2005	140	1340	1.1	1.0	21.9	62.9
Perniško Lake 2004 - 2006	133	1707	0.3	0.2	98.2	206.1
Ledavsko Lake 2003 - 2006	136	2194	0.6	0.4	70.2	176.2
Gajševsko Lake 2006	101	1329	0.8	0.5	37.6	61.8
Klivnik 2003-2005	12	870	3.3	2.6	3.7	6.5
Molja 2003-2005	17	595	2.2	1.6	7.5	17.9
Vogrščček 2006	8	890	3.2	2.7	4.4	12.3
RIVER ACCUMULATION						
Moste 2006	32	802	5.4	2.6	2.0	3.7
Mavčiče 2003 *	152	827	-	0.2	238.7	1306.1
Vrhovo 2003 *	239	1258	-	0.7	71.0	180
Ptujsko j. 2003 *	183	1182	-	1	4.8	6.6

* Results of one sampling during the blooming period

Lake Bled

The establishment of monitoring at Lake Bled and its inflows was related to remedial action for the improvement of the lake status that was in the ’70s already eutrophic, occasionally even hypereutrophic. The status of Lake Bled has therefore been regularly monitored since 1975. The results of monitoring show that the artificial inflow the Radovna (1964), the siphon that functions as a depth outflow from the lake (1980/81) and the partial restoration of the sewage system in Bled (1982–1985) contributed to the improvement of the status of Lake Bled. Since 1983, Lake Bled has been classified as a mesotrophic lake according to OECD criteria. A reduction of the nutrients concentration and a general improvement of the Lake Bled status are apparent in the years 2003 to 2006 in comparison with the years 1979 to 1981. But nevertheless, an occasionally increased production of phytoplankton, expressed by a relatively high average concentration of chlorophyll-a, represents a warning about pressures from the lake basin’s which cannot be entirely amended by the beneficial effects of restoration measures, the Radovna and by the siphon. In addition, the results of the monitoring of inflows show that the concentration of phosphorus, which is the essential biogenic element, has been recently increasing in Mišca. On the basis of phosphorus, Table 7 shows the effectiveness of the siphon in removing the load from the lake and pollution load of Mišca in the years 2003 to 2006.

Table 7: *The annual input and output of phosphorus by Mišca and the siphon in the years 2003 to 2006*

Year	2003 (kg P)	2004 (kg P)	2005 (kg P)	2006 (kg P)
Siphon	308	266	217	260
Mišca	231	372	335	402

Lake Bohinj

According to criteria set by the Group for Alpine Lakes (34) in the process of intercalibration of biological elements, Lake Bohinj belongs to the category of alpine lakes where the impacts of human activity on the aquatic environment are either not present or are insignificant. Additionally, according to OECD criteria, Lake Bohinj was classified as a clear oligotrophic lake with low productivity in the years 2003 to 2006, although the average concentration of nitrogen compounds exceeded the limit value for oligotrophic lakes. A high concentration of nitrogen compounds has been present in Lake Bohinj since the beginning of monitoring of the lake’s status (1993) and is not increasing, which indicates that it is the natural state. With regards to phytoplankton, some species occasionally appear that were not present in previous years and are characteristic of more productive lakes. An assessment of the ecological status of Lake Bohinj will be made when the assessment methods for other biological elements are ready and will also include other pressures and not just the eutrophication.

Coccal green algae Nephrocytiun agardhianum, characteristic of more productive lakes, which also appeared in Lake Bohinj in the years 2003 to 2006.

Cerknica Lake

The intermittent Cerknica Lake is a very unique aquatic ecosystem that does not share any common characteristics with permanent lakes. Due to its great water level fluctuation and the large metabolic role of marsh plants, there is almost no eutrophication. The results of monitoring show that the pollutants, especially heavy metals from industrial plants in the catchment area of the Cerknica Lake, do not exceed the limit values prescribed in the Decree of chemical status of surface waters (Table 1). At the monitoring site Stržen - Dolenje jezero, the chemical status was good in 2005, but in 2006, it was bad due to the exceeded concentration of detergents, which indicates a problem with the unregulated discharge of municipal wastewaters.

Velenje Lake

Velenje Lake was formed in the vicinity of the Thermal Power Plant Šoštanj, as the terrain above the abandoned part of the lignite mine sank and was flooded. In 2006 it was included in the national lake quality monitoring for the first time. Velenje Lake could be classified as a hypereutrophic lake, on the basis of the average concentration of total phosphorus (120 µg/L) and the average concentration of nitrogen (1500 µg/L), but the analysis of phytoplankton and the average concentration of chlorophyll-a (2.7 µg/L) indicated a productivity characteristic of little to moderately charged lakes with nutrients. The primary production in Velenje Lake is probably limited by the presence of other substances, which are in increased amounts present in the lake. In comparison with other lakes, a high average annual concentration of sulphates (594 mg/L), chlorides (41.2 mg/L) and potassium (51.6 mg/L) especially stand out in Velenje Lake. The average concentration of sulphate is 3.9 times higher than the limit value for the chemical status according to the Decree of chemical status of surface waters (7), which classifies Velenje Lake as one with a bad chemical status.

Šmartinsko Lake, Slivniško Lake, Perniško Lake, Ledavsko Lake and Gajševsko Lake

All reservoirs in north-eastern Slovenia, i.e. Šmartinsko Lake, Slivniško Lake, Perniško Lake, Ledavsko Lake and Gajševsko Lake are, under all OECD criteria, eutrophic to hypereutrophic lakes with a high concentration of total phosphorus and nitrogen. All these reservoirs are shallow, silty and overloaded with fish. Chemical analyses of inflows show that, besides high trophic status, the chemical status could also be problematic in some of these reservoirs. Namely, in the inflows of Šmartinsko Lake, Perniško Lake and Ledavsko Lake, increased concentrations of pesticides and heavy metals were occasionally measured, exceeding the limit values specified in the Decree of chemical status of surface waters (7). Due to low sampling frequency, the calculation and evaluation of chemical status of inflows are not possible. The contents of pollutants exceeding the limit values are presented in Table 8.

Šmartinsko Lake

Ledavsko Lake

Table 8: Exceeded limit values (7) of individual pollutants in the reservoirs' inflows in the years 2003 to 2006

RESERVOIR	Monitoring site	Date of sampling	Dissolved cadmium (µg/L)	Metholachlor (µg/L)	Atrazine (µg/L)	Total pesticides (µg/L)	AOX (mg Cl/L)
Ledavsko Lake	Outflow	30. 7. 2003					35
	Outflow	22. 4. 2004					31
	Outflow	21. 7. 2004		0.86		1.23	
	Outflow	13. 4. 2005	1.2				
	Outflow	25. 8. 2005	1.2	0.33	0.1	0.59	
	Outflow	10. 5. 2006		0.75		0.79	
	Outflow	9. 8. 2006		0.16			
	Ledava	22. 4. 2004					
	Ledava	21. 7. 2004		0.4			
	Ledava	13. 4. 2005					
	Ledava	25. 8. 2005	1.2				
	Ledava	10. 5. 2006		0.23			
	Lahajski potok	21. 7. 2004		1.9		2.43	
	Lahajski potok	10. 5. 2006		0.63		0.73	
Šmartinsko Lake	Outflow	16. 4. 2003		0.13			
	Outflow	24. 8. 2005	1.2				25
	Outflow	8. 8. 2006		0.28			
	Outflow	7. 11. 2006		0.12			
	Koprivnica	13. 4. 2005					
	Koprivnica	24. 8. 2005	1.2				30
Perniško Lake	Jareninski potok	19. 8. 2004	1.2				
	Pesnica	19. 8. 2004	1.2				

AOX: Adsorbable organic halogen compounds

Klivnik, Molja and Vogršček

In comparison with reservoirs in north-eastern Slovenia, Klivnik and Molja in Brkini and Vogršček in the Vipavska dolina are less loaded with nutrients. All three can be classified as mesotrophic reservoirs.

Klivnik and Molja are larger reservoirs built in the Reka sub-basin in the years 1979/80, with the purpose of easing the effects of high waters. Their catchment area is sparsely populated; the water quality is therefore relatively good, especially in the upper reservoir Klivnik. Klivnik is a possible source of water supply for the population on the margin of the Karst region. The main pressure of the reservoir is an erosive crumbling of the banks, which especially after rainfall, contributes to an input of suspended substances and consequently to lower transparency of the reservoir.

River Accumulations

In the period from 2003 to 2006, there were draught conditions over the summer months of 2003; such conditions contribute to the reduction of the rate of flow in large river accumulations and initiate intensive development of phytoplankton - 'blooming'. The most intensive 'blooming' was present in the Mavčiče accumulation that already appeared in June. Due to the decomposition of a large biomass of planktonic algae that was generated in the blooming and high temperatures, there was critical oxygen deficiency in water and even cases of fish deaths. Vertical sampling along the water column was carried out in Trbojsko Lake. At the sampling site Prebačevo, only a surface sample was taken and the highest concentration of chlorophyll-a (1306.1 µg/L) was measured there (Table 5). The concentration of oxygen was higher than 25 mg O_2/L and the oxygen saturation exceeded 200%. All other parameters, like the chemical oxygen demand with $K_2Cr_2O_7$ (69.0 mg O_2/L) etc., were also

Klivnik

Vogršček

excessive, which is characteristic of mass 'blooming'. In June 2003, the samples taken from the surface at the Vrhovo accumulation showed an extremely high concentration of chlorophyll-a (180 µg/L), which reflects long-lasting draught conditions and a lower rate of flow in the accumulation, which otherwise prevents the mass development of phytoplankton. In the phytoplankton sample, generally the same phytoplanktonic species were present as in the Mavčiče accumulation, and also some other species that were not found in Mavčiče. The prevailing species was green algae, Pandorina morum. In 2003, a shorter period of 'blooming' also occurred in Ptuj Lake. On the day prior to sampling, the rate of flow at the Markovci dam was increased after a long period of time, and this contributed to the fast outflow of the increased biomass of planktonic algae. At the time of sampling, the measured concentrations of chlorophyll-a were extremely low, despite the high nutrients concentration (nitrogen and phosphorus compounds) (Table 5). Analyses of species composition of phytoplankton showed that the frequency of genuine plankton species is low.

For the first time, the Moste accumulation was included in the national monitoring programme in 2006. Measurements have shown that the accumulation has the status of a lake only when the power plant is not operating and the water stagnates. According to the concentration of nitrogen and phosphorus, the Moste accumulation is on the boundary of mesotrophic and eutrophic status under OECD criteria, and the productivity of phytoplankton is hindered by an occasional higher rate of flow in the accumulation.

2.3 Quality of Marine Water

Seas and oceans cover more than two-thirds of the Earth's surface. A very small portion of it belongs to Slovenia. The Slovenian sea stretches 46 kilometres along the coast of the Trieste Bay. The Trieste Bay is the northern most part of the Mediterranean Sea, and lies at the intersection of the Alps, the Dinaric Alps and the Mediterranean. The sea in the Trieste Bay is shallow with the inflow of rivers containing untreated municipal and industrial wastewaters. The Slovenian rivers that deposit the largest amounts of suspended particles and nutrients to the coastal sea are the Dragonja, Badaševica, Drnica, Rižana and Soča, which in its lower stream also receives wastewaters from Italy. But the Po River represents the largest burden for the Trieste Bay, since more than a half of all municipal and industrial wastewaters in Italy flow into it. For the entire coastal area of the Slovenian sea and its hinterland, dense settlement, intensive agriculture in some places, industry and tourism are characteristic.

All these factors have an important influence on ecological processes and, as a consequence, on the status of the sea. In spite of large pressures from the rear area, a large variety of plant and animal species are characteristic for the Slovenian sea. Between Koper and Isola there is an underwater Posidonia bed, which is an endangered Mediterranean endemite and is a part of the Natura 2000 network.

In compliance with the Rules of identification and classification of surface water bodies (15), six water bodies were determined in the sea. The pressures and impacts analyses has shown that in the coastal area prevail influences from the land (agriculture, tourism, urban areas and industry) while in the open sea area prevail transboundary impacts (the outfalls of the Po and Soča) and the impacts of marine traffic, atmospheric deposition and fisheries. Impacts coming from land sources are less explicit in the open-sea area.

In the previous years (35), the quality of marine water was evaluated as a chemical (7, 8) and trophic (36) status. The results are presented below. Ecological status assessment methods for the marine water in accordance with the Water Framework Directive is still in the course of preparation, as is the case with rivers and lakes. Sampling and analyses of biological quality elements are carried out in compliance with ready-prepared expert documents (37, 38, 39). The system for assessing the status of the marine waters using the chlorophyll-a has been defined, and it will be upgraded with analyses of other biological elements for the assessment of the ecological status.

In the marine monitoring network are included four monitoring sites. The basic monitoring site (CZ) is situated in territorial waters, a reference monitoring site (F) in the southern part of the Trieste Bay and two additional monitoring sites in the coastal sea, in the Piran Bay (MA) and Koper Bay (K). The additional monitoring sites in the vicinity of the coastal sea are influenced by different sources of pollution. Monitoring site K is in the vicinity of the Port of Koper and the outflow of the Rižana, which contains municipal and some industry wastewaters, and monitoring site MA is influenced by the Portorož Marina area.

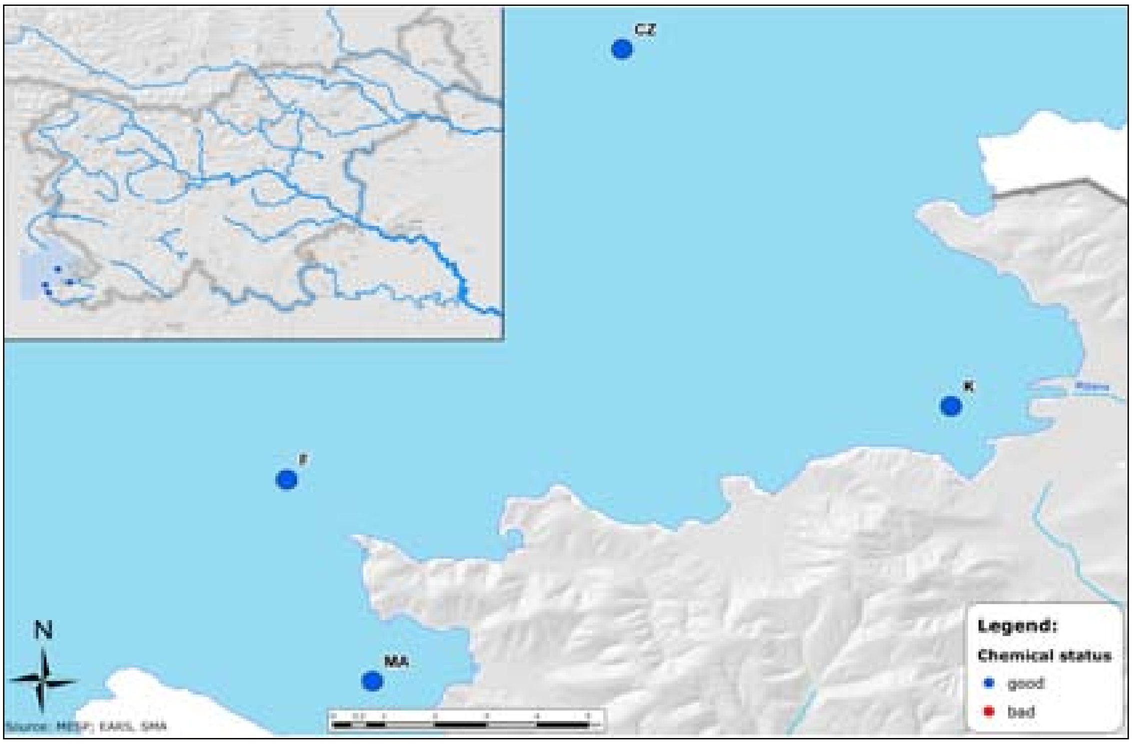
Strunjan

2.3.1 Evaluation of Chemical Status of Marine Water

The monitoring of the chemical status is carried out in accordance with the Decree of chemical status of surface waters (7). It is determined on the basis of annual average values of analysed parameters in the water, for which limit values are specified in the above-mentioned Decree and by the monitoring of the concentrations of some priority substances in the sediment. A good chemical status means that any average annual value of the parameters analysed in a selected monitoring site does not exceed the limit value prescribed in the Decree, and that any parameter in the sediment does not show a tendency to increase.

In the years 2003 to 2006, analyses of metals in water and in the sediment, as well as analyses of priority and indicative parameters (Table1), were carried out at selected monitoring sites in the sea. The analyses showed that the concentrations of priority substances and indicative parameters in water were under the limit values specified by the Decree of chemical status. The chemical status, based on analyses, in the years 2003 to 2006 was good at all monitoring sites in the marine water (Map 4).

***Map 4:** The chemical status of the marine water in the years 2003 to 2006*

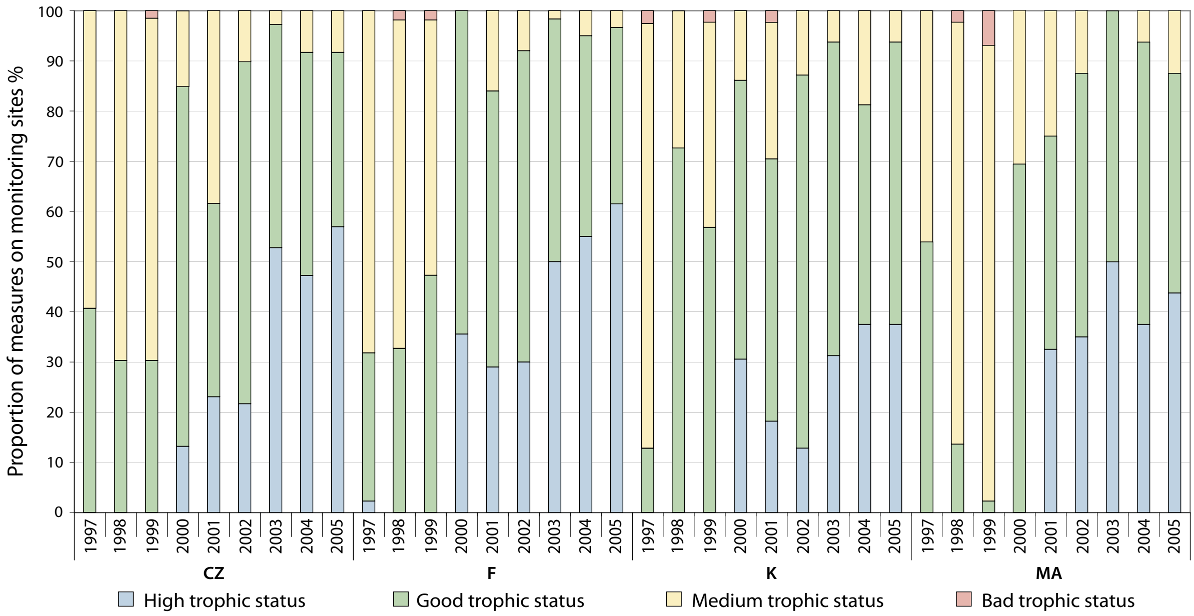


2.3.2 Evaluation of Trophic Status of Marine Water

The trophic status of the marine water is evaluated on the basis of the trophic index – TRIX. The index is used for the assessment of a certain marine environment. It is primarily intended for coastal waters, such as the Trieste Bay. It is based upon the concentration of chlorophyll-a as an indicator of phytoplanktonic biomass, the oxygen saturation, the transparency of the sea and nutrients (salts of nitrogen and phosphorus) concentration (36). High values in the TRIX index coincide with increased values of phytoplanktonic chlorophyll. The numeric scale of the TRIX index comprises values between 0 and 10; lower values mean better marine water quality or an insignificant eutrophication. Values of up to 4 mean a high trophic status, values from 4 to 5 mean a good trophic status, values from 5 to 6 mean a moderate trophic status and values above 6 mean a bad trophic status of the marine water.

Since the year 2000, the trophic status of the marine water has been gradually improving. A presentation of the TRIX index for the period from 1997 to 2005 is given. The best trophic status of the sea was at the reference monitoring site F. A similar status was at the basic monitoring site CZ in the middle of the Trieste Bay. The status at the monitoring site MA was a little worse, and the worst status was at the monitoring site K in Koper Bay (Chart 7).

Chart 7: The trophic status of the marine water at individual monitoring sites in the years 1997 to 2005



2.4 Water Quality in Protected Areas

2.4.1 Quality of Surface Water Intended for the Abstraction of Drinking Water

In many European countries, surface water represents a very important source of drinking water, while in Slovenia only approximately 3% of the population is supplied with drinking water from surface sources (40). Thirty years ago, the European Union has adopted two directives (41, 42) in order to protect these waters. They were transposed into Slovenian legislation in 2000 and 2001 (43, 44). National regulations summarize the mentioned guidelines and requirements that surface sources of drinking water should be classified into three quality classes (A1, A2 in A3) based upon a five-year data set regarding prescribed limit and guide values of physical, chemical and microbiological characteristics of surface water. According to the classification into a certain quality class, A1, A2 or A3, appropriate standard methods of water treatment are defined. They have to be carried out by Public Drinking Water Supply Contractor, and provide wholesome sources of drinking water.

The monitoring programme for the quality of surface water intended for the abstraction of drinking water (45) was according to the legislation for the first time set down for a five-year period from 2002 to 2006. It included the 11 surface sources of drinking water: Rižana, Mrzlek, Podroteja, Ljubija, Hudinja, Bistrica (near Slovenska Bistrica), Kolpa, Soča, Vipava, Veliki Obrh and Malenščica. These sources were selected on the basis of available data from the Institute of Public Health of the Republic of Slovenia at that time, and only those sources were included which supply more than 800 inhabitants. The list also included waters with a direct outfall into Karst aquifers that have a proven underground water flow with a short residence time. The number of inhabitants supplied by a source at that time determined the minimum frequency of sampling of the surface water (once to four times a year) and the required analyses.

The first classification of surface water intended for the abstraction of drinking water was made in 2002 and published in the Official Gazette of the Republic of Slovenia (46). The surface sources of drinking water, Ljubija, Hudinja, Bistrica, Kolpa, Soča, Vipava, Veliki Obrh and Malenščica were classified into quality classes according to data pertaining to water treatment procedures provided by the Public Drinking Water Supply Contractor. The Rižana, Mrzlek and Podroteja were classified according to the monitoring data in the years 1998 to 2002. The required five-year data set regarding the quality of all surface sources of drinking water was therefore gathered solely by the monitoring of the quality of surface water intended for the abstraction of drinking water in the years 2002 to 2006. Based upon these data, the classification of surface water intended for the abstraction of drinking water into quality classes was made; the classifications are shown in Table 9 and in Map 5.

Table 9: *The Classification of surface water intended for the abstraction of drinking water into quality classes based upon monitoring data in the years 1998 to 2006*

Surface water intended for the abstraction of drinking water	The first classification in 2002	Classification in quality classes on the basis of a five-year data set				
		1998–2002	1999–2003	2000–2004	2001–2005	2002–2006
Rižana	A3	A2	A3	A3	A3	A3
Mrzlek	A2	A2	A2	A2	A2	A2
Ljubija	A2	-	-	-	-	A2
Malenščica	A3	-	-	-	-	A2
Hudinja	A1	-	-	-	-	A3
Bistrica	A1	-	-	-	-	A2
Podroteja	A2	A2	A2	A2	A2	A2
Soča	A2	-	-	-	-	A3
Vipava	A2	-	-	-	-	A2
Kolpa	A2	-	-	-	-	A2
Veliki Obrh	A1	-	-	-	-	A2

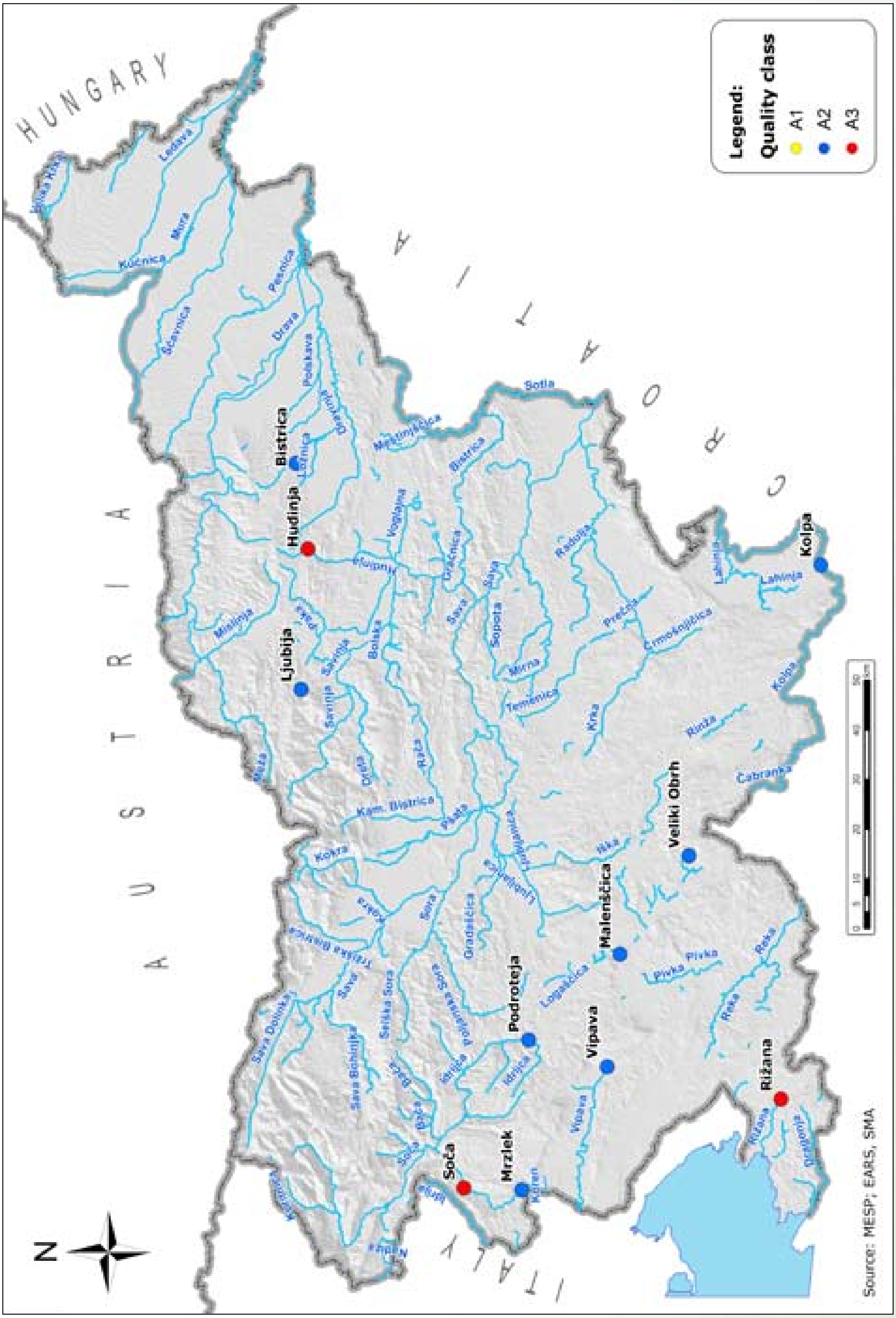
A1, A2, A3: quality classes from the best to the worse
- Five-year data set is not available

The results of the monitoring of the quality of surface water intended for the abstraction of drinking water show that surface sources of drinking water reach the quality of A1 class according to most physical and chemical parameters. Occasionally exceeded microbiological parameters were the reason for the classification of the surface sources Mrzlek, Podroteja, Ljubija, Bistrica, Kolpa, Vipava, Veliki Obrh and Malenščica into class A2. The Rižana has been classified into class A3 due to the occasional presence of Salmonella in water. Salmonella was also identified in one out of seven samples from the Soča, which consequently also caused the classification of the Soča into class A3. In the June 2006 sample from the Hudinja, the limit values of class A2 regarding total coliforms and faecal coliforms were exceeded, which classified the Hudinja into class A3. Regarding the first classification in 2002, the quality of the surface sources Rižana, Mrzlek, Podroteja, Ljubija, Kolpa and Vipava remained the same; the quality deteriorated in the soureces Hudinja (from A1 to A3), Bistrica (from A1 to A2), Soča (from A2 to A3) and Veliki Obrh (from A1 to A2), and it improved in the Malenščica (from A3 to A2). It has to be noted that the Hudinja is not a constant source of drinking water, because of its turbidity in the event of rainfall and is therefore used only in the dry season. The Veliki Obrh is also an auxiliary source of drinking water, as the majority of water is supplied from the well in Kozarišče while the Kolpa as a water source is gradually being phased out and a linkage of the water supply network to the Dobličica source is planned. Public Drinking Water Supply Contractors carry out an internal monitoring of the quality of the source of drinking water and are aware of microbiological pollutions. In the Ljubija and Bistrica, the use of ultrafiltration is therefore planned, to remove the suspended substances and particles of more than 0.01 µm in size and microorganisms, including bacteria and viruses from the water.

Rižana spring

Ljubija spring

Map 5: *Classification of the surface water intended for the abstraction of drinking water based upon the monitoring data in the years 2002 to 2006*



2.4.2 Quality of Bathing Water

In our modern way of life, it is almost impossible for us to dedicate some time to sports and recreation, even though Slovenian rivers, lakes and a part of the Adriatic Sea offer various water-related sports - from traditional bathing and boating for relaxation to adrenaline-inducing white-water descents over waterfalls and rapids. With the intention of protecting bathers' health, in 1976 within the European Union region the Bathing Water Directive (48) was adopted. The requirements of the directive were fully transposed also into Slovenian legislation in 2003 (49, 50). Its implementation is shared by Ministry of the Environment and Spatial Planning and Ministry of Health. The quality of bathing water is monitored in 37 natural bathing waters during the bathing season, which lasts from 15th June to 31st August in fresh waters and from 15th June to 30th September in coastal waters. During this period, bathing water is sampled at least every 14 days. In bathing waters where bathing is explicitly authorized, the bathing water quality monitoring is organised by the bathing water operator who provides the data to the bathing water register at the Institute of Public Health of the Republic of Slovenia; in the other bathing waters, monitoring is carried out by the Environmental Agency of the Republic of Slovenia (51). During the sampling, the presence of visible impurities, phenols, mineral oils and surface-active substances are assessed, and in the laboratory, further physico-chemical analyses (phenols, mineral oils, surface-active substances) and analyses for the presence of microbiological pollutants (total coliforms, feacal coliforms and feacal streptococci) are carried out. The quality results are presented in annual report on the quality of natural bathing waters (47) and also in report to the European Commission on the implementation of the Bathing Water Directive (52), which must be sent to the competent institutions in Brussels by the end of each year. Based on the Member States' annual reports, the Commission draws up a summary report and publishes it on the internet (53), with the aim to inform the public on the quality of bathing water quality in the European Union and in each individual Member State. The information about the bathing water quality is also available on the information boards set up in the bathing water areas; in addition, all reports are available on the websites of the Environmental Agency of the Republic of Slovenia and of the Institute of Public Health of the Republic of Slovenia.

Already at the end of 2004, Slovenia has for the first time reported to the Commission the results of the bathing water quality, even it had been a member of the European Union for only six months. Our reporting obligation is carried out with diligence and the monitoring data from 2004 to 2006 (Chart 8) show that occasionally exceeded microbiological parameters were the only reason for the non-compliance of the freshwater and coastal bathing waters. Considering the strict statistical evaluation

Soča, Čezsoča

Nadiža, Robič

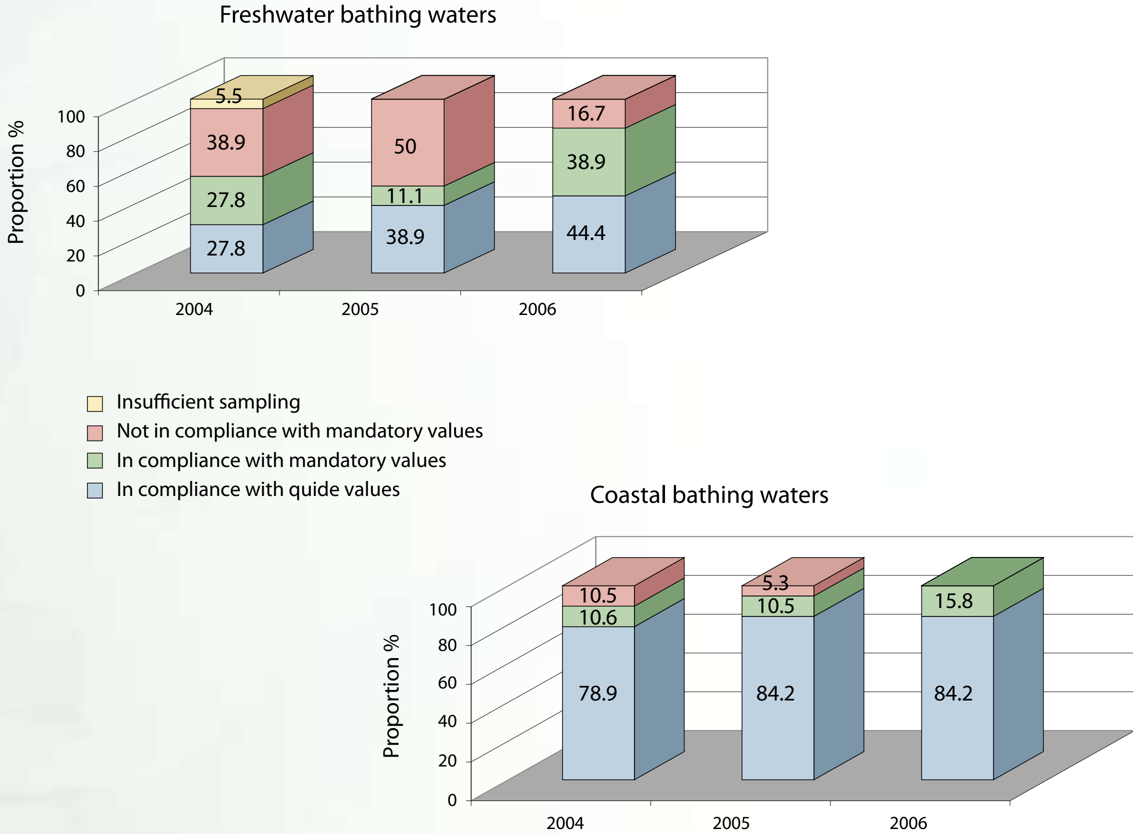
Bathing area, Izola

Kolpa, Adlešiči

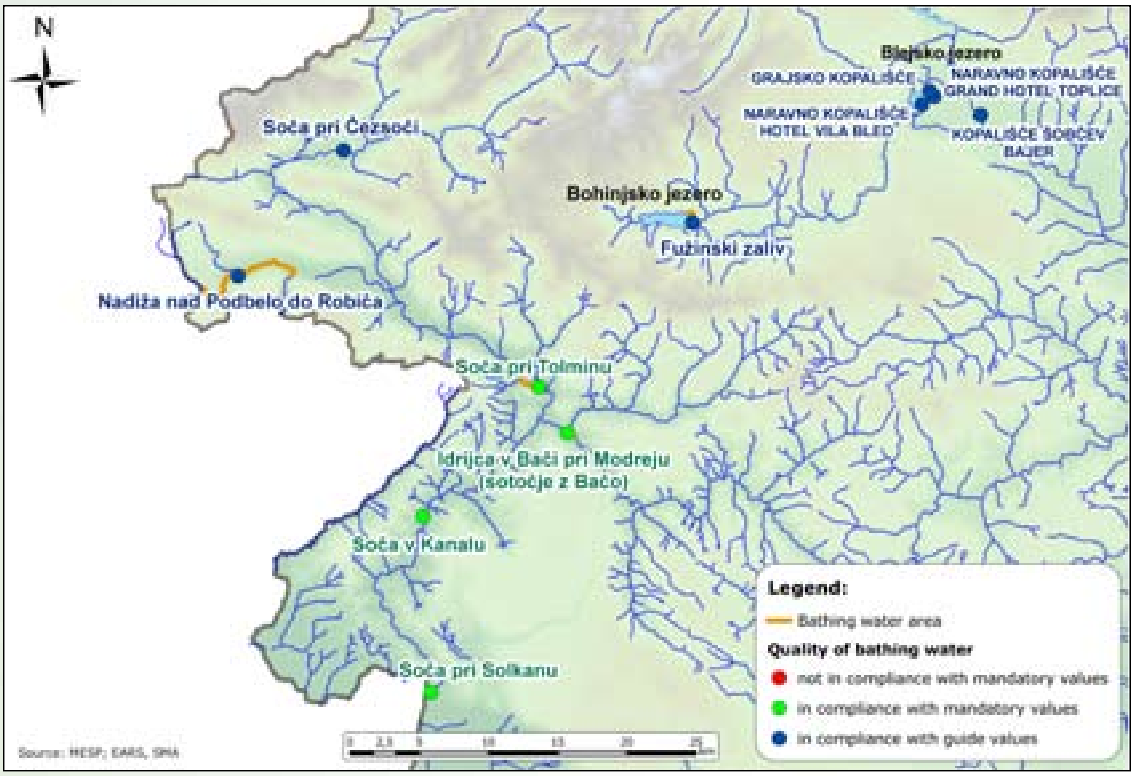
of the results, the quality of natural bathing waters in Slovenia improved substantially in 2006. Namely, in 2005, 50% of Slovenian freshwater bathing waters were not in compliance with mandatory values of the Bathing Water Directive (38.9% in 2004), and in 2006, only 16.7% remained non-compliant. In the non-compliant bathing waters (the Krka – bathing waters Straža and Žužemberk, the Kolpa – bathing water Učakovci – Vinica), the mandatory values of some microbiological parameters were slightly exceeded only once in 2006, due to unstable weather and surface rinsing during storms and rain showers (Maps 6 and 7). There certainly are some opportunities for the improvement of the Slovenian freshwater bathing water quality, but with the total compliance of coastal bathing waters in 2006 (94.7% compliance in 2005), Slovenia is at the top of water quality. Moreover: in 2006, 16 out of 18 coastal bathing waters also fulfilled striker-recommended requirements of the Bathing Water Directive (Map 8). Not even all of the old Member States of the European Union reach such high compliance with the requirements of the Directive, although the Directive has been implemented since 1976 and numerous measures have already been taken to improve the bathing water quality. The Commission has even established that, in the years of reporting, some countries were removing numerous bathing waters from their national lists, in order to conceal the pollution and falsely improve the statistics of the bathing water quality. Due to such practice, the Commission initiated legal procedures against 11 Member States in 2006; Slovenia is not among them.

In the first phase, Slovenia is endeavouring to collect reliable sets of data on bathing water quality, which will be used for the planning of measures to be taken to achieve a required bathing water quality. Construction of numerous water treatment plants in the bathing water catchment areas, which are planned in the Operative Programme for the Urban Wastewater Collecting and Treatment, will certainly contribute to the quality of Slovenian waters.

Chart 8: *Freshwater and coastal bathing water quality in the years 2004 to 2006*

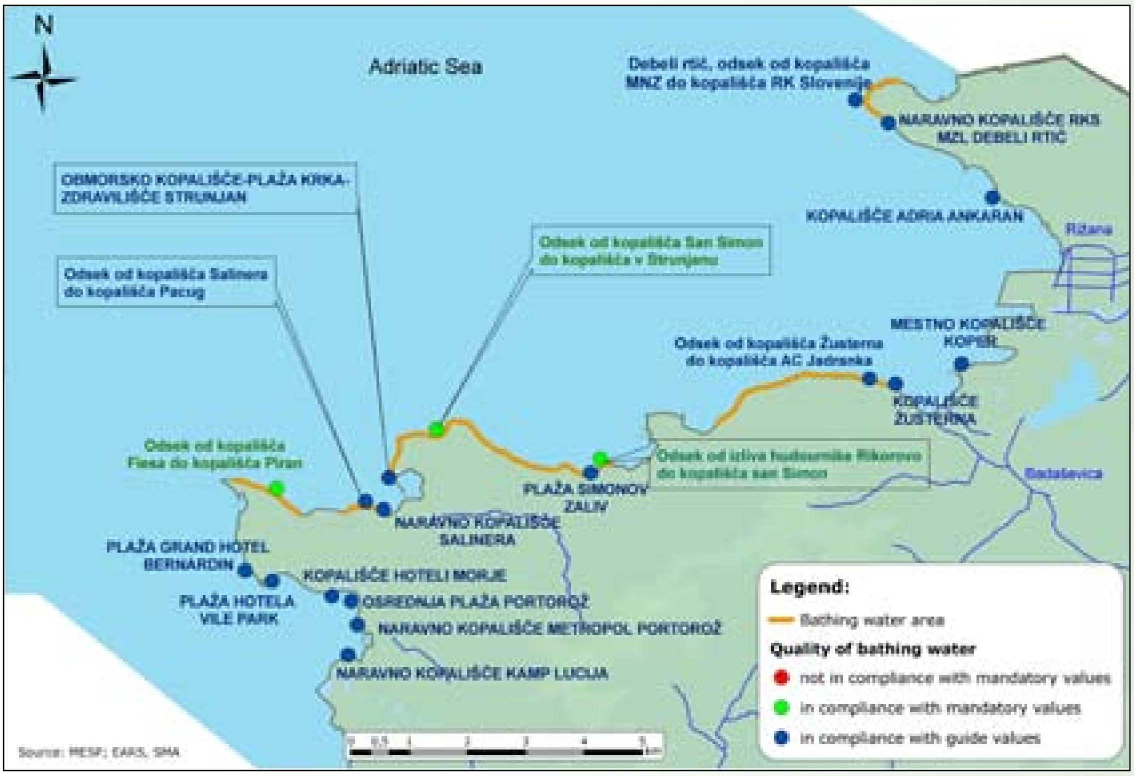


Map 6: *Quality of bathing waters in the Gorenjska and Goriška region in 2006*



Map 7: *Quality of bathing waters in the Dolenjska and Notranjska region in 2006*

Map 8: *Quality of coastal bathing waters in 2006*



2.4.3 Quality of Freshwater needing Protection or Improvement in order to support Fish Life

The consequence of great natural diversity and relatively clean waters in Slovenia is a great variety of aquatic life. In the Slovenian rivers, around 40 species of fish live in the Adriatic and over 70 fish species in the Danube river basin. Specific conditions in rivers, like temperature, flow rate, hydromorphological characteristics, as well as physico-chemical elements change significantly in the river bed from its spring to its outfall into the sea. The conditions influence on the composition of the fish population as well. Slovenia is one of the rare countries in the world where the rivers are clean enough to provide living conditions for numerous salmonid fish species, such as marble (Soča trout), brown and brook trout, the Danube salmon and grayling.

In Slovenia, all together 22 freshwater sections, important for the life of fish species were determined in 2005. Among them, 13 were designated as salmonid and 9 as cyprinid waters (55). Salmonid waters should provide living conditions for the salmonid fish species, like trouts, graylings and Danube salmons and cyprinid waters for the cyprinid fish species like carps, pikes, perches, etc. The purpose of the fish water designations is the protection or improvement of the water quality, which provides living conditions for freshwater fish species.

Since 2003, the Environmental Agency of the Republic of Slovenia has been monitoring water quality in the above-mentioned sections in compliance with national regulations (54, 56, 57). These regulations transpose Directive 78/658/EEC on the quality of fresh waters needing protection or improvement in order to support fish life, which was codified with the Directive 2006/44/ES (58). The aim of this Directive is to protect or improve the quality of those running or standing fresh waters that support, or which, if pollution were reduced or eliminated, would become capable of supporting fish belonging to indigenous species and species the presence of which is judged desirable for water management purposes.

For their life and growth, fish require good living conditions, including good water quality. Too low or too high temperatures, too high concentrations of ammonia, chlorine, nitrite, oxygen deficiency and toxic substances in water primarily endanger the life of fish.

In the monitoring of water quality needing protection or improvement in order to support fish life, the parameters that provide optimal living conditions for the fishes, are included. In compliance with the Decree on the quality of fresh waters supporting fish life (56), temperature, dissolved oxygen, pH, suspended solids, biochemical oxygen demand in 5 days (BOD_5), concentration of phosphorus, nitrite, ammonia, ammonium, total residual chlorine, total zinc and dissolved copper are evaluated in the water samples, collected at all monitoring sites of the salmonid and cyprinid waters. The samples are collected and analysed monthly.

Sava, Otoče

Vipava, Miren

Compliant to the regulations, the quality of fresh water needed for the life of fish species is evaluated for each year individually, according to the mandatory and guide values for salmonid and cyprinid waters, specified in Table 10. Only the results of the samples collected in exceptional natural conditions are excluded. The mandatory or guide values of salmonid and cyprinid waters are not exceeded, if the measurements of the samples collected within the minimum frequency of a one-year period shows that:

- 95% of samples do not exceed the mandatory or guide values for the parameters pH, BOD_5, non-ionized ammonia, total ammonium, nitrite, total residual chlorine, total zinc and dissolved copper; when the sampling frequency is lower than one sample per month, both the abovementioned values and comments shall be respected for all the samples,
- the percentage of samples pertaining to the 'dissolved oxygen' parameter, as listed in Table 10, is not lower than the mandatory or guide values,
- the average concentration defined for the 'suspended solids', does not exceed the mandatory or guide values.

Salmonid or cyprinid water is of not compliant quality and is considered over polluted if the results, according to the above-mentioned evaluation show that the mandatory values have been exceeded.

***Table 10:** Mandatory and guide values for salmonid and cyprinid waters*

Parameter	Expressed as	Unit	Salmonid waters		Cyprinid waters	
			Guide value	Mandatory value	Guide value	Mandatory value
Dissolved oxygen [(1)]	O_2	mg/L	50% ≥ 9 100% ≥ 7	50% ≥ 9 100% ≥ 6	50% ≥ 8 100% ≥ 5	50% ≥ 7 100% ≥ 4
pH				6 - 9 Δ± 0.5[(2)]		6 - 9 Δ± 0.5[(2)]
Suspended solids		mg/L	≤ 25		≤ 25	
BOD_5	O_2	mg/L	≤ 3		≤ 6	
Total phosphorus	PO_4	mg/L		≤ 0.2		≤ 0.4
Nitrite	NO_2	mg/L	≤ 0.01		≤ 0.03	
Ammonia	NH_3	mg/L	≤ 0.005	≤ 0.025	≤ 0.005	≤ 0.025
Ammonium	NH_4	mg/L	≤ 0.04	≤ 1	≤ 0.2	≤ 1
Total residual chlorine	HOCl	mg/L		≤ 0.005		≤ 0.005
Total zinc[(3)],	Zn	mg/L		0.3		1.0
Dissolved copper[(3)],	Cu	mg/L	0.04		0.04	

[(1)] The percentage represents the number of samples collected in a one-year period
[(2)] Artificially induced pH changes must not exceed ± 0.5
[(3)] The values coresponded to water hardness of 100 mg/L $CaCO_3$

The quality of salmonid and cyprinid waters in 2006 is shown in Map 9. In salmonid water sections, the mandatory values were not exceeded at any monitoring sites; in cyprinid water sections, a not compliant quality of the Dragonja at Podkaštel was determined due to too low oxygen concentration in one sample.

The assessment of the salmonid and cyprinid water sections quality in the years 2003 to 2006 is presented in Table 11; not compliant parameters are shown in Table 12.

Table 11: *Evaluation of the quality of salmonid and cyprinid water sections in the years 2003 to 2006*

RIVER	Section	Monitoring site	2003	2004	2005	2006
MURA	from the road bridge Petanjci to the outfall of the Ščavnica	Mota	compliant	compliant	compliant	compliant
DRAVA	from the dam Melje to Borl	Borl	not compliant	compliant	not compliant	compliant
SAVA BOHINJKA	from the outfall of the Mostnica to the confluence of the Sava Bohinjka and Sava Dolinka	Sava Bohinjka above the outfall of the Jezernica	compliant	compliant	compliant	compliant
SAVA	from the Sava Bohinjka and Sava Dolinka to the outfall of the Kokra	Otoče	compliant	compliant	compliant	compliant
SAVA	from the road bridge Medvode to Šentjakob	Šentjakob	compliant	compliant	compliant	compliant
SORA	from the outfall of the Žirovniščica to the outfall into the Sava	Medvode	compliant	compliant	compliant	compliant
MIRNA	from the spring to Boštanj	Boštanj	compliant	compliant	compliant	compliant
KOLPA	from the outfall of the Čabranka to the outfall of the Lahinja	Adlešiči	compliant	compliant	compliant	compliant
KOLPA	from the outfall of the Lahinja to the state border at Božakovo	Radoviči (Metlika)	compliant	compliant	compliant	compliant
LJUBLJANICA	from the spring to Livada	Livada	compliant	compliant	not compliant	compliant
SAVINJA	from the outfall of the Dreta to the outfall of the Bolska	Male Braslovče	not compliant	compliant	not compliant	compliant
SAVINJA	from the outfall of the Bolska to Veliko Širje	Veliko Širje	compliant	compliant	compliant	compliant
KRKA	from the spring of Krka - Gradiček to the outfall of the Bršlinski potok	Srebrniče	compliant	compliant	not compliant	compliant
KRKA	from the outfall of the Bršlinski potok to the outfall into the Sava	Krška vas	compliant	compliant	compliant	compliant
SOČA	from the spring to the outfall of the Tolminka	Trnovo	compliant	compliant	compliant	compliant
IDRIJCA	from the spring to the outfall into the Soča	Hotešk	compliant	compliant	compliant	compliant
VIPAVA	from the spring to the outfall of the Vrtovinšček	Velike Žablje	compliant	compliant	not compliant	compliant
VIPAVA	from the outfall of the Vrtovinšček to the outfall of the Vrtojbica	Miren	compliant	compliant	compliant	compliant
NADIŽA	From the state border to the state	Robič	compliant	compliant	compliant	compliant
REKA	from Zabiče to Cerkvenikov mlin	Cerkvenikov mlin (the mill)	compliant	compliant	compliant	compliant
REKA	from Cerkvenikov mlin to Matavun	Matavun	compliant	compliant	compliant	compliant
DRAGONJA	from Škrline to the border crossing point Dragonja	Podkaštel	compliant	not compliant	compliant	not compliant

Table 12: Parameters not compliant with mandatory values in cyprinid and salmonid water in the years 2003 to 2006

SALMONID WATERS		YEAR	Oxygen	Oxygen	Ammonia	Ammonium
			% < 6 mg/L	% < 9 mg/L	0% > 0.025 mg/L	% > 1mg/L
SAVINJA	MALE BRASLOVČE	2003	0	0	25	0
LJUBLJANICA	LIVADA	2005	0	67	17	17
SAVINJA	MALE BRASLOVČE	2005	0	33	0	17
KRKA	SREBRNIČE	2005	0	67	0	0
VIPAVA	VELIKE ŽABLJE	2005	0	58	0	0
CRITERIA FOR SALMONID WATERS			MV	MV	MV	MV
			0% < 6 mg/L	50% < 9 mg/L	0% > 0.025 mg/L	0% > 1mg/L
CYPRINID WATERS		YEAR	Oxygen	Oxygen	Ammonia	Ammonium
			% < 4mg/L	% < 7 mg/L	% > 0.025 mg/L	% > 1 mg/L
DRAVA	BORL	2003	0	0	25	0
DRAGONJA	PODKAŠTEL	2004	0	8	8	0
DRAVA	BORL	2005	0	8	0	8
DRAGONJA	PODKAŠTEL	2006	8	8	0	0
CRITERIA FOR CYPRINID WATERS			MV	MV	MV	MV
			0% < 4 mg/L	50% < 7 mg/L	0% > 0.025 mg/L	0% > 1 mg/L

Not compliant with the criteria
Compliant with the criteria
Mandatory value for salmonid waters
Mandatory value for cyprinid waters

More frequently than mandatory values, guide values for parameters are exceeded. These values do not classify the salmonid and cyprinid waters into the category of not compliant. However, they show, which parameters are for fish the most problematic in Slovenian rivers. One of the first such parameter is the concentration of nitrite, followed by the concentration of total ammonium and non-ionized ammonia (Charts 8 and 9). Increased concentrations of these parameters are in most cases caused by discharges of untreated municipal wastewater, discharges from municipal water treatment plants and from animal farms.

***Chart 9:** The share of exceeded guide values in cyprinid waters in 2006*

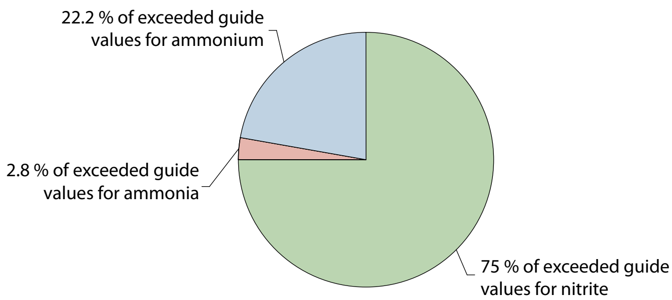
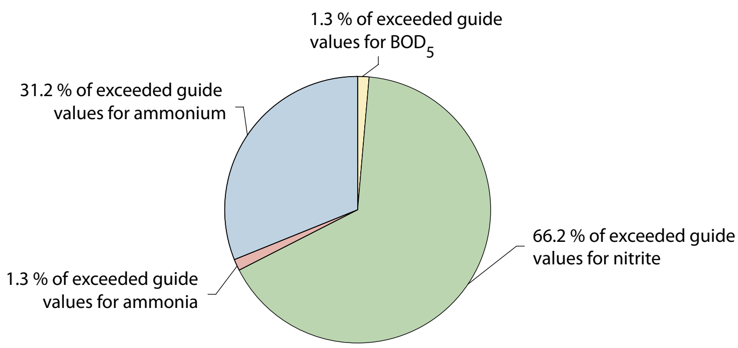
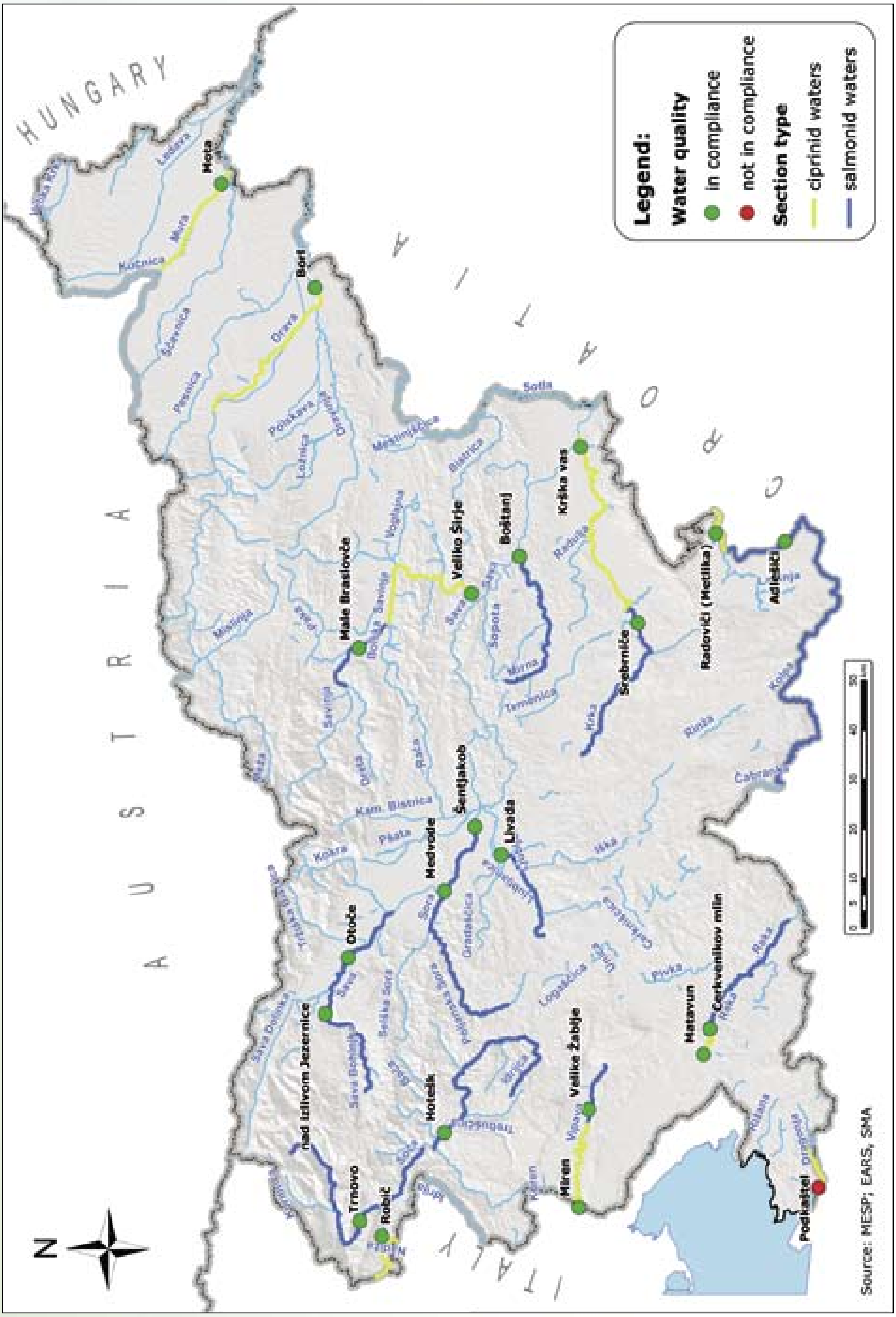


***Chart 10:** The share of exceeded guide values in salmonid waters in 2006*



Map 9: *Water quality evaluation of salmonid and ciprinid waters in 2006*



2.4.4 Quality of Shellfish Waters

Shellfish are molluscs living in hard shells. Their shells can be of various shapes and they protect their soft bodies from threatening dangers. Many shellfish live in the sand or mud at the sea bottom, some can be found attached to a hard surface (rock), and some move around by swimming. They feed on tiny particles of food floating in the water - they open their shells and filter the water through their gills.

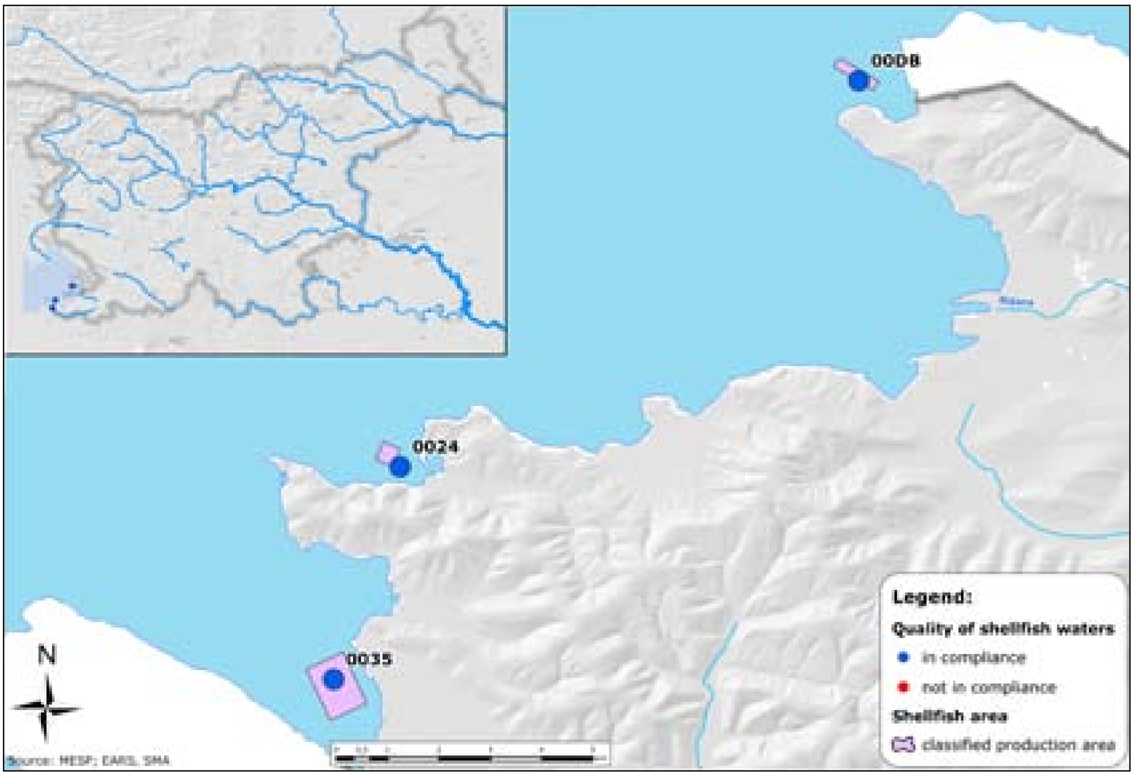
Shellfish are popular as food as well. If they are grown for the market, special floats are made in shellfish farms, thus providing them with conditions similar to those of their natural environment. Because of filtering the water, they improve water quality, but at the same time hazardous substances accumulate in their bodies. It is therefore essential that the shellfish intended for human consumption live in a clean environment. In the 1980's the European Union adopted the Directive on the quality required for shellfish waters (59). Directive requires that the Member States protect and/or improve the quality of coastal and brackish water bodies in which shellfish live, in order to contribute to the quality of edible shellfish products.

The above-mentioned Directive was entirely translated into the Slovenian legislation with the Decree on the quality required of water supporting marine bivalves and gastropods (60), Rules for the monitoring of the quality of waters supporting marine bivalves and gastropods (61) and Rules on the determining marine areas where the quality of water is suitable to support marine bivalves and gastropods (62).

Monitoring according to these regulations has been carried out since 2003 (63). Three monitoring sites have been chosen in the shellfish growing areas, i.e. in the Piran Bay, Strunjan Bay (monitoring sites 0035 and 0024) and at Debeli rtič (monitoring site 00DB).

The basic physico-chemical parameters, organic halogens, metals in water, and cadmium and mercury in both sediment and molluscs flesh are monitored, as part of the programme, with the frequency of twice to 12 times a year. In the period from June to October, analyses of toxic phytoplankton are also included in the programme.

Map 10: *Shellfish growing areas, and monitoring sites*



The quality of required of shellfish waters is evaluated annually. Water needed for the life and growth of marine bivalves and gastropods is of suitable quality if:

- 100% of samples do not exceed the mandatory or guide values for organic halogens and metals,
- 95% of samples are not lower than the mandatory or guide values for dissolved oxygen,
- 75% of samples do not exceed the mandatory or guide values for all other parameters.

The mandatory and guide values required for the quality of shellfish waters are shown in Table 13.

Table 13: *The mandatory and guide values for the quality of shellfish waters*

Parameter	Expressed as	Unit	Guide value	Mandatory value
pH			7.5-8.5	7-9
Oxygen saturation	O_2	%	$\geq$ 80	$\geq$ 70 (1) $\geq$ 60 (2)
Mineral oils			(4)	(3)
Organic halogen compounds:				
1,2 dichloroethane		µg/L		10
Hexachlorobenzene(4)		µg/L		0.03
Hexachlorobutadiene(4)		µg/L		0.1
Hexachlorocyclohexane(4)		µg/L		0.05
Tetrachloroethene		µg/L		10
Trichloroethene		µg/L		10
Trichloromethane		µg/L		12
Metals:			(4)	
Cadmium(4), (5)	Cd	µg/L		0.5
Chromium	Cr	µg/L		10
Copper	Cu	µg/L		5
Mercury(4), (5)	Hg	µg/L		0.3
Nickel	Ni	µg/L		10
Lead	Pb	µg/L		10
Zinc	Zn	µg/L		100
Fecal coliforms	Number of bacteria	FC/100 mL	$\leq$ 300(6)	

(1) Average value,
(2) Individual measuring,
(3) The parameter must not be present in the water in an amount to:
– produce a visible film on the surface of the water and/or on marine molluscs and marine gastropods, or
– have harmful effects on marine molluscs and marine gastropods,
(4) The content is also assessed in the sediments,
(5) The content of organohalogented supstances or metals in the molluscs and gastropods flesh is low enough to enable their direct consumption.
(6) The content can also be assessed in the molluscs and gastropods flesh.

Strunjan

The assessment of the quality of waters supporting marine bivalves and gastropods in the years 2003 to 2006 shows that, during the entire period, water at all three monitoring sites was compliant with the criteria defined in the Decree (Chart 14, Map 10). The physico-chemical parameters did not deviate from the prescribed mandatory values, and neither did fecal coliforms or the concentrations of organic halogens. Heavy metals were in low concentrations present in the water, but the concentrations were below the mandatory values in all monitoring sites.

Table 14: *The shellfish water quality in the years 2003 to 2006*

Marine areas determined as shellfish growing areas	Monitoring site	2003	2004	2005	2006
Debeli rtič	00DB	compliant	compliant	compliant	compliant
Strunjan	0024	compliant	compliant	compliant	compliant
Sečovlje	0035	compliant	compliant	compliant	compliant

3 Groundwater

3.1 Aquifers and Groundwater Bodies

Surface waters and groundwater differ from one another in many aspects. We are often fascinated by the unique beauty of Slovenian rivers and lakes. But it is not so easy to appreciate the richness and beauty of the waters beneath the Earth's surface. Groundwater is a valuable source mostly hidden from our eyes, often we do not even know where it is to be found. It occurs within ground and rock pores and fissures, and we can admire it at its springs or in our karst caves.

The importance of groundwater becomes apparent at the fact that groundwater is the source of drinking water for approximately 97% of the inhabitants of Slovenia. Groundwater quality of many aquifers complies with all the requirements for drinking water. We can therefore consume it in its natural state. This is a very important advantage of Slovenia, being rare in both the European region and elsewhere in the world. In addition, groundwater is an important source of industrial water, and is also used for the irrigation of agricultural land.

The pollution transferred from the pollution source into the aquifer is retained there for a longer period due to slower current, as well as chemical and physical processes between pollutant and humic substances or mineral particles. The natural purification of groundwater in aquifers is a long-lasting process. The artificial purification of groundwater is an expensive technological procedure of very limited effectiveness. The most important task of each individual and every institution is to prevent any pollution of groundwater sources.

In sediments and rocks, voids of different sizes appear. The sediments' and rocks' characteristic of containing voids is called porosity. Permeability is aquifer's ability to conduct water. Rocks of good permeability are highly abundant.

Groundwater is thus stored in moderately to highly permeable sediments and rocks called aquifers. They can be situated near the surface or hundreds of meters beneath it.

The term aquifer is derived from the Latin words aqua (water) and ferre (to carry). An aquifer can be, for example, a layer of gravel, sand, conglomerate, sandstone or a layer of fractured limestone and dolomite.

The largest part of the Slovenian territory is composed by sedimentary rocks of relatively high porosity - i.e., intergranular (19%), fissure (14.2%) and karst-fissure porosity (33.2%). The rest of Slovenia (32.8%) is built by rocks of lower porosity and in this way of smaller abundance (64), (Map 11).

In Slovenia, we thus make a distinction between aquifers with intergranular, karst and fissure porosity.

Aquifers with intergranular porosity, also called alluvial aquifers, are from the Tertiary and Quaternary age. Our larger rivers have deposited layers of flatland gravel and sand into tectonic depressions. They are found in the central, eastern and north-eastern parts of Slovenia. Such flatland regions are, for example, in the valleys of the rivers Sava, Savinja, Krka, Mura and Drava.

Aquifers with karst and fissure porosity are are built by carbonate rocks, mostly limestone and dolomite from the Mesozoic and Palaeozoic ages. They can mostly be found in the northern, north-western, western and southern parts of Slovenia. These are the mountainous karst regions of the

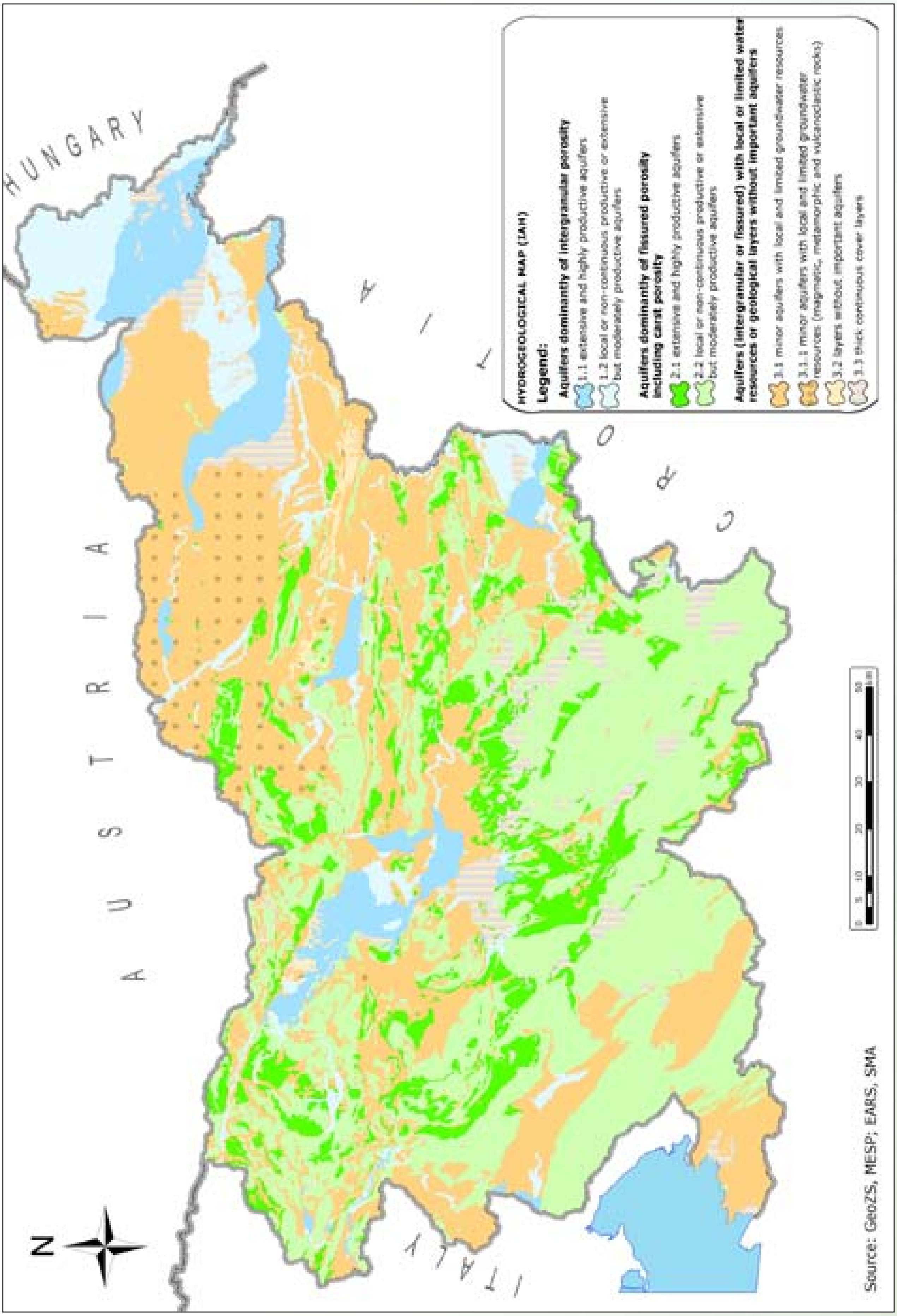
Julian Alps, the Karavanke, the Kamnik and the Savinja Alps, as well as the Karst regions of Notranjska, Dolenjska and Primorska.

A groundwater body is groundwater within one or several neighbouring aquifers. In Slovenia, 21 groundwater bodies have been delimited (65).

Sava Dolinka - Zelenci

The Križna jama Cave

Map 11: Hydrogeological map of Slovenia



3.2 Groundwater Quality

Groundwater quality is influenced by the activities on the Earth's surface and by the vulnerability of aquifers. In flatland river valleys with predominant alluvial aquifers the conditions are ideal for intensive agricultural production, in addition industrial and various craftsmen's activities are also well developed. Settlements and traffic infrastructure are denser in these valleys compared to forested and mountainous regions of Slovenia. All the above-mentioned activities, together with a very high vulnerability, represent a high risk of groundwater pollution. In these aquifers the monitoring results evidence that the groundwater is polluted by nitrates and pesticides originating mostly from the agricultural activity. Groundwater in some aquifers additionally contains chlorinated organic solvents and heavy metals in concentrations above the quality standards. In aquifers with karst na fissure porosity, the pressures are less intense compared to alluvial aquifers. Large parts of the surface above these aquifers are covered by forest, which provides natural protection for the groundwater. At the same time the land use is less intensive, so groundwater pollution is lower in these aquifers.

The transport of pollution into the groundwater and its spreading around the aquifer depends on several factors, like the chemical and physical characteristics of the pollutant, the precipitation amount, the land use, the type of ground layers and the aquifer's characteristics. Due to complex processes influencing the level of groundwater pollution, statistical methods and modelling are included in the interpretation of the monitoring results.

National groundwater quality monitoring, which has been carried out since 1987 (66), is the systematic monitoring of various physical and chemical parameters in groundwater bodies. Every year, the Environmental Agency of the Republic of Slovenia prepares in compliance with Slovene legislative acts for groundwater (67, 68, 69) the national groundwater quality monitoring programme (70), and carries out all monitoring phases. In accordance with the programme, authorised laboratories analyse about 150 different parameters in groundwater sampled at all the monitoring sites twice to four times a year.

A representative monitoring network is the basis for a reliable chemical status assessment. National monitoring network consists of monitoring sites where groundwater is sampled. The monitoring sites in alluvial aquifers are wells and boreholes, while in aquifers with karst and fissure porosity, the monitoring sites are springs and wells. In 2006, the national monitoring network included 129 monitoring sites, which were more concentrated in alluvial aquifers. A significant part of these wells and springs is intended for the drinking water supply.

Glijun spring

Hubelj spring

In groundwater samples, all parameters specified in the Decree (67) as well as potential pollutants of groundwater are determined (Table 15). The groundwater quality standards are summarized in Table 16.

Table 15: *Parameter groups analysed in groundwater*

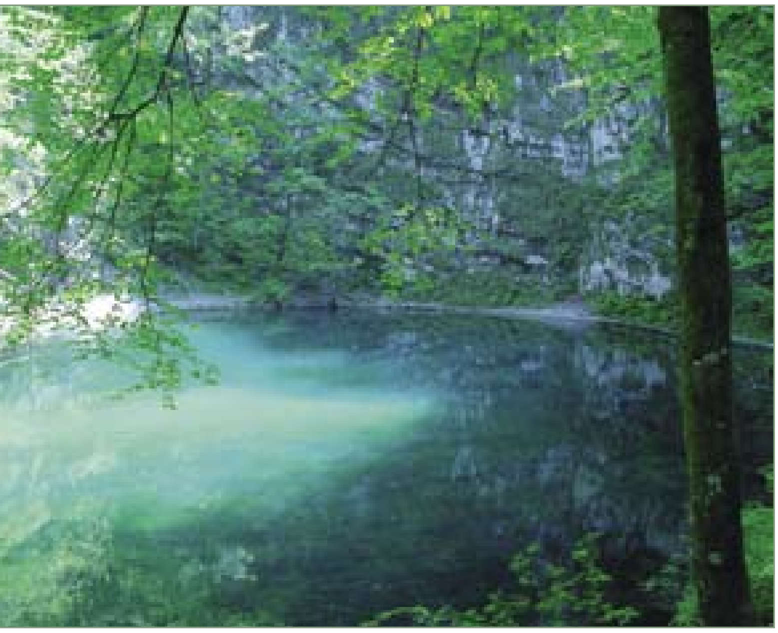
Parameter group	Parameters/Groups
Parameters measured at the sampling	T, pH, conductivity, redox potential, oxygen
Basic parameters	colour, turbidity, COD_{Mn}, TOC, ammonium, nitrite, nitrate, sulphate, chloride, fluoride, o-phosphate, sodium, potassium, magnesium, calcium, hydrogen carbonates
Group pollution parameters	mineral oils, PCB, AOX, detergents
Metals and metalloids	Fe, Mn, Al, Sb, As, Cu, Ba, Be, B, Zn, Cd, Co, Sn, Cr (both total and Cr-VI), Mo, Ni, Se, Ag, Sr, Pb, Ti, V and Hg
Pesticides and their metabolites	organochlorine, organophosphorus, triazines, triazinones, triazoles, anilines, amides, imides, benzonitriles, chloroacetanilides, phenylurea derivatives, phenoxyacetic acid derivatives
Volatile aliphatic halogenic hydrocarbons and aromates	
Methylated and chlorinated benzene derivatives	

COD: Chemical oxygen demand
TOC: Total oganic carbon
PCB: Polychlorinated biphenyls
AOX: Adsorbable organic halogen compounds

Tabela 16: *Standardi kakovosti podzemne vode*

Pollutants - groundwater parameters	Expressed as	Unit	Quality standard
BASIC GROUNDWATER PARAMETERS			
Nitrates	NO_3	mg/L	50
Individual pesticide and its relevant* metabolites		µg/L	0.1
The sum of all measured pesticides		µg/L	0.5
INDICATIVE GROUNDWATER PARAMETERS			
Ammonium	NH_4	mg/L	0.2
Potassium	K	mg/L	10
Orthophosphates	PO_4	mg/L	0.2
Volatile aliphatic halogenated hydrocarbons			
Dichloromethane		µg/L	2.0
Tetrachloromethane		µg/L	2.0
1,2-dichloroethane		µg/L	3.0
1,1-dichloroethene		µg/L	2.0
Trichloroethene		µg/L	2.0
Tetrachloroethene		µg/L	2.0
The sum of volatile halogenated hydrocarbons		µg/L	10
Mineral oils		µg/L	10
Chromium	Cr	µg/L	30

* The relevant metabolites according to pesticide registration regulative acts;



Divje jezero

Krupa spring

Based on statistically treated results, the chemical status of a groundwater body is assessed every year. For each parameter, annual arithmetic mean values (AM) are calculated at individual monitoring sites. From the annual arithmetic mean values of individual monitoring sites, the representative average value for a groundwater body is calculated (AM_{SK}), where each monitoring site is weighted proportionally to the catchment area.

A good groundwater body chemical status is assessed if the following requirements are fulfilled:

- for all parameters at all monitoring sites within the groundwater body borders, the following applies: AM ≤ QS (quality standard)

or

- for all parameters for a groundwater body, the following applies: $AM_{SK} \le QS$,
- drinking water pumped from the groundwater body is compliant with the requirements set out in the Rules on Drinking Water,
- there is no indication of salt water intrusion into the groundwater body,
- groundwater pollution does not deteriorate the status of surface waters and does not have damaging effects on neither terrestrial nor aquatic ecosystems.

Out of 15 groundwater bodies where national monitoring network and monitoring sites are situated, chemical statuses of 9 groundwater bodies were determined in 2006. In four groundwater bodies, the chemical status was only estimated, while for two groundwater bodies the network was not representative enough for evaluation. The chemical status of groundwater bodies in 2006 is presented in Map 12 and in Table 17, together with an indication of the parameters causing a bad chemical status, and the polluted parts of a groundwater body. A bad chemical status assessed on the results for groundwater as well as on the monitoring results of drinking water was determined for three groundwater bodies: the Dravska kotlina, the Murska kotlina and the Krška kotlina. In the Drava and the Krška kotlina, a bad chemical status was assessed due to nitrates and pesticides that are characteristic of agricultural activity, while in the Murska kotlina, additionally due to chlorinated derivatives of ethene that are still used in industrial and trade activities. In 2006, a bad chemical status of the Krška kotlina was determined for the first time.

Map 12: *Monitoring network and chemical status of groundwater bodies in 2006*

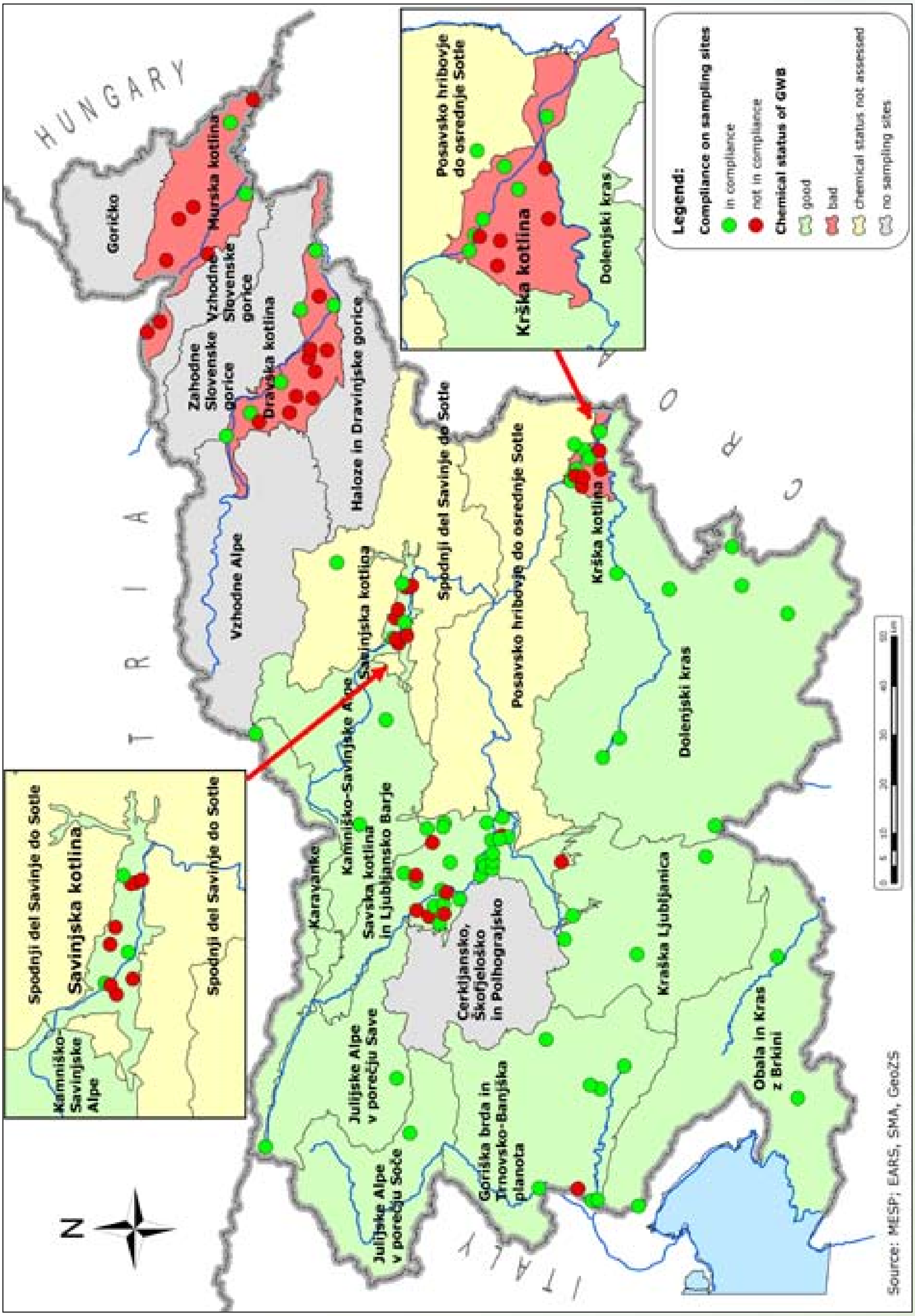


Table 17: *Chemical status of groundwater bodies (GWB) in 2006*

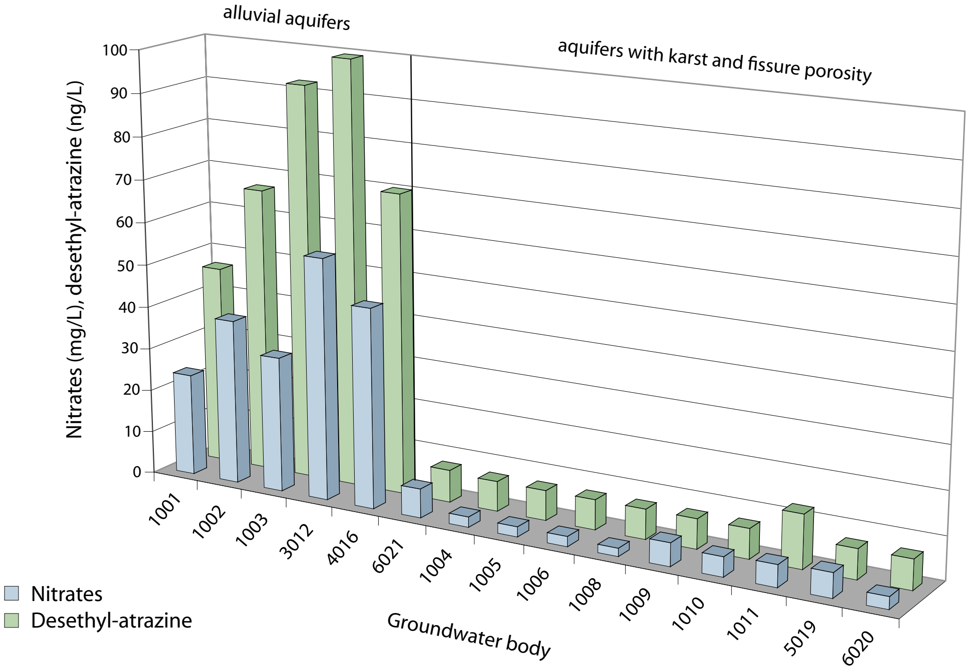
GWB code	GWB name	Aquifer types	Chemical status 2006		Parameters (cause of bad chemical status)	Polluted parts of GWB
			Groundwater	Drinking water		
1001	Savska kotlina in Ljubljansko barje	alluvial	good	good	/	/
1002	Savinjska kotlina	alluvial	good	good	/	/
1003	Krška kotlina	alluvial	bad	bad	nitrates, DAT, BENT	Krško polje, Škocjan - Krško gričevje
1004	Julijske Alpe v porečju Save	karst-fissure	good (estimated)	good	/	/
1005	Karavanke	karst-fissure	good (estimated)	good	/	/
1006	Kamniško-Savinjske Alpe	karst-fissure	good (estimated)	good	/	/
1008	Posavsko hribovje do osrednje Sotle	karst-fissure	0	bad	DAT	Območje Mirne
1009	Spodnji del Savinje do Sotle	karst-fissure	0	good	/	/
1010	Kraška Ljubljanica	karst-fissure	good	good	/	/
1011	Dolenjski kras	karst-fissure	good	good	/	/
3012	Dravska kotlina	alluvial	bad	bad	nitrates, AT	Dravsko polje
4016	Murska kotlina	alluvial	bad	bad	nitrates, AT, DAT, BENT, manganese, DCE, TCE, PCE	Apaško polje, Dolinsko-Ravensko polje
5019	Obala in Kras z Brkini	karst-fissure	good	good	/	/
6020	Julijske Alpe v porečju Soče	karst-fissure	good (estimated)	good	/	/
6021	Goriška Brda in Trnov.-Banjška planota	karst-fissure and alluvial	good	good	/	/

AT: Atrazine
DAT: Desethyl-atrazine
BENT: Bentazone

DCE: 1,2-dichloroethene
TCE: Trichloroethene
PCE: Tetrachloroethene

In the chart 11 different concentration levels of nitrates and desethyl-atrazine in alluvial aquifers as well as in aquifers with karst and fissure porosity are depicted. It is very obvious that groundwater bodies in alluvial aquifers are more polluted by nitrates and desethyl-atrazine compared to groundwater bodies in aquifers with karst and fissure porosity.

Chart 11: *Difference in concentration levels of nitrates and desethyl-atrazine in alluvial and aquifers with karst and fissure porosity in 2006*



Statistical treatment often conceals the problem of pollution; the groundwater quality must therefore be verified at individual monitoring sites. In the Table 18, the monitoring sites with the highest concentrations of pollutants determined in 2006 are listed. In groundwater of the Savinjska kotlina, high concentrations of nitrates, pesticides and tetrachloroethene were analysed at Levec. The pesticide bentazone exceeded ten times the quality standards in groundwater at Cerklje airport in Krško polje. Since the beginning of the groundwater quality monitoring it has been started the most polluted part of the groundwater body Dravska kotlina is the central part in Brunšvik, Kidričevo and Šikole. The main pollutants in all three sites are atrazine and nitrates. High concentrations of atrazine and the high ratio between atrazine and its metabolite desethyl-atrazine indicate that, despite the ban, atrazine is still being used in this area.

In a part of the Murska kotlina, groundwater is heavily polluted with chlorinated organic solvents, primarily with dichloroethene, trichloroethene and tetrachloroethene, and additionally with nitrates, atrazine and its metabolite desethyl-atrazine.

Automatic monitoring station in Ljubljansko polje

A well Črnci in Apaško polje

***Table 18:** Monitoring sites with the most polluted groundwater*

Groundwater body	Monitoring site	Parameter	Concentration (AM)	AM/QS
Savinjska kotlina	LEVEC VC-1772	nitrates	58.8 mg NO_3/L	1.2
		metolachlor	0.32 µg/L	3.2
		terbuthylazine	0.10 µg/L	1.0
		desethyl-terbuthylazine	0.15 µg/L	1.5
		total pesticides	0.68 µg/L	1.4
		tetrachloroethene	3.08 µg/L	1.5
Krška kotlina	CERKLJE C-01	nitrates	50.2 mg NO_3/L	1.0
		bentazone	1.05 µg/L	10.5
		total pesticides	1.17 µg/L	2.3
Dravska kotlina	BRUNŠVIK 1750	nitrates	109.5 mg NO_3/L	2.2
		atrazine	0.25 µg/L	2.5
		desethyl-atrazine	0.17 µg/L	1.7
		prometryn	0.39 µg/L	3.9
		total pesticides	1.02 µg/L	2.0
	ŠIKOLE 1581	nitrates	85.3 mg NO_3/L	1.7
		atrazine	0.24 µg/L	2.4
		desethyl-atrazine	0.15 µg/L	1.5
		bentazone	0.13 µg/L	1.3
		total pesticides	0.51 µg/L	1.0
	KIDRIČEVO 2571	nitrates	55.5 mg NO_3/L	1.1
		atrazine	0.88 µg/L	8.8
		desethyl-atrazine	0.34 µg/L	3.4
		total pesticides	1.23 µg/L	2.5
Murska kotlina	RAKIČAN 2500	nitrates	60.9 mg NO_3/L	1.2
		potassium	12.0 mg/L	1.2
		atrazine	0.13 µg/L	1.3
		1.2-dichloroethene	146.5 µg/L	73.3
		tetrachloroethene	155.0 µg/L	77.5
		trichloroethene	68.8 µg/L	34.4
		LHCH	370.5 µg/L	37.1
	LIPOVCI 2271	nitrates	110.3 mg NO_3/L	2.2
		desethyl-atrazine	0.19 µg/L	1.9

LHCH: The sum of volatile halogenated aliphatic hydrocarbons
AM: Yearly arithmetic mean of parameter in the monitoring site
QS: Quality standard

3.3 Trend Evaluation

The behaviour of an individual parameter over a longer period of time is represented by upward/downward concentration trends. Long-term trends of pollutants' concentration in a groundwater body are determined with a linear regression analysis of at least six-year sets of representative average values for a water body (AM_{SK}). On most occasions, pollution does not affect the entire water body, so more complete information on endangered groundwater is obtained if trends are determined with a linear regression of the annual arithmetic mean values at individual monitoring sites (AM). Remediation measures have to be carried out when the parameter's upward trend reaches 75% of the quality standard.

Due to a ban on the use of atrazine, a downward trend of this pesticide and its metabolite desethyl-atrazine has been established in the majority of groundwater bodies. Chart 12 shows a downward trend of the desethyl-atrazine concentration in the period from 1998 to 2006 in the Murska kotlina where, in 2005, representative average values (AM_{SK}) for the water body decreased below the quality standard of 0,1 µg/L. During the same period, the concentrations of desethyl-atrazine in the Krška kotlina water body have been increasing and almost reached the quality standard in 2006 (Chart 13)

***Chart 12:** Trend of decreasing desethyl-atrazine concentration in the Murska kotlina in the years 1998 to 2006*

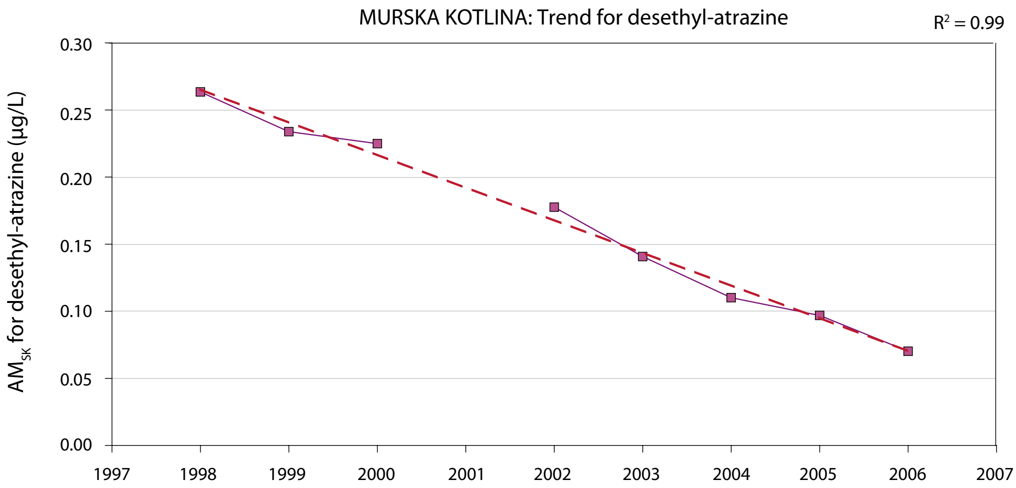
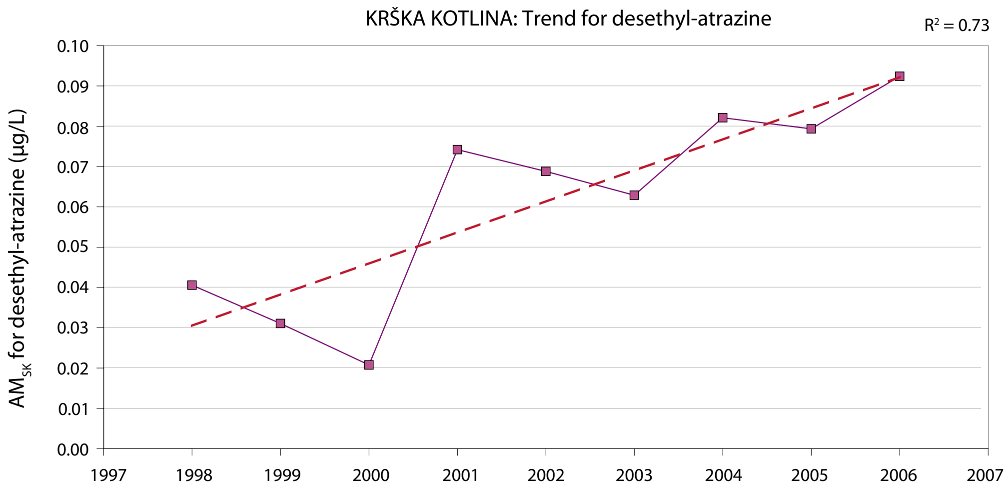
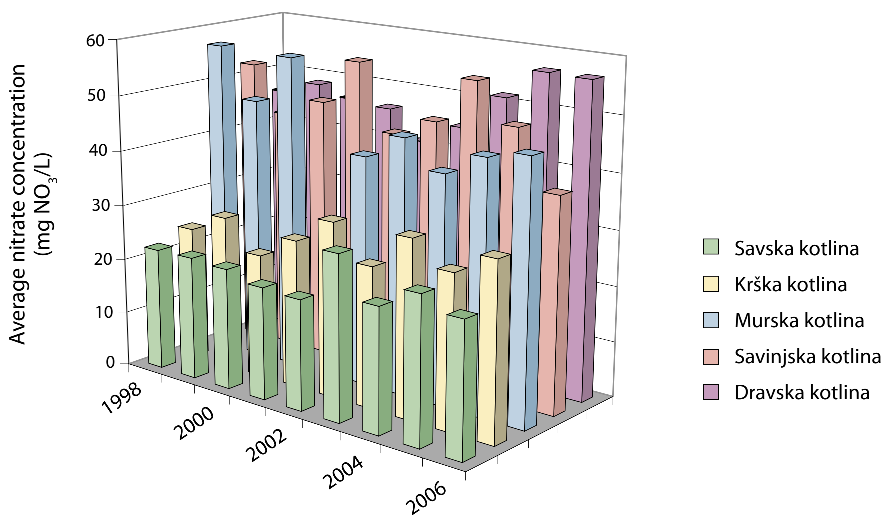


***Chart 13:** Trend of increasing desethyl-atrazine concentration in the Krška kotlina in the years 1998 to 2006*



With regards to nitrates, no explicit trend could be observed in the period from 1998 to 2006. In Chart 14, the average annual nitrate concentrations for all water bodies in alluvial aquifers are shown. During this period, the nitrate concentrations have been increasing in the Dravska and Krška kotlina, slowly decreasing in the Murska kotlina, while they remained at the same level in the Savinja and Savska kotlina.

***Chart 14:** Changing of nitrate concentrations in alluvial groundwater bodies in the years 1998 to 2006*



4 Guidelines for Future Work - Water Quality Assessment in Accordance to the Water Framework Directive

Water quality monitoring in Slovenia has a long tradition, but in 2007, it was for the first time carried out entirely in accordance with the requirements of the Water Framework Directive. The recent monitoring programmes for water quality are prepared according to a new monitoring approach which is being introduced by the Water Framework Directive. They are based on pressure analyses - i.e., data on emissions, land use, surpluses of nitrogen and the amounts of pesticides used etc. According to the analysis of these data, the monitoring programme is problem oriented and involves predominantly problematic water bodies. Other water bodies are less frequently included in the programme.

An essential novelty of the monitoring of the surface water quality is the assessment of the ecological status. The ecological status is evaluated based on four biological and the supporting physico-chemical and hydromorphological quality elements. The biological quality elements are phytoplankton, phytobenthos and macrophytes, benthic invertebrate fauna and fish. The evaluation of the ecological status is determined by measuring the alteration of the ecosystem's structure and deviation from the natural conditions. The natural or reference condition is a status whereby the impact of human activity is either not noticeable or is insignificant. Since the reference status of water bodies are different, a type-specific approach is used whereby the waters are classified into different types according to their natural characteristics and then reference conditions are defined for each type. For each type, five classes of ecological quality are defined. As in most European countries, the system of assessment of ecological status is still being developed in Slovenia.

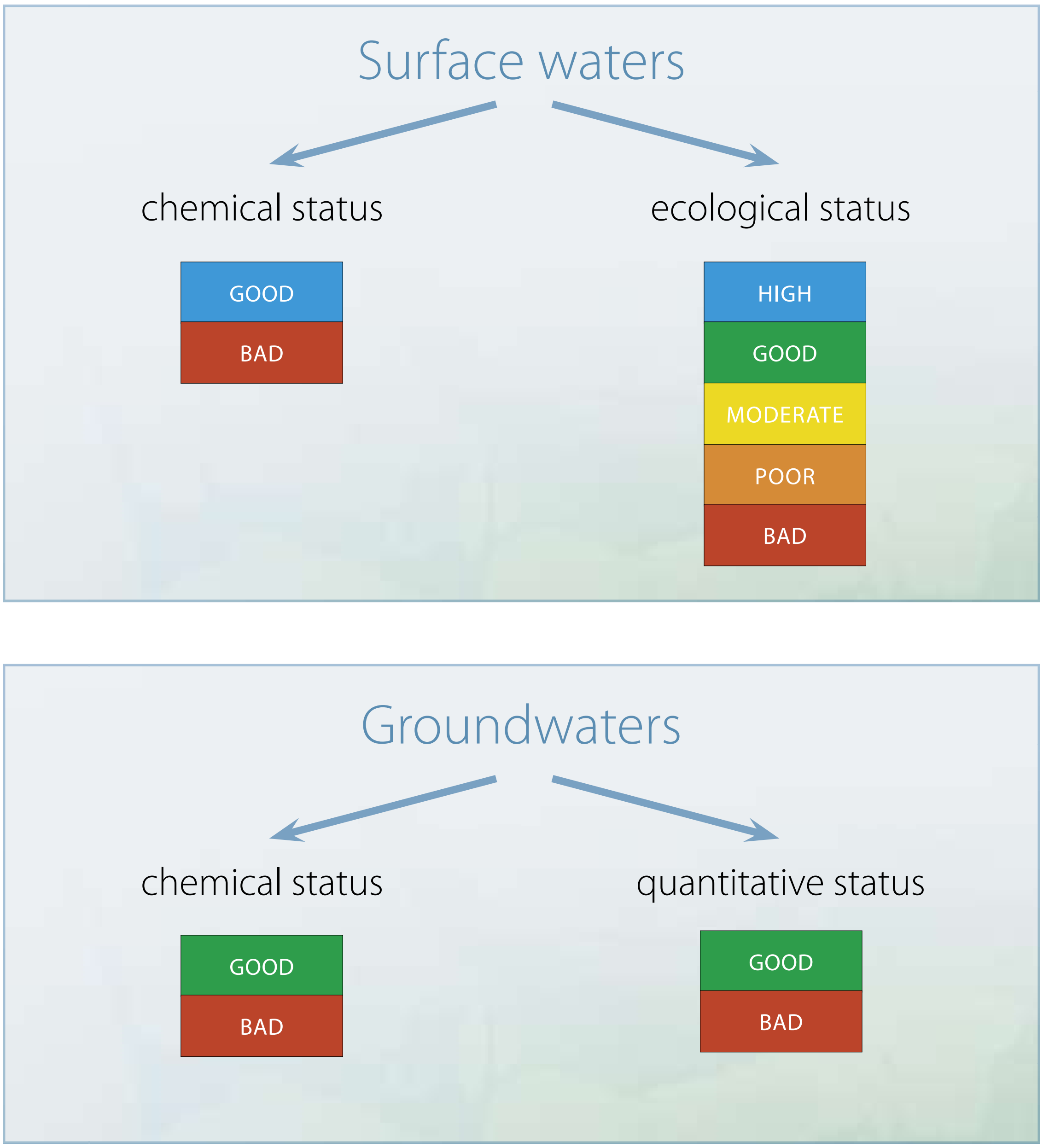
Also, one of the requirements of the Water Framework Directive is the evaluation of the chemical status. For the time being, the chemical status of surface waters is evaluated according to the existing legislation from 2002. In the European Community, the environmental quality standards for the determination of chemical status are in the adoption procedure, but the concentration of hazardous substances will have to be monitored, which must gradually disappear from the aquatic environment. Some of these substances (mercury, cadmium, lead, nickel, atrazine, polycyclic aromatic hydrocarbons...) were already included in previous years, and some will have to be added to the monitoring programme.

In the field of groundwater, the chemical status of those water bodies from which more than 100 m^3 of water is pumped daily for the drinking water supply, should be evaluated. In the case of Slovenia, it means that all of the water bodies will be included in the monitoring programme. Until 2006, monitoring was predominantly oriented towards the aquifers with intergranular porosity, where the problems are the worst, and for the remaining types of aquifers, analyses were carried out only occasionally. Taking this into account the number of monitoring sites for groundwater increased substantially in 2007. The Water Framework Directive allows for water bodies with a good chemical status not to be monitored every year however the frequency will only be changed after the first assessment of the chemical status.

For the last eight years, all European countries have been promoting the Water Framework Directive, which was adopted in order to preserve and improve the quality of water resources. The aim of the Water Framework Directive is to achieve a good chemical and ecological status of surface waters, as well as a good chemical status of groundwater by 2015. With the intention of obtaining a reliable assessment of water status, the Water Framework Directive prescribes monitoring which should be established by the end of 2006 at the latest. The first comprehensive assessments of the status of surface waters and groundwater will be laid out for the purpose of the first river basin management plans by the end of 2009. If countries have water bodies with a bad chemical or ecological status, they will have to start taking measures for the improvement and for the achievement of a good status by 2012 at the latest.

The measures are, in most cases, associated with high financial costs; the construction of water treatment plants and installations with advanced technologies, for example, demand large investments. On the other hand, the closing down of installations, banning the use of individual hazardous substances or other restricting measures can also contribute to the improvement of the status of the aquatic environment and have impacts on the economy and on the living standard of the entire population. Therefore, it is very important that the data from national monitoring are acquired in compliance with the principles of quality assurance, which are also the fundamental principles of the Environmental Agency of the Republic of Slovenia. Only quality data can provide the reliable assessment of chemical and ecological status, which are in turn used as expert groundwork for restoration programmes and serve as a support for integral water management.

A chart of water quality evaluation in accordance with the Water Framework Directive



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6 Glossary of terms

AOX	Adsorbable organic halogen compounds; summary parameter indicative for the content of organically bound halogens (chlorine, bromine, iodine), calculated as chloride.
Anthropogenic pressure	Impact of human activity.
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Atrazine	An organic compound, the herbicide used for the control of broadleaf weeds.
Benthic diatom	Unicellular algae with the cell wall made of silicon dioxide, living at the bottom of a river bed, lake or sea.
Benthic invertebrate fauna	Animals living at the bottom of a riverbed, lake or sea and are of different sizes; organisms larger than 1 mm are called macro benthic invertebrates, organisms smaller than 1 mm belong to mesobenthic invertebrates and organisms smaller than 0.5 mm belong to microbenthic invertebrates.
Biodiversity	Species diversity or diversity of living organisms, which comprises various levels of life: species , genetic and ecosystem diversity.
Biogenious element	A chemical element which is in extremely low concentrations necessary for normal metabolism.
Catchment area	The area from which water naturally drains into a river or into a specific point.
Determination level	A classification level of organisms into systematic categories.
Ecological potential	Ecological potential is a status of a heavily modified or an artificial body of water.
EOX	Extractable organic halogen compounds.
Eutrophication	Enrichment of water with nutrients, especially nitrogen and phosphorus compounds, which results in an excessive growth of planktonic algae and higher aquatic plants; the consequence is a disturbance in the balance and deterioration of water quality.
Groundwater body	A distinct volume of groundwater within an aquifer or aquifers.
Heavily modified water body	A surface water body, which is substantially changed as a result of physical alterations by human activity.

Hydromorphological conditions	The hydrological regime and morphological conditions of water. The hydrological regime: the quantity and dynamics of the water current and linkage to groundwater bodies. The morphological conditions: the depth and width of the river, the structure and substrate of the river bed and the structure of the riverbank zone.
Indicative list of parameters or list of nationally relevant substances	Hazardous substances for which it has been determined on a national level that, due to their presence and widespread use, they present risks to the environment and man.
Indicative weight	Taxon in one or several quality classes, expressed as number ranging from 1 to 5.
Littoral	Shore or coastal zone of a water body where the sunlight reaches the bottom.
Macrophytes	Larger aquatic plants (some algae - Characeae, mosses, ferns, higher plants).
MBAS	Methylene blue active substances, produced by the reaction of anionic surface-active substances and methylene blue.
Metolachlor	An organic compound, the herbicide used for weed control in agriculture, at the roadside and in ornamental plant growing.
Multimicrohabitat sampling method	A method of sampling benthic invertebrate fauna, adapted to the requirements of the Water Framework Directive.
OECD	Organisation for Economic Cooperation and Development.
Organic pollution	Pollution of water with organic substances.
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls; a common term for chlorine substituted biphenyls; many PCBs are persistent, they accumulate in the food chain and have long-lasting damaging effects on organisms.
Periphyton	A biotic community of organisms permanently or occasionally attached to a solid underwater surface.
Phytobenthos	Plants living at the bottom of a river bed, lake or sea.
Phytoplankton	Plant organisms carried by water or floating in it.
Photosynthesis	Synthesis of organic substances from carbon dioxide and water occurring in green plants in the presence of sunlight.
Priority list of hazardous substances	The list of substances that present a significant risk to the environment and man, and are classified for priority action; they are listed in Appendix X of the Water Framework Directive.

Protected areas	Water sections important for the life of freshwater fish species ; parts of the sea with an appropriate water quality for the life of marine molluscs and gastropods; surface waters intended for human consumption; bathing waters in bathing areas.
Reservoir	An object intended for the storage of water and/or its regulation and control.
River Accumulation	An artificial reservoir made by building a barrier (a dam) across a water course behind which water starts to accumulate. Such reservoir is primarily used to drive a hydroelectric power plant.
Saprobic value	Taxon efficiency in relation to organic pollution – saprobic quality of the aquatic environment.
Saprobic index	Numeric expression representing the level of organic pollution.
Siphon in Lake Bled	An artificial outflow of deep - hypolymnetic water from a lake.
Surface water body	A discrete and significant element of surface water
Taxon	An organism within a specific systematic category.
Trophic status	Status according to the amount of nutrients present for plants.
Water emission monitoring	The monitoring of wastewater discharges from sources of pollution into the environment.
Water imission monitoring	Monitoring of effects of pollution on water quality.