CATEGORIZATION OF THE BULGARIAN DANUBE RIVER TRIBUTARIES

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Abstract: The main goal of the present investigation is the establishment and analyzing the water quality categories in the different parts of the Bulgarian Danube tributaries from the point of view of the various water consumptions. Nevertheless the contribution of the Bulgarian tributaries on the Danube water quality is comparatively small, the estuary parts are specially investigated and the water quality there is discussed. The alteration pf the water quality and the corresponding categories along the studied rivers is discussed as well.
Keywords: Danube, water quality, water categories

KATEGORISIERUNG DER BULGARISCHEN NEBENFLÜSSEN VOM FLUSS DONAU

***Zusammenfassung*:** Grundziel der vorliegenden Untersuchung ist Feststellung und Analyse der Kategorien für Wasserqualität in verschiedenen Stellen der bulgarischen Donaunebenflüssen von der Sicht des verschiedenen Wasserverbrauchs. Unabhängig davon, dass der Beitrag der bulgarischen Nebenflüssen zu der Qualität vom Fluss Donau relativ klein ist, die Mündungsrevier sind speziell behandelt und die Wasserqualität dort ist kommentiert. Kommentiert ist auch die Veränderung der Wasserqualität entlang der untersuchten Donaunebenflüssen und die Veränderung der entsprechenden Kategorien.
***Schlüsselworte*:** Donau, Wasserqualität

For more than ten years Bulgaria has gone through a period of significant alterations of its economic and technological basis that essentially impact on the general conditions of the environment. The main goal of the present paper is to be revealed and analysed the water quality categories of the different parts of the main Bulgarian Danube tributaries from the point of view of the different water uses and their impact on the Danube water quality. Nevertheless the contribution of the Bulgarian tributaries over the Danube water quality forming is comparatively small, their local influence could not be neglected especially along the Bulgarian bank.

On the Bulgarian side there are six big tributaries - Ogosta, Iskar, Vit, Ossam, Jantra, Russenski Lom witch are divided in several sectors from the springs to the estuaries (Fig. 1). As intermediate points are chosen the existing monitoring points usually situated under big industrial towns and agriculture centres. Special attention is paid to the last sectors before the inflow into the Danube River. In these sectors could be evaluated the impact of the tributaries on the Danube river water quality.

The choice of a representative period of investigation – from 1994 until 1999 is linked with necessity of comprising the representative period in the new economical conditions and with the availability of the informational in the main institutions monitoring and investigating river water quality in Bulgaria – the National Institute of Meteorology and Hydrology and the Ministry of Environment and Water. The existing hydrochemical and hydrological databases are a part of the National Monitoring System.

In the present investigation are used nine water quality parameters. On the one hand these parameters have significant importance from the point of view of water usage and on the other hand it is supposed they are susceptible to the changes in the new conditions. The used water quality parameters can be group as follow: parameter of oxygen regime and organic content - dissolved oxygen (O_2), biological demand of oxygen in the five day (BOD5), permanganate oxidation (Ox); biogenic elements – nitrate nitrogen ($N\text{-}NO_3$), nitrite nitrogen (N-

NO_2), ammonium nitrogen (N-NH_4), phosphate (PO_4); mineral content – dissolved materials (sum of ions, SUM); content of suspended matter (Sus).

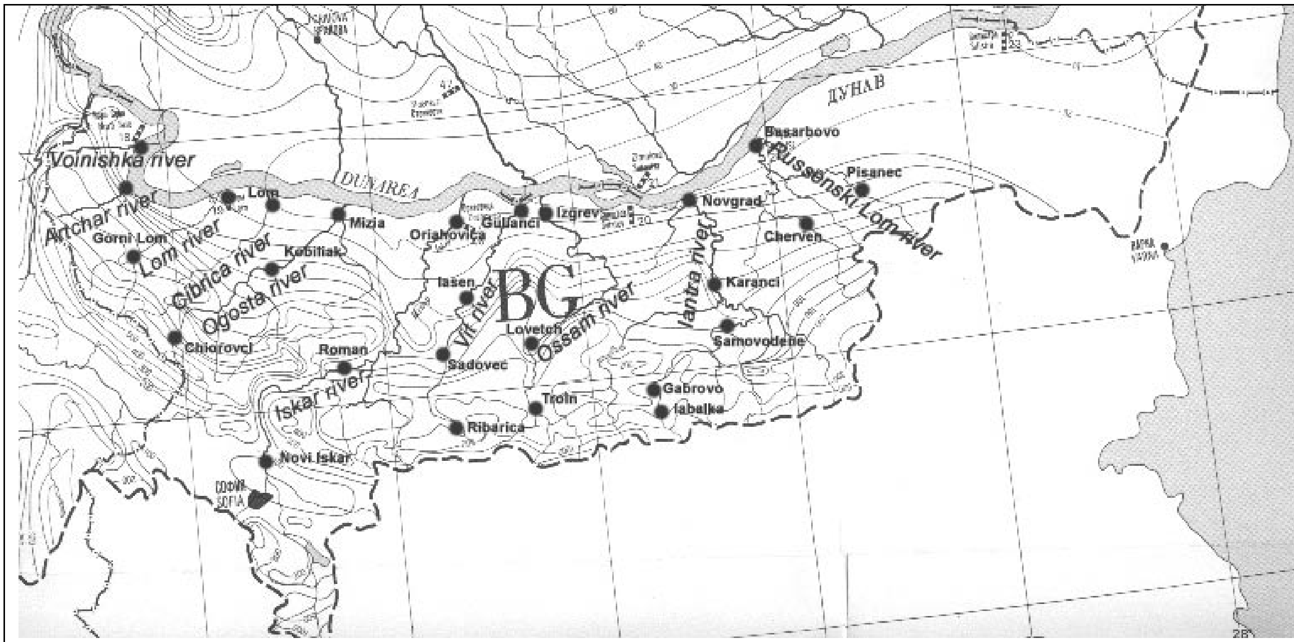

Figure 1. Bulgarian Danube tributaries and monitoring points

To categorize the river water in the Bulgarian Danube tributaries is used the special methodology developed in the National Institute of Meteorology and Hydrology by K. Tzankov (Tzankov, 1998) in accordance with the Bulgarian legislation (Ordinance N7, 12.12.1986). The process of categorization aims to assess the possible usage of the river water depending on different needs of the water consumers: for drinking, technical water supply, irrigation, fishing etc. This assessment reflects practically the significant alterations in the Bulgarian economical and social life in the last ten years period.

To be determined the category (or the level of pollution) of the flowing current in some river section, according to the proposed methodology and the existing national legislation, it is necessary to be revealed the value - $Cd_{95\%}$ - the real value (concentration, mg/l) of any qualitative parameter measured or established when the water discharge is with 95% probability of the average minimal monthly water discharge – $Q_{95\%}$ for some long-term homogenous period. This period depends on the hydrological cycle and the organization of the monitoring system. The number of the necessary water quality measurements is not limited but the practice shows that the number must be more than 25-30 sampling for a period of several years (Blaskova, 2002). Obviously the increasing the number of measurements improves the correlation links between the water discharge and the studied water quality parameters. Integrated approach for parallel measurements, common investigation and assessment of the water quantity and some chosen hydrochemical parameters requires common statistical proceedings and establishment of correlation relationships between water quantity and quality parameters. Establishing relationships between the different water quantity and quality characteristics for some homogenous periods of time could enlarge the historical database, fill the gaps and foresee the conditions in the water body for some long-term period of time.

To be determined the value of $Cd_{95\%}$ - the real value of some water quality parameter when the water discharge is with 95% probability of the average minimal monthly water discharge it is necessary to establish the correlation link between the water discharge values and the measured concentrations of any studied quality parameter – Cd = f(Q). Correlation analyses between water quantity and quality parameters are implemented, using specialized software, looking for the curve with the best correlation coefficient $|r|$, respectively r^2, among big number of curves ($C=a+b.Q^c$, $C=a+b.\exp(-Q/c)$, $C=a+b.\ln(Q)$, $C=a+b/\ln(Q)$, $C=a+b.Q$, $C=a+b/Q$, $C=a+b/Q^c$, $C=a+b.Q.\ln(Q)$, $C=a+c/\ln(Q)$, $C=a+b.e^{-Q}$…). In the choice of the best relationship between the studied parameters, the physical meaning in some cases could be decisive. The statistical relationships can be accepted as significant if the correlation coefficient is equal or bigger than 0.5 ($|r|$ = 0,5 /r^2 = 0.25) and reaching to these values would be possible with long rows hydrological and hydrochemical parameters for some homogenous period. By the way, using the created correlation curves for the river water categorization, could be restored the gaps in the historical series as well.

For the river water quality categorization, knowing the water discharge with 95% probability – $Q_{95\%}$ for the studied period and according the Bulgarian legislation and the proposed methodology [1], from the established curves can be determine the value of $Cd_{95\%}$ whence - the relevant corresponding category. The main goal for the categorization of the different river sections is to assess the water quality from the point of view the water usages as drinking water supply, irrigation, fishing, industrial use and so on. On the other hand the process of categorization aims to help the prevention and protection activities oriented to improve the ecological status of the water body. That is why the acting Bulgarian legislation and the proposed methodology assess the water category in the most severe conditions – very small water discharge ($Q_{95\%}$) and respectively high level of the water quality parameters concentration.

Considering the above-explained approach, the correlation curves, the concentrations of selected water quality parameters with 95% probability - $Cd_{95\%}$ and finally the corresponding category are determined. On the Table 1 are presented the results for the Bulgarian Danube tributaries at the estuary monitoring points. According the acting Bulgarian legislation (Ordinance N7, 12.12.1986) the surface flowing water is divided in tree categories (I, II and III), which determine its possibility for use.

Table 1. Correlation links between water quality parameters and water discharge, water quality categories at the estuary sections in the Bulgarian Danube tributaries

River - monitoring point	P	equations C=f(Q)	r^2	$Q_{95\%}$ m^3/s	$C_{95\%}$ mg/l	C
Voinishka - village Tarnene	O_2	$O_2 = 4.02 + 7.56\ Q^{0.17}$	0,361	0,031	8,21	I
	BOD5	BOD5 = 2.51 - 0.39 lnQ	0,266	0,031	3,86	I
	Ox	Ox = 4.36 - 0.12 Q2 lnQ	0,322	0,031	4,36	I
	$N\text{-}NO_3$	$N\text{-}NO_3 = 1.18 - 0.65\ Q^{0.30}$	0,255	0,031	0,95	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.014 - 2.94.10\text{-}6 \ln Q / Q^2$	0,333	0,031	0,02	II
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.30 - 0.032\ Q^{1.51}$	0,252	0,031	0,30	II
	PO_4	$PO_4 = 0.076 - 0.00023 / Q^{1.5}$	0,253	0,031	0,03	I
	SUM	$SUM = 520.28 - 33.63\ Q^{1.53}$	0,267	0,031	520,1	I
	Sus	$Sus = 41.90 - 40.15\ Q^{1.19}$	0,526	0,031	41,26	II
Artchar - village Artchar	O_2	$O_2 = 9.79 + 1.13\ Q^{0.43}$	0,289	0,085	10,18	I
	BOD5	BOD5 =2.14 + 1.20 exp(-Q / 1.38)	0,278	0,085	3,27	I
	Ox	Ox =3.65 - 0.56 lnQ	0,293	0,085	5,03	I
	$N\text{-}NO_3$	$N\text{-}NO_3 = 0.43 + 0.0097 / Q^{1.5}$	0,322	0,085	0,82	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.012 - 0.00086$ Q0.5 lnQ	0,315	0,085	0,01	II

River - monitoring point	P	equations C=f(Q)	r^2	$Q_{95\%}$ m^3/s	$C_{95\%}$ mg/l	C
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.12 - 0.017 \ln Q$	0,296	0,085	0,16	II
	PO_4	$PO_4 = 0.098 - 0.081 e^{-Q}$	0,324	0,085	0,02	I
	SUM	SUM = 393.49 - 21.97 Q0.5 lnQ	0,326	0,085	409,2	I
	Sus	Sus = 39.12 + 4.95 Q0.5 lnQ	0,355	0,085	35,56	II
Lom - town Lom	O_2	$O_2 = 10.78 + 0.04 Q \ln Q$	0,274	0,141	10,77	I
	BOD5	BOD5 = 3.28 - 0.45 lnQ	0,269	0,141	4,16	I
	Ox	Ox = 3.93 - 0.05 Q1.05	0,297	0,141	3,92	I
	$N\text{-}NO_3$	$N\text{-}NO_3 = 0.24 + 0.79 / Q^2$	0,365	0,141	3,30	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.010 + 0.0086 / Q^2$	0,326	0,141	0,08	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.071 + 0.18 / Q^2$	0,367	0,141	0,81	II
	PO_4	$PO_4 = 0.075 - 1.51 Q^3$	0,311	0,141	0,07	I
	SUM	$SUM = 314.11 - 22.04 Q^{0.57}$	0,324	0,141	306,8	I
	Sus	$Sus = 39.26 + 0.0002 Q^3$	0,294	0,141	39,26	II
Cibrica - village Dolni Cibar	O_2	$O_2 = 6.58 + 2.99$ Q0.39	0,318	0,276	8,39	I
	BOD5	BOD5 = 2.34 + 0.80 / Q	0,289	0,276	5,24	II
	Ox	Ox = -1.33 + 6.96 exp(-Q / 11.18)	0,273	0,276	5,46	I
	$N\text{-}NO_3$	$N\text{-}NO_3 = 0.91 - 0.20 \ln Q / Q$	0,264	0,276	1,84	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.085 - 0.027 Q^{0.5}$	0,257	0,276	0,07	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.15 + 3.05 \exp(-Q / 0.18)$	0,277	0,276	0,81	II
	PO_4	$PO_4 = 0.62 - 0.35 Q^{0.29}$	0,309	0,276	0,38	II
	SUM	$SUM = 711.77 - 152.88 Q^{0.54}$	0,334	0,276	635,4	I
	Sus	$Sus = 61.42 + 1.02 Q^{1.88}$	0,323	0,276	61,51	III
Ogosta town Mizia	O_2	$O_2 = 8.01 + 0.24 \exp(-Q / 47.25)$	0,301	1,454	8,24	I
	BOD5	$BOD5 = 2.13 + 25.09 / Q^{1.5}$	0,33	1,454	7,44	II
	Ox	Ox = 5.48 - 0.82 lnQ	0,329	1,454	11,15	II
	$N\text{-}NO_3$	$N\text{-}NO_3 = 1.62 - 0.028 Q^{0.83}$	0,277	1,454	1,58	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.011 + 0.17 / Q^{1.5}$	0,295	1,454	0,11	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.21 + 10.58 / Q^2$	0,286	1,454	5,21	III
	PO_4	$PO_4 = 0.63 - 0.009$ Q0.5 lnQ	0,284	1,454	0,63	II
	SUM	$SUM = 117.33 + 727.43 / Q^{0.5}$	0,365	1,454	702,0	II
	Sus	$Sus = 44.88 + 1.11 Q^{3.19}$	0,36	1,454	48,54	II
Iskar - village Oriahovica	O_2	$O_2 = 9.03 + 0.0005 Q^{1.97}$	0,369	12,5	9,10	I
	BOD5	BOD5 = 2.86 + 15.15 exp(-Q/11.78)	0,27	12,5	8,10	II
	Ox	$Ox = 7.20 - 0.0041 Q^{1.5}$	0,275	12,5	7,02	I
	$N\text{-}NO_3$	$N\text{-}NO_3 = 0.74 - 0.0006 Q \ln Q$	0,278	12,5	0,72	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.030 + 23579.6 \exp(-Q/1.13)$	0,425	12,5	0,40	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.73 - 0.13 \ln Q$	0,263	12,5	0,40	II
	PO_4	$PO_4 = 0.31 + 57.10/Q^2$	0,261	12,5	0,68	II
	SUM	SUM = 335.63 - 0.016 Q1.83	0,528	12,5	334,0	I

River - monitoring point	P	equations C=f(Q)	r^2	$Q_{95\%}$ m^3/s	$C_{95\%}$ mg/l	C
	Sus	Sus = 35.91 + 1.63 exp(Q/24.75)	0,261	12,5	38,61	II
Vit - village Gulianci	O_2	$O_2 = 9.60 - 0.72 / Q^2$	0,257	0,344	5,50	II
	BOD5	BOD5 = 3.34 + 39.84 exp(-Q / 0.77)	0,297	0,344	28,83	III
	Ox	Ox = 4.97 + 3.01 / Q	0,392	0,344	23,72	II
	$N\text{-}NO_3$	$N\text{-}NO_3 = 0.57 + 1.17\ e^{-Q}$	0,27	0,344	1,40	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.21 - 0.12\ Q^{0.11}$	0,284	0,344	0,10	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.50 + 1.54 \exp(-Q / 2.64)$	0,322	0,344	1,85	II
	PO_4	$PO_4 = 0.51 - 0.077 \ln Q$	0,302	0,344	0,59	II
	SUM	SUM = 510.90 - 60.35 lnQ	0,576	0,344	575,3	I
	Sus	$Sus = 25.24 + 0.73\ Q^{0.90}$	0,335	0,344	25,52	I
Ossam - village Izgrev	O_2	$O_2 = 9.85 - 0.0086\ Q^{1.46}$	0,267	0,567	9,85	I
	BOD5	BOD5 = 2.93 + 8.70/Q	0,539	0,567	14,28	II
	Ox	$Ox = 9.11 - 2.22\ Q^{0.30}$	0,378	0,567	7,24	I
	$N\text{-}NO_3$	$N\text{-}NO_3 = 0.70 + 0.85 / Q^{1.5}$	0,286	0,567	2,69	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.0098 + 0.044 \exp(-Q / 22.42)$	0,259	0,567	0,05	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.23 + 1.48 / Q$	0,724	0,567	2,84	III
	PO_4	$PO_4 = 0.25 - 0.056 \ln Q$	0,352	0,567	0,28	II
	SUM	SUM = 592.53 - 85.08 lnQ	0,489	0,567	640,8	I
	Sus	$Sus = 29.75 + 0.25\ Q^{1.68}$	0,899	0,567	29,85	I
Iantra - village Novgrad	O_2	$O_2 = 7.01 + 0.40 \ln Q$	0,289	3,869	7,55	I
	BOD5	$BOD5 = 4.85 + 80.46 / Q^{1.5}$	0,391	3,869	14,92	II
	Ox	Ox = 4.78 + 40.99 / Q	0,417	3,869	15,37	II
	$N\text{-}NO_3$	$N\text{-}NO_3 = 0.48 + 12.99 / Q^2$	0,298	3,869	1,35	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.041 + 0.30 / Q^2$	0,267	3,869	0,06	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 0.22 + 18.02 / Q^2$	0,306	3,869	1,42	II
	PO_4	$PO_4 = 0.075 + 1.03 \exp(-Q / 12.78)$	0,287	3,869	0,84	II
	SUM	SUM = 238.65 + 297.98 / lnQ	0,287	3,869	458,8	I
	Sus	$Sus = 27.28 + 0.012\ Q^{1.59}$	0,264	3,869	27,38	I
Russenski Lom - village Basarbovo	O_2	$O_2 = 8.18 - 1.59 / Q^2$	0,315	1,21	7,09	I
	BOD5	BOD5 = 6.49 + 7.73 / Q	0,306	1,21	12,88	II
	Ox	Ox = 8.73 + 37.73 exp(-Q / 0.56)	0,302	1,21	13,08	II
	$N\text{-}NO_3$	$N\text{-}NO_3 = 2.05 - 1.25 \ln Q / Q^2$	0,261	1,21	1,89	I
	$N\text{-}NO_2$	$N\text{-}NO_2 = 0.027 + 0.05 / Q^2$	0,258	1,21	0,06	III
	$N\text{-}NH_4$	$N\text{-}NH_4 = 1.15 - 1.19 / Q^{0.5}$	0,357	1,21	0,17	II
	PO_4	$PO_4 = 0.053 + 6.85 \exp(-Q / 2.01)$	0,261	1,21	3,80	III
	SUM	SUM = 524.06 + 113.0 exp(-Q / 25.12)	0,32	1,21	631,7	I
	Sus	$Sus = 531.86 - 551.86 / Q^{0.5}$	0,266	1,21	30,17	II

The presented results reveal the categories and the real water quality of the Bulgarian tributaries just in front of their inflow into the Danube River. Obviously the water quality varies as well as the water discharge. These two factors determine the different impact on the Danube water quality.

Furthermore the category of the different parameters shows different kind of pollution. The increased concentrations of nitrite ions (N-NO_2) and ammonium ions (N-NH_4) – II and III category, and phosphate ions (PO_4) – mainly II category, show that some kind of biogenic pollution is character for all Bulgarian tributaries. The values vary but the processes are similar. This pollution is a result of municipal wastewaters and the significant agricultural and stockbreeding activity in the whole region.

Considering the parameters BOD5 and permanganate oxidation (Ox) could be noticed a moderate level of organic pollution – mainly II category for some of the Bulgarian tributaries – especially Vit, Ogosta, Iantra, Russenski Lom as a result of industrial activities and the accelerated process of urbanization. But the oxygen concentration is comparatively high – the water in the Bulgarian estuary sections is I category with one only exception – the Vit river (II category).

The total mineralization of the Bulgarian tributaries is small – the concentration of the dissolved materials (SUM) is in the limits of the I category. Only the water quality in the mouth section of the Ogosta River comes slightly in the II category. The mineral content in the water of Bulgarian river is not big. The content of suspended matter (Sus) varies significantly from I to III category. The origin of the rivers, the background, the erosion processes and anthropogenic activities are very different in the different part of the Bulgarian catchment area. It is not possible to conclude some common rule for formation and regime of the suspended matter for all studied rivers.

The size of Bulgarian rivers is very different. Obviously the influence of big rivers as Ogosta, Iskar or Iantra is different then of the small ones as Voinishka, Artchar or Cibrica. The influence of the Bulgarian rivers, especially the bigger ones, should not be neglected. Their influence surely is essential close to the inflow and along the Bulgarian bank. But the total water discharge of the all-Bulgarian tributaries is small compare to the water discharge of the Danube River, moreover the level of pollution in the mouth sections is not significant (with some exceptions) Table 1. The fact is that the Danube water quality is formed above the Bulgarian boundary.

Nevertheless the estuary sections are the most interesting parts considering the Danube water quality it is interesting the alteration of the different categories along the studied rivers from the springs to the inflows into the Danube River. These alterations reflect mainly the impacts of the industrial, agricultural and municipal point and no-point sources of pollution. Considering the anthropogenic factors as decisive for the change of the water quality, respectively the water category, it should be mentioned that some natural factors affect significantly the water quality as natural biological processes for example. The presented changes summarize the influence of the both factors – mainly anthropogenic factors but the natural ones as well. The alterations of the categories presented in the major monitoring points along the Bulgarian tributaries, considering the same selected and important water quality parameters, are shown on the Table 2.

Obviously the parameters characterizing the water quality, respectively the categories, in the different sections of the studied rivers are conservative remaining constant, other water quality parameters vary. The alterations along the investigated river streams depending on the local conditions are various, no common characteristics or longitudinal tendencies could be extracted. For example the river Lom does not change its quality along the studied stretch, except some increase of the nitrite nitrogen (N-NO_2) content. There are not big changes in the water quality of the rivers Iskar and Russenski Lom (Table 2). From the town Novi Iskar to the inflow into Danube the Iskar River does not change its water quality characteristics, even though there is a process of some decrease of the phosphate (PO_4) and ammonium nitrogen ($N-NH_4$) content – from III to II category. But it is necessary to be added that the investigation about the Iskar River begins from the town Novi Iskar, after the nearby lying capital – Sofia. The upper most mountain part of the river is not touched by the investigation. The water quality of the Iskar River in front of the drinking water reservoir "Iskar" and the city of Sofia is much better and the categories are different. No changes are revealed in the water quality of Russenski Lom, except some decrease of suspended matter content approaching the Danube River.

Very dissimilar is the alteration of the water quality along the others Bulgarian Danube tributaries. For example the Ogosta river changes its quality characteristics, respectively its categories not in one-way. Some water quality parameters remain constant - as oxygen (O_2), others show tendencies of improvement just closer to the Danube river where the concentrations of nitrate nitrogen ($N-NO_3$) and phosphate (PO_4) diminished, the rest studied water quality parameters, respectively water categories are worsening (Table 2).

Table 2. Water quality categories in the different monitoring points along the Bulgarian Danube tributaries

River - point	O_2	BOD5	Ox	$N-NO_3$	$N-NO_2$	$N-NH_4$	PO_4	SUM	Sus
Voinishka - village Tarnene	I	I	I	I	II	II	I	I	II
Artchar - village Artchar	I	I	I	I	II	II	I	I	II
Lom - village Gorni Lom	I	I	I	I	II	II	I	I	II
Lom - town Lom	I	I	I	I	III	II	I	I	II
Cibrica - village Dolni Cibar	I	II	I	I	III	II	II	I	III
Ogosta - town Chiprovci	I	I	I	I	II	II	I	I	I
Ogosta - village Kobiliak	I	II	II	II	III	III	III	I	II
Ogosta - town Mizia	I	II	II	I	III	III	II	II	II
Skat - town Mizia	I	II	I	I	III	II	II	I	II
Iskar - town Novi Iskar	I	II	II	I	III	III	III	I	II
Iskar - town Roman	I	II	I	I	III	II	III	II	II
Iskar - village Oriahovica	I	II	I	I	III	II	II	I	II
Beli Vit - village Ribarica	I	I	I	I	II	I	I	I	I
Vit - village Sadovec	I	I	I	I	II	II	I	I	I
Vit - village Iasen	I	II	II	I	II	II	I	I	I
Vit - village Gulianci	II	III	II	I	III	II	II	I	I
Ossam - town Troian	II	III	III	I	II	III	II	I	II
Ossam - town Lovetch	I	II	II	I	III	III	II	I	I
Ossam - village Izgrev	I	II	I	I	III	III	II	I	I
Iantra - village Iabalka	I	I	I	I	II	II	I	I	II
Iantra - town Gabrovo	I	III	III	I	III	III	II	I	III
Iantra - village Samovodene	I	II	I	I	II	II	I	I	III
Iantra - village Karanci	III	III	III	I	III	II	II	I	II
Iantra - village Novgrad	I	II	II	I	III	II	II	I	I
Rosica - village Polikraeshte	I	II	I	I	II	II	II	I	II
Beli Lom - village Pisanec	I	II	II	I	III	II	III	II	III
Cherni Lom - village Cherven	I	II	I	I	III	II	III	I	III
Rusenski Lom – village Basarbovo	I	II	II	I	III	II	III	I	II

Exploring the Vit River water quality changes could be demonstrated a typical example of a constant and smoothly increasing longitudinal alteration of the all water quality parameters from the background monitoring station to the estuary. Of course some water quality parameters remain in the frame of I category like nitrate nitrogen (N-NO_3), dissolved materials (SUM) and suspended matter (Sus) but bigger part of them changes the water category till II category, even though – III category for nitrite nitrogen (N-NO_2) and BOD5 just in from the inflow into Danube. Obviously the negative factors impact on the water quality of the Vit River steadily and are more evenly distributed (Table 2).

On the opposite is the example of the Iantra River. The water quality and respectively categories change several times along the studied river. Two big "peaks" are noticed – the first one is after the town Gabrovo and the second in the region of Karanci village (after the VelikoTarnovo town). The local municipal and industrial wastewaters have affected seriously the river water quality. Between these peaks the river water quality is improving and practically the Iantra river inflows into the Danube River in better condition. One exception is noticed only – the content of nitrite nitrogen (N-NO_2) remains comparatively high – III category. All other explored water quality parameters are I or II category (Table 2).

Very particular is the example of the Ossam River. Practically the water quality parameters and the water categories are higher in the upper part after the town of Troian. The reason for this not usual situation is the local industry and its water pollution added to the municipal wastewater. Examining the water quality parameters and the corresponding categories could be caught sight of the big organic and biogenic pollution. The water quality parameters BOD5, Oxidation, nitrite (N-NO2) and ammonium nitrogen (N-NH_4) determine III category. Only the dissolved materials content and nitrate nitrogen (N-NO_3) is small. From the Troian town, trough the Lovetch town until the estuary parts the organic pollution diminishes – the parameter BOD5 determines II category, the parameter permanganate oxidation reaches concentrations determining I category. The oxygen regime is improving, the parameter dissolved oxygen determines in the middle and the lowest parts of the river I category. The content of biogenic elements however remains unalterable.

Following the Bulgarian tributaries of the Danube River could be noticed a big variety of cases regarding water quality alteration and the water quality categories from the springs to the estuaries. The influence of each river on the Danube water quality should be assessed separately depending on the water discharge of the rivers and water quality in the last section in frown of the inflow. The water usage of the studied river depends on the suitable river water category and the water needs. Evidently any decision has to be taken after necessary assessment of water quality and water quality categories and according the Bulgarian legislation.

References

Tzankov K. (1998): Methodology for categorization of the river flows on the example of the Mesta river, Bulgarian Journal of Meteorology and Hydrology, vol.9, no.2, Sofia, Bulgaria.

Blaskova S. (2002) Hydrochemical load of the Bulgarian Danube tributaries, XXI Conference of the Danube countries, Bucharest, Romania

Raikova B., Kirova J. (2001) The formation rules of groundwater chemical composition in the North-West Bulgaria. Collected works of III colloquium of physics, Gyolitchitza, Bulgaria (in Bulgarian).

Rainova V. (2001) Condition of the Danube talveg in connection with the Bulgarian-Romanian boundary, Conference on Innovation and Environment protection in the Danube basin, Sofia, Bulgaria