# Water Quality in the Danube River Basin - 2011

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International Commission for the Protection of the Danube River
Internationale Kommission zum Schutz der Donau

## TNMN – Yearbook 2011

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# Table of content

# 1. Introduction

## *History of the TNMN*

In June 1994, the Convention on Cooperation for the Protection and Sustainable Use of the Danube River (DRPC) was signed in Sofia, coming into force in October 1998 with the main objectives of achieving sustainable and equitable water management, including the conservation, improvement and the rational use of surface and ground waters in the Danube catchment area. The DRPC also emphasizes that the Contracting Parties shall cooperate in the field of monitoring and assessment. In this respect, the operation of the Trans National Monitoring Network (TNMN) in the Danube River Basin aims to contribute to the implementation of the DRPC. This Yearbook reports on results of the basin-wide monitoring programme and presents TNMN evaluated data for 2011.
The TNMN has been in operation since 1996, although the first steps towards its creation were taken about ten years earlier. In December 1985 the governments of the Danube riparian countries signed the Bucharest Declaration. The Declaration had as one of its objectives to observe the development of the water quality of the Danube, and in order to comply with this objective, a monitoring programme containing 11 cross-sections of the Danube River was established.

## *Revision of the TNMN to meet the objectives of EU WFD*

The original objective of the TNMN was to strengthen the existing network set up by the Bucharest Declaration, to enable a reliable and consistent trend analysis for concentrations and loads of priority pollutants, to support the assessment of water quality for water use and to assist in the identification of major pollution sources. In 2000, having the four-year experience of the TNMN operation, the main objective of the TNMN was reformulated: to provide a structured and well-balanced overall view of the status and long-term development of quality and loads in terms of relevant constituents in the major rivers of the Danube Basin in an international context. Implementation of the EU Water Framework Directive (2000/60/EC, short WFD) after 2000 necessitated the revision of the TNMN in the Danube River Basin District. In line with the WFD Art. 8, the revision process has been completed in 2007.

The major objective of the revised TNMN is to provide an overview of the overall status and long-term changes of surface water and – where necessary – groundwater status in a basin-wide context with a particular attention paid to the transboundary pollution load. In view of the link between the nutrient loads of the Danube and the eutrophication of the Black Sea, it is necessary to monitor the sources and pathways of nutrients in the Danube River Basin District and the effects of measures taken to reduce the nutrient loads into the Black Sea.
To meet the requirements of both EU WFD and the Danube River Protection Convention the revised TNMN for surface waters consists of following elements:

- Surveillance monitoring I: Monitoring of surface water status
- Surveillance monitoring II: Monitoring of specific pressures
- Operational monitoring
- Investigative monitoring

Surveillance monitoring II is a joint monitoring activity of all ICPDR Contracting Parties that produces annual data on concentrations and loads of selected parameters in the Danube and major tributaries.
Surveillance monitoring I and the operational monitoring is based on collection of the data on the status of surface water and groundwater bodies in the DRB District to be published in the DRBM Plan once in six years.
Investigative monitoring is primarily a national task but at the basin-wide level the concept of Joint Danube Surveys was developed to carry out investigative monitoring as needed, e.g. for harmonization of the existing monitoring methodologies, filling the information gaps in the monitoring networks operating in the DRB, testing new methods or checking the impact of "new" chemical substances in different matrices. Joint Danube Surveys are carried out every 6 years.
A new element of the revised TNMN is monitoring of groundwater bodies of basin-wide importance. More information on this issue is provided in the respective chapter in this Yearbook.

Detailed description of the revised TNMN is given in the Summary Report to EU on monitoring programmes in the Danube River Basin District designed under WFD Article 8.

This Yearbook presents the results of the Surveillance monitoring II: Monitoring of specific pressures.

# 2. Description of the TNMN Surveillance Monitoring II: Monitoring of specific pressures

### *Objectives*

Surveillance Monitoring II aims at long-term monitoring of specific pressures of basin-wide importance. Selected quality elements are monitored annually. Such denser monitoring programme is needed to identify the specific pressures in the Danube River Basin District in order to allow a sound and reliable long-term trend assessment of specific quality elements and to achieve a sound estimation of pollutant loads being transferred across states of Contracting Parties and into the Black Sea.
Surveillance Monitoring II is based on the set-up of the original TNMN and is fitted to respond to pressures of basin-wide importance. The monitoring network is based on the national monitoring networks and the operating conditions are harmonized between the national and basin-wide levels to minimise the efforts and maximise the benefits.

## *Selection of monitoring sites*

The selection of monitoring sites is based on the following criteria:

- Monitoring sites that have been monitored in the past and are therefore suitable for long-term trend analysis; these include sites
  - o located just upstream/downstream of an international border,
  - o located upstream of confluences between Danube and main tributaries or main tributaries and larger sub-tributaries (to enable estimation of mass balances),
  - o located downstream of the major point sources,
  - o located to control important water uses.

- Sites required to estimate pollutant loads (e.g. of nutrients or priority pollutants) which are transferred across boundaries of Contracting Parties, and which are transferred into the marine environment.

The sites are located in particular on the Danube and its major primary or secondary tributaries near crossing boundaries of the Contracting Parties. List of monitoring sites is in the Table 1.

**Table 1: List of monitoring sites**

| No. | Country code | DEFF Code | TNMN code | River | Name of site | Locations | x- coord. | y-coord. | River-km | Altitude | Catch-ment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DE | L2130 | DE2 | Danube | Jochenstein | M | 13.703 | 48.520 | 2 204 | 290 | 77 086 |
| 2 | DE | | DE5 | Danube | Dillingen | L | 10.499 | 48.568 | 2 538 | 420 | 11 315 |
| 3 | DE | L2150 | DE3 | /Inn | Kirchdorf | M | 12.126 | 47.782 | 195 | 452 | 9 905 |
| 4 | DE | L2160 | DE4 | /Inn/Salzach | Laufen | L | 12.933 | 47.940 | 47 | 390 | 6 113 |
| 5 | AT | L2220 | AT1 | Danube | Jochenstein | M | 13.703 | 48.521 | 2 204 | 290 | 77 086 |
| 6 | AT | | AT5 | Danube | Enghagen | R | 14.512 | 48.240 | 2 113 | 241 | 84 869 |
| 7 | AT | L2180 | AT3 | Danube | Wien-Nussdorf | R | 16.371 | 48.262 | 1 935 | 159 | 101 700 |
| 8 | AT | | AT6 | Danube | Hainburg | R | 16.993 | 48.164 | 1 879 | 136 | 130 759 |
| 9 | CZ | L2100 | CZ1 | /Morava | Lanzhot | M | 16.989 | 48.687 | 79 | 150 | 9 725 |
| 10 | CZ | L2120 | CZ2 | /Morava/Dyje | Pohansko | M | 16.885 | 48.723 | 17 | 155 | 12 540 |
| 11 | SK | L1840 | SK1 | Danube | Bratislava | LMR | 17.104 | 48.139 | 1 869 | 128 | 131 329 |
| 12 | SK | L1860 | SK2 | Danube | Medveďov | M | 17.652 | 47.794 | 1 806 | 108 | 132 168 |
| 13 | SK | L1960 | SK4 | /Váh | Komárno | MR | 18.142 | 47.761 | 1 | 106 | 19 661 |
| 14 | SK | L1871 | SK5 | Danube | Szob | M | 18.964 | 47.787 | 1 707 | 100 | 183 350 |
| 15 | SK | | SK6 | /Morava | Devín | M | 48.188 | 16.976 | 1 | 145 | 26 575 |
| 16 | SK | | SK7 | /Hron | Kamenica | M | 47.826 | 18.723 | 1.7 | 114 | 5 417 |
| 17 | SK | | SK8 | /Ipoly | Salka | M | 47.886 | 18.763 | 12 | 110 | 5 060 |
| 18 | HU | L1470 | HU1 | Danube | Medvedov | M | 17.652 | 47.792 | 1 806 | 108 | 131 605 |
| 19 | HU | L1475 | HU2 | Danube | Komarom | LMR | 18.121 | 47.751 | 1 768 | 101 | 150 820 |
| 20 | HU | L1490 | HU3 | Danube | Szob | LMR | 18.964 | 47.787 | 1 708 | 100 | 183 350 |
| 21 | HU | L1520 | HU4 | Danube | Dunafoldvar | LMR | 18.934 | 46.811 | 1 560 | 89 | 188 700 |
| 22 | HU | L1540 | HU5 | Danube | Hercegszanto | LMR | 18.814 | 45.909 | 1 435 | 79 | 211 503 |
| 23 | HU | L1604 | HU6 | /Sio | Szekszard-Palank | M | 18.720 | 46.380 | 13 | 85 | 14 693 |
| 24 | HU | L1610 | HU7 | /Drava | Dravaszabolcs | M | 18.200 | 45.784 | 78 | 92 | 35 764 |
| 25 | HU | L1770 | HU8 | /Tisza/Sajo | Sajopuspoki | M | 20.340 | 48.283 | 124 | 148 | 3 224 |
| 26 | HU | L1700 | HU9 | /Tisza | Tiszasziget | LMR | 20.105 | 46.186 | 163 | 74 | 138 498 |
| 27 | HU | | HU10 | /Tisza | Tiszabecs | M | 22.830 | 48.102 | 757 | 114 | 9707 |
| 28 | HU | | HU11 | /Tisza/Szamos | Csenger | M | 22.404 | 47.513 | 45 | 113 | 15283 |
| 29 | HU | | HU12 | /Tisza/Hármas-Körös/Sebes-Körös | Korosszakal | M | 21.392 | 47.011 | 59 | 92 | 2489 |
| 30 | HU | | HU13 | /Tisza/Hármas-Körös/Kettõs-Körös/Fekete-Körös | Sarkad | M | 21.255 | 46.414 | 16 | 85 | 4302 |
| 31 | HU | | HU14 | /Tisza/Hármas-Körös/Kettõs- | Gyulavari | M | 21.201 | 46.374 | 9 | 85 | 4251 |

| No. | Country code | DEFF Code | TNMN code | River | Name of site | Locations | x- coord. | y-coord. | River-km | Altitude | Catch-ment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | HU | | HU15 | Körös/Fehér-Körös /Tisza/Maros | Nagylak | R | 20.421 | 46.094 | 51 | 80 | 30149 |
| 33 | SI | L1390 | SI1 | /Drava | Ormoz | LM | 16.155 | 46.403 | 300 | 192 | 15 356 |
| 34 | SI | L1330 | SI2 | /Sava | Jesenice | R | 15.692 | 45.861 | 729 | 135 | 10 878 |
| 35 | HR | L1315 | HR1 | Danube | Batina | MR | 16.938 | 46.241 | 1 429 | 86 | 210 250 |
| 36 | HR | L1320 | HR2 | Danube | Borovo | R | 18.201 | 45.783 | 1 337 | 89 | 243 147 |
| 37 | HR | L1300 | HR9 | /Drava | Ormoz | LM | 16.155 | 46.403 | 300 | 192 | 15356 |
| 38 | HR | L1240 | HR4 | /Drava | Botovo | MR | 18.829 | 45.875 | 227 | 123 | 31 038 |
| 39 | HR | L1250 | HR5 | /Drava | Donji Miholjac | MR | 16.691 | 46.419 | 78 | 92 | 37 142 |
| 40 | HR | L1220 | HR6 | /Sava | Jesenice | LR | 18.696 | 45.040 | 729 | 135 | 10 834 |
| 41 | HR | L1150 | HR7 | /Sava | Upstream Una Jasenovac | L | 16.369 | 45.484 | 525 | 87 | 30 953 |
| 42 | HR | L1060 | HR8 | /Sava | Zupanja | LMR | 16.953 | 45.251 | 254 | 85 | 62 890 |
| 43 | HR | | HR10 | /Sava | Drenje | L | 15.690 | 45.862 | 728.8 | 135 | 10 878 |
| 44 | RS | L2350 | RS1 | Danube | Bezdan | L | 18.854 | 45.864 | 1 427 | 83 | 210 250 |
| 45 | RS | L2360 | RS2 | Danube | Bogojevo | L | 19.084 | 45.529 | 1 367 | 80 | 251 253 |
| 46 | RS | L2370 | RS3 | Danube | Novi Sad | R | 19.842 | 45.225 | 1 258 | 75 | 254 085 |
| 47 | RS | L2380 | RS4 | Danube | Zemun | R | 20.417 | 44.849 | 1 174 | 71 | 412 762 |
| 48 | RS | L2390 | RS5 | Danube | Pancevo | L | 20.594 | 44.856 | 1 155 | 70 | 525 009 |
| 49 | RS | L2400 | RS6 | Danube | Banatska Palanka | M | 21.345 | 44.826 | 1 077 | 69 | 568 648 |
| 50 | RS | L2410 | RS7 | Danube | Tekija | R | 22.424 | 44.700 | 955 | 0 | 574 307 |
| 51 | RS | L2420 | RS8 | Danube | Radujevac | R | 22.686 | 44.263 | 851 | 32 | 577 085 |
| 52 | RS | L2430 | RS9 | Danube | Backa Palanka | L | 19.386 | 45.234 | 1 287 | 0 | 253 737 |
| 53 | RS | L2440 | RS10 | /Tisza (Tisa) | Martonos | R | 20.087 | 46.114 | 152 | 76 | 140 130 |
| 54 | RS | L2450 | RS11 | /Tisza (Tisa) | Novi Becej | L | 20.140 | 45.586 | 66 | 74 | 145 415 |
| 55 | RS | L2460 | RS12 | /Tisza (Tisa) | Titel | M | 20.320 | 45.205 | 9 | 73 | 157 147 |
| 56 | RS | L2470 | RS13 | /Sava | Jamena | L | 20.320 | 45.205 | 195 | 78 | 64 073 |
| 57 | RS | L2480 | RS14 | /Sava | Sremska Mitrovica | L | 19.608 | 44.966 | 136 | 75 | 87 996 |
| 58 | RS | L2490 | RS15 | /Sava | Sabac | R | 19.704 | 44.770 | 104 | 74 | 89 490 |
| 59 | RS | L2500 | RS16 | /Sava | Ostruznica | R | 20.317 | 44.732 | 17 | 0 | 37 320 |
| 60 | RS | L2510 | RS17 | /Velika Morava | Ljubicevski Most | R | 21.138 | 44.585 | 35 | 75 | 37 320 |
| 61 | BA | | BA5 | /Sava | Gradiska | M | 17.255 | 45.141 | 457 | 86 | 39 150 |
| 62 | BA | | BA6 | /Sava/Una | Kozarska Dubica | M | 16.849 | 45.200 | 16 | 94 | 9 130 |
| 63 | BA | | BA7 | /Sava/Vrbas | Razboj | M | 17.458 | 45.050 | 12 | 100 | 6 023 |
| 64 | BA | | BA8 | /Sava/Bosna | Modrica | M | 18.313 | 44.961 | 24 | 114 | 10 500 |
| 65 | BA | | BA9 | /Sava/Drina | Foca | M | 18.833 | 43.344 | 234 | 442 | 3 884 |
| 66 | BA | | BA10 | /Sava/Drina | Badovinci | M | 19.344 | 44.779 | 16 | 90 | 19 226 |
| 67 | BA | | BA11 | /Sava | Raca | M | 19.335 | 44.891 | 190 | 80 | 64 125 |
| 68 | BA | | BA12 | /Sava/Una | Novi Grad | M | 16.295 | 44.988 | 70 | 137 | 4 573 |
| 69 | BA | | BA13 | /Sava/Bosna | Usora | M | 18.074 | 44.664 | 78 | 148 | 7 313 |
| 70 | BG | L0730 | BG1 | Danube | Novo Selo harbour | LMR | 22.785 | 44.165 | 834 | 35 | 580 100 |
| 71 | BG | | BG9 | Danube | Lom | R | 23.270 | 43.835 | 741 | 24 | 588 860 |
| 72 | BG | | BG10 | Danube | Orjahovo | R | 23.997 | 43.729 | 679 | 22 | 607 260 |
| 73 | BG | L0780 | BG2 | Danube | Bajkal | R | 24.400 | 43.711 | 641 | 20 | 608 820 |
| 74 | BG | | BG11 | Danube | Nikopol | R | 25.927 | 43.701 | 598 | 21 | 648 620 |
| 75 | BG | L0810 | BG3 | Danube | Svishtov | R | 25.345 | 43.623 | 554 | 16 | 650 340 |
| 76 | BG | L0820 | BG4 | Danube | Upstream Russe | R | 25.907 | 43.793 | 503 | 12 | 669 900 |
| 77 | BG | L0850 | BG5 | Danube | Silistra | LMR | 27.268 | 44.125 | 375 | 7 | 698 600 |
| 78 | BG | | BG12 | /Iskar | mouth | M | 24.461 | 43.706 | 4 | 27 | 8 646 |
| 79 | BG | | BG13 | /Vit | Guljantzi | M | 24.728 | 43.644 | 7 | 29 | 3 225 |
| 80 | BG | | BG14 | /Jantra | mouth | M | 25.579 | 43.603 | 4 | 25 | 7 869 |
| 81 | BG | | BG15 | /Russenski Lom | mouth | M | 25.936 | 43.813 | 1 | 17 | 2 974 |
| 82 | RO | L0020 | RO1 | Danube | Bazias | LMR | 21.384 | 44.816 | 1 071 | 70 | 570 896 |
| 83 | RO | | RO18 | Danube | Gruia/Radujevac | LMR | 22.684 | 44.270 | 851 | 32 | 577 085 |
| 84 | RO | L0090 | RO2 | Danube | Pristol/Novo Selo | LMR | 22.676 | 44.214 | 834 | 31 | 580 100 |
| 85 | RO | L0240 | RO3 | Danube | Dunare - upstream Arges (Oltenita) | LMR | 26.619 | 44.056 | 432 | 16 | 676 150 |
| 86 | RO | L0280 | RO4 | Danube | Chiciu/Silistra | LMR | 27.268 | 44.128 | 375 | 13 | 698 600 |
| 87 | RO | L0430 | RO5 | Danube | Reni | LMR | 28.232 | 45.463 | 132 | 4 | 805 700 |
| 88 | RO | L0450 | RO6 | Danube | Vilkova-Chilia arm/Kilia arm | LMR | 29.553 | 45.406 | 18 | 1 | 817 000 |
| 89 | RO | L0480 | RO7 | Danube | Sulina - Sulina arm | LMR | 29.530 | 45.183 | 0 | 1 | 817 000 |
| 90 | RO | L0490 | RO8 | Danube | Sf. Gheorghe-Ghorghe arm | LMR | 29.609 | 44.885 | 0 | 1 | 817 000 |
| 91 | RO | L0250 | RO9 | /Arges | Conf. Danube (Clatesti) | M | 26.599 | 44.145 | 0 | 14 | 12 550 |
| 92 | RO | L0380 | RO10 | /Siret | Conf. Danube (Sendreni) | M | 27.933 | 45.406 | 0 | 4 | 42 890 |
| 93 | RO | L0420 | RO11 | /Prut | Conf. Danube | M | 28.203 | 45.469 | 0 | 5 | 27 480 |

| No. | Country code | DEFF Code | TNMN code | River | Name of site | Locations | x- coord. | y-coord. | River-km | Altitude | Catch-ment |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | (Giurgiulesti) | | | | | | |
| 94 | RO | | RO12 | /Tisza/Somes | Dara (frontiera) | M | 22.720 | 47.815 | 3 | 118 | 15 780 |
| 95 | RO | | RO13 | /Tisza/Hármas-Körös/Sebes-Körös/Crisul Repede | Cheresig | M | 21.692 | 47.030 | 3 | 116 | 2 413 |
| 96 | RO | | RO14 | /Tisza/Hármas-Körös/Kettõs-Körös/Crisul Negru | Zerind | M | 21.517 | 46.627 | 13 | 86.4 | 3 750 |
| 97 | RO | | RO15 | /Tisza/Hármas-Körös/Kettõs-Körös/Crisul Alb | Varsand | M | 21.339 | 46.626 | 0.2 | 88.9 | 4 240 |
| 98 | RO | | RO16 | /Tisza/Mures | Nadlac | M | 20.727 | 46.145 | 21 | 85.6 | 27 818 |
| 99 | RO | | RO17 | /Tisza/Bega | Otelec | M | 20.847 | 45.620 | 7 | 46 | 2 632 |
| 100 | RO | | RO19 | /Jiu | Zaval | M | 23.845 | 43.842 | 9 | 30.9 | 10 046 |
| 101 | RO | | RO20 | /Olt | Islaz | M | 24.797 | 43.744 | 3 | 32 | 24 050 |
| 102 | RO | | RO21 | /Ialomita | Downstream Tandarei | M | 27.665 | 44.635 | 24 | 8.5 | 10 309 |
| 103 | MD | L2230 | MD1 | /Prut | Lipcani | L | 26.483 | 48.152 | 658 | 100 | 8 750 |
| 104 | MD | L2270 | MD3 | /Prut | Conf. Danube-Giurgiulesti | LMR | 28.124 | 45.285 | 0 | 5 | 27 480 |
| 105 | MD | | MD5 | /Prut | Costesti Reservoir | L | 27.145 | 47.513 | 557 | 91 | 11 800 |
| 106 | MD | | MD6 | /Prut | Braniste | L | 27.145 | 47.475 | 546 | 63 | 12 000 |
| 107 | MD | | MD7 | /Prut | Valea Mare | L | 27.515 | 47.075 | 387 | 55 | 15 200 |
| 108 | UA | L0630 | UA1 | Danube | Reni | M | 28.241 | 45.463 | 132 | 4 | 805 700 |
| 109 | UA | L0690 | UA2 | Danube | Vylkove | M | 29.246 | 45.436 | 18 | 1 | 817 000 |
| 110 | UA | | UA4 | /Tisza | Chop | M | 22.184 | 48.416 | 342 | 92 | 33000 |
| 111 | UA | | UA5 | /Tisza/Bodrog/Latoritsa | Strazh | M | 22.212 | 48.454 | 144 | 97 | 4418 |
| 112 | UA | | UA6 | /Prut | Tarasivtsi | M | 26.336 | 48.183 | 262 | 122 | 9836 |
| 113 | UA | | UA7 | /Siret | Porubne | M | 26.030 | 47.981 | 100 | 303 | 2070 |
| 114 | UA | | UA8 | /Uzh | Storozhnica | R | 22.200 | 48.617 | 106 | 112 | 1582 |
| 115 | ME | | ME1 | /Lim | Dobrakovo | L | 19º46'22" | 43º07'17" | 112 | 609 | 2875 |
| 116 | ME | | ME2 | /Cehotina | Gradac | L | 19º09'14" | 43º23'45" | 55.5 | 55 | 809.8 |

Distance: The distance in km from the mouth of the mentioned river
Altitude: The mean surface water level in meters above sea level
Catchment: The area in square km, from which water drains through the station
ds. Downstream of
us. Upstream of
Conf. Confluence tributary/main river
/ Indicates tributary to river in front of the slash. No name in front of the slash means Danube

Sampling location in profile:
L: Left bank
M: Middle of river
R: Right bank

## Figure 2-1: The Danube Stationmap TNMN

## *Quality elements*

### Parameters indicative of selected biological quality elements

To cover pressures of basin-wide importance as organic pollution, nutrient pollution and general degradation of the river, following biological quality elements have been agreed for SM2:

- Phytoplankton (chlorophyll-a)
- Benthic invertebrates (mandatory parameters: Saprobic index and number of families once yearly, both Pantle&Buck and Zelinka&Marvan SI are acceptable; optional parameters: ASPT and EPT taxa)
- Phytobenthos (benthic diatoms – an optional parameter)

### Priority substances and parameters indicative of general physico-chemical quality elements

The list of parameters for assessment of trends and loads and their monitoring frequencies are given in Table 2

**Table 2: Determinand list for water for TNMN**

| | **Surveillance Monitoring 2** | |
|---|---|---|
| | **Water** | **Water** |
| | **concentrations** | **load assessment** |
| **Parameter** | | |
| Flow | annually / 12 x per year | daily |
| Temperature | annually / 12 x per year | |
| Transparency (1) | annually / 12 x per year | |
| Suspended Solids (5) | annually / 12 x per year | annually / 26 x per year |
| Dissolved Oxygen | annually / 12 x per year | |
| pH (5) | annually / 12 x per year | |
| Conductivity @ 20 °C (5) | annually / 12 x per year | |
| Alkalinity (5) | annually / 12 x per year | |
| Ammonium ($NH_4^+$ -N) (5) | annually / 12 x per year | annually / 26 x per year |
| Nitrite ($NO_2^-$ -N) | annually / 12 x per year | annually / 26 x per year |
| Nitrate ($NO_3^-$ -N) | annually / 12 x per year | annually / 26 x per year |
| Organic Nitrogen | annually / 12 x per year | annually / 26 x per year |
| Total Nitrogen | annually / 12 x per year | annually / 26 x per year |
| Ortho-Phosphate ($PO_4^{3-}$ -P) (2) | annually / 12 x per year | annually / 26 x per year |
| Total Phosphorus | annually / 12 x per year | annually / 26 x per year |
| Calcium ($Ca^{2+}$) (3, 4, 5) | annually / 12 x per year | |
| Magnesium ($Mg^{2+}$) (4, 5) | annually / 12 x per year | |
| Chloride ($Cl^-$) | annually / 12 x per year | |
| Atrazine | annually / 12 x per year | |
| Cadmium (6) | annually / 12 x per year | |

| | Surveillance Monitoring 2 | |
|---|---|---|
| | Water | Water |
| | concentrations | load assessment |
| **Parameter** | | |
| Lindane (7) | see below | |
| Lead (6) | annually / 12 x per year | |
| Mercury (6) | annually / 12 x per year | |
| Nickel (6) | annually / 12 x per year | |
| Arsenic (6) | annually / 12 x per year | |
| Copper (6) | annually / 12 x per year | |
| Chromium (6) | annually / 12 x per year | |
| Zinc (6) | annually / 12 x per year | |
| p,p´-DDT and its derivatives (7) | see below | |
| $COD_{Cr}$ (5) | annually / 12 x per year | |
| $COD_{Mn}$ (5) | annually / 12 x per year | |
| Dissolved Silica | | annually / 26 x per year |
| $BOD_5$ | annually / 12 x per year | |

(1) Only in coastal waters
(2) Soluble reactive phosphorus SRP
(3) Mentioned in the tables of the CIS Guidance document but not in the related mind map
(4) Supporting parameter for hardness-dependent eqs of PS metals
(5) Not for coastal waters
(6) Measured in a dissolved form. Measurement of total concentration is optional
(7) In areas with no risk of failure to meet the environmental objectives for DDT and Lindane the monitoring frequency is 12 x per a RBMP period; in case of risk the frequency is 12 x year

## *Analytical Quality Control (AQC)*

The 2011 analytical quality control scheme involved quarterly distribution of surface water samples to be analysed for general parameters, nutrients, metals and organic pollutants. After a considerable decline in participation in 2010, number of laboratories further dwindled in 2011 in all component groups: 48 laboratories from 8 Danube countries participated in the scheme. This trend results in the increasing uncertainty of assigned values and decreases the reliability of evaluation.

Following the Youden-pair experimental design and evaluation technique, samples were prepared in duplicates, i.e. two samples of identical matrix and similar concentration were sent out for each determinand. In accordance with previous expericence, general components were measured with negligible problem. The same holds true for nutrients and metals as well, traditionally among the successful determinations. Total nitrogen is increasingly the component of choice instead of Kjeldahl nitrogen. In case of organic indicator components, the improved agreement of results experienced in 2010 remained also in 2011. Similarly to previous years, the most problematic component group was organic micropollutants. Lowered concentrations of PCBs were a major challenge. Further decrease of organic micropollutant concentration ranges - rightfully asked by some participants - is not feasible within the current organisational setup.

Financial constraint leads to an increasing share of synthetic samples in the programme.

## *TNMN Data Management*

The procedure of TNMN data collection is organized at a national level. The National Data Managers (NDMs) are responsible for data acquisition from TNMN laboratories as well as for data checking, conversion into an agreed data exchange file format (DEFF) and sending it to the TNMN data management centre in the Slovak Hydrometeorological Institute in Bratislava. This centre performs a secondary check of the data and uploads them into the central TNMN database. In cooperation with the ICPDR Secretariat, the TNMN data are uploaded into the ICPDR website (www.icpdr.org).

# 3. Results of basic statistical processing

150 sites at 112 TNMN monitoring stations were monitored in the Danube River Basin in 2011 (some monitoring stations contain two or three sampling sites - left, middle and/or right side of the river). The data was collected from 73 sampling sites at 40 stations on the Danube river and from 77 sampling sites at 72 stations at the tributaries.

The basic processing of the TNMN data includes the calculation of selected statistical characteristics for each determinand/monitoring site. Results are presented in tables in the Annex I using the following format:

| Term used | Explanation |
|---|---|
| **Determinand name** | name of the determinand measured according to the agreed method |
| **Unit** | unit of the determinand measured |
| **N** | number of measurements |
| **Min** | minimum value of the measurements done in the year 2011 |
| **Mean** | arithmetical mean of the measurements done in the year 2011 |
| **Max** | maximum value of the measurements done in the year 2011 |
| **C50** | 50 percentile of the measurements done in the year 2011 |
| **C90** | 90 percentile of the measurements done in the year 2011 |

When processing the TNMN data and presenting them in the tables of the Annex, the following rules have been applied:

- *If "less than the quantification limit" values were present in the dataset for a given determinand, then the ½ value of the limit of quantification was used in statistical processing of the data.*
- *If the number of measurements for a particular determinand was lower than four, then only the minimum, maximum and mean are reported in the tables of the Annex.*
- *The statistic value "C90" is equal to 90 percentile (10 percentile for dissolved oxygen and lower limit of pH value) if the number of measurements in a year was at least eleven. If the number of measurements in a year was lower than eleven, then the "C90" value is represented by a maximum value from a data set (a minimum value for dissolved oxygen and lower limit of pH value).*

Problem is the reduced monitoring frequency for certain determinands such as dissolved phosphorus, biological determinands, heavy metals and specific organic micropollutants, primarily in the lower part of the Danube River Basin.

Table 3, created on the basis of data in tables in the Annex I, shows in an aggregated way the concentration ranges and mean annual concentrations of selected determinands in the Danube River and its tributaries in 2011. These include indicators of the oxygen regime, nutrients, heavy metals, biological determinands and organic micropollutants.

Table 3 also includes information about the number of monitoring locations and sampling sites providing measurements of the determinands.

The table provides the minimal and maximal values for all determinands calculated for all data from Danube and tributary stations and minimal and maximal values for all determinands calculated from mean (average) values from all Danube or tributary stations.

* For some heavy metals in Table 3, the statistical values for dissolved form are in certain cases higher than those for the total content. The reason is that not all countries report on the dissolved metals which lead to differences in the processed statistical values.

## Table 3: Concentration ranges and mean annual concentrations of selected determinands in the Danube River and its tributaries in 2011

| Determinand name | Unit | Danube | | | | | Tributaries | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No.of monitoring locations / No. of monitoring sites with measurements | Range of values | | Mean | | No.of monitoring locations / No. of monitoring sites with measurements | Range of values | | Mean | |
| | | | Min | Max | Min$_{avg}$ | Max$_{avg}$ | | Min | Max | Min$_{avg}$ | Max$_{avg}$ |
| Temperature | °C | 70/40 | 0.6 | 28.1 | 11.2 | 27.0 | 72/70 | 0.0 | 29.2 | 8.427 | 20.4 |
| Suspended Solids | mg/l | 66/38 | < 0.25 | 281 | 4 | 95 | 72/70 | < 0.15 | 1067 | < 0.15 | 283 |
| Dissolved Oxygen | mg/l | 70/40 | 5.1 | 18.1 | 7.5 | 11.2 | 72/70 | < 0.25 | 93 | 7.74 | 16.83 |
| BOD$_5$ | mg/l | 71/41 | < 0.25 | 8.2 | 0.8 | 4.9 | 73/71 | < 0.1 | 12 | 0.89 | 8.63 |
| COD$_{Mn}$ | mg/l | 59/33 | 1.3 | 10.0 | 2.3 | 5.8 | 43/41 | < 0.5 | 29 | 1.82 | 8.41 |
| COD$_{Cr}$ | mg/l | 60/30 | 2.0 | 50.0 | 5.6 | 24.9 | 60/58 | < 0.5 | 294.18 | 3.46 | 68.65 |
| TOC | mg/l | 53/33 | < 0.5 | 11.0 | 1.7 | 6.1 | 36/34 | < 0.5 | 65.3 | 1.34 | 18.23 |
| DOC | mg/l | 6/6 | 1.1 | 7.6 | 2.1 | 2.7 | 2/2 | 0.5 | 3.3 | 1.406 | 1.408 |
| pH | | 64/38 | 6.6 | 9.0 | 7.5 | 8.4 | 72/70 | 4.94 | 9.17 | 7.13 | 8.5 |
| Alkalinity | mmol/l | 69/39 | 1.4 | 5.4 | 1.7 | 4.8 | 58/56 | 0.59 | 290 | 1.24 | 208.25 |
| Ammonium-N | mg/l | 70/40 | < 0.001 | 0.76 | 0.02 | 0.19 | 73/71 | < 0.001 | 6.1 | 0.028 | 2.563 |
| Nitrite-N | mg/l | 69/39 | < 0.0010 | 2.152 | 0.011 | 0.049 | 73/71 | 0.001 | 0.491 | 0.0041 | 0.1317 |
| Nitrate-N | mg/l | 71/41 | < 0.003 | 4.40 | 0.60 | 3.02 | 73/71 | < 0.035 | 9.5 | 0.298 | 4.948 |
| Total Nitrogen | mg/l | 64/34 | 0.7 | 5.9 | 1.4 | 3.9 | 60/58 | 0.3 | 14.074 | 0.625 | 8.02 |
| Organic Nitrogen | mg/l | 33/23 | < 0.025 | 3.30 | < 0.1 | 1.57 | 29/27 | 0.038 | 4.318 | 0.108 | 1.376 |
| Ortho-Phosphate-P | mg/l | 64/38 | < 0.001 | 0.670 | 0.025 | 0.137 | 69/67 | < 0.001 | 1.75 | 0.0078 | 1.185 |
| Total Phosphorus | mg/l | 69/39 | < 0.0035 | 0.960 | 0.054 | 0.262 | 59/57 | < 0.0035 | 2.44 | 0.0278 | 0.5195 |
| Total Phosphorus - Dissolved | mg/l | 69/39 | 0.01 | 0.190 | 0.045 | 0.124 | 20/20 | < 0.0025 | 0.44 | 0.0149 | 0.1527 |
| Chlorophyll-a | µg/l | 63/35 | 0.30 | 132.00 | 2.70 | 27.69 | 48/46 | 0.09 | 315.24 | 1.45 | 114.63 |
| Conductivity 20°C | µS/cm | 64/36 | 8 | 2011 | 353 | 585 | 67/65 | 104 | 1660 | 209 | 1308 |
| Calcium | mg/l | 70/40 | 12.6 | 98.0 | 46.2 | 86.7 | 67/65 | 10.4 | 183 | 31.63 | 109.99 |
| Sulphates | mg/l | 66/40 | 8.0 | 207.4 | 18.8 | 62.5 | 55/53 | < 5.0 | 189 | 12.18 | 140.5 |
| Magnesium | mg/l | 67/39 | 5.0 | 53.7 | 11.2 | 21.8 | 68/66 | 2.43 | 79 | 4.9 | 65.91 |
| Potassium | mg/l | 61/37 | 1.0 | 16.8 | < 2.00 | 4.5 | 42/40 | < 0.05 | 97 | 0.64 | 17.73 |
| Sodium | mg/l | 61/37 | 1.90 | 32.20 | 10.87 | 25.54 | 42/40 | 2.5 | 86 | 3.95 | 50.82 |
| Manganese | mg/l | 38/20 | < 0.0005 | 0.10 | 0.0028 | 0.14 | 23/23 | < 0.0025 | 24.9 | 0.018 | 6.24 |
| Iron | mg/l | 35/19 | < 0.005 | 1.6 | 0.01 | 1.616 | 26/26 | < 0.005 | 14.5 | 0.049 | 2.89 |
| Chlorides | mg/l | 71/41 | 11.0 | 477.0 | 18.1 | 44.7 | 73/71 | 0.5 | 383 | 3.32 | 218.32 |
| Silicates (SiO2) | mg/l | 8/6 | 0.7 | 7.8 | 2.4 | 11.7 | 9/7 | 3.3 | 23.9 | 5.1 | 18.9 |
| Silicates(SiO2), dissolved | mg/l | 38/20 | < 0.04 | 13.8 | 2.3 | 10.9 | 24/24 | <0.25 | 31.38 | 2.34 | 15.38 |
| Macrozoobenthos- saprobic index | | 5/5 | 2.06 | 2.13 | 2.06 | 2.52 | 7/7 | 1.84 | 2.45 | 1.84 | 2.45 |
| Macrozoobenthos - no.of taxa | | 0/0 | | | | 49 | 7/7 | 34 | 56240 | 34 | 26747 |
| Macrozoobenthos-number of families | | 1/1 | 13 | 13 | 13 | 16 | 4/4 | 8 | 30 | 8 | 30 |

**Table 3: Concentration ranges and mean annual concentrations of selected determinands in the Danube River and its tributaries in 2011 (cont.)**

[redacted]

# 4. Profiles and trend assessment of selected determinands

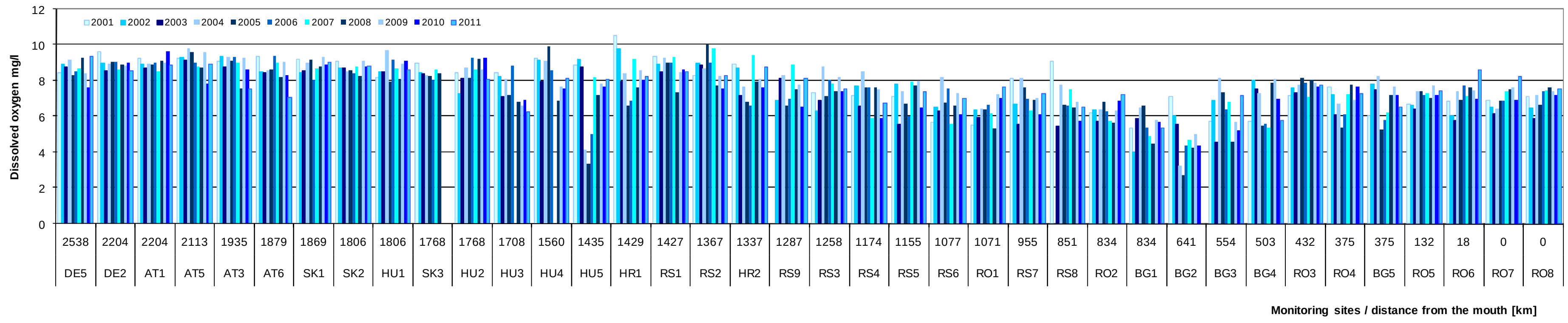
The 90 percentiles (C90) of selected determinands (dissolved oxygen, $BOD_{5,}$ $COD_{Cr}$, N-$NH_{4,}$ N-$NO_3$, P-$PO_4$, $P_{total}$ and Cd) measured in last ten years are displayed in the Figures 4.1-4.16. Due to revision of the TNMN in 2006 following monitoring points on the Danube were replaced : AT2 rkm 2120 to AT5 rkm 2113, AT4 rkm 1874 to AT6 rkm 1879, DE1 rkm 2581 to DE5 rkm 2538. Among tributaries the site HR3 rkm 288 was replaced by HR9 rkm 300 BG8 rkm 54 to BG14 rkm 4 and BG8 rkm 13 to BG15 rkm 1. In 2008 HR6 rkm 729 was replaced by HR10 rkm 728.8. In 2009 SK3 was replaced with SK5; this monitoring site is in graphs also referred to as the Hungarian point HU3. For trend graphs SK3 and HU3 were used, because for SK5 only two years of monitoring are available.
To indicate the long-term trends in the upper, middle and lower Danube a more detailed analysis for the selected parameters ($BOD_{5,}$ N-$NO_3$, $P_{total}$) is provided for the sites SK1 Bratislava, HU5 Hercegszanto and RO5 Reni (Figures 4.17-4.33).

The highest values of dissolved oxygen were observed in the upper part of the Danube, in the lower Danube dissolved oxygen levels decrease (Figure 4.1). The lowest value was observed at the monitoring point BG2. Low values of dissolved oxygen were measured in 2011 in tributaries Arges, Prut, Sio and Tisza.

Decreasing tendencies of biodegradable organic matter were observed in the upper Danube and also at some stations of the lower Danube (see Figure 4.3). The BOD levels were increased in 2011 at SK1, HU5 and RO5 (Figure 4.17-4.19).
A decreasing tendency of levels the BOD in the tributaries Dyje, Arges and Siret have been observed (Figure 4.4).
The decreasing concentration of ammonium-N was recorded in the whole Danube River. During the last ten years of TNMN operation, concentration of ammonium was decreasing in the Inn, Salzach, Morava, Dyje, Sajo, Siret, Sava, Tisza and Prut rivers. In 2011 concentration of ammonium-N in increased the tributary Arges (Figure 4.8).
The level of nitrate-N concentrations is rather stable during recent years. A decrease was observed at several stations in the Danube (for example RS1, RS6, RO1, see Figure 4.9). The nitrate-N has a decreasing tendency in the tributaries Sio, Sava, Arges, Prut and Siret (Figure 4.10).
The nitrate level in the monitoring points SK1 and RO5 was decreased in 2011, but it increased in HU5 (see in Figure 4.20-4.22).
In the last decade a decreasing tendency of ortho-phosphate-P concentrations is mostly seen in the upper part of the Danube, last year concentration decreased also in some sites in the lower part (BG2, RO6, RO7, Figure 4.11). Decreasing tendency of ortho-phosphate-P was observed in the tributaries Vah, Sajo and Sava (Figure 4.12). In 2011 ortho-phosphate-P concentration increased in the tributary Arges.
P-total concentration decreased in the tributaries Vah, Sio and Sava (see Figure 4.14).

In SK1 Bratislava P-total concentration has a decreasing tendency over the last decade, while HU5 Hercegszanto and RO5 Reni keep a rather stable pattern (Figure 4.23-4.25).
The trends of COD in Danube river was rather stable during last ten years, the highest concentrations was in lower part of Danube river. The highest COD concentrations in 2011 were observed in tributaries Prut, Siret and Russenski Lom.
The 90 and 10 percentiles of selected determinands (N-$NH_4$, P-$PO_4$, $COD_{Cr}$, $BOD_5$) measured in 2011 are displayed in the Figures 4.26-4.33. Pictures indicate the margins of a usual annual concentration range for a given parameter and site. In graphs for tributaries there are rkm of Danube, where tributary discharge to the Danube river.
Lower concentrations of N-$NH_4$ were observed in the upper part of Danube (Figure 4.26), the highest concentration was in RO5. In tributaries the highest values were observed in Ialomita (Figure 4.27).
The highest values of percentiles of P-$PO_4$ were observed in the Serbian part of the Danube (Figure 4.28). The highest value among tributaries was observed in Russenski Lom (Figure 4.29).
The maximal values of $COD_{Cr}$ percentiles were found in the lower Danube and in tributaries Ialomita, Russenski Lom, Siret, Olt and Szamos (Figure 4.30 and Figure 4.31).
The highest values of $BOD_5$ were in the middle and lower part of the Danube in Hungary and Bulgaria and points (Figure 4.32). In tributaries the highest values were observed in Ialomita, Russenski Lom, Vit, Iskar and Szamos (Figure 4.33).
The annual differences between C90 and C10 has an insignificant variation for P-$PO_4$ and $COD_{cr}$ in the whole Danube and in the upper and middle section tributaries. The visible differences were observed $BOD_5$ along the whole Danube. Differences were observed also for $BOD_5$ in the tributaries.

## Figure 4.1.: Temporal changes of dissolved oxygen (c10) in the Danube river.




## Figure 4.2.: Temporal changes of dissolved oxygen (c10) in tributaries.

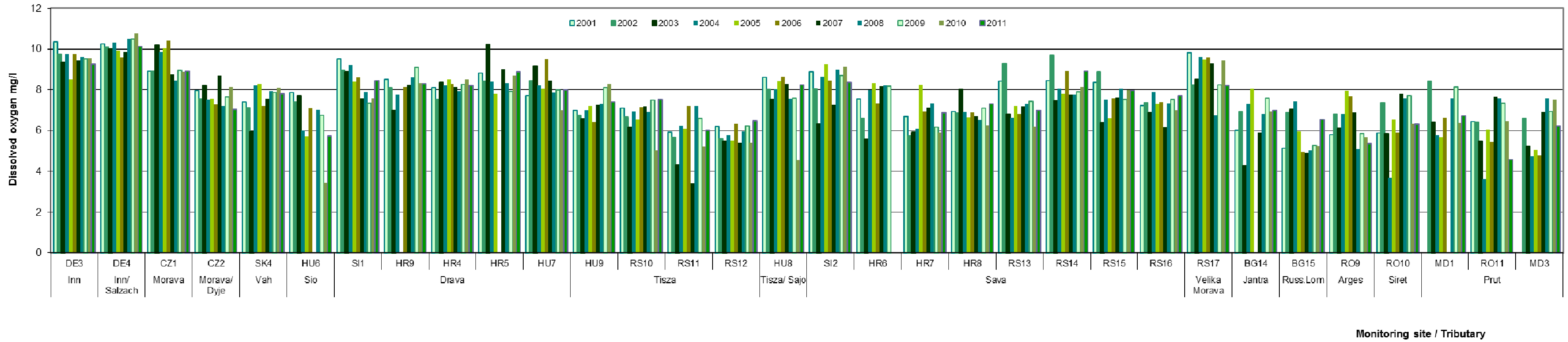


**Figure 4.3.: Temporal changes of $BOD_5$ (c90) in the Danube river.**

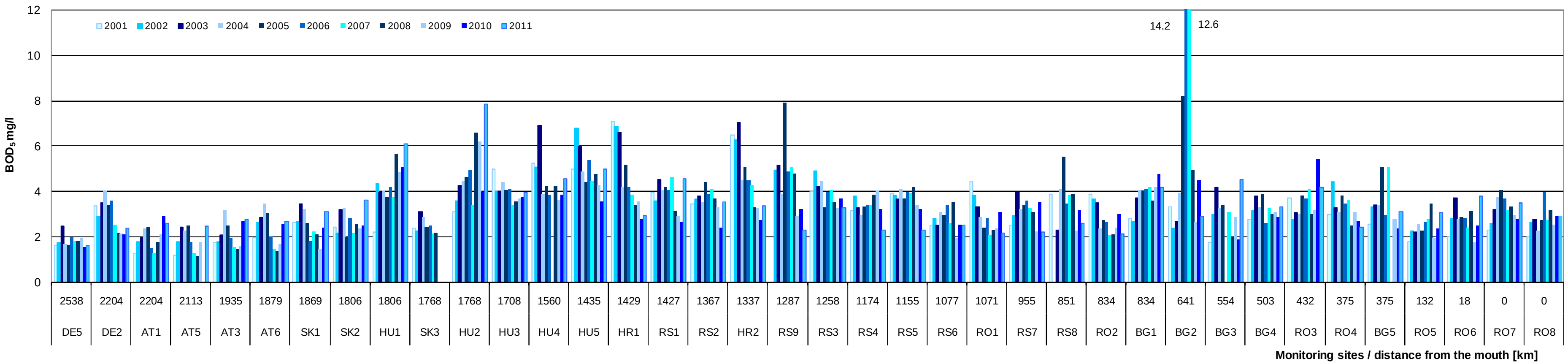



**Figure 4.4.: Temporal changes of $BOD_5$ (c90) in tributaries.**

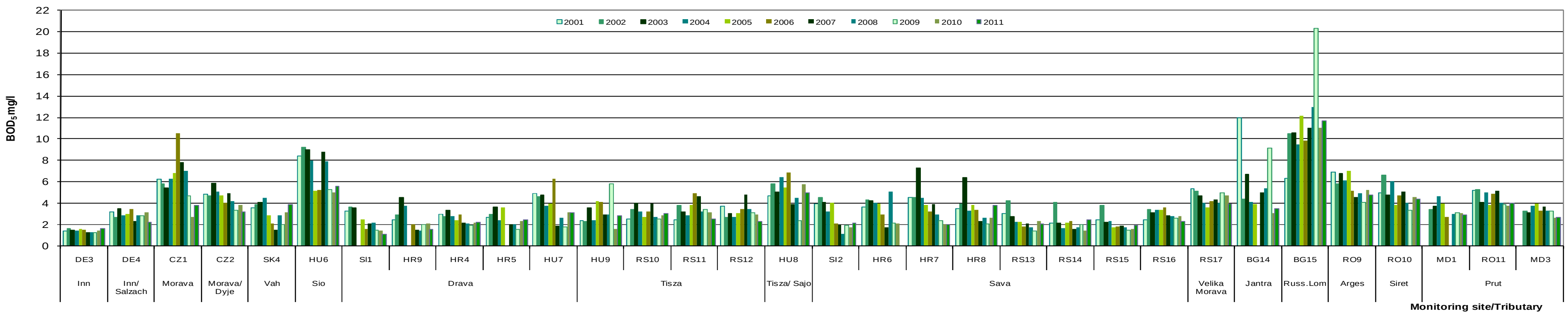


**Figure 4.5.: Temporal changes of $COD_{Cr}$ (c90) in the Danube river.**

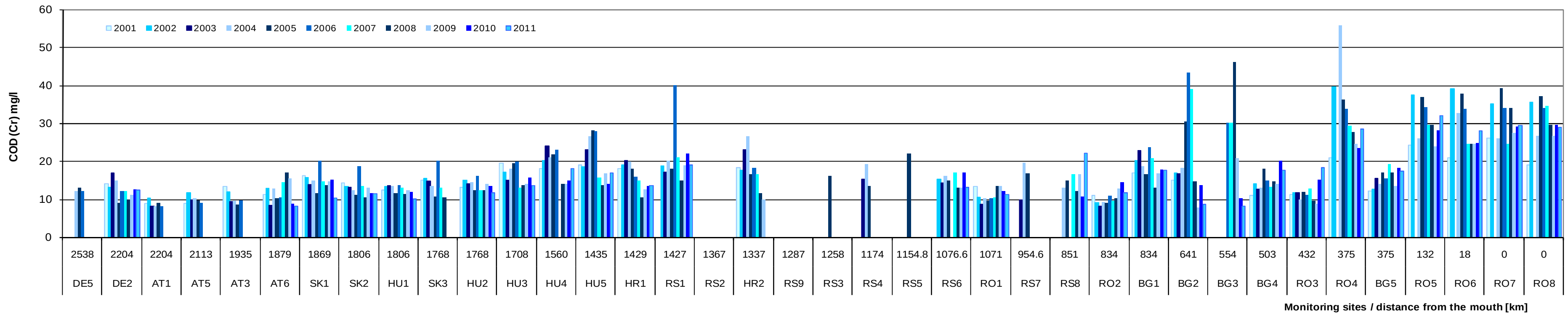
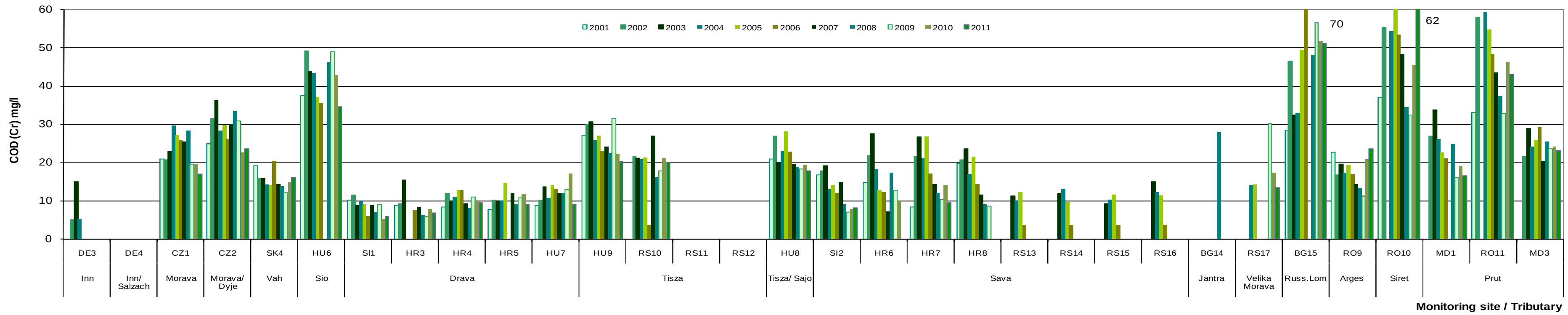
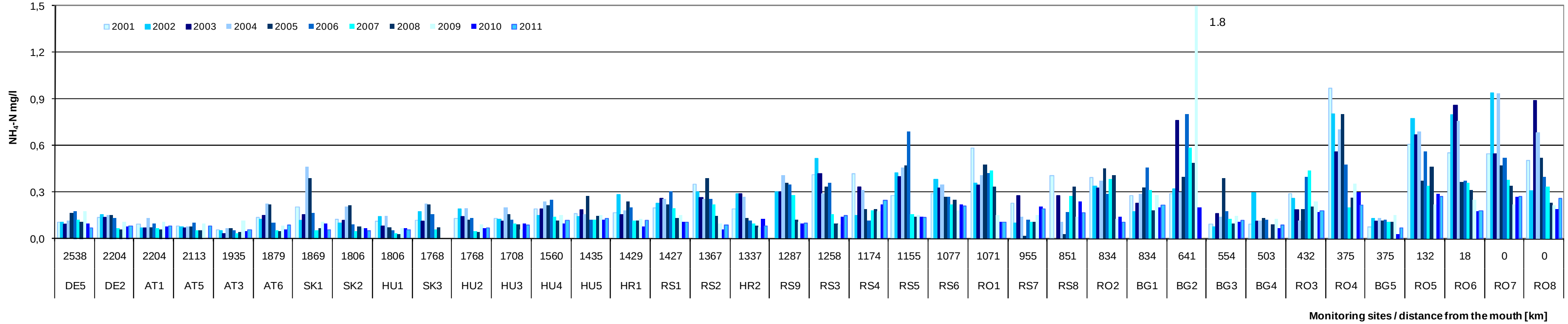



**Figure 4.6.: Temporal changes of $COD_{Cr}$ (c90) in tributaries.**



## Figure 4.7.: Temporal changes of ammonium-nitrogen (c90) in the Danube river.




## Figure 4.8.: Temporal changes of ammonium-nitrogen (c90) in tributaries.

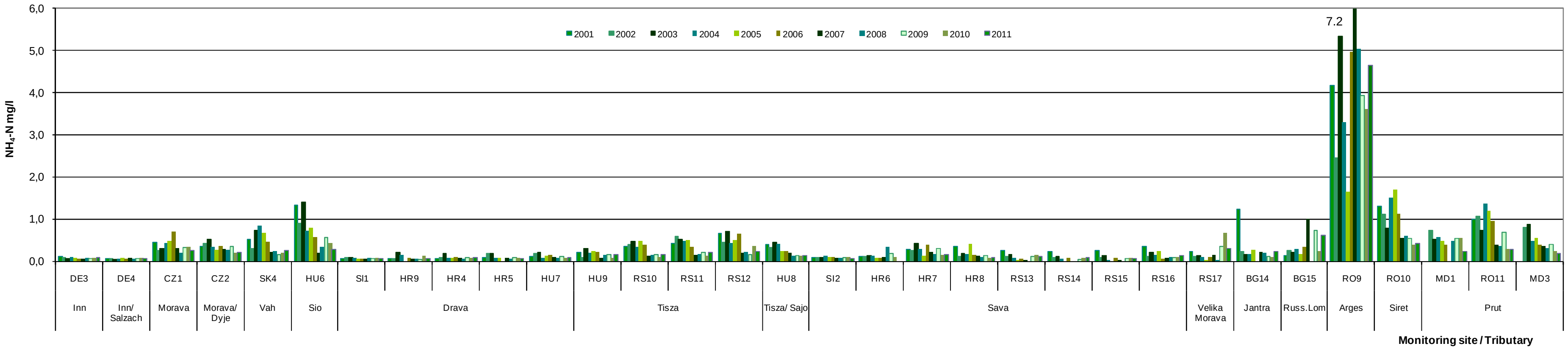


**Figure 4.9.: Temporal changes of nitrate-nitrogen (c90) in the Danube river.**

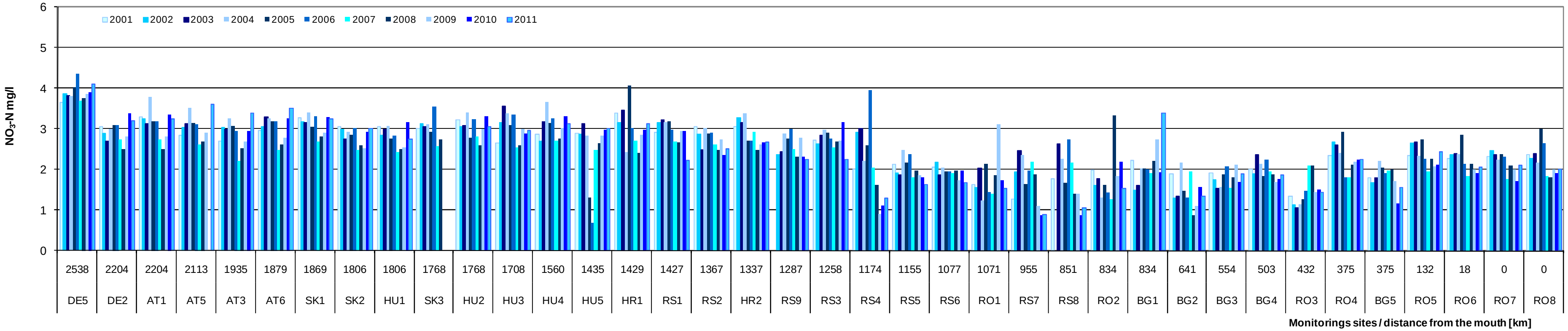



**Figure 4.10.: Temporal changes of nitrate-nitrogen (c90) in tributaries.**

**Figure 4.11: Temporal changes of ortho-phosphate-phosphorus (c90) in the Danube river.**

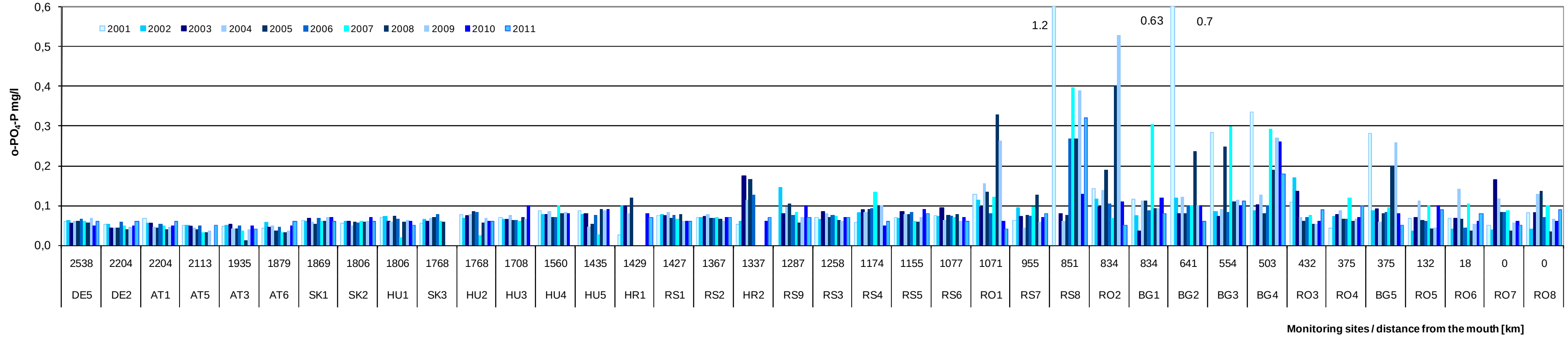



**Figure 4.12: Temporal changes of ortho-phosphate-phosphorus (c90) in tributaries**

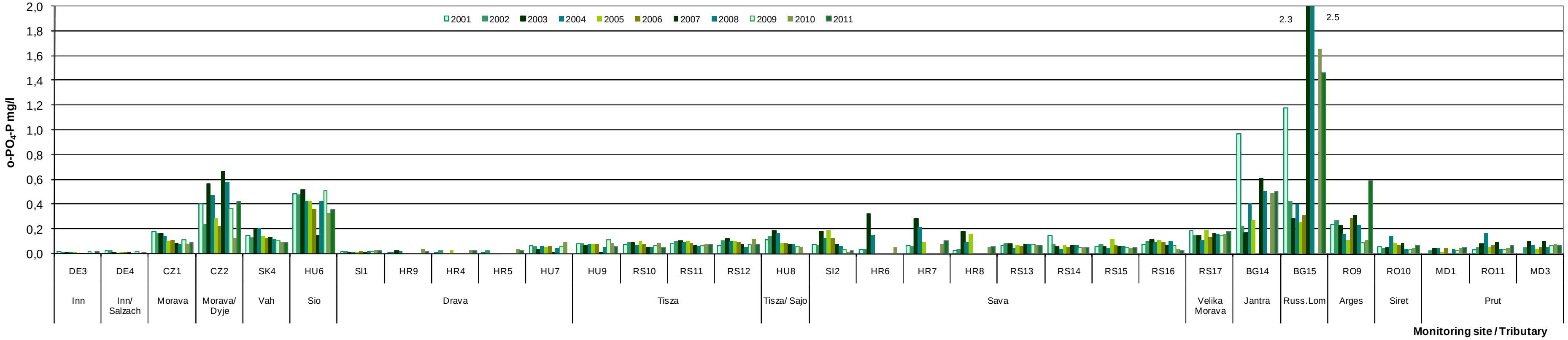


**Figure 4.13: Temporal changes of total phosphorus (c90) in the Danube river.**

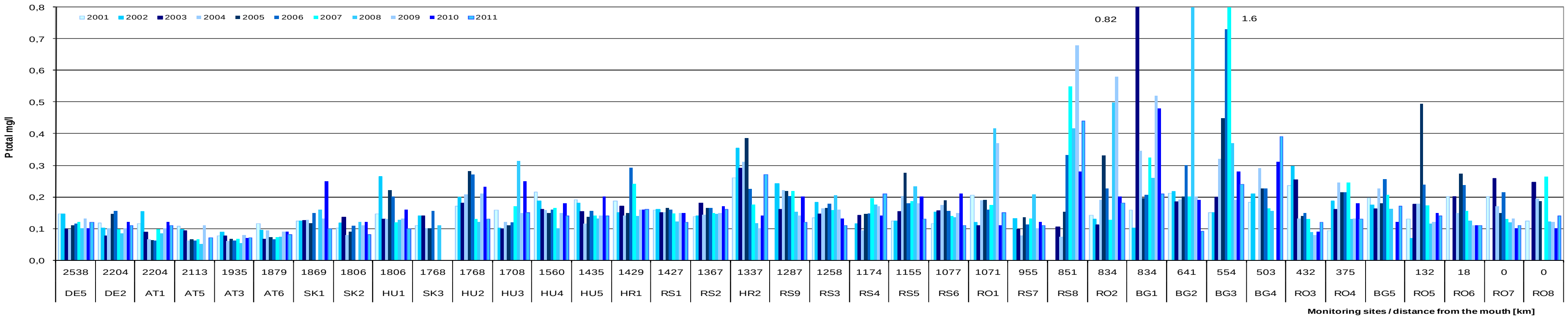



**Figure 4.14: Temporal changes of total phosphorus (c90) in tributaries.**

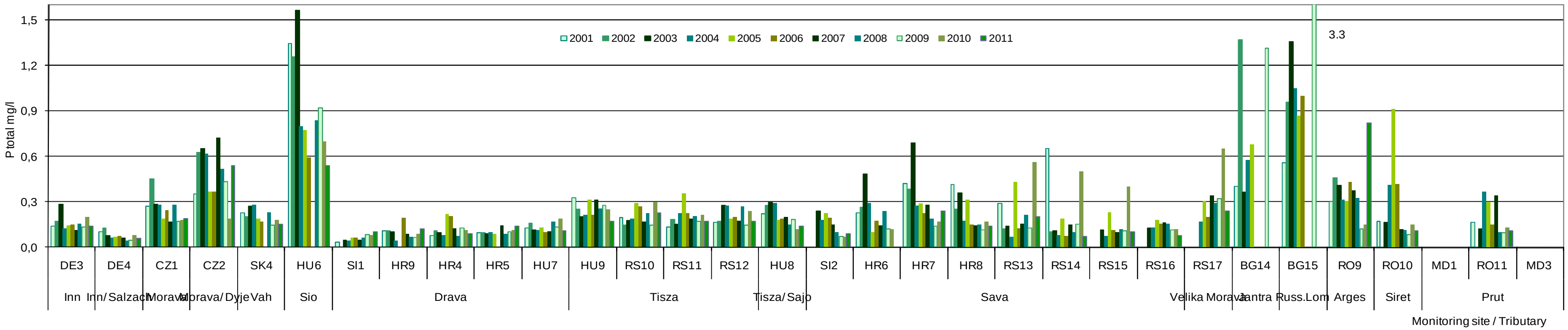


**Figure 4.15: Temporal changes of cadmium (c90) in the Danube river.**

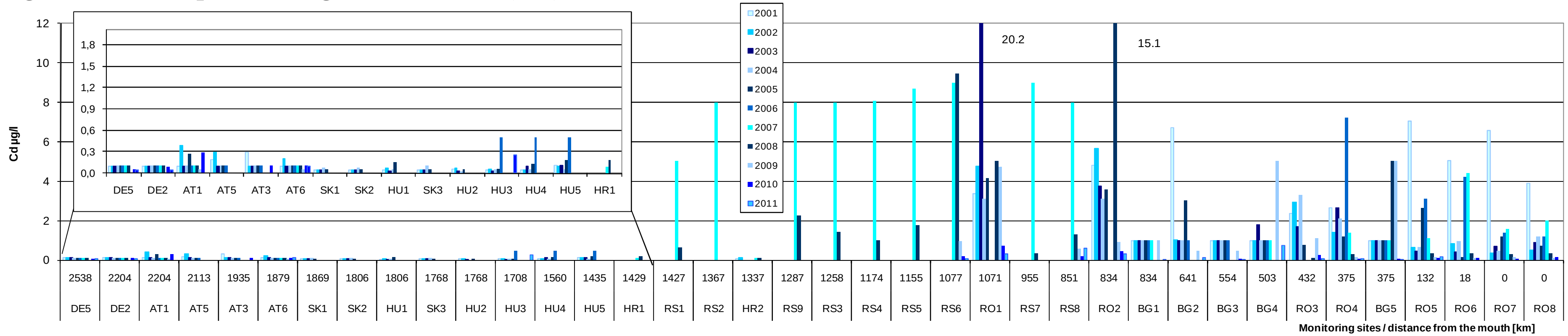



**Figure 4.16: Temporal changes of cadmium (c90) in tributaries.**

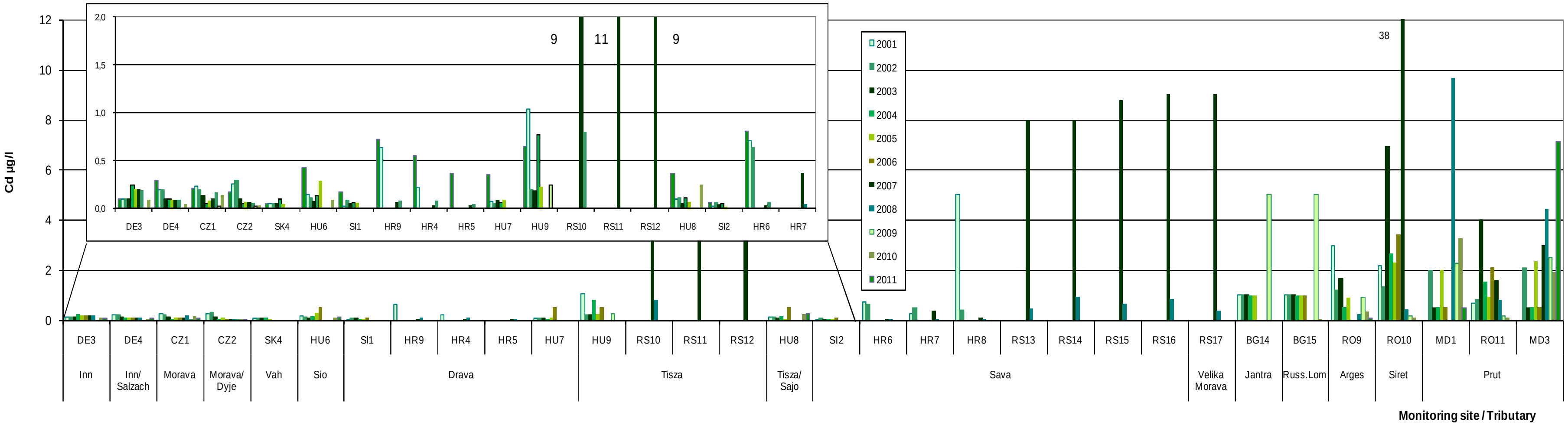


**Figure 4.17: Temporal changes of $BOD_5$ (c90) in Bratislava**

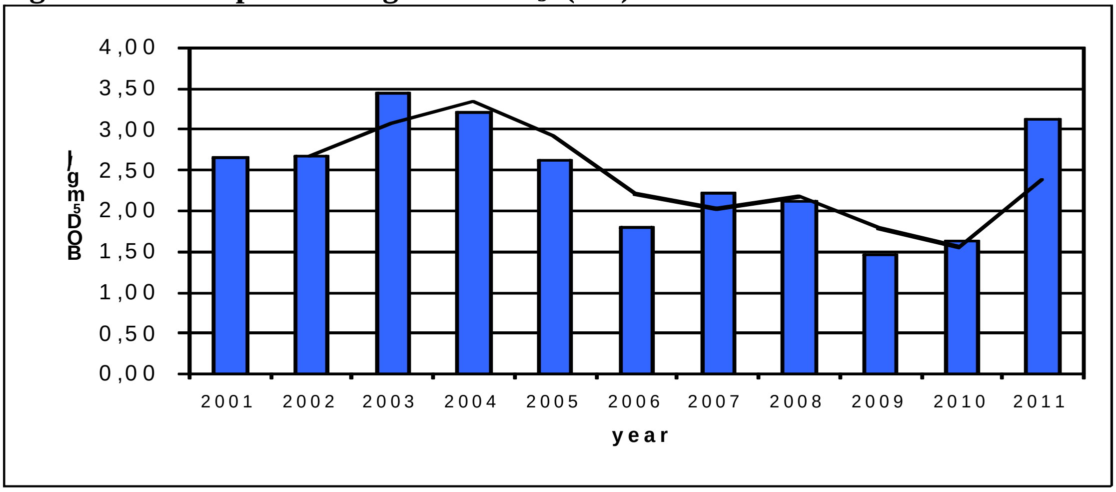



**Figure 4.18: Temporal changes of $BOD_5$ (c90) in Hercegszanto**

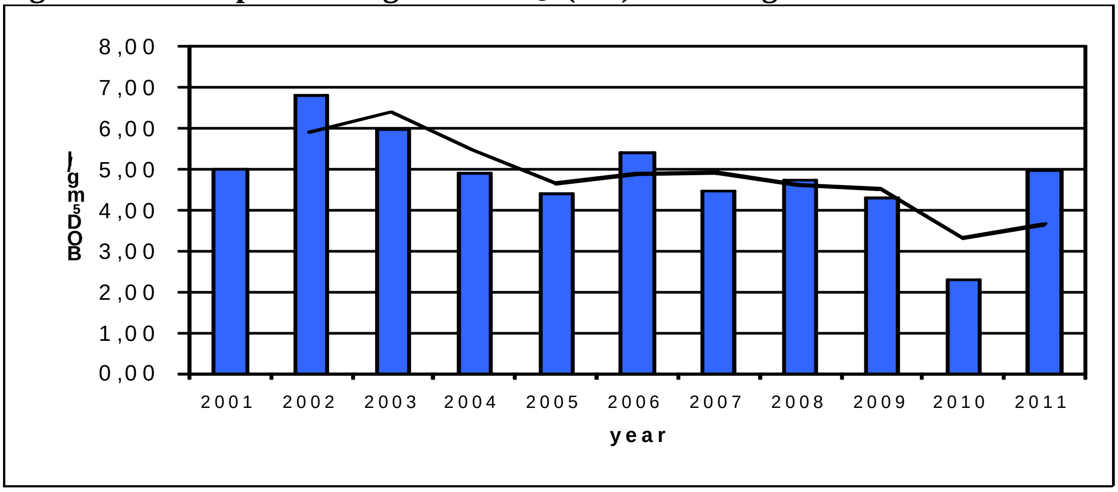



**Figure 4.19: Temporal changes of $BOD_5$ (c90) in Reni**

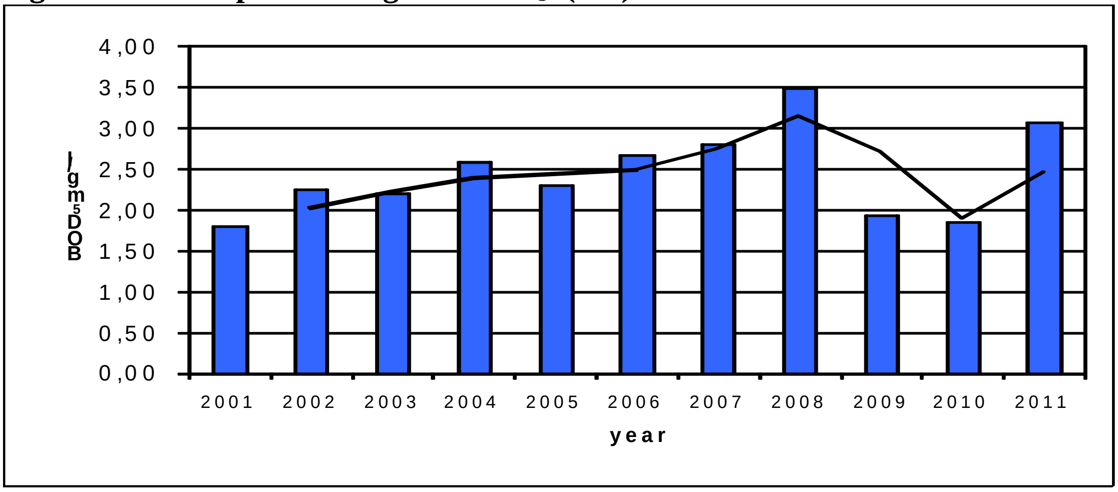


**Figure 4.20: Temporal changes of nitrate-nitrogen (c90) in Bratislava**

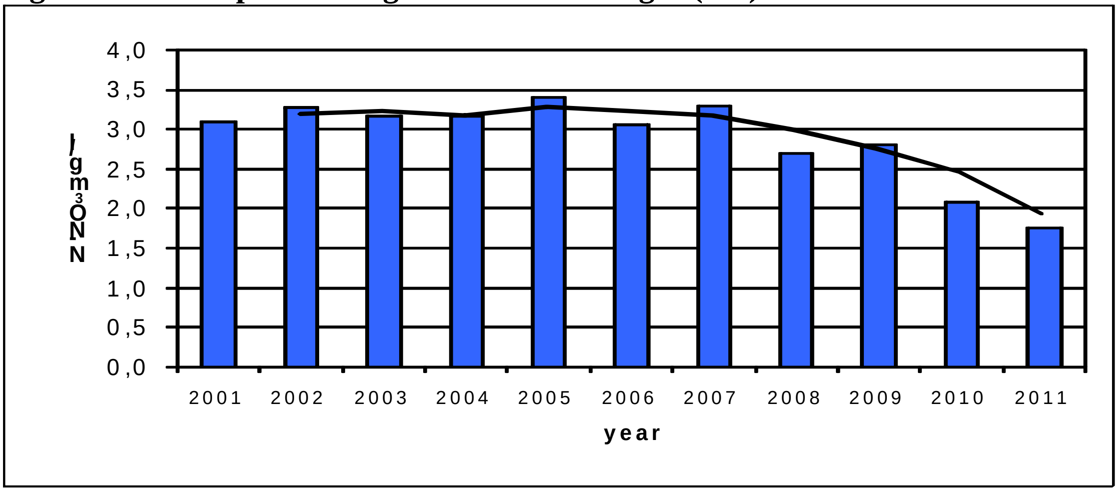



**Figure 4.21: Temporal changes of nitrate-nitrogen (c90) in Hercegszanto**

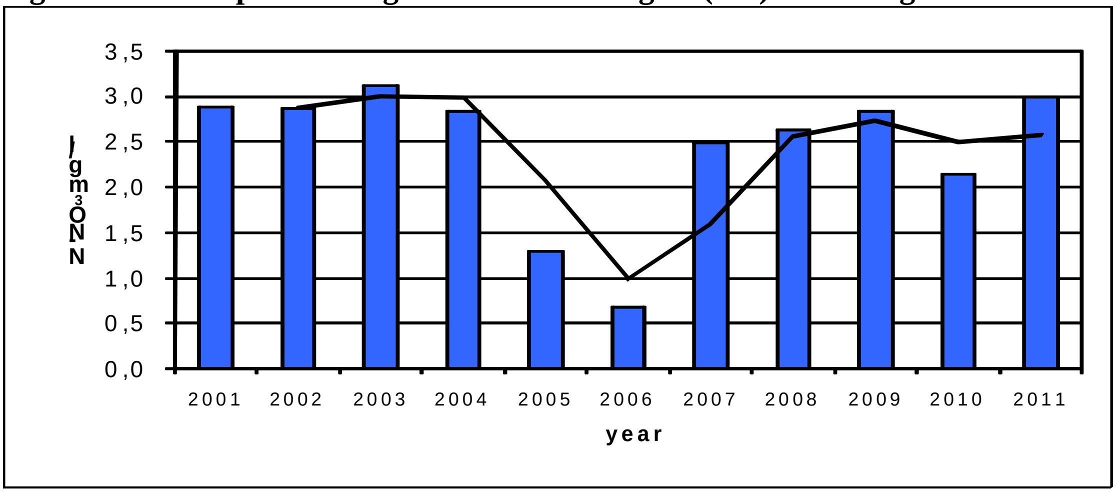



**Figure 4.22: Temporal changes of nitrate-nitrogen (c90) in Reni**

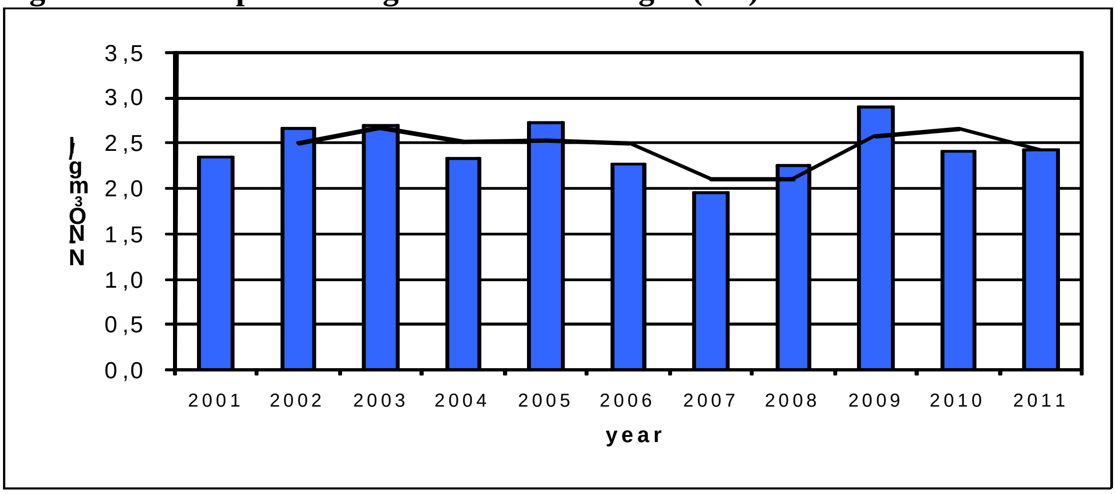


**Figure 4.23: Temporal changes of total phosphorus (c90) in Bratislava**

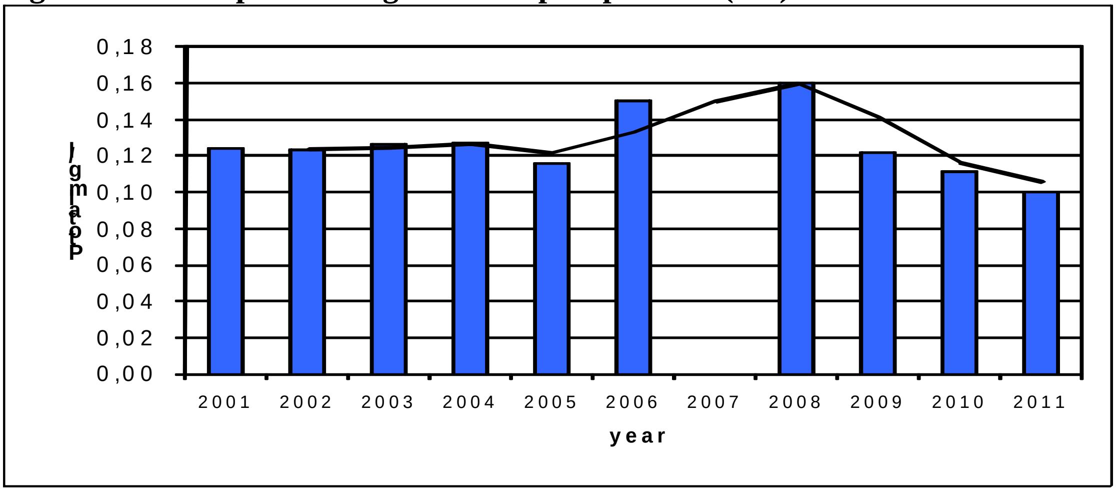



**Figure 4.24: Temporal changes of total phosphorus (c90) in Hercegszanto**

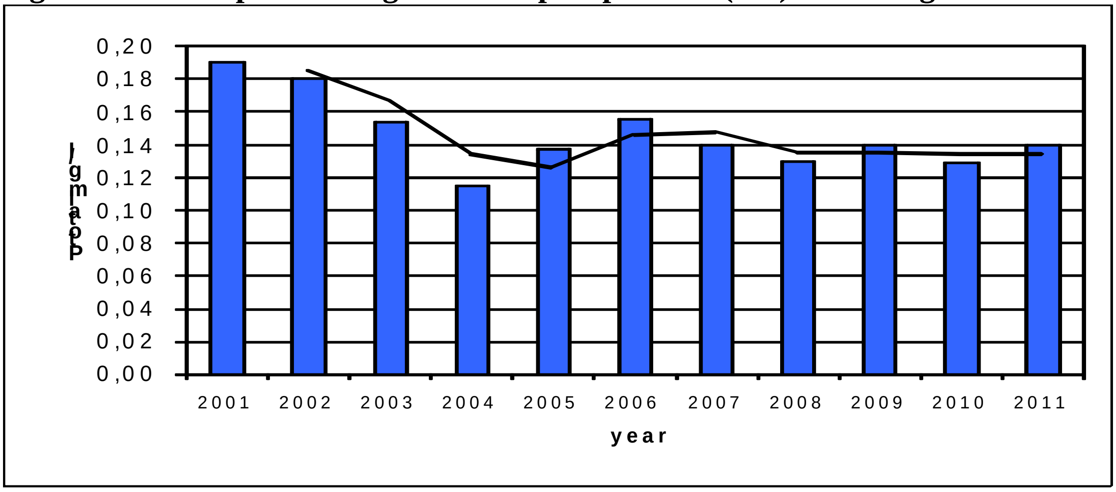



**Figure 4.25: Temporal changes of total phosphorus (c90) in Reni**

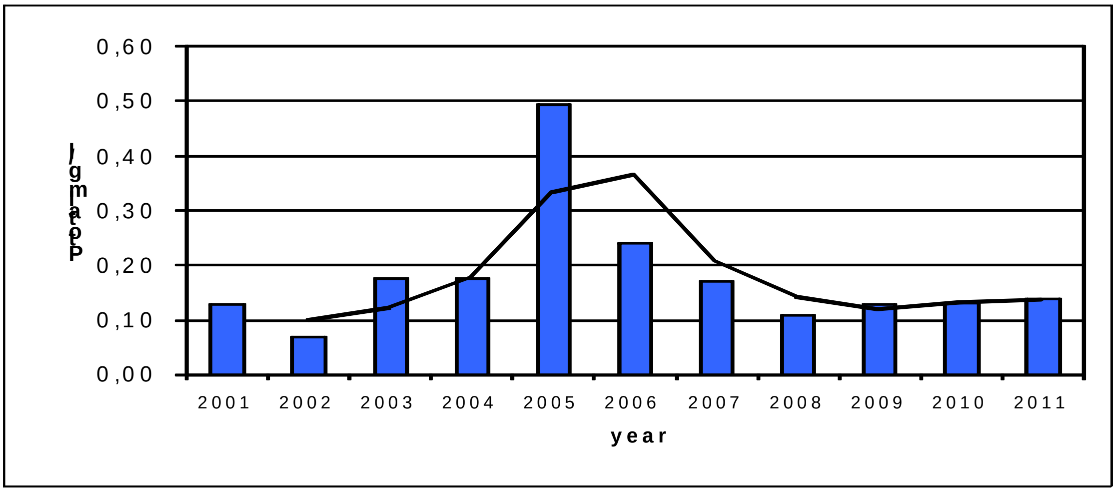


**Figure 4.26: The percentile (90, 10) of $N\text{-}NH_4$ concentration along the Danube river in 2011.**

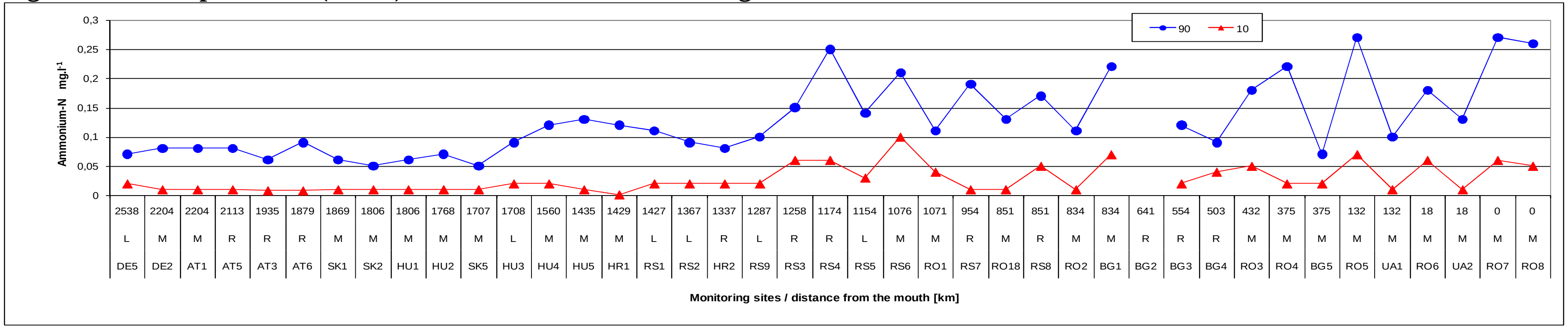



**Figure 4.27: The percentile (90, 10) of $N\text{-}NH_4$ concentration in the tributaries in 2011.**

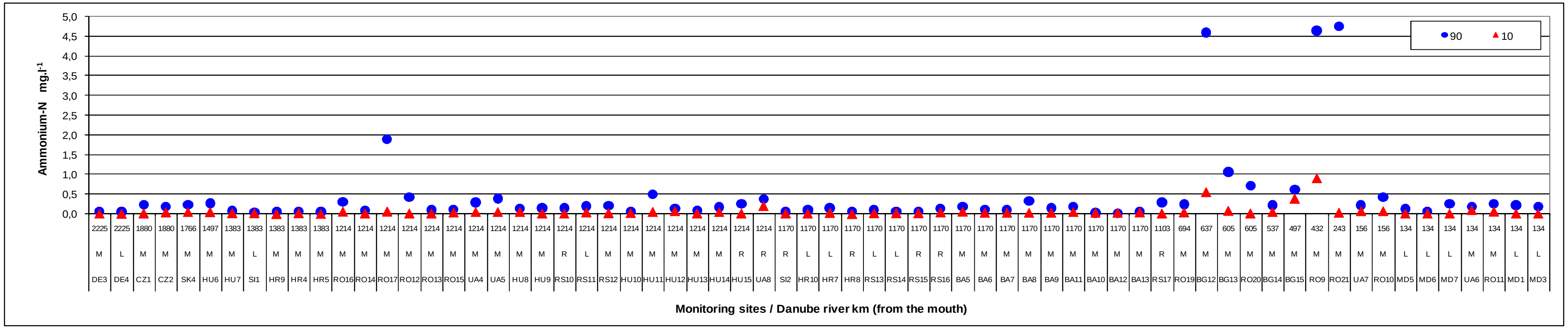


**Figure 4.28: The percentile (90, 10) of P-$PO_4$ concentration along the Danube river in 2011.**

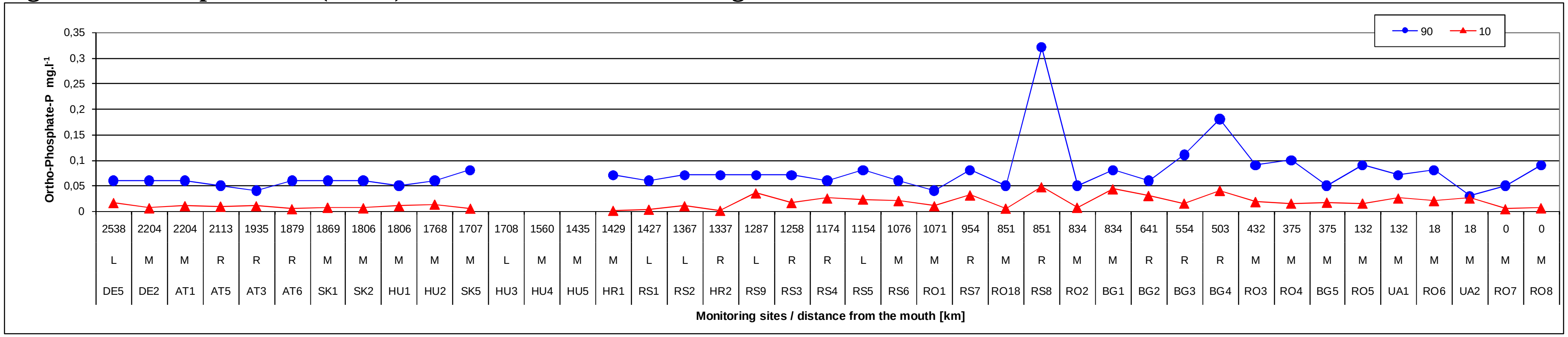



**Figure 4.29: The percentile (90, 10) of P-$PO_4$ concentration in the tributaries in 2011.**

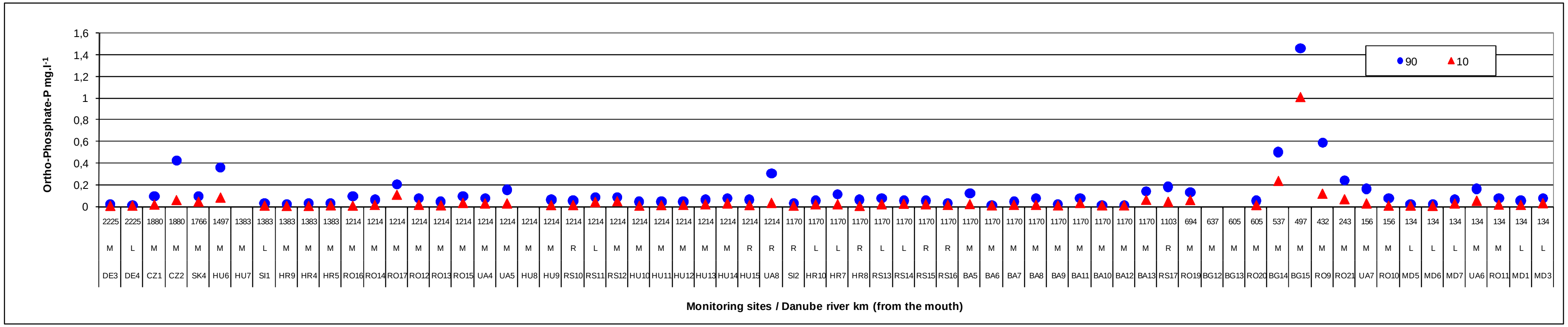


Figure 4.30: The percentile (90, 10) of $COD_{cr}$ concentration along the Danube river in 2011.

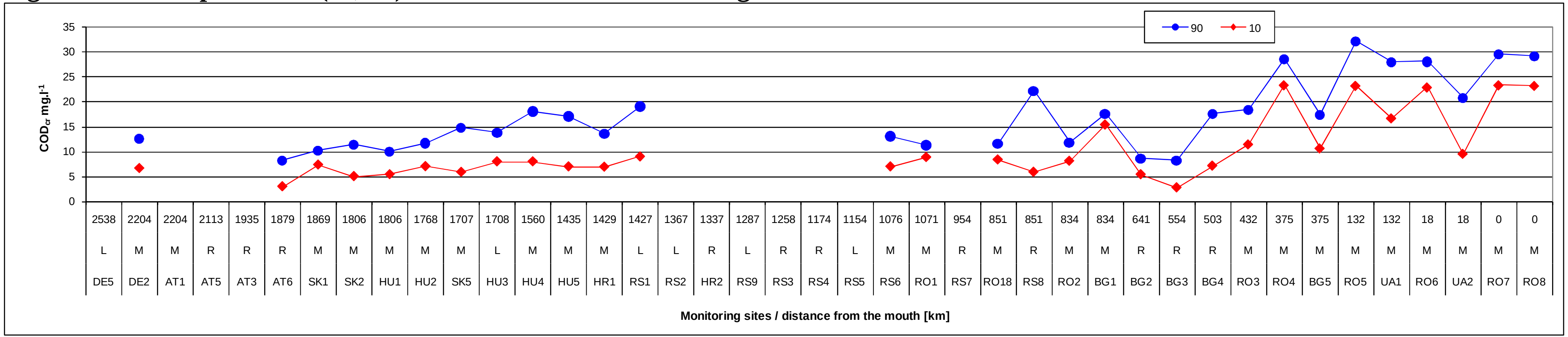



Figure 4.31: The percentile (90, 10) of $COD_{cr}$ concentration in the tributaries in 2011.

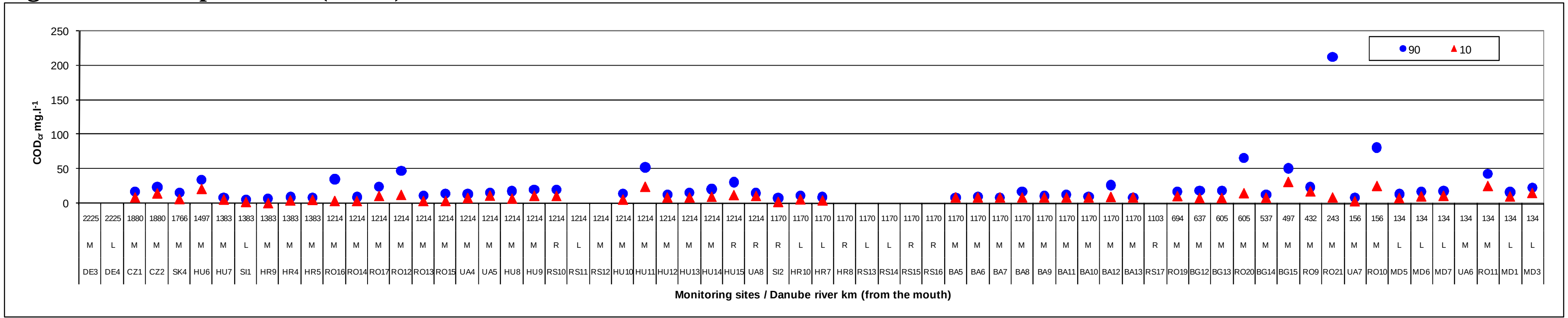


Figure 4.32: The percentile (90, 10) of $BOD_5$ concentration along the Danube river in 2011.

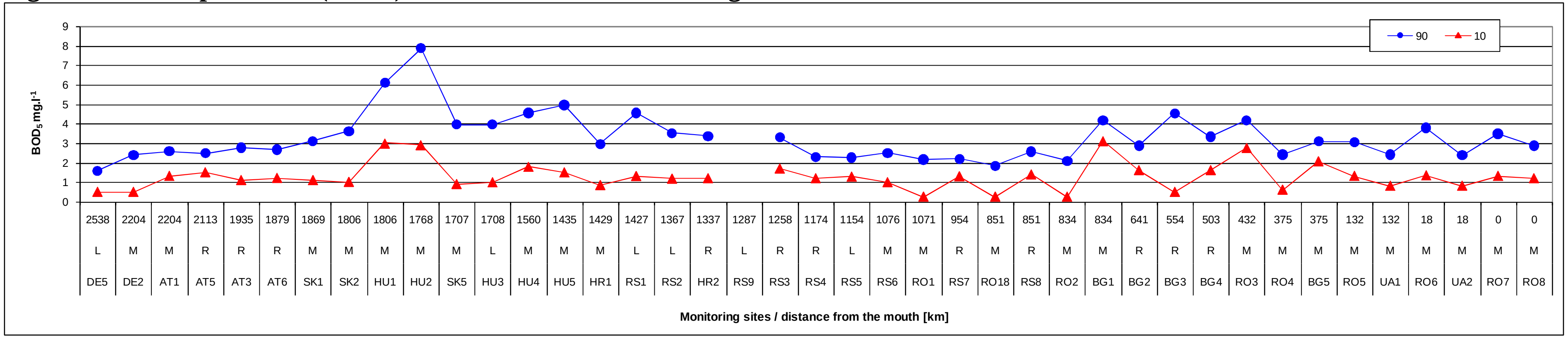



Figure 4.33: The percentile (90, 10) of $BOD_5$ concentration in the tributaries in 2011.

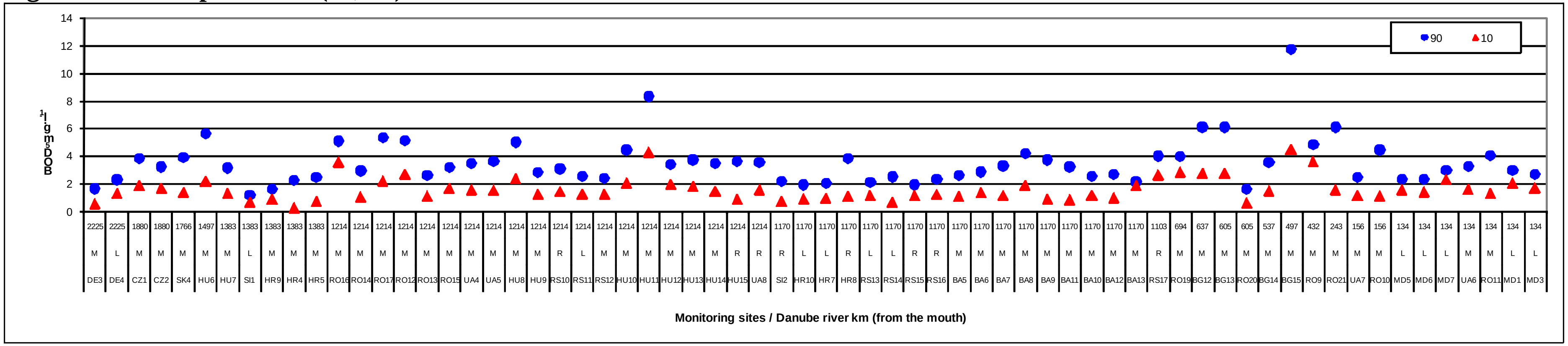


**Figure 4.34: The maximum of Macrozoobenthos- saprobic index along the Danube river in 2011.**

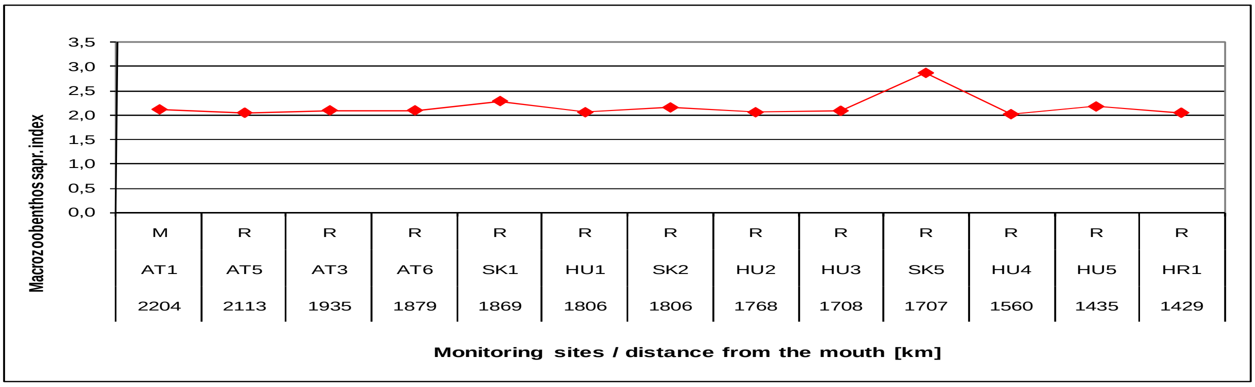
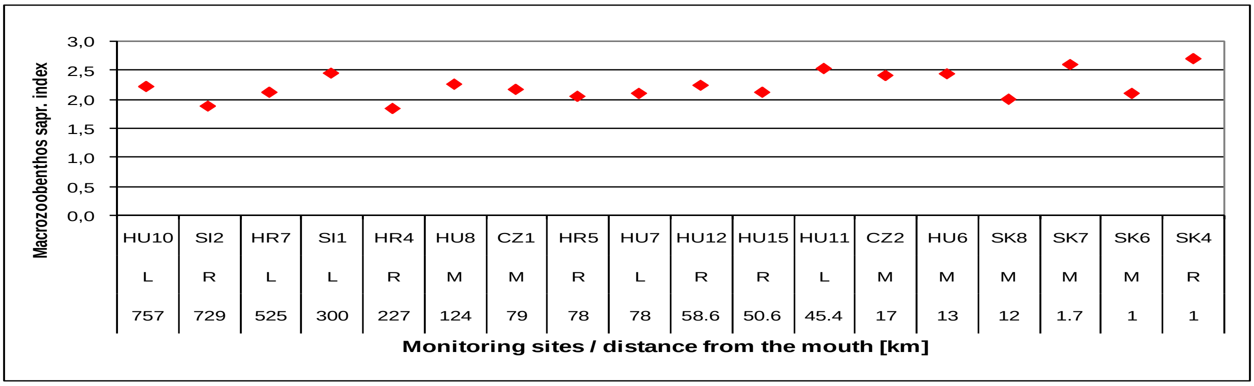
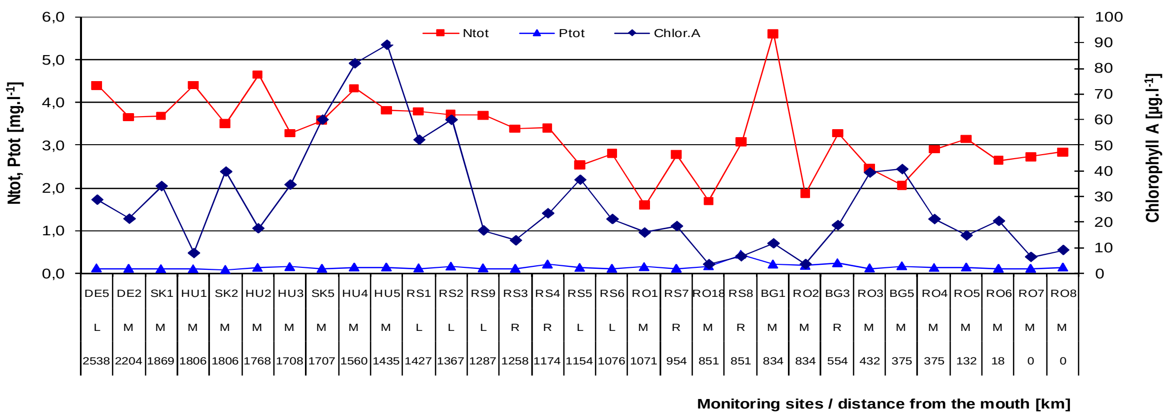



**Figure 4.35: The maximum of Macrozoobenthos- saprobic index in the tributaries in 2011**




The maximum of macrozoobenthos- saprobic index in the Danube river and its tributaries is presented in the Figures 4.34 and 4.35. The macrozoobenthos data was delivered in 2011 for 13 monitoring points located in the Danube River and for 18 monitoring points in the tributaries. The maximal value of saprobic index in the Danube was determined in SK5 Szob. As for the tributaries, the highest macrozoobenthos- saprobic index was found in the Vah (SK4).

**Figure 4.36: The percentile (90) of total nitrogen, phosphorus and chlorophyll-A concentration along the Danube river in 2011.**




The concentration of nutrients and chlorophyll A are presented in Figure 4.36 (it shows only those monitoring sites where all three determinands were measured). The maximal concentration of chlorophyll A was observed in the middle part of the Danube at HU5. The highest concentration of $N_{total}$ was observed in the lower Danube at BG1 and maximal concentration of $P_{total}$ was observed in RS8.

**Figure 4.37: The percentile (90) of $N_{tot.}$, $N\text{-}NH_4$ and $N\text{-}NO_3$ concentration along the Sava river in 2011.**

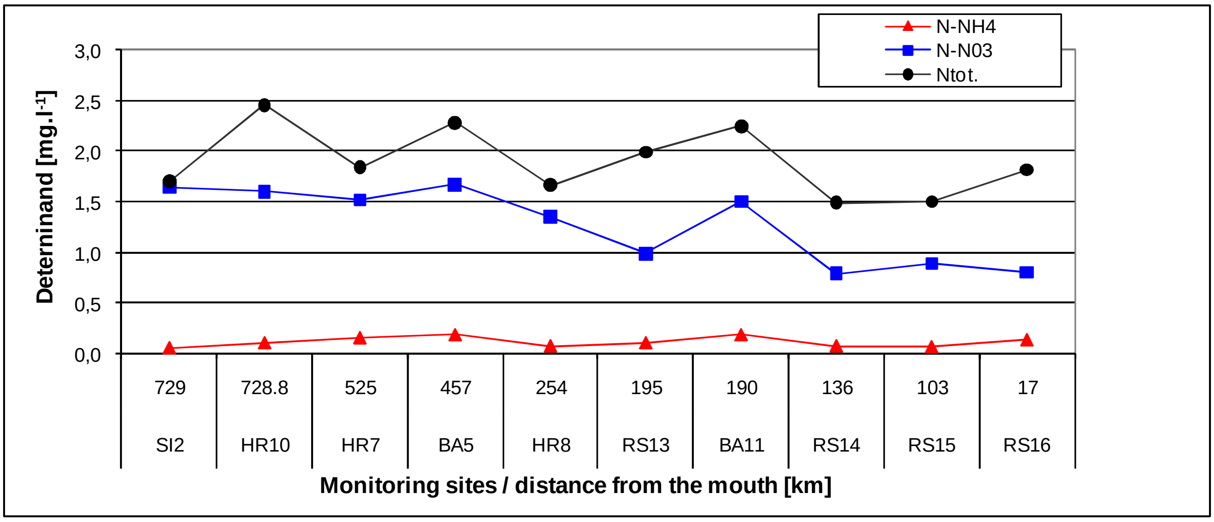
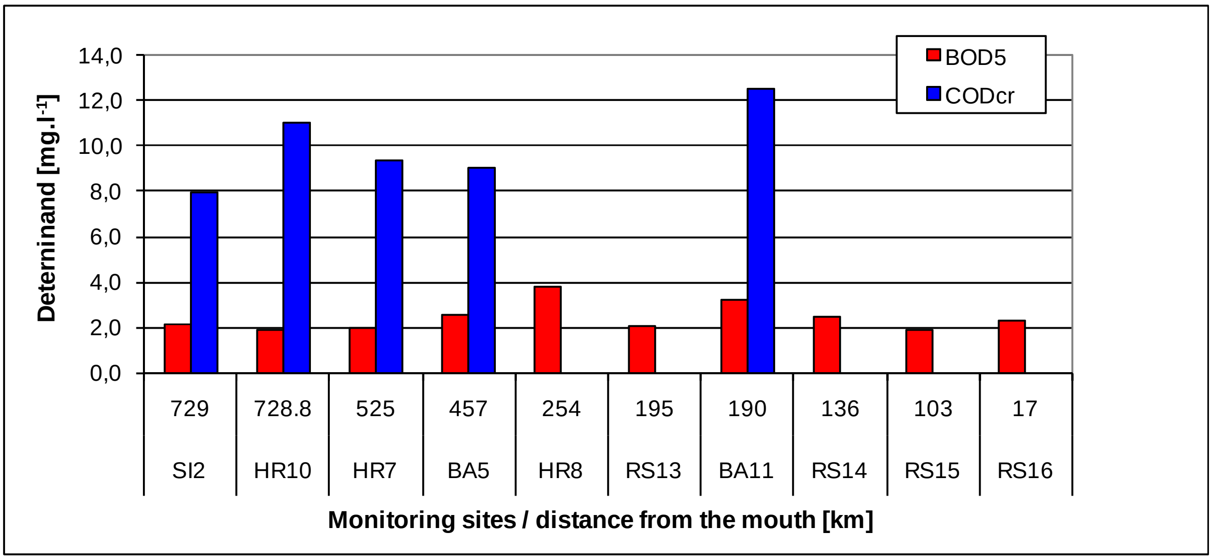



**Figure 4.38: The percentile (90) of $BOD_5$ and $COD_{cr}$ concentration along the Sava river in 2011.**




The 90 percentiles of nutrients and $COD_{cr}$ & $BOD_5$ measured in 2011 in Sava and Tisza rivers are presented in the Figures 4.37-4.40. The highest value of $N\text{-}NH_4$ in Sava river was found in monitoring point BA11 (rkm 190). The maximal concentration of $N\text{-}NO_3$ was observed in BA5 (rkm 457) and the maximum of $N_{total}$ was measured in HR10 (rkm 728.8, Figure 4.37). The highest values of $BOD_5$ in Sava river was measured in monitoring point HR8 rkm 254 and the highest $COD_{cr}$ value was measured in monitoring point BA11 (rkm 190), Figure 4.38).

**Figure 4.39: The percentile (90) of total nitrogen, N-$NH_4$ and N-$NO_3$ concentration along the Tisza river in 2011.**

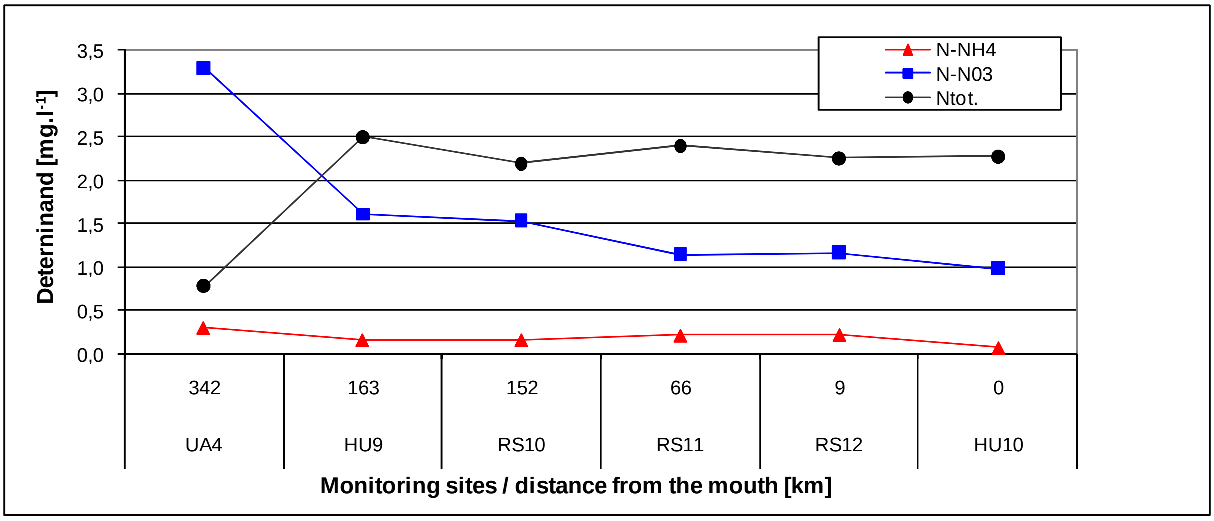
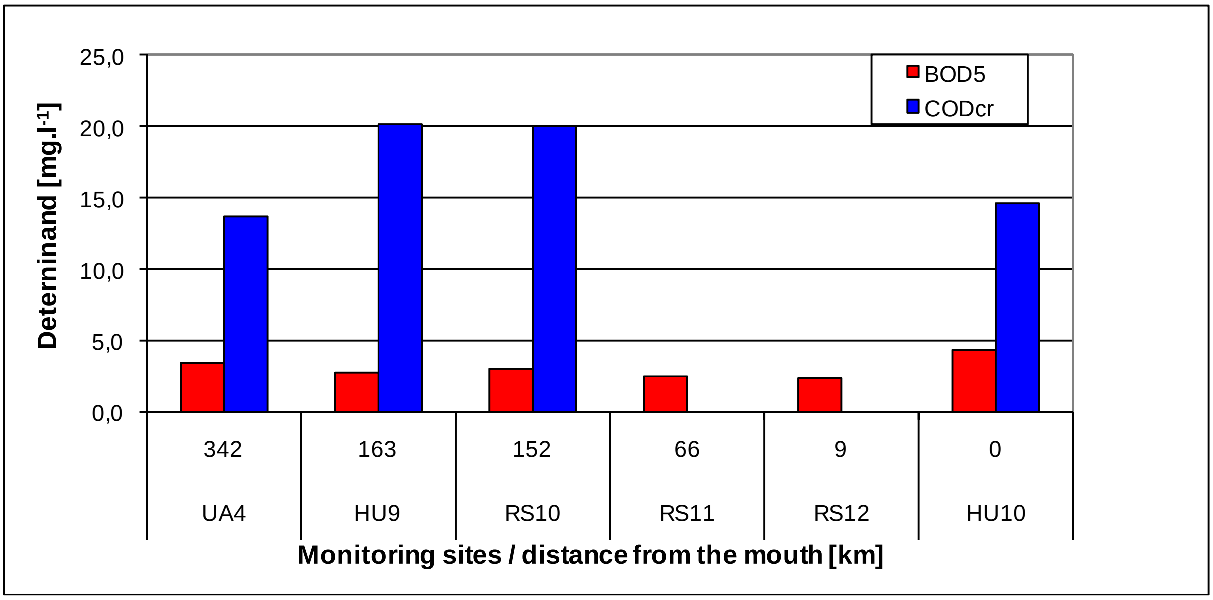



**Figure 4.40: The percentile (90) of $BOD_5$ and $COD_{cr}$ concentration along the Tisza river in 2011.**




The maximal value of N-$NH_4$ and N-$NO_3$ in Tisza river was measured in monitoring point UA4 rkm 342 (see Figure 4.39). The highest value of $N_{total}$ was measured in HU9. The highest value of $BOD_5$ in Tisza river was found in monitoring point HU10 (rkm 0) and the highest $COD_{cr}$ in HU9 (rkm 163, Figure 4.40).

# 5. Load Assssment

## Introduction

The long-term development of loads of relevant determinands in the important rivers of the Danube Basin is one of the major objectives of the TNMN. This is why the load assessment programme in the Danube River Basin started in 2000. For the calculation of loads, a commonly agreed standard operational procedure is used.

## Description of load assessment procedure

The following principles have been agreed for the load assessment procedure:

- *Load is calculated for the following determinands: $BOD_5$, inorganic nitrogen, ortho-phosphate-phosphorus, dissolved phosphorus, total phosphorus, suspended solids and - on a voluntary basis - chlorides; based on the agreement with the Black Sea Commission, silicates are measured at the Romanian load assessment sites since 2004;*
- *The minimum sampling frequency at sampling sites selected for load calculation is set at 24 per year;*
- *The load calculation is processed according to the procedure recommended by the Project "Transboundary assessment of pollution loads and trends" and described in Chapter 6.4. Additionally, countries can calculate annual load by using their national calculation methods, results of which would be presented together with data prepared on the basis of the agreed method;*
- *Countries should select for load assessment those TNMN monitoring sites for which valid flow data is available (see Table 5).*

Table 5 shows TNMN monitoring locations selected for the load assessment program. It also provides information about hydrological stations collecting flow data for load assessment. Altogether 27 monitoring locations from nine countries are included in the list. One location – Danube-Jochenstein have been included by two neighboring countries, therefore the actual number of locations is 26, with ten locations on the Danube River itself and 16 locations on the tributaries. Rivers Prut and Siret were added in year 2010.
The second location that could potentially be processed by using combined data from two countries is Sava-Jesenice, but from 2009 Croatian side performed samplings at the location Drenje (left side of the river Sava) located under the influence of the estuary Sotla. Therefore the results at the location Sava Drenje do not show the load of the Sava River in the border profile.

## *Monitoring Data in 2011*

The monitoring frequency is an important factor for the assessment of pollution loads in water courses. Table 6 shows the number of measurements of flow and water quality determinands in the TNMN load assessment sites.

Data are shown in tables 7 and 9. Flow data are missing from one Croatian monitoring location HR2. In most of the locations, the number of samples was higher than 20, lower frequency was for chlorides. A frequency of 12-15 times per year was applied only in Czech and for Croatians monitoring stations. In 2010 was added load calculation for Slovakian monitoring points on tributaries Morava, Hron, Ipoly, also for this points frequency of monitoring were 12.

The loads in the Danube at Jochenstein are being assessed on the basis of combined data from Germany and Austria, there is no problem with insufficient frequency there.

Regarding particular determinands, there is still a lack of data on dissolved phosphorus as it was measured in 10 locations only. At 15 monitoring points the silicate load was calculated. This calculation of the silicate load is to respond to the agreements with the Black Sea Commission.

### Table 5: List of TNMN locations selected for load assessment program

| Country | River | Water quality monitoring location | | | Hydrological station | |
|---|---|---|---|---|---|---|
| | | Country Code | Location | Distance from mouth (Km) | Location | Distance from mouth (Km) |
| **Germany** | Danube | DE2 | Jochenstein | 2204 | Achleiten | 2223 |
| **Germany** | Inn | DE3 | Kirchdorf | 195 | Oberaudorf | 211 |
| **Germany** | Inn/Salzach | DE4 | Laufen | 47 | Laufen | 47 |
| **Austria** | Danube | AT1 | Jochenstein | 2204 | Aschach | 2163 |
| **Austria** | Danube | AT6 | Hainburg | 1879 | Hainburg (Danube)<br>Angern (March) | 1884<br>32 |
| **Czech Republic** | Morava | CZ1 | Lanzhot | 79 | Lanzhot | 79 |
| **Czech Republic** | Morava/Dyje | CZ2 | Pohansko | 17 | Breclav-Ladná | 32,3 |
| **Slovak Republic** | Danube | SK1 | Bratislava | 1869 | Bratislava | 1869 |
| **Slovak Republic** | Váh | SK4 | Komárno | | Sum of: Maly Dunaj -Trstice<br>Vah- Sala<br>Nitra -Nove Zamky | 22,5<br>58,8<br>12,3 |
| **Slovak Republic** | Morava | SK6 | Devín | | Zahorska Ves | 32,5 |
| **Slovak Republic** | Hron | SK7 | Kamenica | | Kanenin | 10,9 |
| **Slovak Republic** | Ipoly | SK8 | Salka | | Salka | 12,2 |
| **Hungary** | Danube | HU3 | Szob | 1708 | Nagymaros | 1695 |
| **Hungary** | Danube | HU5 | Hercegszántó | 1435 | Mohács | 1447 |
| **Hungary** | Tisza | HU9 | Tiszasziget | 163 | Szeged | 174 |
| **Croatia** | Danube | HR2 | Borovo | 1337 | Vukovar | 1337 |
| **Croatia** | Sava | HR10 | Drenje | 728.8 | Jesenice II | 728.5 |
| **Croatia** | Sava | HR7 | Una Jesenovac | 525 | Una Jesenovac | 525 |
| **Croatia** | Sava | HR8 | Zupanja | 254 | Zupanja | 254 |
| **Slovenia** | Drava | SI1 | Ormoz | 300 | Borl<br>HE Formin | 325<br>311 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | Pesnica-Zamusani | 10.1(to the Drava) |
| **Slovenia** | Sava | SI2 | Jesenice | 729 | Catez<br>Sotla -Rakovec | 737<br>8.1 (to the Sava) |
| **Romania** | Danube | RO2 | Pristol-Novo Selo | 834 | Gruia | 858 |
| **Romania** | Danube | RO4 | Chiciu-Silistra | 375 | Chiciu | 379 |
| **Romania** | Danube | RO5 | Reni | 132 | Isaccea | 101 |
| **Romania** | Siret | RO10 | Sendreni | 0 | Sendreni | 0 |
| **Romania** | Prut | RO11 | Giurgiulesti | 0 | Giurgiulesti | 0 |
| **Ukraine** | Danube | UA2 | Vylkove | 18 | | |

## *Calculation Procedure*

Regarding several sampling sites in the profile, the average concentration at a site is calculated for each sampling day. In case of values “below the limit of detection”, the value of the limit of detection is used in the further calculation. The average monthly concentrations are calculated according to the formula:

$$C_m\,[mg.l^{-1}] = \frac{\sum_{i \in m} C_i\,[mg.l^{-1}]\,.\,Q_i\,[m^3.s^{-1}]}{\sum_{i \in m} Q_i\,[m^3.s^{-1}]}$$

where $C_m$ average monthly concentrations
$C_i$ concentrations in the sampling days of each month
$Q_i$ discharges in the sampling days of each month

The monthly load is calculated by using the formula:

$$L_m\,[tones] = C_m\,[mg.l^{-1}]\,.\,Q_m\,[m^3.s^{-1}]\,.\,days\,(m)\,.\,0{,}0864$$

where $L_m$ monthly load
$Q_m$ average monthly discharge

- *If discharges are available only for the sampling days, then $Q_m$ is calculated from those discharges.*
- *For months without measured values, the average of the products $C_m.Q_m$ in the months with sampling days is used.*

The annual load is calculated as the sum of the monthly loads:

$$L_a\,[tones] = \sum_{m=1}^{12} L_m\,[tones]$$

## Table 6: Number of measurements in TNMN locations selected for assessment of pollution load in 2011

| Country Code | River | Location | Location in profile | River Km | Number of meausrements in 2011 Q | SS | $N_{inorg}$ | $P\text{-}PO_4$ | $P_{total}$ | $BOD_5$ | Cl | $P_{diss}$ | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DE2 | Danube | Jochenstein | M | 2204 | 365 | 26 | 38 | 38 | 38 | 24 | 26 | 35 | |
| DE3 | Inn | Kirchdorf | M | 195 | 365 | 26 | 22 | 26 | 26 | 26 | 26 | 20 | |
| DE4 | Inn/Salzach | Laufen | L | 47 | 365 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | |
| AT1 | Danube | Jochenstein | M | 2204 | 365 | 9 | 37 | 37 | 37 | 12 | 12 | 34 | |
| AT6 | Danube | Hainburg | R | 1879 | 365 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | |
| CZ1 | Morava | Lanzhot | M | 79 | 365 | 12 | 12 | 12 | 12 | 12 | 12 | | |
| CZ2 | Morava/Dyje | Pohansko | M | 17 | 365 | 12 | 12 | 12 | 12 | 12 | 12 | | |
| SK1 | Danube | Bratislava | M | 1869 | 365 | 25 | 25 | 25 | 25 | 25 | 12 | 25 | 25 |
| SK4 | Váh | Komárno | M | 1 | 365 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| SK6 | Morava | Devín | M | 1 | 365 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| SK7 | Hron | Kamenica | M | 2 | 365 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| SK8 | Ipoly | Salka | M | 12 | 365 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| HU3 | Danube | Szob | L | 1708 | | 24 | 24 | | 24 | 24 | 24 | | |
| | | | M | 1708 | 365 | 24 | 24 | | 24 | 24 | 24 | | |
| | | | R | 1708 | | 24 | 24 | | 24 | 23 | 24 | | |
| HU5 | Danube | Hercegszántó | M | 1435 | 365 | 24 | 24 | | 24 | 24 | 24 | | 23 |
| HU9 | Tisza | Tiszasziget | L | 163 | | 25 | 25 | 25 | 25 | 12 | 12 | | 24 |
| | | | M | 163 | 365 | 24 | 24 | 24 | 24 | 11 | 11 | | 25 |
| | | | R | 163 | | 24 | 24 | 24 | 24 | 11 | 11 | | 24 |
| HR2 | Danube | Borovo | R | 1337 | 0 | 12 | 12 | 12 | 12 | 12 | 12 | | 12 |
| HR10 | Sava | Drenje | L | 729 | 365 | 12 | 12 | 12 | 12 | 12 | 12 | | 12 |
| HR7 | Sava | us Una Jesenovac | L | 525 | 365 | 12 | 12 | 11 | 12 | 12 | 12 | | 12 |
| HR8 | Sava | ds Zupanja | ML | 254 | 365 | 12 | 12 | 12 | 12 | 12 | 11 | | 11 |
| SI1 | Drava | Ormoz | L | 300 | 365 | 26 | 26 | 26 | 26 | 26 | 12 | | |
| SI2 | Sava | Jesenice | R | 729 | 365 | 26 | 26 | 26 | 26 | 26 | 12 | | |
| RO2 | Danube | Pristol-Novo Selo | L | 834 | | 24 | 24 | 24 | 24 | 24 | 16 | | 14 |
| | | | M | 834 | | 24 | 24 | 24 | 24 | 24 | 16 | | 14 |
| | | | R | 834 | | 24 | 24 | 24 | 24 | 24 | 16 | | 14 |
| RO4 | Danube | Chiciu-Silistra | L | 375 | | 25 | 26 | 26 | 26 | 26 | 11 | | 25 |
| | | | M | 375 | | 25 | 25 | 26 | 26 | 26 | 11 | | 25 |
| | | | R | 375 | | 23 | 24 | 24 | 24 | 24 | 11 | | 25 |
| RO5 | Danube | Reni | L | 132 | | 25 | 26 | 26 | 26 | 26 | 14 | | 25 |
| | | | M | 132 | | 25 | 26 | 26 | 26 | 26 | 14 | | 25 |
| | | | R | 132 | | 25 | 26 | 26 | 26 | 26 | 14 | | 25 |
| RO10 | M | Siret | M | 0 | | 26 | 26 | 26 | 26 | 23 | 10 | | 26 |
| RO11 | M | Prut | M | 0 | | 25 | 26 | 25 | 26 | 24 | 10 | | 26 |
| UA2 | Danube | Vylkove | M | 18 | 365 | 12 | 12 | 12 | | 12 | 12 | 12 | 12 |

## *Results*

The mean annual concentrations and annual loads of suspended solids, inorganic nitrogen, ortho-phosphate-phosphorus, total phosphorus, $BOD_5$, chlorides and – where available – dissolved phosphorus and silicates - are presented in tables 7 to 10, separately for monitoring locations on the Danube River and for monitoring locations on tributaries. The explanation of terms used in the tables 7 to 10 is as follows.

| Term used | Explanation |
|---|---|
| **Station Code** | TNMN monitoring location code |
| **Profile** | location of sampling site in profile (L-left, M-middle, R-right) |
| **River Name** | name of river |
| **Location** | name of monitoring location |
| **River km** | distance to mouth of the river |
| **$Q_a$** | mean annual discharge in the year 2011 |
| **$c_{mean}$** | arithmetical mean of the concentrations in the year 2011 |
| **Annual Load** | annual load of given determinand in the year 2011 |

Table 10 shows loads of other determinands (nitrogen forms and heavy metals) at the profile Reni, which are monitored since 2005 based on the agreement with the Black Sea Commission.

The mean annual discharge in whole Danube river was lower than in 2010, especially in Reni the discharge was lower than in 2010.

The spatial pattern of the annual load along the Danube is similar to the previous year. In the case of suspended solids, inorganic nitrogen, $BOD_5$, ortho-phosphate, total phosphorus and chlorides, the highest load is observed in the lower part of the Danube River. A maximum for suspended solids, inorganic nitrogen, $BOD_5$, ortho-phosphate and chlorides was found at the monitoring location Danube-Reni (RO5). Maximal load for total phosphorus and silicates was measured in Pristol-Novo Selo (RO2).

In the case of tributaries, the highest load of inorganic nitrogen, ortho-phosphate, total phosphorus, $BOD_5$ and chlorides are coming from the Tisza river. The highest load for suspended solids was from Siret river.

## Table 7: Mean annual concentrations in monitoring locations selected for load assessment on Danube River in 2011

| Station Code | Profile | River Name | Location | River km | $Q_a$ | $c_{mean}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Suspended Solids | Inorganic Nitrogen | Ortho-Phosphate Phosphorus | Total Phosphorus | $BOD_5$ | Chlorides | Phosphorus - dissolved | Silicates |
| | | | | | $(m^3.s^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ |
| DE2 +AT1 | M | Danube | Jochenstein | 2204 | 1218 | 12.40 | 2.19 | 0.03 | 0.07 | 1.73 | 20.04 | 0.05 | |
| AT6 | R | Danube | Hainburg | 1879 | 1674 | 12.19 | 2.34 | 0.04 | 0.06 | 2.04 | 19.37 | 0.05 | |
| SK1 | M | Danube | Bratislava | 1869 | 1700 | 19.72 | 2.02 | 0.04 | 0.08 | 1.98 | 20.04 | 0.05 | 5.33 |
| HU3 | LMR | Danube | Szob | 1708 | 1882 | 18.47 | 2.02 | | 0.11 | 2.60 | 27.85 | | |
| HU5 | M | Danube | Hercegszántó | 1435 | 1971 | 23.46 | 2.00 | | 0.11 | 3.03 | 27.60 | | 4.48 |
| HR2 | R | Danube | Borovo | 1337 | | 15.37 | 1.82 | 0.04 | 0.18 | 2.13 | 19.54 | | 4.52 |
| RO2 | LMR | Danube | Pristol-Novo Selo | 834 | 4182 | 30.51 | 1.32 | 0.05 | 0.15 | 1.18 | 22.40 | | 5.09 |
| RO4 | LMR | Danube | Chiciu-Silistra | 375 | 4827 | 16.80 | 1.79 | 0.05 | 0.06 | 1.77 | 29.02 | | 2.79 |
| RO5 | LMR | Danube | Reni | 132 | 5303 | 26.69 | 1.68 | 0.05 | 0.07 | 2.18 | 31.95 | | 2.23 |
| UA2 | M | Danube | Vylkove | 18 | 2598 | 44.78 | 1.45 | 0.03 | | 2.56 | 35.53 | 0.03 | 2.56 |

## Table 8: Mean annual concentrations in monitoring locations selected for load assessment on tributaries in 2011

| Station Code | Profile | River Name | Location | River km | $Q_a$ | $c_{mean}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Suspended Solids | Inorganic Nitrogen | Ortho-Phosphate Phosphorus | Total Phosphorus | $BOD_5$ | Chlorides | Phosphorus - dissolved | Silicates |
| | | | | | $(m^3.s^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ |
| DE3 | M | Inn | Kirchdorf | 195 | 235 | 38.06 | 0.53 | 0.01 | 0.07 | 0.95 | 8.13 | 0.02 | |
| DE4 | L | Inn/Salzach | Laufen | 47 | 194 | 8.64 | 0.68 | 0.01 | 0.03 | 1.76 | 9.07 | 0.01 | |
| CZ1 | M | Morava | Lanzhot | 79 | 50 | 29.33 | 2.89 | 0.05 | 0.13 | 2.71 | 29.33 | | |
| CZ2 | L | Morava/Dyje | Pohansko | 17.00 | 37 | 17.08 | 3.08 | 0.19 | 0.28 | 2.42 | 45.25 | | |
| SK4 | M | Váh | Komárno | 1 | 162 | 15.67 | 2.13 | 0.07 | 0.13 | 2.52 | 20.78 | 0.09 | |
| SK6 | M | Morava | Devín | 1 | 97 | 37.33 | 2.82 | 0.11 | 0.19 | 3.52 | 34.71 | 0.12 | |
| SK7 | M | Hron | Kamenica | 2 | 36 | 12.92 | 2.73 | 0.09 | 0.12 | 2.09 | 14.86 | 0.10 | |
| SK8 | M | Ipoly | Salka | 12 | 16 | 24.58 | 2.85 | 0.12 | 0.17 | 2.13 | 27.26 | 0.15 | |
| HU9 | LMR | Tisza | Tiszasziget | 163 | 759 | 33.00 | 1.03 | 0.04 | 0.12 | 1.63 | 39.08 | | 7.89 |
| SI1 | L | Drava | Ormoz | 300 | 259 | 8.50 | 1.10 | 0.02 | 0.04 | 0.89 | 6.60 | | |
| SI2 | R | Sava | Jesenice | 729 | 175 | 5.02 | 1.39 | 0.02 | 0.06 | 1.23 | 8.52 | | |
| HR10 | L | Sava | Drenje | 729 | 171 | 6.88 | 1.17 | 0.04 | 0.10 | 1.68 | 12.85 | | 3.77 |
| HR7 | L | Sava | us. Una Jasenovac | 525 | 407 | 8.04 | 1.34 | 0.07 | 0.08 | 1.50 | 10.01 | | 2.34 |
| HR8 | ML | Sava | ds. Zupanja | 254 | 614 | 7.55 | 1.09 | 0.03 | 0.02 | 1.98 | 25.54 | | 3.45 |
| RO10 | M | Siret | Conf. Danube (Sendreni) | 0 | 191 | 128.88 | 1.99 | 0.04 | 0.07 | 2.77 | 58.75 | | 4.05 |
| RO11 | M | Prut | Conf. Danube (Giurgiulesti) | 0 | 80 | 88.12 | 1.64 | 0.04 | 0.06 | 2.68 | 60.16 | | 3.66 |

## Table 9: Annual load in selected monitoring locations on Danube River

| Station Code | Profile | River Name | Location | River km | Annual Load in 2011 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Suspended Solids | Inorganic Nitrogen | Ortho-Phosphate Phosphorus | Total Phosphorus | $BOD_5$ | Chlorides | Phosphorus - dissolved | Silicates |
| | | | | | ( $x10^6$ tonns ) | ( $x10^3$ tonns ) | ( $x10^3$ tonns ) | ( $x10^3$ tonns ) | ( $x10^3$ tonns ) | ( $x10^6$ tonns ) | ( $x10^3$ tonns ) | ( $x10^6$ tonns ) |
| DE2 +AT1 | M | Danube | Jochenstein | 2204 | 0.55 | 83.35 | 1.38 | 3.00 | 61.64 | 0.73 | 1.91 | |
| AT6 | R | Danube | Hainburg | 1879 | 1.10 | 123.56 | 2.05 | 3.56 | 110.38 | 1.00 | 2.93 | |
| SK1 | M | Danube | Bratislava | 1869 | 1.23 | 112.06 | 2.50 | 4.60 | 99.36 | 1.08 | 2.78 | 0.30 |
| HU3 | LMR | Danube | Szob | 1708 | 1.23 | 123.24 | | 6.60 | 168.09 | 1.61 | | |
| HU5 | LMR | Danube | Hercegszántó | 1435 | 1.89 | 129.66 | | 7.85 | 189.19 | 1.64 | | 0.28 |
| HR2 | R | Danube | Borovo | 1337 | | | | | | | | |
| RO2 | LMR | Danube | Pristol-Novo Selo | 834 | 4.03 | 180.88 | 5.95 | 17.04 | 112.55 | 2.91 | | 0.48* |
| RO4 | LMR | Danube | Chiciu-Silistra | 375 | 3.15 | 286.52 | 6.99 | 10.01 | 284.02 | 4.12 | | 0.40* |
| RO5 | LMR | Danube | Reni | 132 | 4.76 | 304.09 | 9.08 | 12.13 | 368.63 | 5.44 | | 0.35* |
| UA2 | M | Danube | Vylkove | 18 | 3.91 | 110.43 | 2.35 | | 144.90 | 2.85 | 10.32 | 0.22 |

*Silicates ($SiO_2$) in dissolved form

## Table 10: Annual load in selected monitoring locations on tributaries

| Station Code | Profile | River Name | Location | River km | Annual Load in 2011 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Suspended Solids | Inorganic Nitrogen | Ortho-Phosphate Phosphorus | Total Phosphorus | $BOD_5$ | Chlorides | Phosphorus - dissolved | Silicates |
| | | | | | ( $x10^6$ tonns ) | ( $x10^3$ tonns ) | ( $x10^3$ tonns ) | ( $x10^3$ tonns ) | ( $x10^3$ tonns ) | ( $x10^6$ tonns ) | ( $x10^3$ tonns ) | ( $x10^6$ tonns ) |
| DE3 | M | Inn | Kirchdorf | 195 | 0.40 | 3.62 | 0.06 | 0.68 | 6.09 | 0.06 | 0.12 | |
| DE4 | L | Inn/Salzach | Laufen | 47 | 0.07 | 3.93 | 0.05 | 0.21 | 10.27 | 0.05 | 0.10 | |
| CZ1 | M | Morava | Lanzhot | 79 | 0.06 | 4.92 | 0.08 | 0.20 | 4.56 | 0.04 | | |
| CZ2 | L | Morava/Dyje | Pohansko | 17 | 0.02 | 5.17 | 0.17 | 0.26 | 2.82 | 0.05 | | |
| SK4 | M | Váh | Komárno | 1 | 0.08 | 11.04 | 0.37 | 0.63 | 12.93 | 0.10 | 0.40 | 0.03 |
| SK6 | M | Morava | Devín | 1 | 0.12 | 10.20 | 0.29 | 0.57 | 10.63 | 0.10 | 0.35 | 0.03 |
| SK7 | M | Hron | Kamenica | 2 | 0.02 | 2.82 | 0.09 | 0.12 | 2.07 | 0.01 | 0.08 | 0.01 |
| SK8 | M | Ipoly | Salka | 12 | 0.01 | 1.45 | 0.05 | 0.07 | 1.30 | 0.01 | 0.05 | 0.01 |
| HU9 | LMR | Tisza | Tiszasziget | 163 | 0.95 | 27.25 | 0.98 | 2.90 | 37.39 | 0.83 | | 0.22 |
| SI1 | L | Drava | Ormoz | 300 | 0.08 | 8.57 | 0.22 | 0.44 | 7.09 | 0.05 | | |
| SI2 | R | Sava | Jesenice | 729 | 0.03 | 7.72 | 0.08 | 0.32 | 6.23 | 0.05 | | |
| HR10 | L | Sava | Drenje | 728.8 | 0.04 | 6.84 | 0.20 | 0.57 | 9.04 | 0.06 | | 0.02* |
| HR7 | L | Sava | us. Una Jasenovac | 525 | 0.09 | 17.21 | 0.68 | 1.66 | 19.86 | 0.12 | | 0.03* |
| HR8 | ML | Sava | ds. Zupanja | 254 | 0.14 | 20.52 | 0.57 | 1.59 | 33.26 | 0.34 | | 0.05* |
| RO10 | M | Siret | Conf. Danube (Sendreni) | 0 | 1.46 | 10.20 | 0.21 | 0.38 | 20.19 | 0.27 | | 0.03* |
| RO11 | M | Prut | Conf. Danube (Giurgiulesti) | 0 | 0.24 | 4.31 | 0.10 | 0.15 | 6.70 | 0.12 | | 0.01* |

*Silicates ($SiO_2$) in dissolved form

## Table 11: Additional annual load data at Reni for reporting to the Black Sea Commission

| River | Location | Location in profile | River km | Number of measurements in 2011 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Q | $N\text{-}NH_4$ | $N\text{-}NO_2$ | $N\text{-}NO_3$ | $N_{total}$ | $Cu_{diss.}$ | $Pb_{diss.}$ | $Cd_{diss.}$ | $Hg_{diss.}$ |
| Danube | Reni | LMR | 132 | 365 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 25 |
| **River** | **Location** | **Location in profile** | **River km** | $c_{mean}$ | | | | | | | | |
| | | | | $Q_a$ | $N\text{-}NH_4$ | $N\text{-}NO_2$ | $N\text{-}NO_3$ | $N_{total}$ | $Cu_{diss.}$ | $Pb_{diss.}$ | $Cd_{diss.}$ | $Hg_{diss.}$ |
| | | | | $(m^3.s^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(mg.l^{-1})$ | $(\mu g.l^{-1})$ | $(\mu g.l^{-1})$ | $(\mu g.l^{-1})$ | $(\mu g.l^{-1})$ |
| Danube | Reni | LMR | 132 | 5303 | 0.16 | 0.03 | 1.50 | 2.03 | 2.68 | 2.16 | 0.15 | 0.017 |
| **River** | **Location** | **Location in profile** | **River km** | Annual Load in 2010 | | | | | | | | |
| | | | | | $N\text{-}NH_4$ | $N\text{-}NO_2$ | $N\text{-}NO_3$ | $N_{total}$ | $Cu_{diss.}$ | $Pb_{diss.}$ | $Cd_{diss.}$ | $Hg_{diss.}$ |
| | | | | | $(x10^3 tonns)$ | $(x10^3 tonns)$ | $(x10^3 tonns)$ | $(x10^3 tonns)$ | (tonns) | (tonns) | (tonns) | (tonns) |
| Danube | Reni | LMR | 132 | | 26.83 | 5.76 | 271.55 | 375.05 | 464.00 | 329.97 | 14.84 | 1.530 |

Figure 5.1: Annual load of suspended solids at monitoring locations along the Danube River.

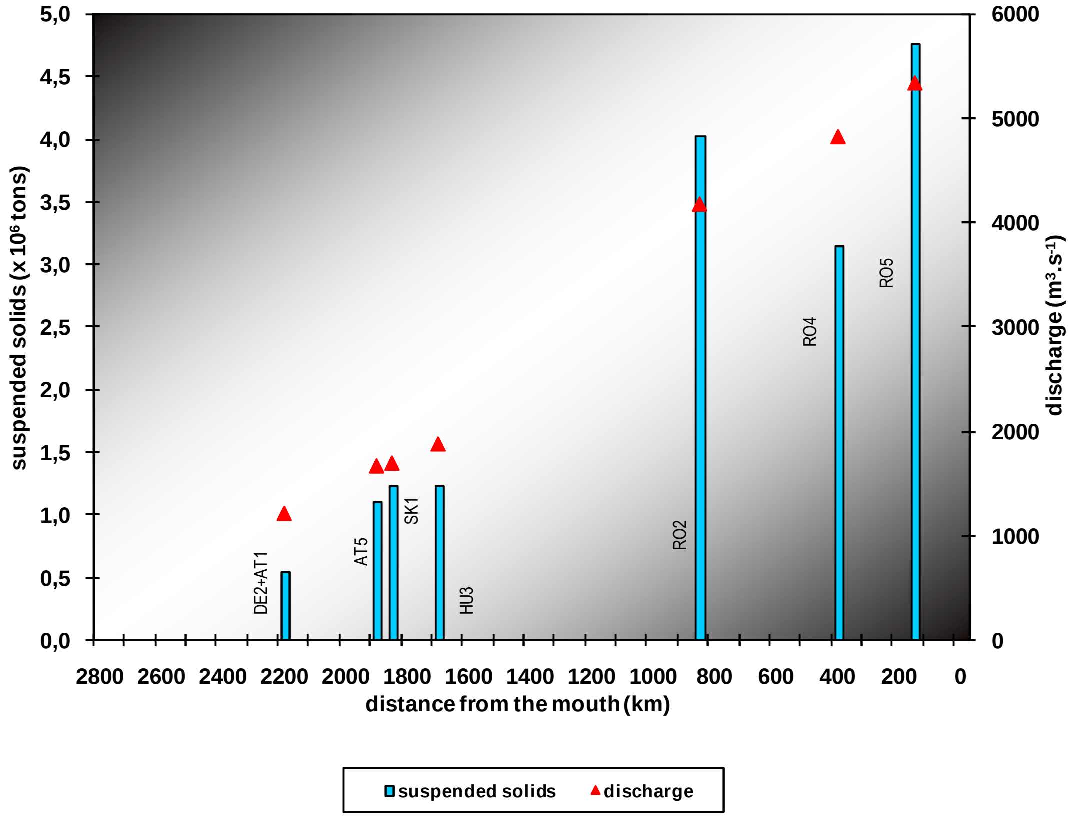



Figure 5.2: Annual load of suspended solids at monitoring locations on tributaries.

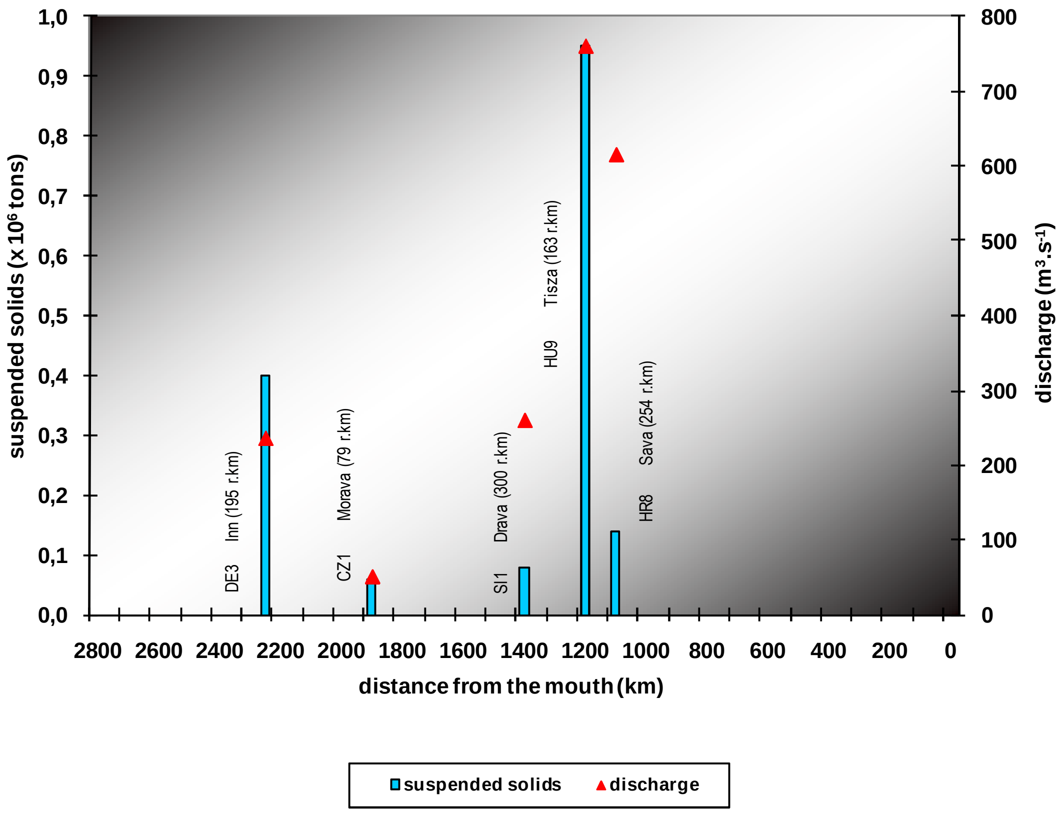


Figure 5.3: Annual loads of inorganic nitrogen at monitoring locations along the Danube River.

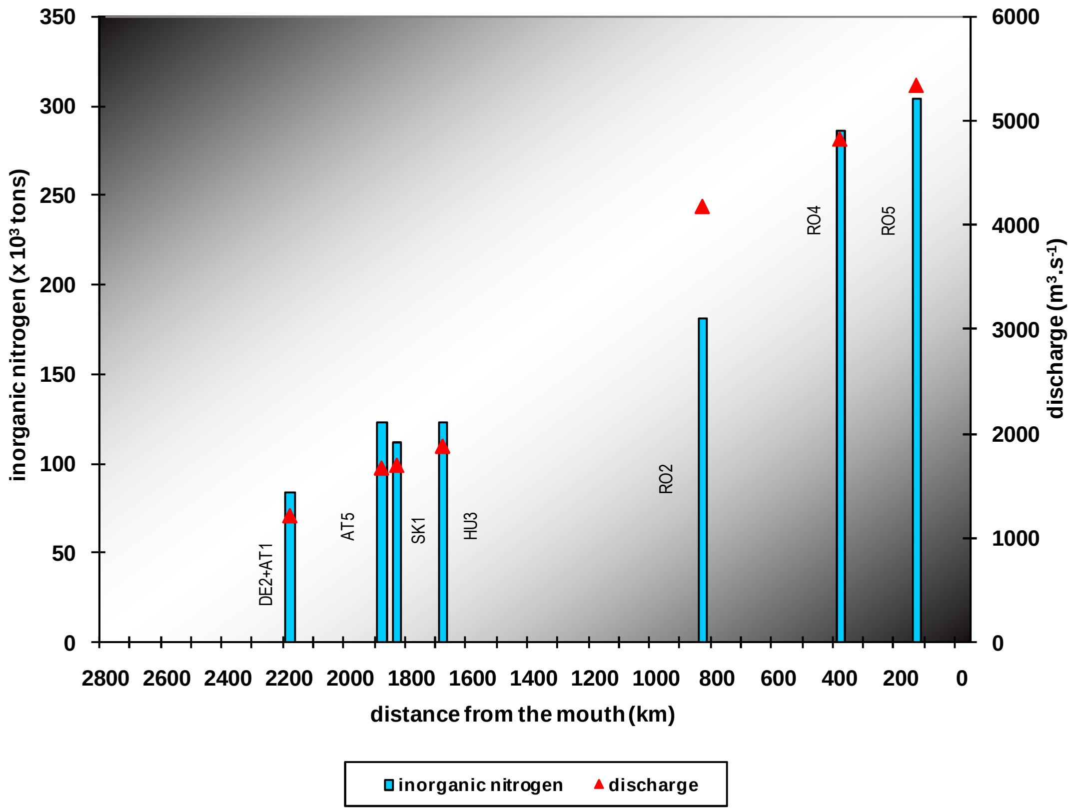



Figure 5.4: Annual loads of inorganic nitrogen at monitoring locations on tributaries.

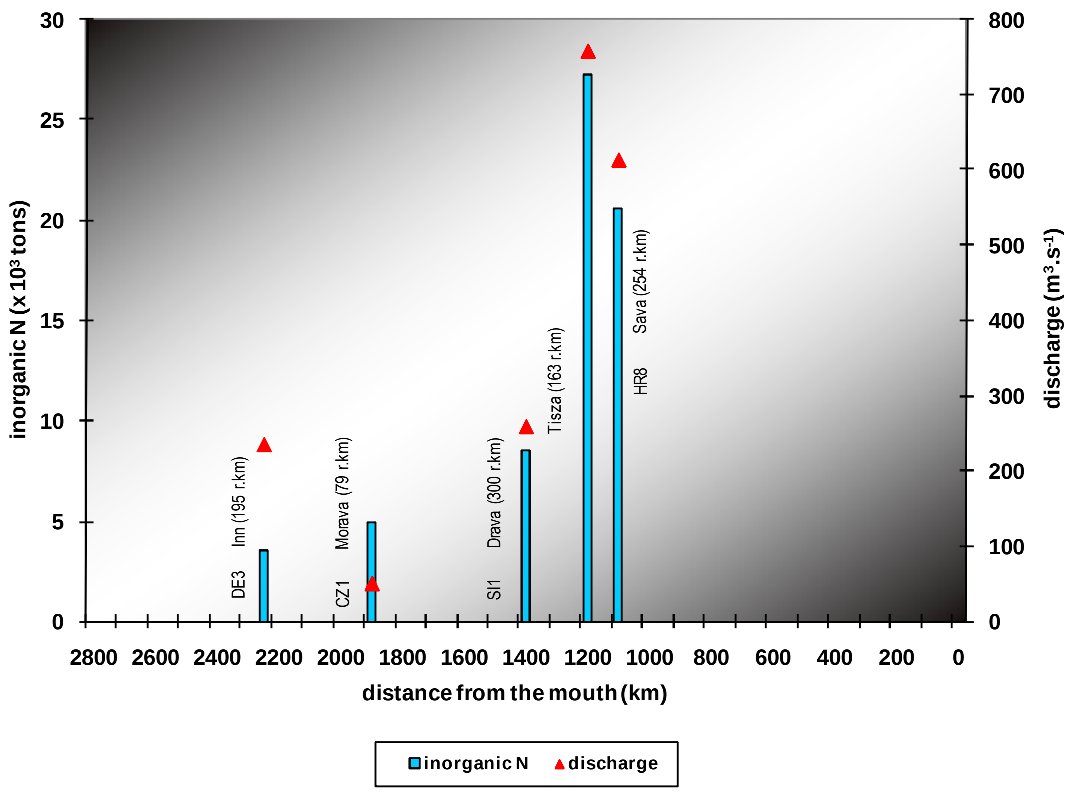


Figure 5.5: Annual loads of ortho-phosphate-P at monitoring locations along the Danube River.

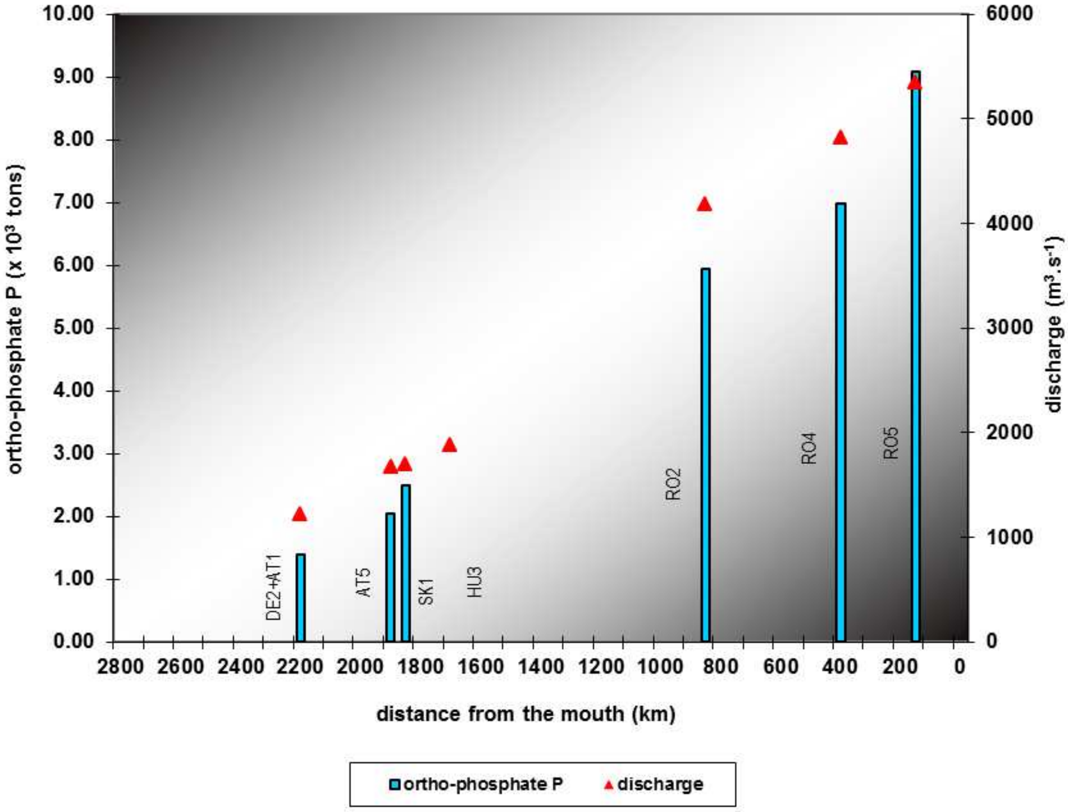



Figure 5.6: Annual loads of ortho-phosphate-P at monitoring locations on tributaries.

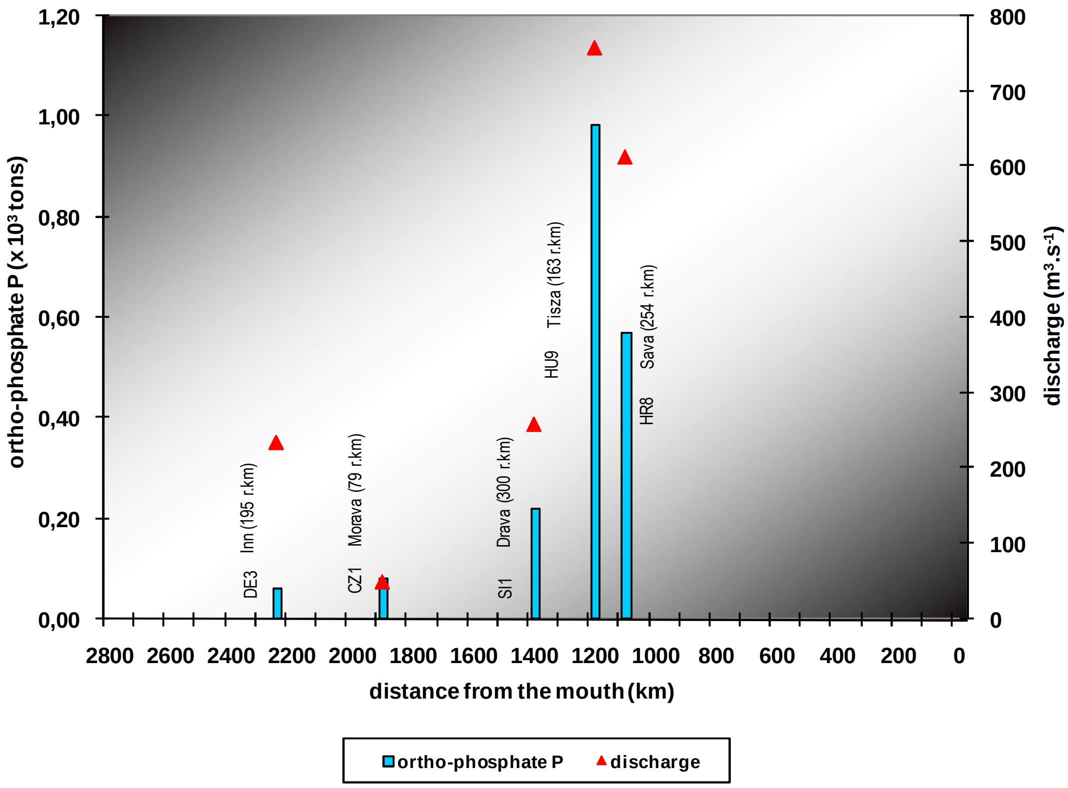


Figure 5.7: Annual loads of total phosphorus at monitoring locations along the Danube River.

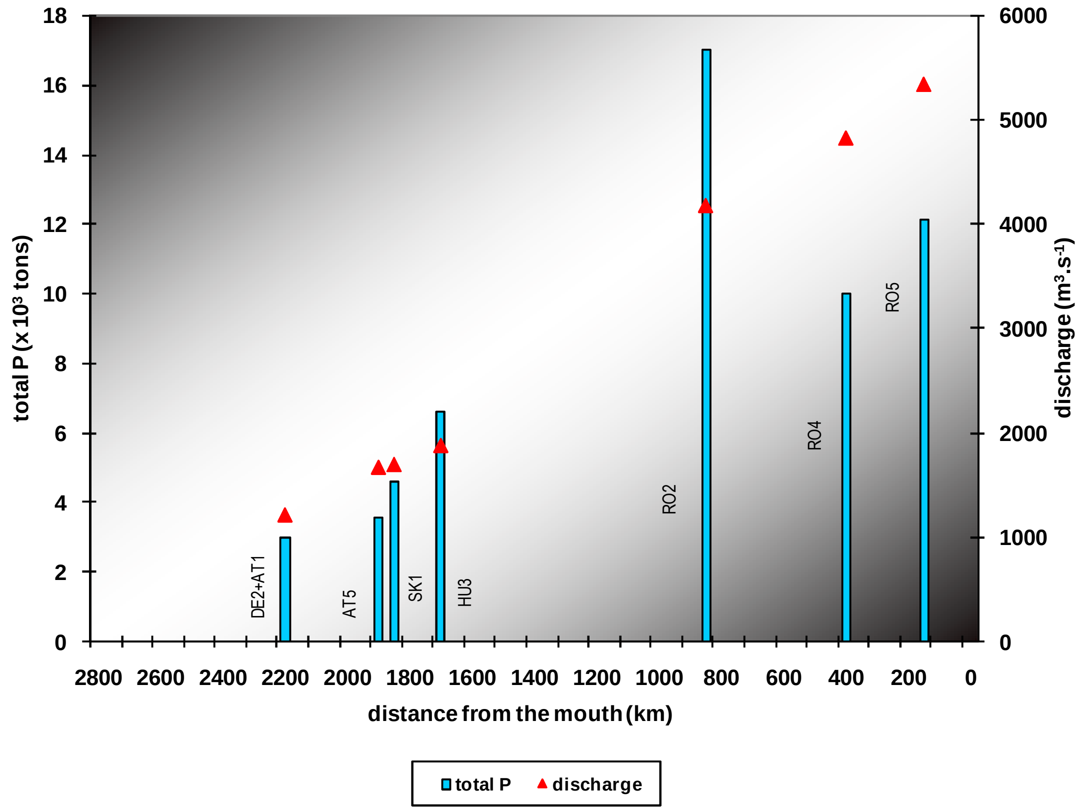



Figure 5.8: Annual loads of total phosphorus at monitoring locations on tributaries.

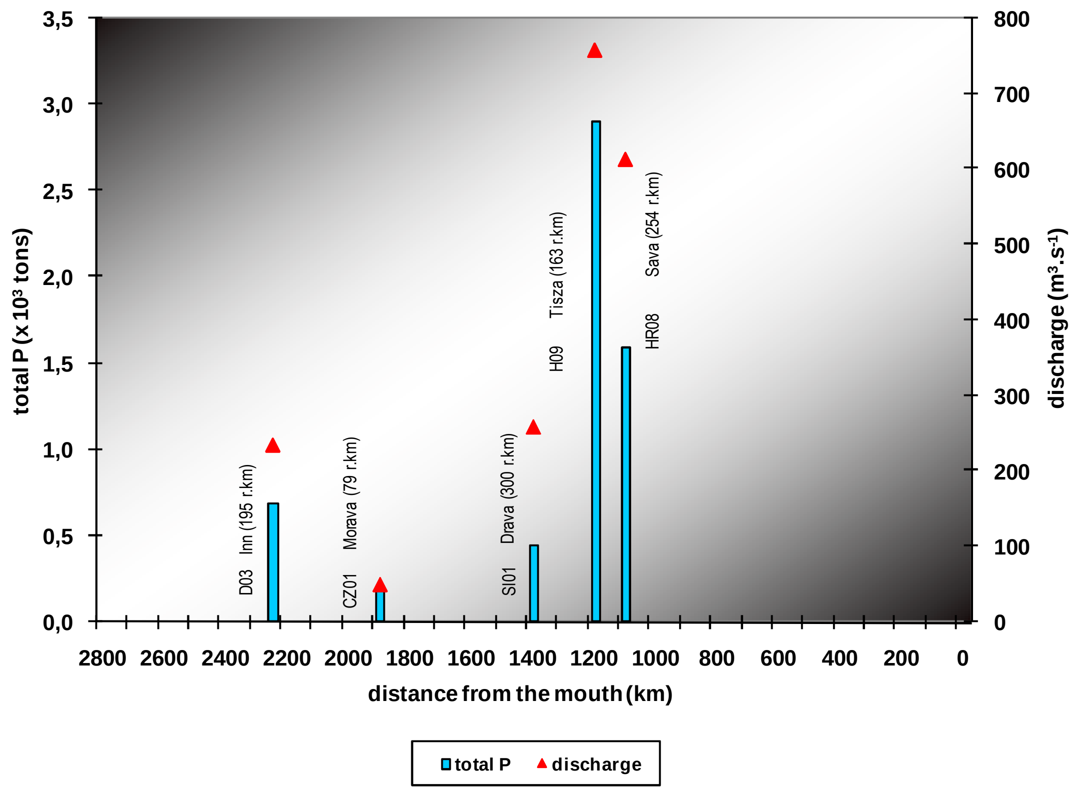


Figure 5.9: Annual loads of $BOD_5$ at monitoring locations along the Danube River.

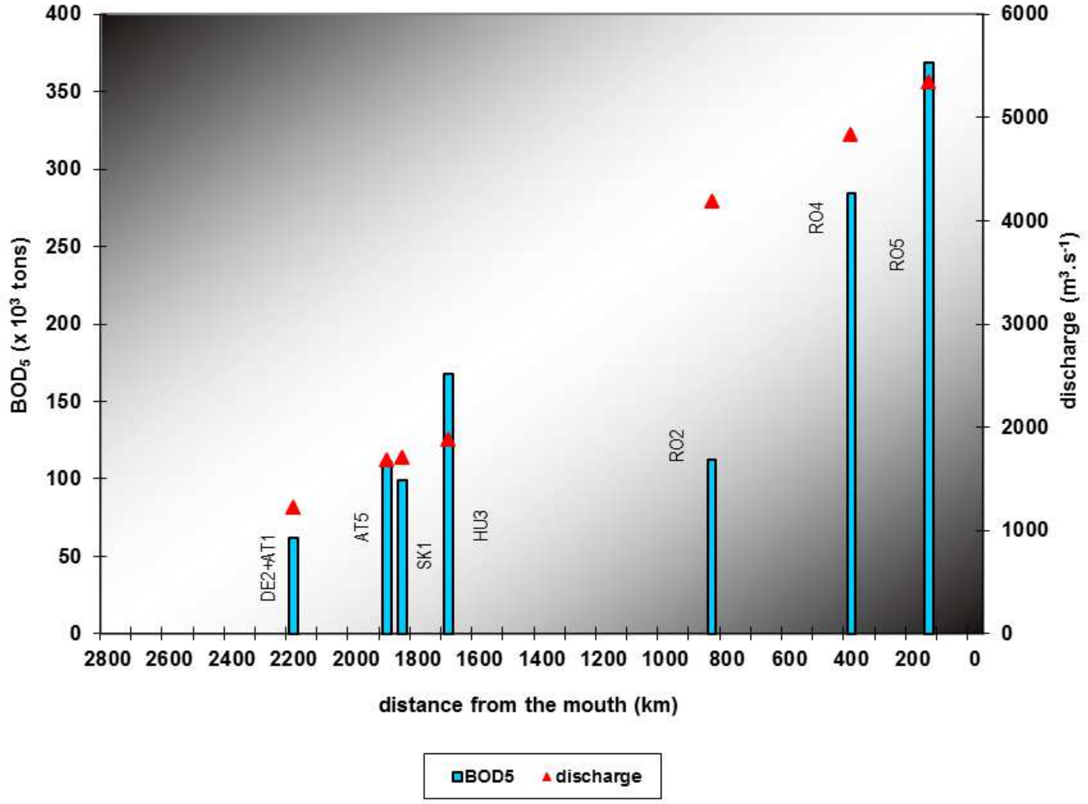



Figure 5.10: Annual loads of $BOD_5$ at monitoring locations on tributaries.

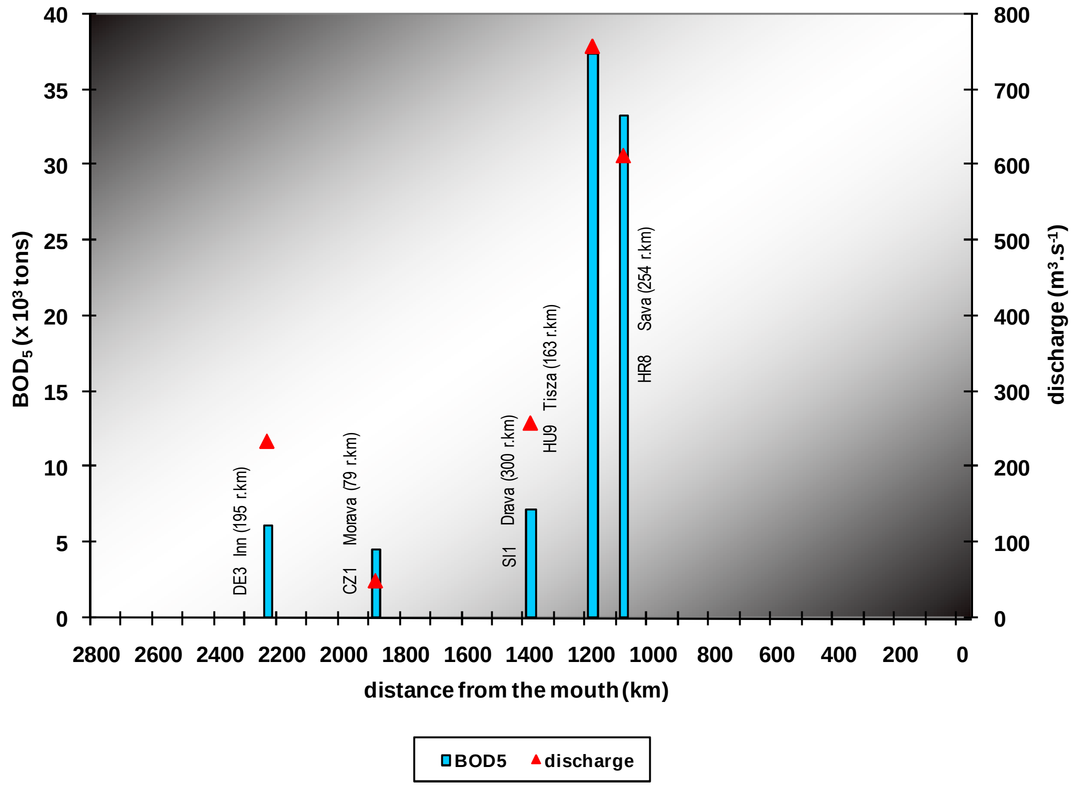


Figure 5.11: Annual loads of chlorides at monitoring locations along the Danube River.

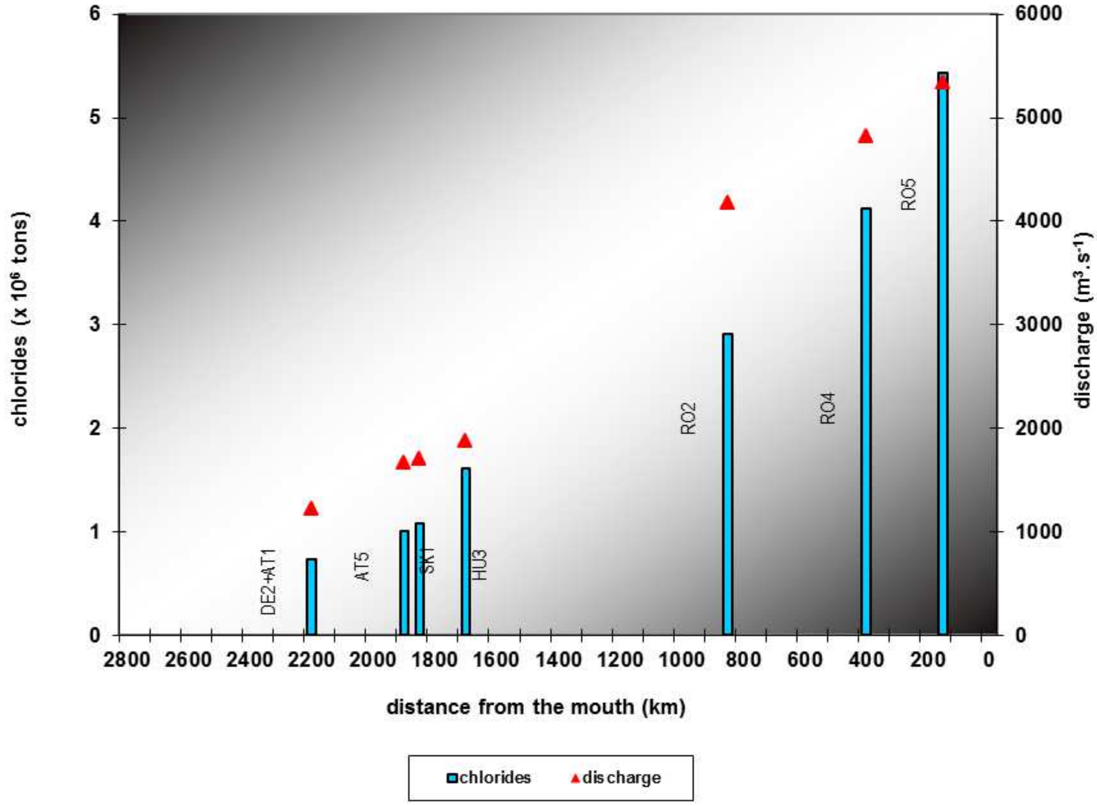
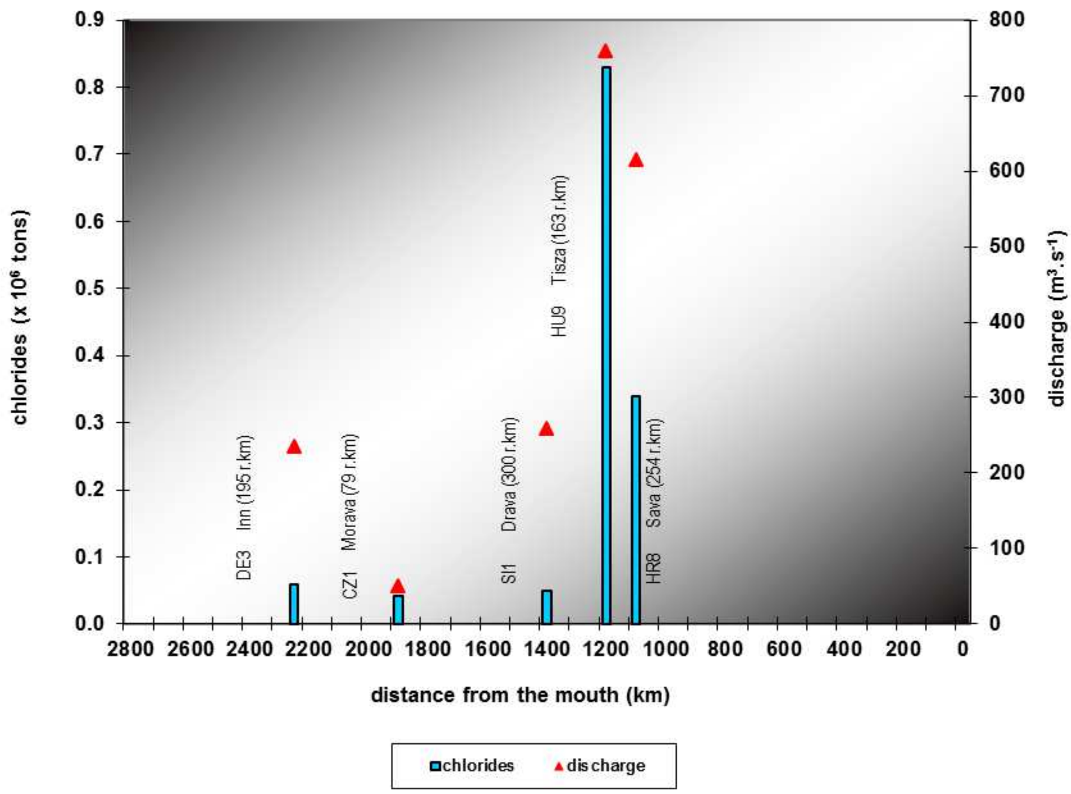



Figure 5.12: Annual loads of chlorides at monitoring locations on tributaries.



# 6. Groundwater monitoring

## *GW bodies of basin-wide importance*

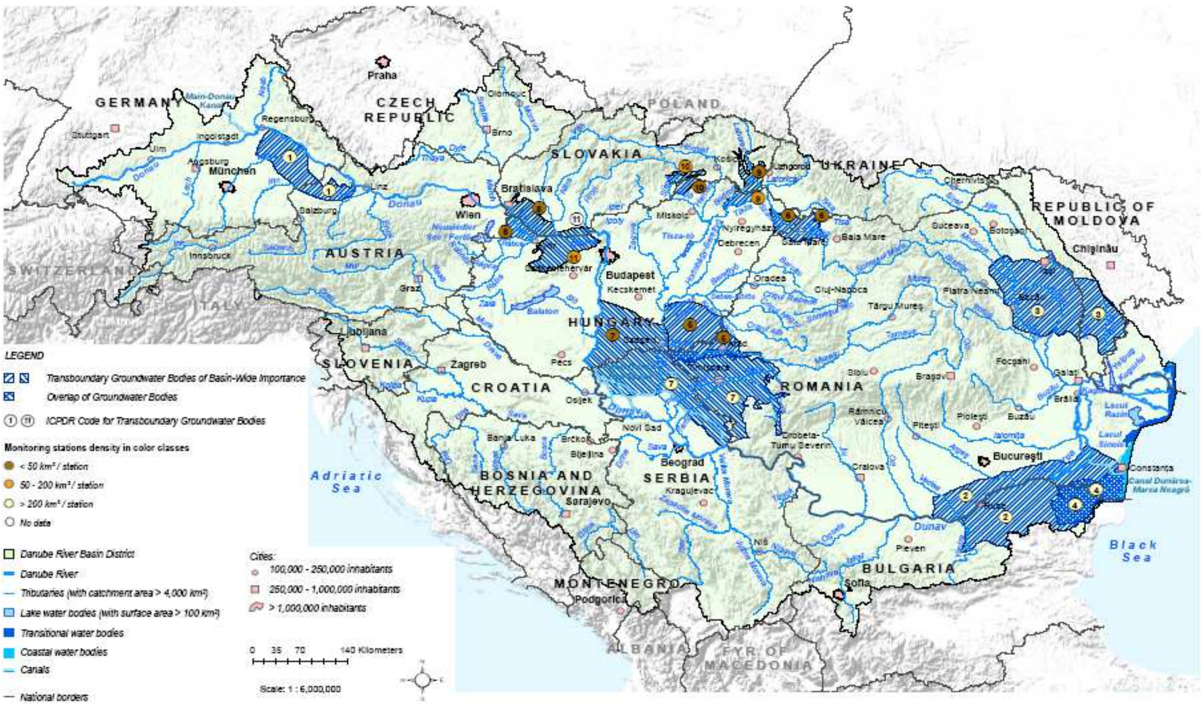
According to the Article 2 of the EU Water Framework Directive (2000/60/EC) 'Groundwater' means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. The analysis and review of the groundwater bodies in the Danube River Basin as required under Article 5 and Annex II of the WFD was performed in 2004 and it identified 11 GW-bodies or groups of GW-bodies of basin-wide importance, which are shown in Map (Figure 6.1.1).

GW-bodies of basin-wide importance were defined as follows:

- important due to the size of the groundwater body which means an area larger than 4000 km² or
- important due to various criteria e.g. socio-economic importance, uses, impacts, pressures interaction with aquatic eco-system. The criteria need to be agreed bilaterally.

This means that the other groundwater bodies even those with an area larger than 4000 km², which are fully situated within one country of the DRB are dealt with at the national level. A link between the content of the DRBMP and the national plans is given by the national codes of the groundwater bodies.

**Figure 6.1: Transboundary GW-bodies of basin-wide importance and their transnational monitoring network**



## *Reporting on groundwater quality*

According to the WFD groundwater is an integral part of the river basin management district and therefore monitoring of groundwater of basin-wide importance was introduced into the TNMN in the Danube River Basin. The detailed description of the current status in development of the groundwater monitoring network in the Danube River Basin District is given in the TNMN Groundwater monitoring report (Part II of the Summary Report to EU on monitoring programs in the Danube River Basin District designed under Article 8).

For groundwater monitoring under TNMN a six-year reporting cycle is foreseen, which is in line with the WFD reporting requirements. Information on status of the groundwater bodies of basin-wide importance is provided in the DRBM Plans published every six years. This sufficiently allows for making any relevant statement on significant changes of groundwater status for the GW-bodies of basin-wide importance.

# 7. Abbreviations

| Abbreviation | Explanation |
|---|---|
| **AQC** | Analytical Quality Control |
| **BSC** | Black Sea Commission |
| **DEFF** | Data Exchange File Format |
| **DRPC** | Convention on Cooperation for the Protection and Sustainable Use of the Danube River (short: Danube River Protection Convention) |
| **ICPDR** | International Commission for the Protection of the Danube River |
| **LOD** | Limit of Detection |
| **MA EG** | Monitoring and Assessment Expert Group (former MLIM EG) |
| **MLIM EG** | Monitoring, Laboratory and Information Management Expert Group |
| **NRL** | National Reference Laboratory |
| **SOP** | Standard Operational Procedure |
| **TNMN** | Trans National Monitoring Network |
| **WFD** | EU Water Framework Directive |
| **DRB** | Danube River Basin |
| **DRBMP** | Danube River Basin Management Plan |
| **GW** | Groundwater |
| **$BOD_5$** | Biochemical oxygen demand (5 days) |
| **$COD_{Mn}$** | Chemical oxygen demand (Potassium permanganate) |
| **$COD_{Cr}$** | Chemical oxygen demand (Potassium dichromate) |
| **TOC** | Total organic carbon |
| **DOC** | Dissolved organic carbon |
| **AOX** | Adsorbable organic halogens |
| **PAH** | Polycyclic aromatic hydrocarbons |
| **PCB** | Polychlorinated biphenyls |

//// Deutschland //// Österreich //// Česká republika //// Slovensko //// Magyarország //// Slovenija //// Hrvatska //// Bosna i Hercegovina //// Srbija i Crna Gora //// România //// България //// Moldova //// Україна ////

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