Watersketch, Minija river case study, the first phase 2005

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Introduction

The Watersketch-project focuses on combining the spatial planning and implementation of the Water Framework Directive (WFD). Minija river is one out of six case studies in Baltic Sea Region describing environmental problems and conflicts of river/lagoon basins and supporting sustainable development to create a water resources management plan according requirements of WFD. The aim this case study is to evaluate the impact of the hydrotechnical and recreational activities in the Minija river drainage area to the nature protected areas, migratory fish stocks, water quality and biodiversity. The results should be important for the sustainable development recommendations as well to mitigate the negative consequences.

Background Information on the Minija river basin

General characteristics of river basin

The Minija river - the right tributary of Atmata, the northern branch of the Nemunas Delta - is eighth river in Lithuania by length (201,8 km), its whole basin is located in Lithuanian territory and occupies 2942 km^2 (Gailiušis, Jablonskis, Kovalenkovienė,2001). The spring of the river is Didovo lake, situated approximately 200 km north-east from the mouth of the Minija River (App.).

Minija River basin, especially its Western part, is characterised by rather maritime climate. The mean annual air temperature is 5.6 – 6.4^{0}C. The coldest months are January and February, during winter season stable frosts, frozen ground, snow and ice cover occur in the Minija River basin a month later than in the rest of Lithuania. Air masses coming from the Atlantic Ocean in winter bring frequent thawing periods that prevent formation of permanent snow cover and cause significant fluctuations in hydrological regime of the river network. Summers are often cool and gloomy with rather abundant precipitation (VKI, et al,1994).

There are aproximately 1360 tributaries in the Minija river basin. But mostof them are less than 30 km lenght. The density of river network in Minija basin – 1,53 km/km^2. The 51% oh them are leftside tributaries.

The biggest (>40 km lenght) tributaries of Minija are:

- Tenenys River (left tributary, length – 71,9 km, basin area – 300,0 km^2);
- Veiviržas River (left tributary, length – 67,9 km, basin area – 668,0 km^2);
- Alantas River (left tributary, lenght – 42,9 km and 146,4 km^2);
- Babrungas River (right tributary, lenght – 47,3 km and basin area – 270,4) and
- Salantas River (right tributary, lenght 42,1 km – basin area – 268,5 km^2).

The exceptional feature of Minija River Basin is the difference of length of right and left tributaries. Majority of the right tributaries of Minija are short, while the left ones are long, therefore the Minija basin is asymmetric. This asymmetry is caused by relief, which was formed during the glacier period in Western Lithuania and by later post-glacial processes.

Near the mouth (18,4 km) the Klaipėda (Vilhelmo) channel connects Minija River with Klaipėda harbour. From its source to the mouth Minija descends 157 m, creating an average slope of 0.8‰. The annual average water discharge in the mouth of the Minija river is 39m^3 /s, i.e. an average runoff coefficient of 13 l/s/km^2.

The Minija River exhibits an unusual characteristic – it discharges to two locations. The major flow discharges to the Nemunas River (Atmata), the remainder flows direct to the Curonian Lagoon (via Upaitis) or to Klaipėda harbour via Klaipėda channel. It is recommended to assign the Minija River basin as a sub-basin of the Nemunas River for the below listed specifications:

- the major discharge is to the Nemunas River;
- discharge direct to the Curonian Lagoon during cold weather occurs infrequently;

- § the water quality of the Curonian Lagoon and the Lithuanian part of the Baltic Sea coastal zone is dominated by the Nemunas River discharge (hence the Curonian Lagoon and the coastal waters of the Baltic Sea are likely to be attributed to the Nemunas River basin district) (Center for ..., 2003).

However the discharge to the Nemunas River may cease due to ice jams hence the Minija River discharges direct to the Curonian Lagoon and sometimes acts as a separate river basin.

Minija is a river with dominance of rain floods in the runoff balance. About half of the total runoff comes from rainwater, snow and ground water comprises 22% and 25% respectively. The highest water level in the river is observed from November to March (Kilkus 1998). From a geomorphologic aspect Minija River basin could be divided into several smaller units: the very upstream of Minija runs across Mid-Žemaičiai Highland, formed by the fringe of glacier: with medium size hills, with abundance of lakes and marshy depressions. Below Zarėnai settlement Minija enters a 20-25 m deep valley. Crossing the Western Žemaičiai plateau, the Minija River crosses several low ridges, formed by the glacial fringe.

The upper part of the Minija River basin is largely occupied by forests, where coniferous tree species prevail. The share of forested area in the Minija River basin is about 21 percent. Part of the river that is located in the coastal lowland is attributed to southern floristic belt with temperate vegetation. In the valleys of Minija and its larger tributaries grass plants of flood platins dominate.

Lakes in basin area cover only 0,6% of the area of the basin, while bogs and marshes cover 5,2% of the basin area. There are 17 impoundments in the basin, total area ~ 1539 ha (0,41%). The basin of Babrungas, right tributary of Minija, differs significantly from the rest of territory with 5.5% of lakes and 14.1% of bogs.

The soil cover on the entire territory is quit homogenous and only glacial highlands in the north east characterized by local diversity and contrast. The share of forested area of the Minija river basin is 21.4% which is less than the average percentage for Lithuania (Babrungas river basin - 47% and Tenenys basin – 37%).

State of water resources and biodiversity

The biodiversity and natural landscape of Minija River basin is protected through the national nature protection network. There are a big number of protected areas located in basin. The most important of them are:

Žemaitija National Park. It was established in 1991 with the aim of preserving, managing and sustainable development those areas of Žemaitija in north – western Lithuania, that are most valuated for their natural and cultural qualities. The part of them belongs to Minija River basin.

Regional Park of Salantai situated on the junction of Kretinga, Skuodas and Plunge regions and occupies 13630 ha was established in 1992. It covers interesting and valuable natural complexes and objects of North West Lithuania. Regional Park of Nemunas' delta aims to protect the landscape of Nemunas' delta, its natural ecosystem and the values of cultural heritage. Since 1993 the park is inscribed into the Ramsar convention list of the territories of international importance.

The 155.9 km of river belongs to Minija river ichtiological reserve. Here are protected reproduction areas for Salmon, sea trout and vimba – all of this species are migratory. Minija river is mentioned as index river in "Baltic salmon action plan 2010", prepared by IBSFC and HELCOM. There are a number of smaller landscape, geomorphological, pedological, telmological, botanical and entomological reserves in Minija River basin area also.

Hydrochemical conditions of the water in the Minija river basin are predetermined by the chemical compositions of rocks and water regime. Infiltration of precipitation and soil erosion in the Minija river basin take a longer time and are more intensive than elsewhere in Lithuania. It means that the amount of leaching of chemical elements is larger. Especially big amounts of chemicals leach from cultivated soils. Agricultural land occupies large part of the river basin – approximately 52% of the whole basin area, therefore the contamination of the surface water directly depends on the intensity of agriculture. It was experimentally established that under Lithuanian conditions,

depending on type of soil and agricultural practices, the leaching of nitrate nitrogen ranges from 10 to 140 kg/ha/year.

The hydrological and meteorological parameters are monitored in the stations of the hidrometeorological service. The runoff of Minija basin is monitored in the Minija River at the Kartena and at the Lankupiai, in the Veiviržas – near Mikužiai and in the Upita River at Eidukai. Meteorological observations are carried out in Vėžaičiai and Kartena. Since 1992 Joint Research Centre was responsible for the river monitoring, since 2003 newly established Environmental Protection Agency from now on is responsible for river monitoring.

The quality of rivers water in the Minija River basin is presented in anual reports on the Water Quality regional environment protection department of Klaipeda (see table below).

Classification of rivers in the Minija River basin according to the general parameters

River	Location	Parameter	1997	1998	1999	2000	2001	2002
Minija	Upstream Plungė	BDS_7, mgO_2/l	2,2	2,9	1,8	1,7		
		N_{min}, mgN/l	1,053	1,042	1,117	1,003		
		PO_4-P, mgP/l	0,037	0,037	0,043	0,036		
	Downstream Plungė	BDS_7, mgO_2/l	2,0	2,8	1,7	2,1		
		N_{min}, mgN/l	1,351	1,057	1,331	1,244		
		PO_4-P, mgP/l	0,060	0,047	0,067	0,085		
	Downstream Gargždai	BDS_7, mgO_2/l	1,9	2,0	2,3	3,2	4,0	2,3
		N_{min}, mgN/l	1,673	1,531	0,950	1,032	1,21	0,72
		PO_4-P, mgP/l	0,032	0,032	0,031	0,031	0,04	0,12
	Downstream Priekulė	BDS_7, mgO_2/l	2,3	2,0	2,3	2,6	2,6	2,6
		N_{min}, mgN/l	1,565	1,490	0,934	1,011	1,40	0,65
		PO_4-P, mgP/l	0,032	0,024	0,029	0,029	0,03	0,04
Veiviržas	Near Veiviržėnai	BDS_7, mgO_2/l	2,0	2,0	1,7	2,3	2,2	2,1
		N_{min}, mgN/l		1,23	0,76	0,92	1,08	0,56
		PO_4-P, mgP/l		0,02	0,03	0,03	0,02	0,05

Human activities.

The following issues are important and may influence water qualities and habitats for wildlife in Minija river basin:

- § agriculture;
- § recreational activity;
- § hydrotechnical activities (damming of river for hydropower stations);
- § waste water from Minija river drainage area;
- § oilfield exploitation.

Agriculture has been prevailing in the rest of the river basin till the middle of 1990s. Since 1995 use of land for agricultural purposes has been decreasing. Currently approximately 53% of land is used for agricultural purposes. Flax has been among most popular crops in the northern part of the river basin, therefore flux production companies have been serious polluters. Currently flux production is approximately 30% lower than in 1995.

As it was mentioned above the soil erosion is intensive in Minija River basin and the pollution of the river is highly dependent on the agricultural practices. The results of assessment of river quality presented in the Master plan also suggest that agricultural production activities have a significant impact on rivers in the Nemunas Lowland River basin. The nutrient loads from livestock farms to the environment are also significant (Center for ..., 2003).

The Minija River basin is situated near the Baltic Sea; therefore fishing is one of the traditional occupations in the basin. In particular fishing is popular in the southern part of the basin, where river enters the Curonian lagoon. Bigger part of the population in Šilutė region is employed in fishing business. Fishermen of the region have established the fishermen association

“Lampetra”. There are anglers also. Active fishing in the Minija river basin caused a decrease of fish populations; moreover illegal fishing creates another serious problem of the region.

New activities like ecological farming and water tourism are emerging in the region. Water tourism and agricultural tourism are being developed at the bigger rivers of the basin and in the Nemunas Delta Regional Park. Agricultural tourism has also strong potential in the area of Žemaitija National Park.

Hydrographic network of the basin is affected because of modification of water bodies. Currently there are three hydropower energy stations built in the river basin. There are three power stations in Minija River basin:

Hydropower stations constructed in the Minija River basin

Name of the station	River	Distance to the river mouth, km	Water flow, m³/s	Dam	
				area (ha)	capacity, (1000 m³)
Plungė HE	Babrungas	21,5	2,74	1,5	30
Gondinga HE	Babrungas	15,5	2,95	88,0	3420
Vasiliausko	Kartenalė	1,5	-	-	-

A Master Plan was prepared for Nemunas Lowland River basin in 2002 as a background document for the program of the implementation of the Urban Waste Water Directive (Centre for ..., 2003).

The economic analysis of water use in the Nemunas Lowland basin was carried for the preparation of Master Plan. The situation on water use in the settlements of the Minija River Basin is provided in the table below.

Consumption of water in the settlements of the basin of the Minija River.

Source:

Master Plan …, 2002 (Center for …, 2003)

Municipality	Settlements with more than 500 inhabitants	Amount of inhabitants	Water tariff, Lt/m³	Consumption of water, m³/day /person*	Water consumption in the settlement, m³/dieną	Cost of water, Lt/year	Expenditures for water, Lt/year /person
Klaipėda region (Househods use 45% of water)	Gargždai	15000	3,06-4,06**	0,12	1800,00	6498,00	134,12
	Dovilai	1279		0,05	63,95	230,86	55,88
	Vėžaičiai	1825		0,06	100,38	362,35	61,47
	Kvietiniai	562		0,05	25,29	91,30	50,29
	Endriejavas	748		0,05	37,40	135,01	55,88
	Agluonėnai	740		0,05	37,00	133,57	55,88
	Judrėnai	586		0,05	26,37	95,20	50,29
	Veiviržėnai	1080		0,05	54,00	194,94	55,88
	Ketvergiai	500		0,05	22,50	81,23	50,29
	Priekulė	1800		0,06	99,00	357,39	61,47
	Total	**24120**			**2265,89**	**8179,84**	
Kretinga region (Households use 71% of water)	Salantai	2200	4,46-4,38	0,06	121,00	536,85	89,60
	Kūlupėnai	1332	2,87-5,26	0,05	66,60	237,30	52,41
	Kartena	1041		0,05	52,05	185,46	52,41
	Baubliai	536		0,05	24,12	85,94	47,17
	Total	**5109**			**263,77**	**1045,56**	
Skuodas region	Notėnai	513	4,68	0,05	23,09	108,04	76,92
	Total	**513**			**23,09**	**108,04**	
Šilutė region	Saugos	962	4,08	0,05	48,10	196,25	74,51
	Vilkyčiai	878		0,05	43,90	179,11	74,51
	Gardamas	501		0,05	22,55	91,98	67,06
	Inkakliai	519		0,05	23,36	95,29	67,06
	Švėkšna	2208		0,06	121,44	495,48	81,96
	Total	**5068**			**259,34**	**1058,11**	
Plungė region	Plungė	24696	3,21	0,12	2963,52	9512,90	140,69
	Plateliai	990		0,05	49,50	158,90	58,62
	Kuliai	927		0,05	46,35	148,78	58,62
	Šateikiai	787		0,05	39,35	126,31	58,62
	Stalgėnai	502		0,05	22,59	72,51	52,76
	Norvaišai	502		0,05	22,59	72,51	52,76
	Total	**28404**			**3143,90**	**10091,92**	
TOTAL:		**63214**			**5955,98**	**20483,47**	

**the norms for consumption are determined according to the size of settlemen: **private use – industries*

The economic analysis carried out for the Master plan however does not correspond to the economic analysis of water use required by the WFD. The environmental costs of water use that need to be evaluated were not included in the analysis carried for the Master Plan (Centre for ...,2002).

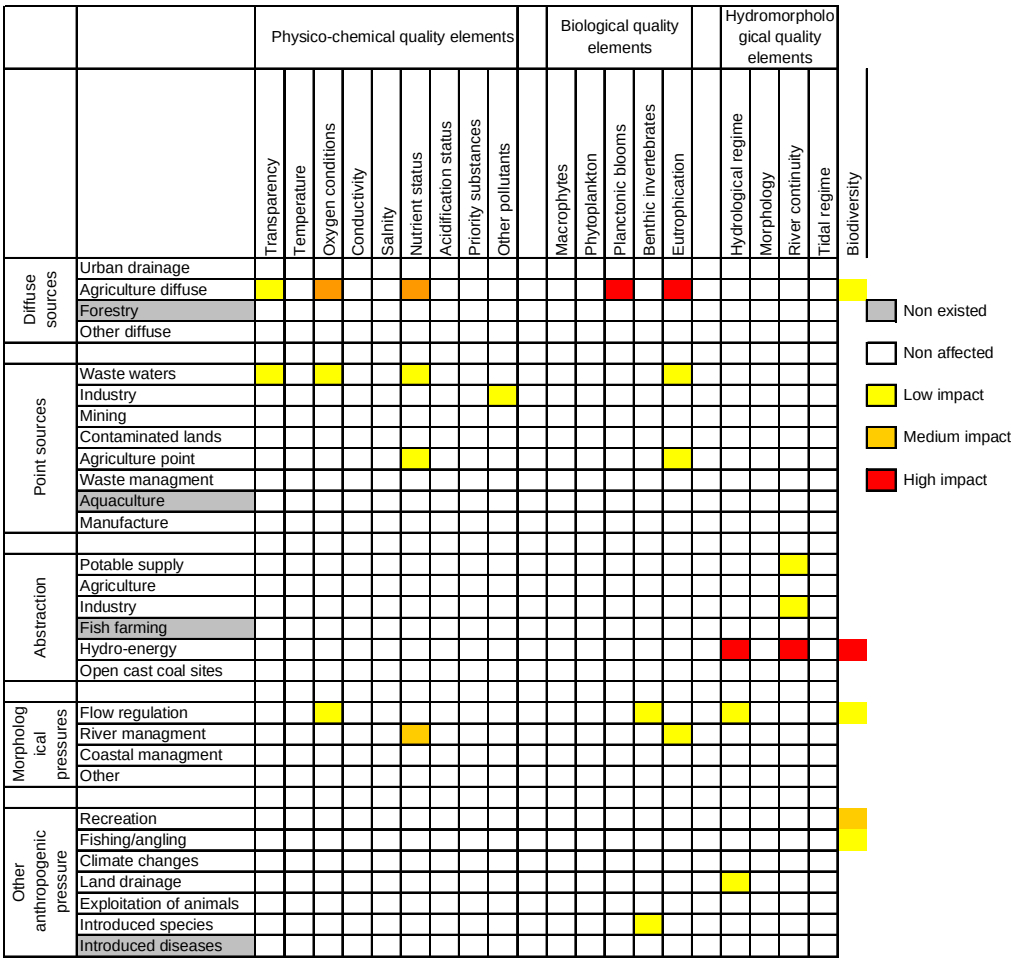
Wastewater

The biggest urban areas in Minija River basin are Plunge, Gargždai and Salantai There are no important industrial branches developed in the Minija River basin, except oil exploration. Oil was discovered in Lithuania in the 1950s. Oil exploration in western Lithuania began in 1958. Presently

not many wells are operating, but all oh them are located in the western part of the country mostly in Minija basin area.

Environmental and water related problems

Preliminary estimation of impacts and pressures in the Minija river drainage area are presented in following matrix:



Problems that directly relate to the requirements of the WFD are diffuse sources of immissions in Minija river basin waters, biodiversity protection and activities related with hydroenergy.

The importance of this river for the reproduction of migratory fish species, especially wild Baltic salmon and sea trout create here conflicts between EU requirements on protection of biodiversity, water quality and use of removable energy sources.

Diffuse sources mainly derive from land-runoff. In areas of high population density, surface run-off can contribute substantially to the quality of small-scaled water bodies. Significant input can also be expected by diffuse emissions from agricultural used areas in form of nutrients and fertilizers.

Workplan of the case study (until 3rd milestone

This study is lead by the Coastal research and planning institute, Klaipeda University. General background information consists of hydraulic regime, water quality, fish stocks data, nature protected areas, biodiversity and socio-economic data. A risk assessment on the basis of existing information will be carried out in order to prioritize risks and sources with regard to the

implementation of the WFD.

- Schedule 2005

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Meetings												
Data & information gathering												
Risk Assessment												
Reporting												

- Parties involved: environmental authorities, fisherman associations, administrations of nature protected areas, municipalities, hydroenergetics, recreational tourism companies.
- Final outcome: Prioritization of different sources and activities with regard to their contribution to the water quality, protection of rare fish species and biodiversity; recreation, recommendations for management activities

References

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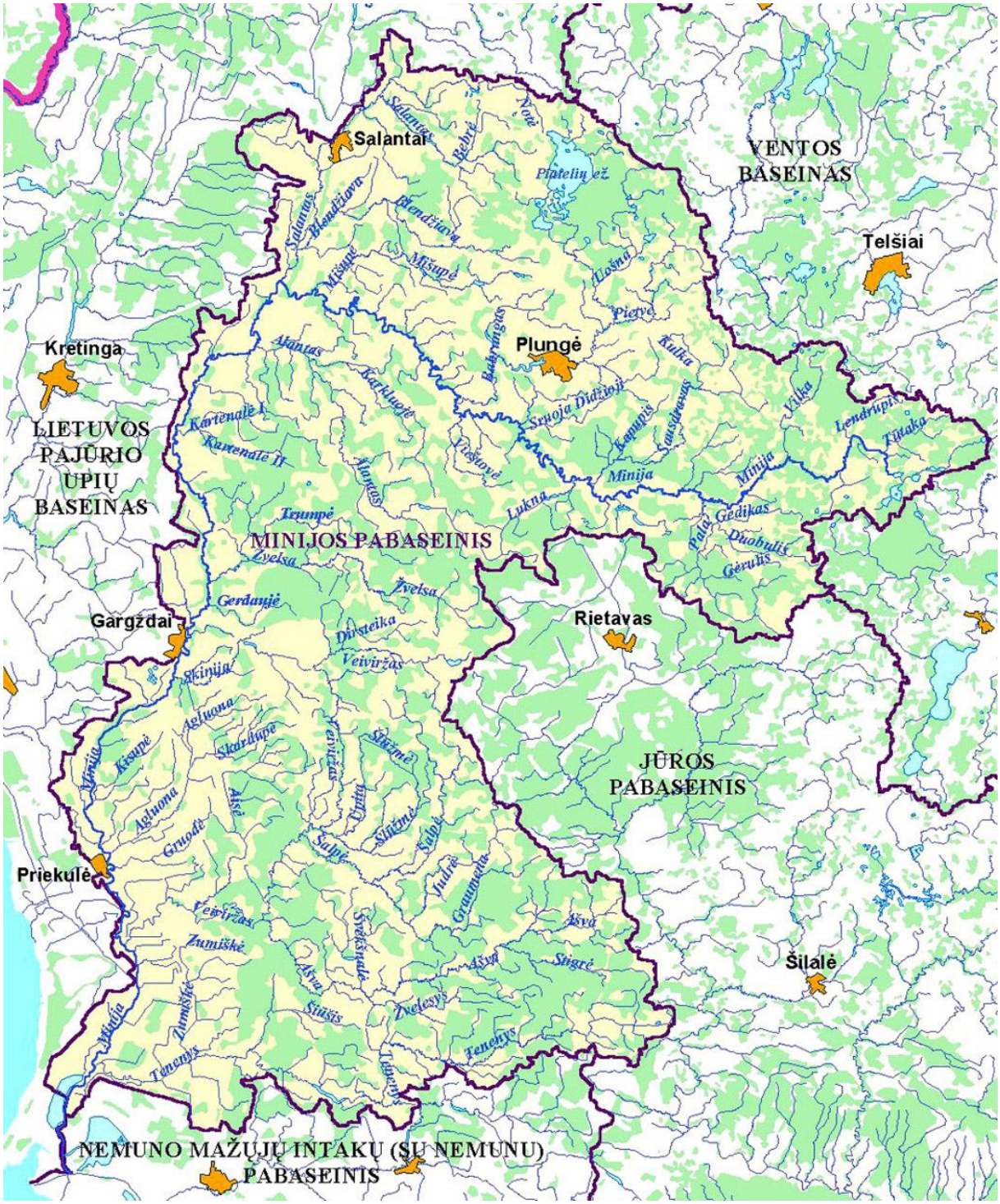
3. Kilkus, K. (1998) Lietuvos vandenų geografija, Vilnius
4. Lietuvos upių vandens kokybės metraščiai (Annual reports on the Lithuanian Rivers Quality) (1995 – 2002) Ministry of Environment, Vilnius
5. Project "Transposition of the EU Water Framework Directive and Elaboration of a National Strategy for the Management of Water Resources in Lithuania" Technical Note 1: River Basin Districts.
6. VKI, Denmark, Institute of Geography, Lithuania and Klaipėda university, Lithuania (1994). Runoff of Nutrients

EU - Water Framework Directive:
http://europa.eu.int/comm/environment/water/water-framework/index_en.html

http://www.vilniusconsult.lt/index.php/pageid/111 (Master plan.....2002)

Appendix:


Salantai
Kretinga
Plungė
Telšiai
Gargždai
Rietavas
Priekulė
Šilalė
VENTOS BASEINAS
LIETUVOS PAJŪRIO UPIŲ BASEINAS
MINIJOS PABASEINIS
JŪROS PABASEINIS
NEMUNO MAŽŲJŲ INTAKŲ (ŠU NEMUNU) PABASEINIS