VIRU-PEIPSI CATCHMENT AREA MANAGEMENT PLAN

Draft

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INTRODUCTION

The use and protection of water has been regulated in the European Union through specific directives for nearly 30 years already. The Water Framework Directive (2000/60/EC) adopted in 2000 constitutes an attempt to combine the efforts in the field of water policy, serving the following objectives:

- Water management must be based on river basins;
- All waters need to be protected – surface waters, groundwater and coastal water;
- Combined use of emission limit values and environmental quality standards;
- Further deterioration of the state of waters must be prevented;
- "Good status" of all water bodies is to be achieved by 2015 or, with good reason, by 2027 at the latest;
- A good ecological potential of artificial or heavily modified water bodies is to be ensured;
- True and fair price of water;
- More active involvement of citizens in decision-making processes.

One of the central principles of the Framework Directive on Water Policy (Water Framework Directive, WFD) is water management based on river basins. According to the WFD, a water management plan is to be drawn up for each river basin district, specifying measures to achieve the targets set for the district by the year 2015 and, subsequently, within every 6 years. For preparing a water management plan for the Viru-Peipsi catchment area, an international LIFE-Environment project *„Viru-Peipsi Catchment Area Management Plan"*(LIFE00ENV/EE/00025) was launched in 2002. The project financed by the European Union (LIFE-Environment), the French Environmental Fund (*Fond Francais pour L'Environement Mondial*), the Estonian Environmental Investment Centre and the Estonian Ministry of the Environment.

The project deals with the Viru and Peipsi river basin sub-districts (Figure 1), referred to as the Viru-Peipsi catchment area for the purposes of this project and hereinafter in this document.

The Viru-Peipsi Catchment Area Management Plan was drawn up with the involvement of the following institutions and experts:

- Estonian Environment Information Centre (EEIC)
- French Geological Survey (BRGM)
- French National Geographic Institute (IGN-FI)
- Estonian Ministry of the Environment (MoE)
- Institute of Zoology and Botany, Estonian Agricultural University (ZBI), reorganised into Institute of Agricultural and Environmental Sciences (IAES)
- Institute of Environmental Engineering, Tallinn University of Technology (TUT IEE)
- Institute of Geology, Tallinn University of Technology
- Maves Ltd.
- Maa ja Vesi Ltd.
- Estonian Water Consultancy Ltd. (EWC)
- Wildlife Estonia (WE)
- Geological Survey of Estonia
- County Environmental Departments
- Local authorities
- Astrid Saava (health protection expert)
- Urmas Lips (marine expert)

As an outcome of Phase I of the project, an assessment of the state of surface waters and groundwater of the area was prepared. The materials were published in 2004 as a summary publication “Viru-Peipsi Catchment Area Management Plan, Assessment of the State of Surface Water Bodies and Groundwater” in Estonian and English languages.

Phase II of the project resulted in the preparation of an assessment of human impact, an economic analysis and a programme of measures until 2009 and 2015, which aims to achieve a good status of water bodies and groundwater and to ensure the supply of high quality drinking water to the population.

The materials of the Catchment Area Management Plan are available on the home page of the Viru-Peipsi LIFE project (www.envir.ee/viru.peipsi).

Figure 1 Boundaries of river basin districts (RBD) and sub-districts (SRBD)

1 VIRU-PEIPSI CATCHMENT AREA

1.1 General data

1.1.1 Location and area

The Viru-Peipsi catchment area (Figure 1) encompasses 38% of the territory of Estonia (coastal sea excluded), thus being the largest river basin district in Estonia and, unfortunately, also the one with the severest environmental problems.

Table 1 Viru-Peipsi catchment area

District	Total area km^2	Area km^2
Land area and small lakes of Viru river basin sub-district		5146
Land area and small lakes of Peipsi river basin sub-districts		10 420
Lake Peipsi (islands included) and the Estonian part of it	3555[1]	1570
Narva Reservoir (islands included) and the Estonian part of it	106	35
Coastal sea associated with the Viru river basin sub-district (islands included, boundary undefined)		3362
Viru and Peipsi sub-districts together (for the purposes of this project – the Viru-Peipsi catchment area)		**20 533**
Võrtsjärv river basin sub-district		3259
Three East-Estonian river basin sub-districts together		23 792

[1] With water level at 30.0 m above sea level. When water level is at 30.1 m, the area is 3583 km^2

The areas for transboundary water bodies and coastal sea are not final, as the official border between Estonia and Russia has not been defined and a map of the extent of coastal sea is absent.

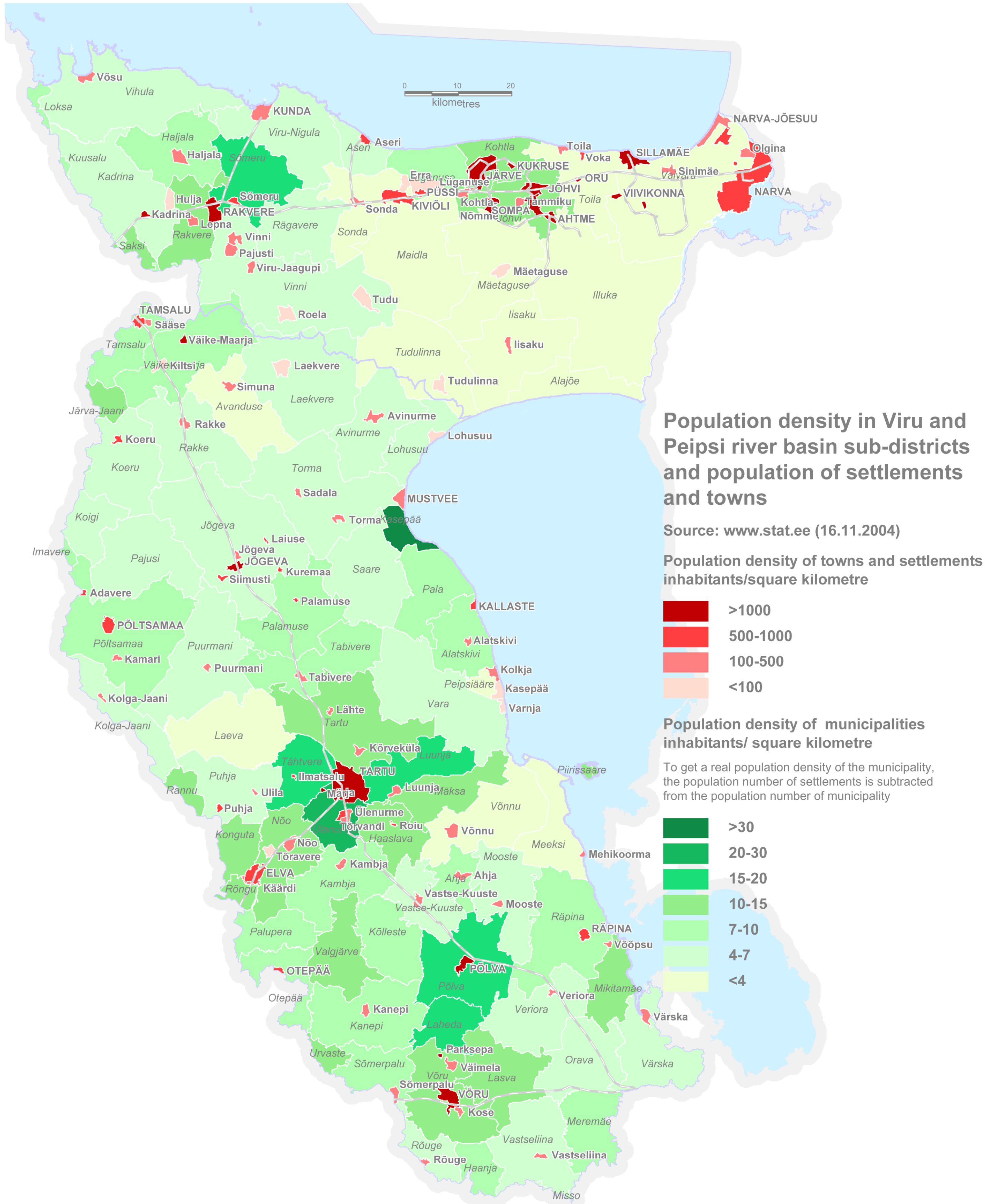
1.1.2 Administrative division and population

The Viru-Peipsi catchment area includes either the whole or part of 19 towns and 89 rural municipalities in 10 counties (Figure 2).

Table 2 Administrative units in Viru-Peipsi catchment area

County	Municipalities falling within the Viru-Peipsi catchment area
Ida-Viru (East-Viru)	Rural municipalities of Alajõe, Aseri, Avinurme, Iisaku, Illuka, Jõhvi, Kohtla, Kohtla-Nõmme, Lohusuu, Lüganuse, Maidla, Mäetaguse, Sonda, Toila, Tudulinna and Vaivara, towns of Jõhvi, Kiviõli, Kohtla-Järve, Narva-Jõesuu, Narva, Püssi and Sillamäe
Lääne-Viru (West-Viru)	The municipalities of Avanduse, Vihula, Viru-Nigula, Haljala, Kadrina, Sõmeru, Rägavere, Rakvere, Rakke, Vinni, Väike-Maarja and Laekvere and the towns of Rakvere, Kunda and Tamsalu are included in full. Most of the territory of Tamsalu and Saksi municipalities and the town of Tapa are excluded.
Järva	Most of Koeru municipality, the eastern part of Koigi municipality and the south-eastern corner of Järva-Jaani municipality.
Jõgeva	Jõgeva, Kasepää, Pajusi, Pala, Palamuse, Puurmani, Saare, Tabivere and Torma municipalities and the towns of Jõgeva, Mustvee and Põltsamaa are included in full. The westernmost edge of Põltsamaa municipality is excluded.
Tartu	Alatskivi, Haaslava, Kambja, Laeva, Luunja, Meeksi, Mäksa, Nõo, Peipsiääre, Piirissaare, Puhja, Tartu, Tähtvere, Vara, Võnnu and Ülenurme municipalities and the towns of Elva, Kallaste and Tartu are entirely included. Most of the territory of Rannu and Rõngu municipalities and the western part of Konguta municipality are excluded.
Põlva	Ahja, Kanepi, Kõlleste, Laheda, Mikitamäe, Mooste, Orava, Põlva, Räpina, Valgjärve, Vastse-Kuuste, Veriora and Värska rural municipalities and the town of Põlva.
Valga	Most of Palupera municipality and the northern part of Otepää municipality.
Võru	All of Meremäe, Lasva and Võru municipalities and Võru town and most of Vastseliina municipality, the northern part of Haanja and Sõmerpalu municipalities and north-eastern parts of Urvaste and Rõuge municipalities are included, making up slightly less than a half of the county's territory.
Viljandi	Nearly a half of the Kolga-Jaani municipality.
Harju	The easternmost part of Loksa municipality and part of Kuusalu municipality.

As of the beginning of the 21st century, there lived half a million people in the catchment area (according to different data, 484–513 000), with 44% of them living in the Viru river basin sub-district (36% in Ida-Viru County) and 56% in the Peipsi sub-district (30% in Tartu County).



Municipality	Population
Kamari	198
Võõpsu	243
Erra	246
Varnja	258
Mehikoorma	273
Kasepää	276
Kiltsi	278
Tõravere	291
Tudulinna	302
Sadala	316
Ulila	352
Sinimäe	363
Viru-Jaagupi	381
Tammiku	385
Kolkja	400
Lohusuu	405
Kolga-Jaani	411
Alatskivi	414
Sõmerpalu	424
Tudu	437
Mooste	446
Rõuge	447
Laiuse	458
Lüganuse	466
Roiu	469
Simuna	478
Võsu	484
Laekvere	486
Sääse	490
Lähte	494
Lepna	498
Ilmatsalu	514
Olgina	519
Vastse-Kuuste	521
Torma	531
Mäetaguse	540
Kuremaa	549
Jõgeva	551
Palamuse	553
Kõrveküla	559
Veriora	561
Kose	563
Käärdi	571
Hulja	572
Värska	579
Luunja	583
Roela	597
Sonda	611
Märja	624
Ahja	634
Võnnu	644
Adavere	644
Kanepi	650
Puurmani	654
Kambja	728
Parksepa	751
Pajusti	761
Väimela	788
Avinurme	796
Siimusti	826
Vastseliina	846
Toila	863
Iisaku	948
Vinni	1 028
Ülenurme	1 051

Municipality	Population
Rakke	1 060
Voka	1 066
Puhja	1 069
Tabivere	1 071
Kohtla-Nõmme	1 163
KALLASTE	1 193
Haljala	1 240
Koeru	1 289
Sõmeru	1 363
Tõrvandi	1 562
Nõo	1 615
MUSTVEE	1 696
PÜSSI	1 855
Aseri	1 859
OTEPÄÄ	2 178
Väike-Maarja	2 184
Kadrina	2 433
TAMSALU	2 604
NARVA-JÕESUU	2 875
RÄPINA	2 927
KUNDA	3 820
PÕLTSAMAA	4 801
ELVA	5 914
JÕGEVA	6 410
PÕLVA	6 483
KIVIÕLI	7 146
JÕHVI	11 743
VÕRU	14 750
SILLAMÄE	16 901
RAKVERE	16 913
JÄRVE	KOHTLA-JÄRVE CITY DISTRICTS SUM 46 765
KUKRUSE	
ORU	
SOMPA	
VIIVIKONNA	
AHTME	
NARVA	67 752
TARTU	101 190

Figure 2 Population density in Viru and Peipsi river basin sub-districts and population of settlements and towns

1.1.3 Landscapes

The Viru-Peipsi catchment area encompasses very varied landscapes. Moving from north to south, the following landscape regions occur within the district: the North-Estonian Coastal Plain and islands of the Gulf of Finland, North East Estonian Plateau, Pandivere Upland, Alutaguse, Central-Estonian Plain, Vooremaa Drumlin Area, Lowland of Lake Võrtsjärv, South East Estonian Plateau, Lowland of Lake Peipsi, Otepää Upland, northern slope of Hargla Depression, Võru Depression, Palumaa and Haanja Upland (altogether, 14 landscape regions of the 24 regions of Estonia). Thus the landscapes of the area range from flat lowlands, extensive bogs, limestone plateaus, karst areas and undulating moraine flats to drumlins with lakes and mires in between and uplands with hilly moraine landscapes rich in lakes.

1.1.4 Land use

According to the data of the Estonian Statistical Office, arable land makes up nearly 68% of the total agricultural land in the region, while grasslands make up 30% and other agricultural land – 2%. The Viru-Peipsi catchment area includes four counties where the share of agricultural land exceeds the Estonian average (34%). Compared to the socialist period, a big part of less fertile agricultural land has been abandoned (nearly 35% of former agricultural land). Current land use illustrated by Figure 3.

1.1.5 Water use

The main field of use of water bodies in the Viru-Peipsi area is recreation and tourism, which includes bathing, watercraft traffic, recreational fishing, etc., mainly on big rivers and Lake Peipsi. The water of the Narva River is used for hydropower production, as drinking water and as cooling water for thermal power plants. There is an increasing interest to utilize also the power of other rivers. Yet the possibilities of use of hydropower are limited by small productivity and negative impact on fish fauna. Only the Narva River could constitute an exception, but hydropower of this river is currently utilised almost in full by Russia. Some project ideas for utilising the hydropower of the River Narva are still being discussed.

The main source of drinking water in the Viru-Peipsi catchment area is groundwater.

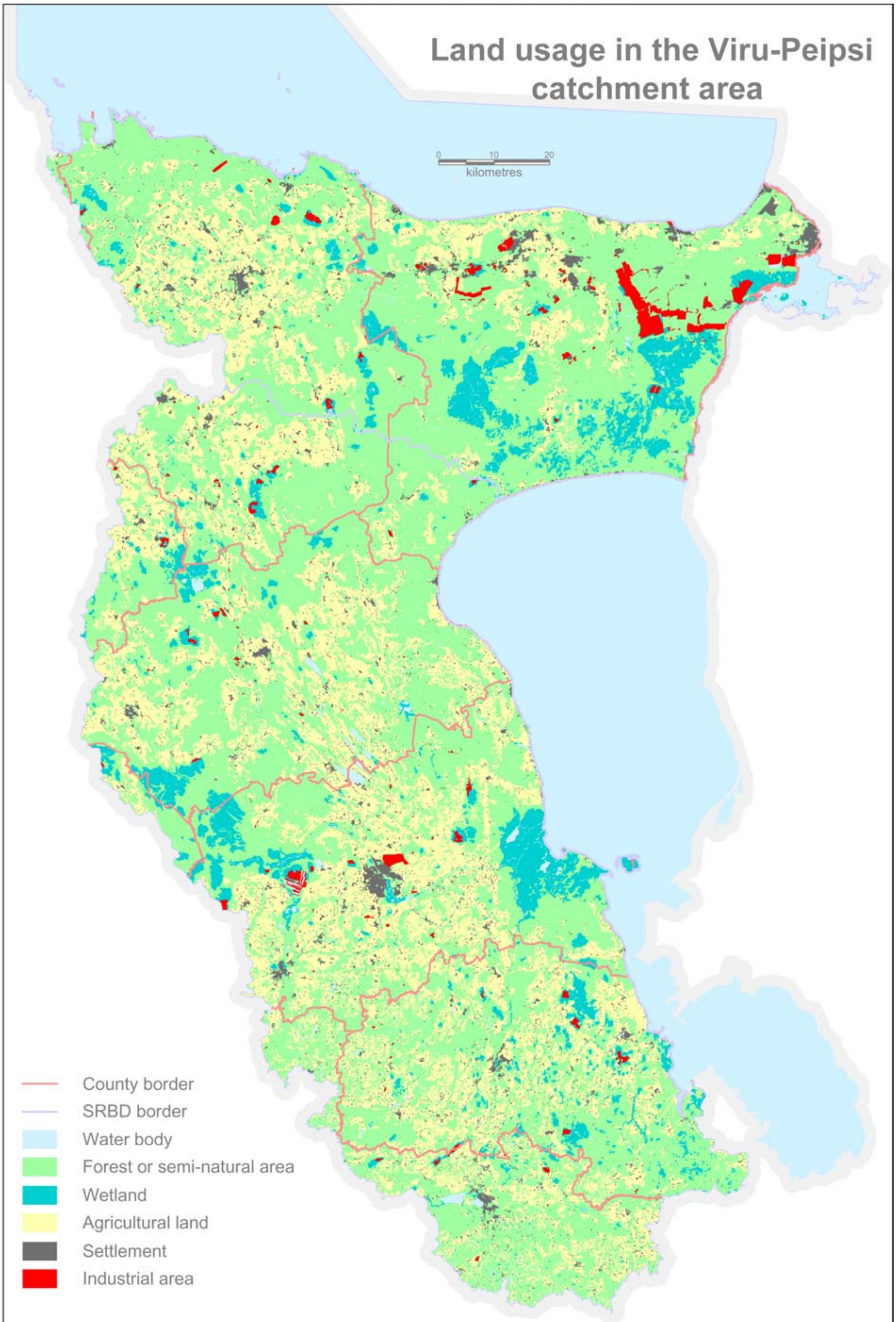


Figure 3 Land use in the Viru-Peipsi catchment area (as of 1998)

1.2 Typology of surface water bodies

Requirements for the chemical and ecological status of water bodies depend on the category and type of water body. The water Framework Directive (WFD) divides all surface water bodies into four categories:

- Rivers,
- Lakes,
- Transitional waters,
- Coastal waters.

The following typology of surface water bodies is based on the classification of surface water body types according to system B in Annex II to the WFD. The total of 22 surface water body types are differentiated in Estonia: 8 for rivers, 8 for lakes and 6 for coastal sea. Types of transitional waters (transition areas between river mouth and seawater) have not been designated in Estonia.

1.2.1 Typology of rivers

It is not possible to deal with all small streams, ditches, artificial lakes, lakelets and ponds in water management plans. The WFD and the guidance documents developed for its implementation do not provide specific recommendations on the lower size limit of rivers and lakes to be addressed individually in a water management plan. The Guidance Document on Identification of Water Bodies refers to the catchment size of 10 km^2 as a general recommendation for the lower limit for rivers. The same document notes that this limit can be adjusted according to local conditions and emphasizes that the aim of the Directive is to protect all water bodies.

According to the official list of rivers, streams and ditches of Estonia (1984), there are 637 rivers, streams and ditches in the Viru-Peipsi catchment area. The type was identified and status assessed for all watercourses with a catchment size of 10 km^2 or above, i.e. for 395 rivers, streams and ditches with the total length of 5476 km.

Similar to other rivers of Estonia, the rivers in the Viru-Peipsi area are short and poor in water – there are only 14 rivers longer than 50 km in the area. The biggest ones according to their discharge and catchment size are the Narva River (catchment area 56 200 km^2, with 1/3 of it in the territory of Estonia; average discharge 390–410 m^3/s) and the Emajõgi River (catchment 9960 km^2; average discharge 60–75 m^3/s)

All rivers of Estonia are lowland rivers according to the definition of the WFD (altitude below 200 m). The biota and water quality of rivers depend first of all on catchment size and discharge of the river and on the overburden in the area. The watercourses of Estonia are divided into four groups according to their catchment size:

I small rivers with the catchment size of 10 – 100 km^2, 345 rivers in total in the Viru and Peipsi river basin sub-districts;

II medium-size rivers with the catchment size of 100 – 1000 km^2 , 44 rivers in total;

III large rivers with the catchment size of 1000 – 10 000 km^2, 5 rivers in total (Emajõgi, Pedja, Põltsamaa, Võhandu and Ahja);

IV very large rivers with the catchment size of more than 10 000 km^2. The Narva River is the only very big river in Estonia.

According to the nature of catchment area the rivers of Estonia are divided according to the content of humic substances (permanganate oxidation value) into brownwater rivers (high content of humic substances) – type **A** and whitewater rivers (low content of humic substances) – type **B**. A third type – rivers with a high content of clay minerals flowing on the West Estonian varved clay plains (**type C**) – is differentiated among small rivers of Estonia but is not represented in the Viru-Peipsi region.

Rivers of six types occur in the Viru-Peipsi catchment area:

IA – small brownwater rivers (catchment area 10 – 100 km^2);

IB – small whitewater rivers (catchment area 10 – 100 km^2);

IIA – medium size brownwater rivers (catchment area 100 – 1000 km^2);

IIB – medium size whitewater rivers (catchment area 100 – 1000 km^2);

IIIB – large whitewater rivers (catchment area 1000 – 10 000 km^2);

IVB – very large whitewater rivers (catchment area over 10 000 km^2).

As the biota of rivers, in particular the fish fauna, largely depends on the morphology of river bed and discharge of river, the type of river may change along the river. For example, the upper course of the Pedja River until the Karaski Stream is classified as small whitewater river, the middle course until the Põltsamaa River – as medium size whitewater river, and the lower course – as large whitewater river (Figure 4).

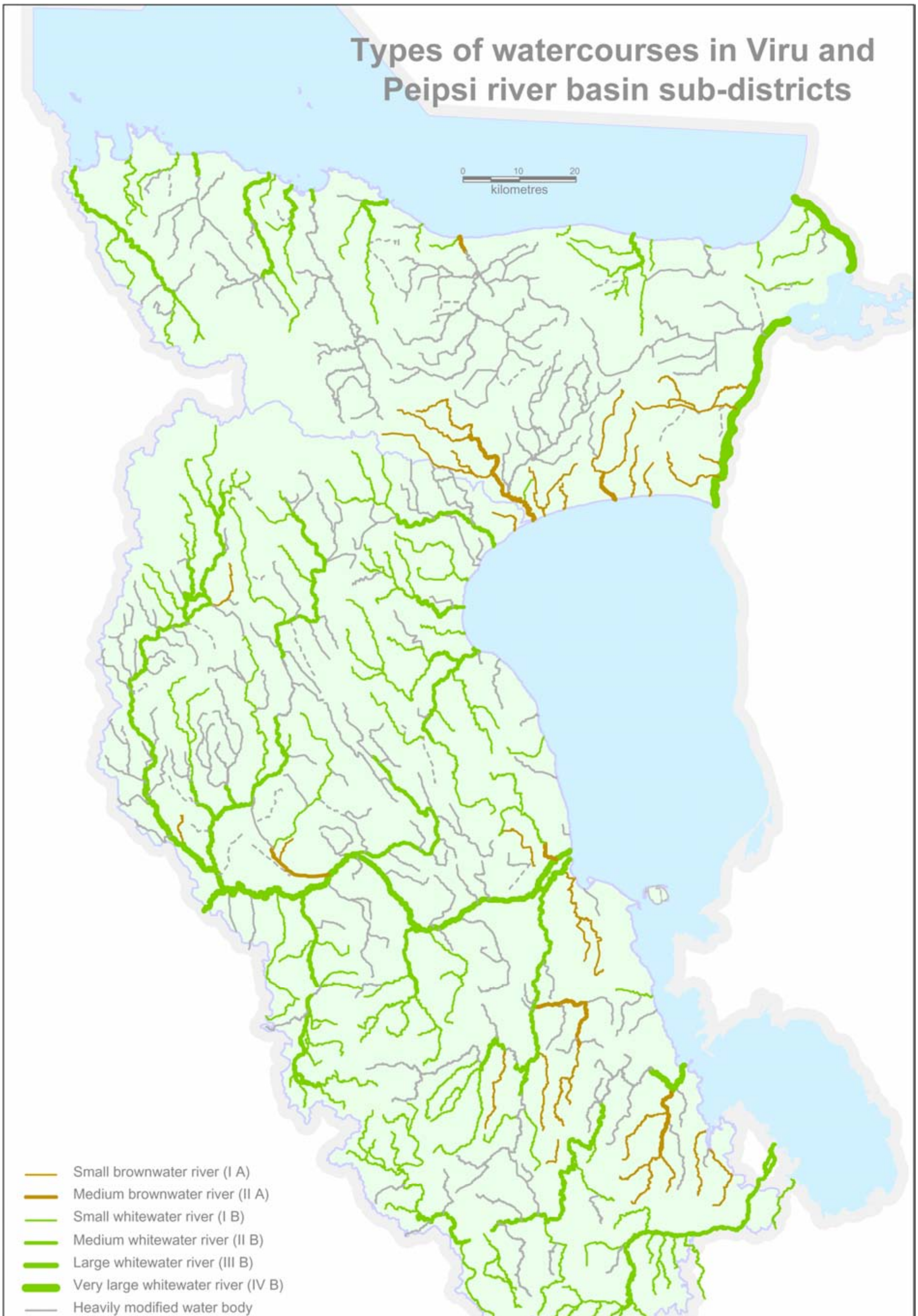


Figure 4 Types of watercourses in Viru and Peipsi river basin sub-districts

1.2.2 Natural, heavily modified water bodies and artificial water bodies

The WFD aims to achieve a good ecological and chemical status of all surface water bodies by the year 2015. For different reasons it is not possible to achieve this objective for all water bodies. According to Article 4(3) of the Directive, water bodies whose character has substantially changed as a result of physical alterations by human activity can be designated as "heavily modified water bodies". Restoration of the natural state of those water bodies is not required in case the restoration measures necessary for achieving a good ecological state would have a significant adverse impact on the specified use of the water bodies (e.g. navigation, hydropower generation, drinking water supply or flood protection) or on "the wider environment", and in case technically feasible and cost-effective solutions are absent.

Instead of the type specific "good ecological status" of natural water bodies, the environmental objective for heavily modified water bodies is defined as "good ecological potential", which takes into account the existing alterations.

The Guidance Document for Identification and Designation of Artificial and Heavily Modified Water Bodies [25] defines a heavily modified water body as a water body whose character has substantially changed as a result of physical alterations by human activity and whose good ecological status cannot be achieved. Pollution of a water body does not provide sufficient ground to designate a water body as heavily modified.

According to the above Guidance Document, artificial water bodies are water bodies which have been created in a location where no water body existed before and which have not been created by direct physical modification of an existing water body or movement or realignment of an existing water body.

Thus, the interpretation of heavily modified and artificial water bodies under the WFD is somewhat different from the conventional understanding. For the purposes of the WFD, a reservoir or artificial lake created on a river is not an artificial water body but a heavily modified part of river.

All member states were requested to submit a national list of heavily modified and artificial water bodies [25] to the European Commission by March 2005. In Estonia, the main causes of physical modification are dredging and straightening of rivers and streams and creation of dams and artificial lakes. Rivers were identified as heavily modified in cases where their fish fauna has significantly changed due to the above reasons and achievement of a type specific good ecological status is not possible without removing the alterations. If spawning migration of salmon and sea trout blocked by dams on rivers flowing into the sea (e.g. the Kunda and Purtse Rivers), such rivers, too, were designated as heavily modified. Also the majority of largely straightened rivers and all watercourses carrying the name of main ditch were designated as heavily modified, assuming that main ditches have usually been created in place of small rivers or streams. If the impact of dams or amelioration structures on fish fauna has not caused significant changes in the latter, the rivers and streams were identified as natural. For instance, the Piusa River was identified as natural despite its numerous dams because the changes in fish fauna are not so big as to obstruct the achievement of a good ecological status

All watercourses carrying the name of ditch were designated as artificial water bodies, assuming that no significant watercourse existed in their location before. Artificial water bodies also include, for example, the water bodies in open cast mines and the canals of power stations in the Viru river basin sub-district and the Anne Canal in the Peipsi sub-district. This designation was provisional. According to the Guidance Document [25], a designation test has to be carried out for all heavily modified water bodies in future. A water body may be finally designated as heavily modified and thus less stringent environmental objectives applied to it only where the removal of physical alterations is disproportionately costly, or where the benefits from the alterations significantly outweigh the damage caused and where equivalent benefits cannot be achieved by another, environmentally less damaging option. Most of our dredged and straightened water bodies will probably remain "heavily modified" also in future because their full restoration would be too expensive and would bring about an expansion of overmoisture and floods. However, in the case of rivers spoiled by dams it needs to be carefully considered whether the benefits of the dam outweigh the damage caused to the river biota. This concerns in particular some hydropower plants and artificial lakes created in the course of amelioration works and by private initiative.

If a river has been designated as heavily modified water body on the basis of a designation test and such situation is declared inevitable, an as good as possible ecological potential should be determined for this water body to achieve. The same procedure has to be carried out for artificial water bodies.

A good chemical status equal to that of natural water bodies is obligatory also for heavily modified water bodies. In the case of artificial water bodies, the purpose of their use has to be taken as a basis. If the activity that caused the creation of the water body (e.g. extraction of minerals) ceases, the shaping of an as natural as possible water body should be targeted.

1.2.3 Water bodies

Success in achieving the objectives of the WFD is measured mainly according to the status of water bodies. The WFD uses the term *water body* for the purposes of reporting on the type and state of rivers. *Water body* is defined in the WFD as a "*discrete and significant* element of surface water, such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, a transitional water or a stretch of coastal water." According to the Guidance Document on Identification of Water Bodies [26] „discrete and significant" means that water bodies should not be arbitrary formations. "Significant" means that a water body should have an importance in achieving the goals of the directive. "Distinct" refers to the fact that a water body should be clearly and easily delineated. A water body must not be split between different categories of surface water (river, lake, coastal sea, etc.) and different types. Nor may the ecological status class significantly differ within the boundaries of a water body. Hence, a river whose upper course is in a good ecological status and lower course in a moderate status should not be regarded as one water body.

In describing water bodies and assessing their status, the following principle should be applied as a rule: an entire water body must fall within a single category, a single type and a single status class. Conventional descriptions and assessments *a´ la* the status of a river (water body) is good in the upper course, moderate in the middle course and poor in the lower course are not acceptable. As a water body has to be continuous, a river flowing through a lake (in case the lake is differentiated as a separate water body) thus cannot be one water body because the lake belongs to another surface water category.

According to the Directive, member states had to complete an initial characterisation of water bodies by 22 December 2004 and report to the Commission by 22 March 2005. As the status of all of the differentiated water bodies needs to be assessed, changes therein monitored and also the results reported, it is not expedient to differentiate all rivers, streams, ditches, lakes and reservoirs as separate water bodies.

In the Guidance Document on Identification of Water Bodies it is emphasized that identification of water bodies is a continuous process and a tool for reporting and planning, not an objective in itself. For example, where a river was formerly divided into three water bodies due to differences in its status, it can be identified as a single water body after a good status has been achieved for the entire river (provided that the type remains the same).

1.2.4 Identification of rivers as water bodies

For practical considerations it was tried to minimize the number of water bodies identified. Rivers in the same status and of the same type were identified as a single water body in cases where one river flows into another (the requirement of continuity is met). Minimum catchment size of a separate body of flowing water was set at 10 km^2. As a water body must not be split between different types, all medium-size rivers regardless of their status were inevitably divided into two water bodies and big rivers into three water bodies. Changes in the status of rivers may further increase the number of water bodies.

The largest number of separate water bodies was differentiated on the Võhandu River, the longest river in Estonia, where the large number of water bodies is due to differences not only in type but also in status and due to Lake Vagula, which was identified as a separate water body and thus constitutes a boundary between river water bodies. The Võhandu River (length 162 km, catchment area 1420 km^2) is divided into the following water bodies:

- Võhandu River from the headwaters to the Sillaotsa River, type 1B, good status. The same water body also includes the streams of the same type flowing into Võhandu in the upper course: Mügra Stream, Kokle River, Sillaotsa River, Kangrusoo Stream and Lokuoja Stream;
- Võhandu River from Sillaotsa River to Utita Dam, type 2B, good status:
- Võhandu River from Utita Dam to Lake Vagula, type 2B, moderate status;
- Võhandu River from Lake Vagula to Viluste Stream; type 2B, moderate status;
- Võhandu River from Viluste River to Räpina Dam, designated as heavily modified water body due to permanent damming;
- Võhandu River from Räpina Dam to the mouth, type 3B, moderate status.

Most of the smaller reservoirs were not identified as separate water bodies and are addressed together with the river.

In total, 299 bodies of flowing water (watercourses) were identified in the Viru and Peipsi river basin sub-districts, with 151 of them being natural, 128 heavily modified and 20 artificial water bodies (Figure 5 and Annex 1).

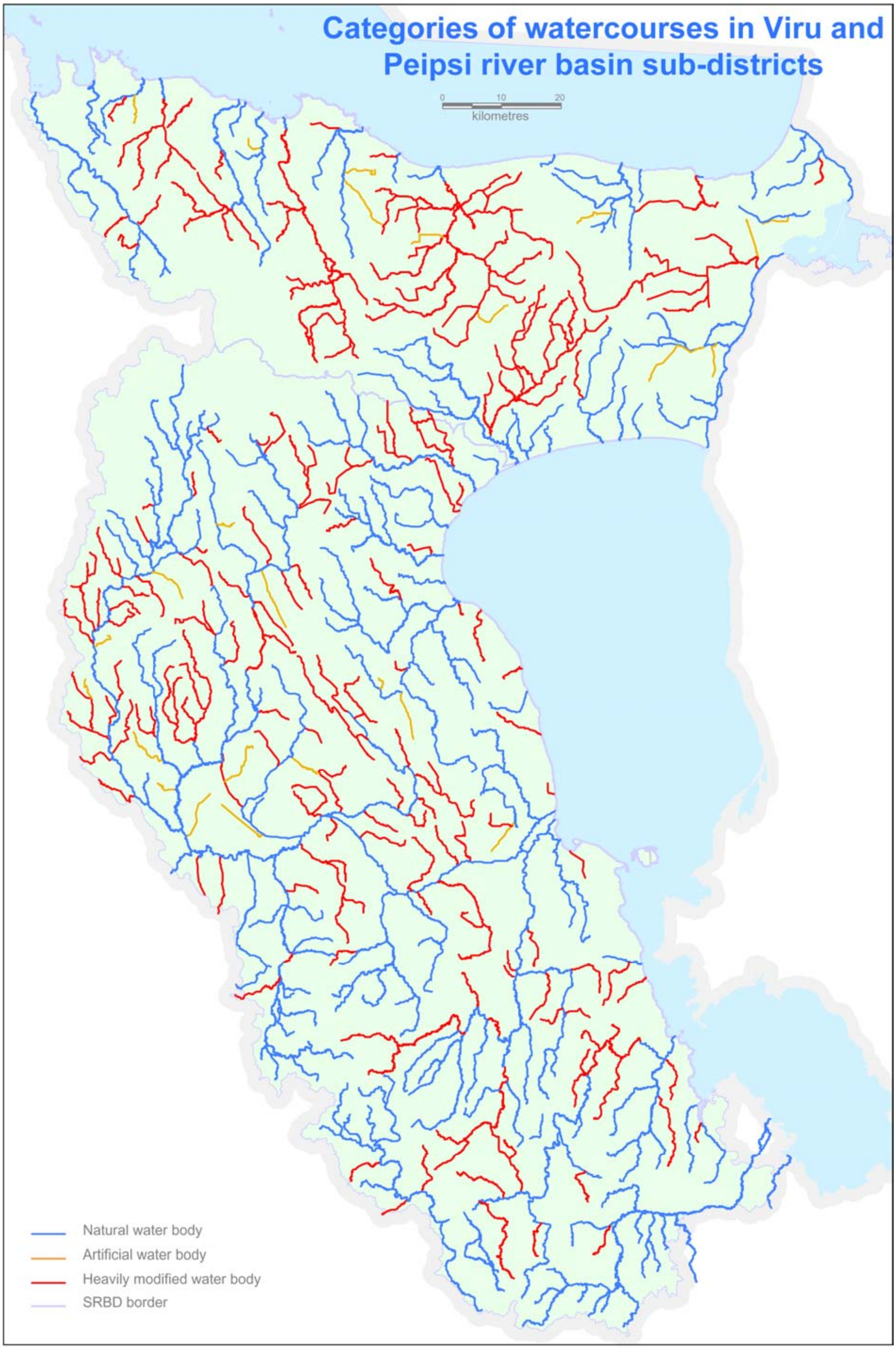


Figure 5 Categories of watercourses in Viru and Peipsi river basin sub-districts

1.2.5 Reservoirs

Nearly 200 artificial lakes and reservoirs are located within the Viru and Peipsi river basin sub-districts. Most of them are small and have a local importance as recreation areas, valuable elements of landscape, sources of irrigation water, localities for fish farming and power generation. The materials gathered under this project provided information on 173 dams or old dam sites located on watercourses (Annex.1 2 and Figure 6).

Reservoirs located on watercourses usually form cascades and have so fundamentally changed the character of the watercourse that the watercourse or stretch of watercourse has to be regarded as heavily modified water body.

Lake Väimela Alajärv and Lake Vagula are treated as reservoirs, but only due to the water management measures typical for reservoirs. The question whether the remaining reservoirs and artificial lakes should be regarded as lakes or parts of watercourses still remains to be answered. Until the relevant assessment is made, the criteria of watercourses will be applied to the remaining reservoirs.

There are three reservoirs and artificial lakes bigger than 50 ha in the Viru-Peipsi catchment area.

In addition, reservoirs with the size of 10–50 ha and some smaller reservoirs covered under this project for different reasons are addressed in the Management Plan.

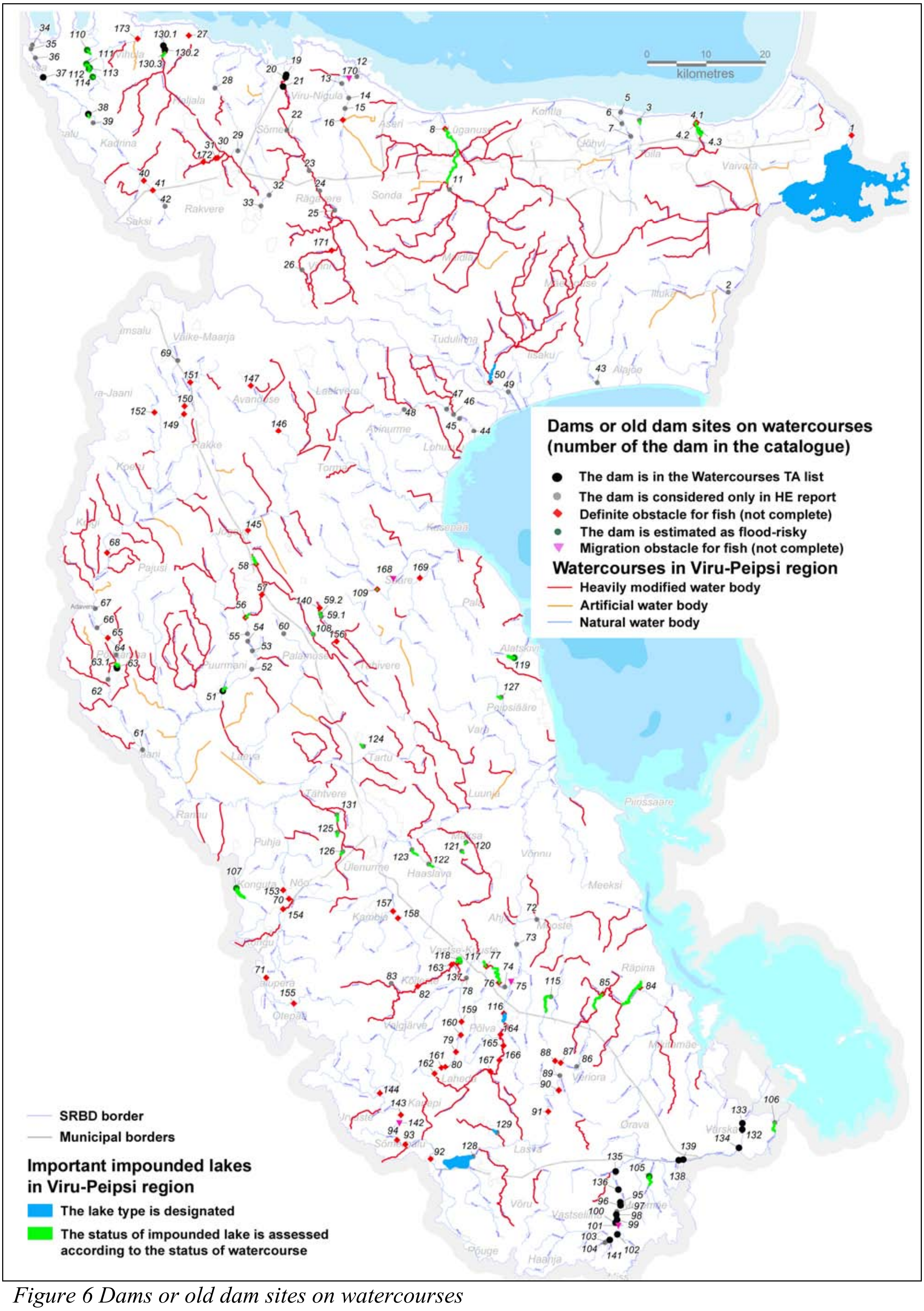


Figure 6 Dams or old dam sites on watercourses

Typology of lakes

The lakes of the project area are diverse and numerous. The biggest and most important lake here is Lake Peipsi, the fourth-largest lake in Europe (3555 km^2, including Lake Pihkva and Lake Lämmijärv), of which 1570 km^2 fall within the territory of Estonia. There are numerous small lakes (especially on the Haanja and Otepää Uplands), lake systems (Vooremaa Lakes, Kurtna Lakes, etc.), reservoirs and artificial lakes in the area. The biggest reservoir (heavily modified water body) here is the Narva Reservoir (102–107 km^2) located on the border between Estonia and Russia.

Most of the lakes are shallow (less than 20 m deep). The deepest of the lakes is Lake Rõuge Suurjärv (38 m) on Haanja Upland at the southern border of the region, being also the deepest lake in Estonia.

Just like rivers, all lakes in Estonia are classified as lowland lakes for the purposes of the WFD (altitude below 200 m). The typology of Estonian lakes is based on five elements – size of lake, hardness of water, colour, overburden of catchment area and depth of lake. Lakes are divided according to their size into big lakes with the area of 100 km^2 and above (Lake Võrtsjärv and Peipsi Lake System) and small lakes, which include all the remaining lakes smaller than 100 km^2. All lake types differentiated in Estonia are represented in the Viru-Peipsi area, except the type of Lake Võrtsjärv (type 6) and coastal lakes (type 8):

Type 1 – small whitewater lakes with hard water (alkalitrophic);

Type 2 – shallow, non-stratified small whitewater lakes with medium-hard water (eutrophic, hard-water mixotrophic);

Type 3 – deep stratified small whitewater lakes with medium-hard water (eutrophic, hard-water mixotrophic);

Type 4 – soft- and brownwater small lakes (dystrophic, acidotrophic, soft-water mixotrophic);

Type 5 – soft-water small lakes with light to slightly coloured water (oligotrophic, semidystrophic);

Type 7 – Lake Peipsi (big non-stratified whitewater lake with medium-hard water, eutrophic).

The WFD and the Guidance Document on Identification of Water Bodies recommend that the lower size limit for lakes be set at 50 ha. However, this limit seems to be too high for Estonian conditions, as e.g. a lake of 25 ha is often much more important for local people (as a bathing or fishing lake) than a less than 10-km stream or ditch with a catchment area of a dozen km^2.

There are 747 lakes of over 1 ha in the Viru-Peipsi area, including 112 lakes of 10–50 ha and 30 lakes of over 50 ha. The latter include also the big lakes of the Peipsi Lake System, Lake Pihkva, Lake Lämmijärv and Narva Reservoir. The type and status was identified for all lakes larger than 10 ha and also for smaller lakes of ecological value or recreational importance. The limnological database of ZBI/IAES was used as a basis and additional studies were carried out on 8 lakes (Imatu, Jõksi, Karsna, Kõvera, Laiuse Kivijärv, Puhatu, Räätsma, Viisjaagu). The data allowed to identify the type of 126 lakes, of which 32 are smaller than 10 ha. Data necessary for status assessment were available for 107 lakes. The type of 44 lakes and the status of 63 lakes (bigger than 10 ha) remained unidentified.

Figure 7 Lake types in Viru and Peipsi river basin sub-districts

1.2.6 Peipsi Lake System

The name *Lake Peipsi* is used in two meanings. It denotes both the entire Peipsi Lake System (Lake Suurjärv or Lake Peipsi in the narrower sense, Lake Lämmijärv and Lake Pihkva) and only the northernmost and biggest lake of the system – Lake Suurjärv (Table 3).

Table 3 Basic parameters of Peipsi Lake System

	Lake Suurjärv	Lake Lämmijärv	Lake Pihkva	Total
Surface area (km^2) incl. the Estonian part (km^2)	2611 1387	236 118	708 25	3555 1529
Greatest depth (m)	12.9	15.3	5.3	15.3
Average depth (m)	8.3	2.5	3.8	7.1
Water volume (km^3)	21.79	0.60	2.68	25.07

The Peipsi Lake System is relatively shallow but it has a great importance for fisheries due to its size and richness in fish. The northern coast of Lake Suurjärv is an important recreation area.

In the typology of Estonian lakes, Lake Peipsi is assigned a separate type (7).

1.2.7 Narva Reservoir

The Narva Reservoir was created in 1955–56. Its surface area at normal headwater level (25.0 m) is 191 km^2. Only 35 km^2 (18%) of the reservoir fall within the territory of Estonia.

The Narva Reservoir was designated as a heavily modified water body. The closest type of water body, which is to be used as a basis for determining a good ecological potential for the Reservoir, is shallow whitewater lake with medium-hard water and a predominantly mineral catchment area (type 2).

1.2.8 Identification of lakes as water bodies

Lakes of over 10 ha on the type and status of which there exist sufficient data and smaller lakes of significant conservation value, acting as recipients of wastewater or having an importance as bathing waters were identified as water bodies. In total, 104 lake water bodies were provisionally identified in the Viru-Peipsi area. Lakes whose type has not been determined due to the lack of data were not identified as water bodies. It is recommended that the type and status of lakes larger than 10 ha be determined in future and all such lakes be identified as water bodies.

Lakes belonging to the same type and subject to similar pressures and human impact were added together into a single water body. In the Viru-Peipsi catchment area, such grouping was applied to Viitna Lakes, part of Kurtna Lakes, Kooraste Lakes, Tilsi Lakes, part of Rõuge Lakes and Plaani Lakes.

Two water bodies were differentiated in the Peipsi Lake System: Lake Peipsi and Lake Pihkva. Lake Lämmijärv is divided between the above two water bodies at its narrowest point.

Green Lake (ash water lake of the Baltic Power Plant) will be turned into a wetland under an ash field closure project and is thus no longer regarded as a water body.

1.3 Types of coastal sea

According to the WFD, sea water is divided into two zones – achievement of a good ecological status is an objective for coastal sea only, while a good chemical status is to be achieved for sea water in general, i.e. for the entire territorial sea. Coastal sea is defined as inland sea (sea areas between the coastline and the seaward baseline of territorial waters) and sea areas bordering the inland sea at a distance of one nautical mile from the baseline of territorial waters. It is suggested that 6 types of coastal water to be differentiated in the coastal sea of Estonia. According to this scheme, two types would be represented in the Gulf of Finland: type I – oligohaline open coastal water (Narva Bay), and type III – mesohaline deep coastal water (western part of the Gulf of Finland). On the basis of the geomorphological and hydrophysical parameters used for determining the types, the above two types would differ from each other in the following parameters: salinity, depth, mixing characteristics, nature of bottom sediments, ice cover duration [4].

Table 4 Values of geomorphological and hydrophysical parameters characteristic of natural types of coastal waters occurring within the Viru river basin sub-district

Factor	**Type I (Narva Bay) oligohaline open coastal water**	**Type III (western part of the Gulf of Finland) mesohaline deep coastal water**
Salinity	0.5 – 5	>5
Depth [m]	< 30 (in places > 30)	> 30 (in places < 30)
Wave exposure	exposed	exposed
Mixing conditions	partially stratified	partially stratified (in places permanently stratified)
Residence time	Days	days
Substratum	sand-gravel	mixed sediments
Duration of ice cover [days]	90 to 150	< 90

As the types of coastal water have to be clearly distinct from each other also in terms of their ecosystem parameters, a proposal has been made to draw the line between type I and type III from the Vainupea Cape to the outward boundary of coastal sea along the line of topographically determined sea areas, which served as a basis also for defining the boundaries of water bodies in the coastal sea.

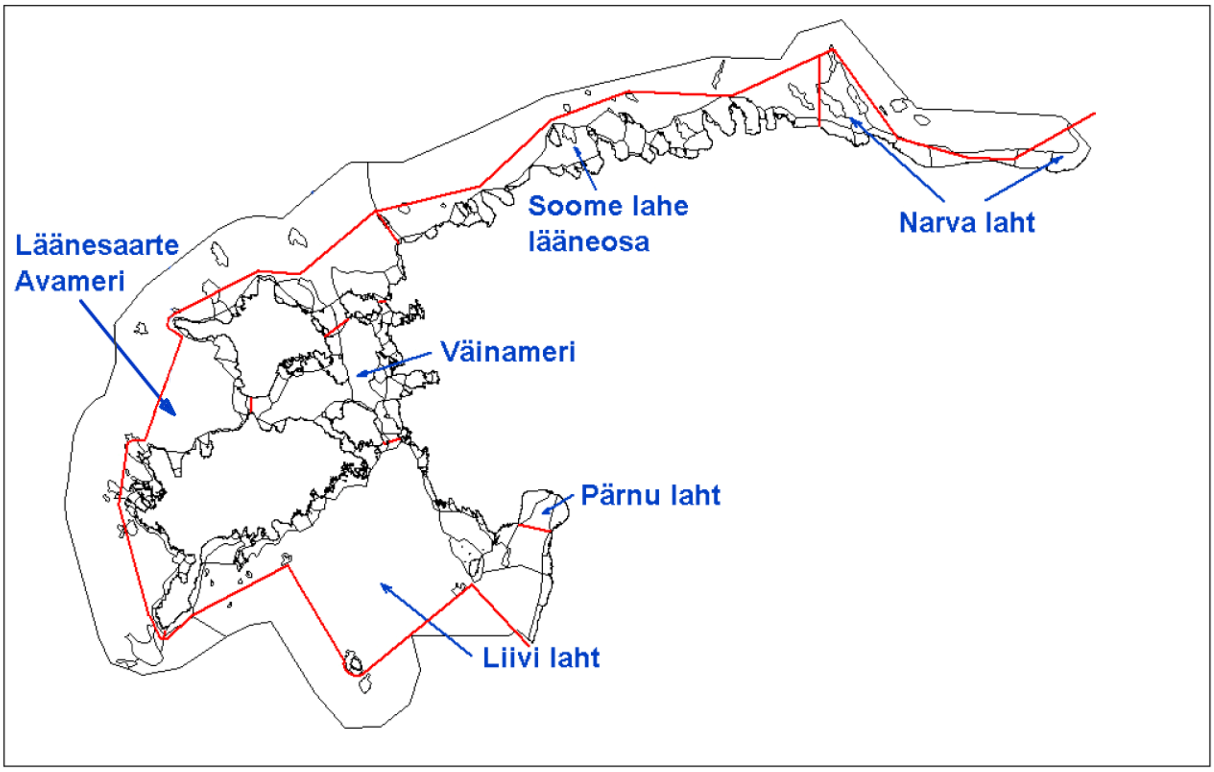


Figure 8 Extent (red line) and typology of coastal waters of Estonia (provisional boundaries of types are given as red lines drawn from the coast to the boundary of coastal waters)

1.4 General description of groundwater bodies

Groundwater is the main source of drinking water in Estonia. In the Peipsi river basin sub-district it is the only source of drinking water and in the Viru sub-district only the town of Narva uses purified surface water as drinking water.

Groundwater is addressed in this Management Plan by groundwater bodies. Such groundwater bodies do not constitute classical hydrogeological units but a groundwater volume delineated in water management plans (a reporting unit for water management plans – groundwater currently used or recommended to be used in future as a source of drinking water or having some other importance).

Groundwater of all Estonian aquifers is found in the Viru-Peipsi region. Due to the southward inclination of bedrock layers, there exist areas with only one groundwater body and areas where even 5 groundwater bodies concur.

There are 19 groundwater bodies in the Viru-Peipsi catchment area, including a small part of the Cambrian-Vendian groundwater body (3), which is in the area of responsibility of the West Estonian river basin district (catchment area). The Ordovician-Cambrian (4) and Cambrian-Vendian Voronka (2) groundwater bodies are transboundary groundwater bodies. The status of the Ordovician groundwater body of Ida-Viru oil shale basin (6) has a direct impact on many terrestrial ecosystems and surface waters. The quantitative status of the Quaternary Vasavere groundwater body has an impact on the Kurtna Lakes (incl. those designated as Natura 2000 water bodies).

The groundwater bodies of Estonia are listed in Regulation No. 47 of 10 May 2004 of the Minister of Environment „Status classes of groundwater bodies, values of qualitative parameters corresponding to the status classes of groundwater bodies and procedure for determination of status classes".

Identification of groundwater bodies was based on the following reports of the Geological Survey of Estonia: „Hydrogeological map of Estonia (Tallinn 1998, GIS map on the scale 1:400000); „Hydrogeological model of Estonia" (Tallinn 2002, text of illustrated report), and reports of geological and hydrogeological mapping of various regions of Estonia on the scale of 1:50000. Groundwater bodies were delineated in cooperation with the French Geological Survey (BRGM) on the basis of the GIS database of bore wells under the groundwater cadastre of the Geological Survey of Estonia (as of the end of 2001) and the existing reports on groundwater stock. Identification of groundwater bodies is addressed in more detail in a separate report [30].

Identification of groundwater bodies is final, unless amendments are proposed in water management plans of river basin sub-districts. Changes due to administrative water management reasons are possible, too.

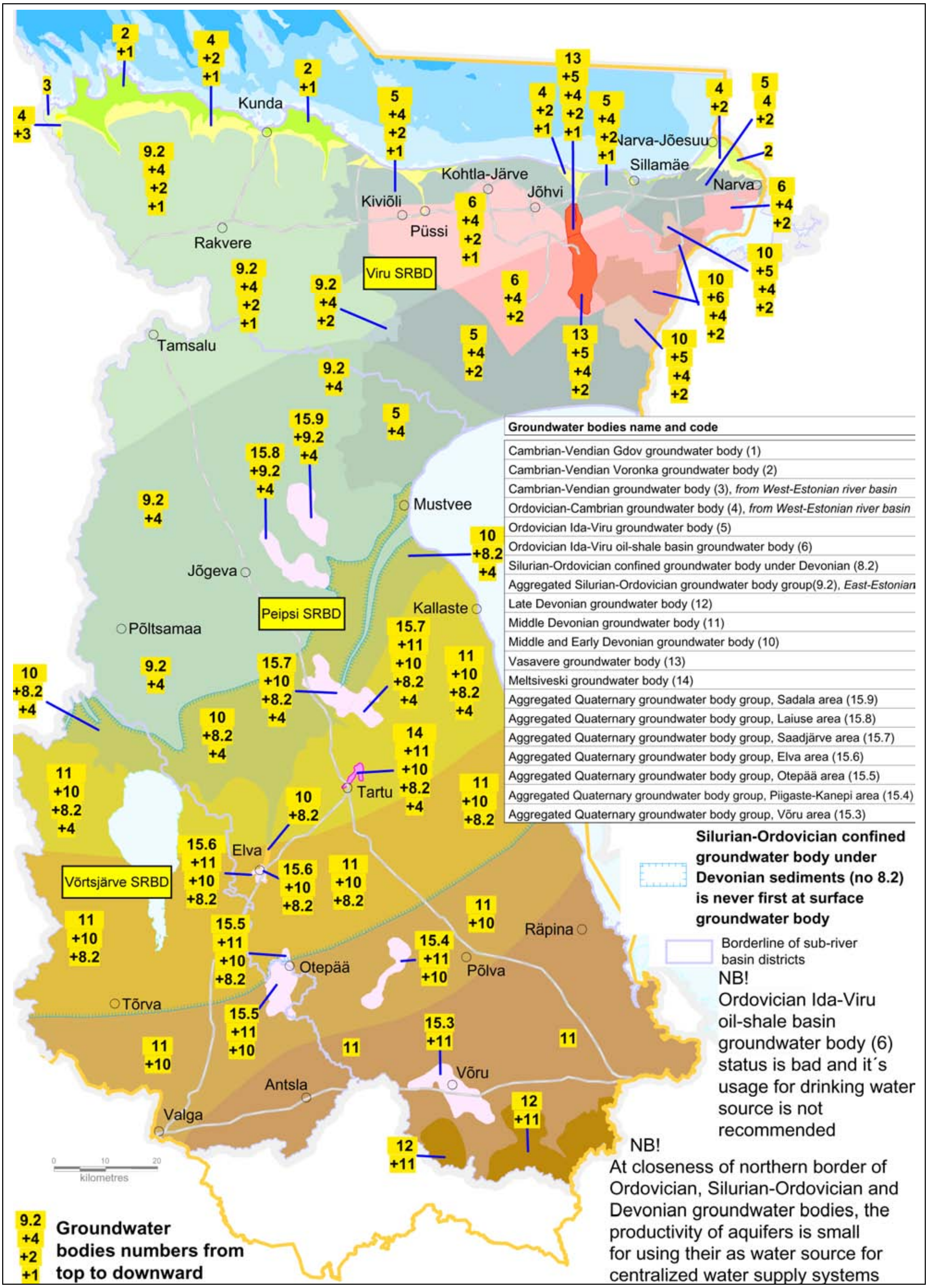


Figure 9 Groundwater bodies in Viru, Peipsi and Võrtsjärv sub-districts of the East Estonian river basin district

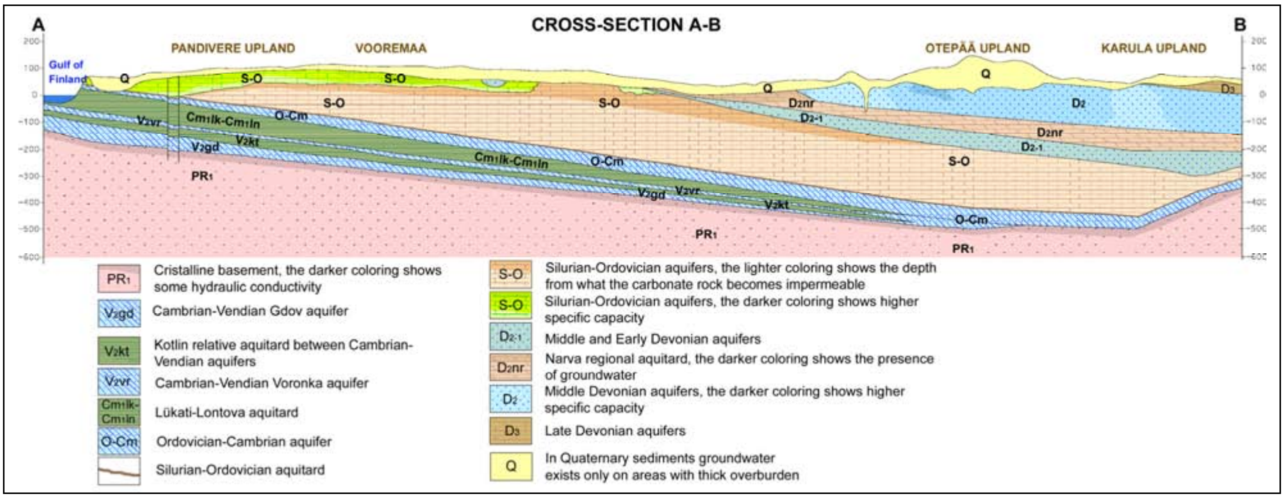


Figure 10 Location of aquifers and aquitards

Table 5 General description of groundwater bodies in the Viru and Peipsi sub-districts

Groundwater body	Water-bearing rocks	Brief information on parameters and major impacts
Quaternary Vasavere groundwater body (13), 80 km^2.	Fluvioglacial sands-gravels; k=1–20 m/d	High content of Fe_2^+, Mn^+ and NH_4^+ and high permanganate oxidation value refer to the impact of mires. Groundwater vulnerable. Infiltration of mine water into the groundwater body constitutes a real danger. Quantitative status of groundwater body influenced by abstraction of water and by mining activities.
Quaternary Meltsiveski groundwater body (14), 8.7 km^2.		Varying water quality, raised NO_3 content (15–25 mg/l). Dangerous substances have been found in a few samples. Groundwater vulnerable. Quantitative status of the water body influenced by abstraction of water and qualitative status influenced by location in town. The present sanitary protection zone does not ensure the preservation of water quality. Longer-term planning of water supply constitutes a risk for the water company.
Quaternary aggregated groundwater body (15) 325.2 km^2: Sadala area (55.6 km^2), Laiuse area (56.1 km^2), Saadjärve area (80.7 km^2), Elva area (7.4 km^2), Piigaste-Kanepi area (39.6 km^2),Võru area (76.1 km^2).		Raised Fe_2^+ and NH_4^+ content due to natural anaerobic water environment. Groundwater mostly vulnerable. Qualitative status influenced by agricultural production. Quantitative status not influenced by current small-scale water abstraction and significantly increased abstraction from the water bodies is not planned.
Upper Devonian groundwater body (12), 285 km^2.	Karsted and fissured dolomites and limestones; k=1–50 m/d	Fe_2^+ content raised but lower than in other Devonian groundwater bodies. Groundwater non-vulnerable in areas with thick overburden. Qualitative status may be affected by agricultural production; quantitative status is not affected by current small-scale water abstraction and significantly increased abstraction from the water body is not planned.

Groundwater body	Water-bearing rocks	Brief information on parameters and major impacts
Middle Devonian groundwater body (11), 6444 km^2.	Sandstones and aleurolites; k=1–3 m/d	Raised Fe_2^+, Mn^+ and NH_4^+ content due to natural anaerobic water environment. Groundwater non-vulnerable in areas with thick overburden. Qualitative status affected by agricultural production; quantitative status not affected by current water abstraction and significantly increased abstraction from the water body is not planned.
Middle Lower Devonian groundwater body (10), 5749 km^2.	Sandstones and aleurolites. When consumed together with Silurian aquifers, the groundwater body is regarded as the Middle Lower Devonian-Silurian water complex; k=2–5 m/d.	Raised Fe_2^+ and NH_4^+ content and permanganate oxidation value, in places also raised content of Mn^+ and F^-. Groundwater mostly non-vulnerable. No significant impacts on the qualitative status; quantitative status not affected by current water abstraction and significantly increased abstraction from the water body is not planned.
Ordovician Ida-Viru groundwater body (5), 2043 km^2.	The 30m thick upper part consists of limestones and dolomites, strongly karsted and fissured in places	Raised Fe_2^+ content and permanganate oxidation due to natural anaerobic water environment and influence of the surrounding mires. Groundwater mostly vulnerable to pollution. Qualitative status may be affected by agricultural pollution and changes in the groundwater body of Ordovician Ida-Viru oil shale basin. Quantitative status is not affected by current water abstraction but may be significantly affected by drainage of the Ordovician groundwater body of Ida-Viru oil shale basin in the course of oil shale mining.
Ordovician groundwater body of Ida-Viru oil shale basin (6), 1154 km^2. Groundwater body heavily modified by human activity.		Raised content of Fe_2^+, SO_4^{-2} and NH_4^+ in water primarily due to natural anaerobic water environment and the impact of mires. Raised SO_4^{2-} content, minerality and hardness is due to drainage associated with oil shale production and also due to different conditions of groundwater formation in closed mines. Groundwater is vulnerable to pollution and dangerous substances originating from oil shale chemical industry and ash hills have been found in the groundwater. The groundwater body is in a poor qualitative and quantitative status as a consequence of human activity and achievement of a good status is unrealistic. The groundwater body has no prospect as a source of drinking water. Modifications in the groundwater body have an impact on the surrounding Ida-Viru groundwater body.
Silurian-Ordovician groundwater body beneath Devonian layers (8.2), 4408 km^2.	Limestones and dolomites; k=1–10 m/d. Forms the Middle Lower Devonian- Silurian water complex together with the limestones of the Pärnu horizon in places.	Raised Fe_2^+ and NH_4^+ content in water due to natural anaerobic environment. High natural content of F^- in Tartu area. Groundwater confined, non-vulnerable to pollution. There are no significant impacts on the qualitative status; quantitative status is not affected by current abstraction of water and significantly increased abstraction is not planned.
East Estonian part of Silurian-Ordovician aggregated groundwater body	Limestones and dolomites, often karsted and fissured;	Raised NO_3^- content in water (average 10.1 mg/l) is related mainly to agricultural activity in nitrate sensitive areas. Raised natural content of NH_4^+, Fe_2^+ and Mn^+. Groundwater vulnerable to pollution. Qualitative status is affected primarily by agricultural production; quantitative

Groundwater body	Water-bearing rocks	Brief information on parameters and major impacts
(9.2), 5859 km^2 (Peipsi part 4121 km^2 and Viru part 1738 km^2).	k=1–50 m/d.	status is not affected by current water abstraction and significantly increased abstraction from the groundwater body is not planned.
Ordovician-Cambrian groundwater body (4), 12 150 km^2. Crosses the national border and constitutes a transboundary groundwater body.	Lower Ordovician and Cambrian sandstones and aleurolites; k=1–3 m/d	Raised content of Mn^+, Fe_2^+ and NH_4^+ in water is primarily due to natural anaerobic water environment. Groundwater confined and non-vulnerable to pollution. Infiltration of water from the groundwater body of Ida-Viru oil shale basin into the O-Cm groundwater through faults and worn-out bore wells has led to an increase in the content of sulphates and occurrence of phenols in groundwater. There are no significant impacts on the qualitative status of the water body. Quantitative status is not affected by current abstraction of water but abstraction from this groundwater body is increasing.
Cambrian-Vendian Voronka groundwater body (2)., 5475 km^2 in terrestrial areas. Crosses the national border and constitutes an international groundwater body	Sandstones and aleurolites of Lower Cambrian series and Voronka formation of Vendian system; k=2–5 m/d	Raised content of Mn^+, Fe_2^+ and NH_4^+ in water is mainly due to natural anaerobic water environment. Also the natural content of radium is high and may cause an excessive effective dose when using the water as drinking water. Groundwater is confined and non-vulnerable. Possible dangers include the intrusion of seawater into the water intakes located on the Gulf of Finland, and in places also possible flow of chloride-rich Gdov water into Voronka aquifers through bore wells. Intrusion of seawater has not been observed as yet and other impacts on the qualitative status of the water body are absent. The quantitative status is not affected by current and planned abstraction of water.
Cambrian-Vendian Gdov groundwater body (1). 3621 km^2 in terrestrial areas.	Sandstones and aleurolites of Gdov formation of Vendian system; k=5–8 m/d	High natural content of Cl^- and Na^+ (in places also Ba^+) in groundwater. Also the natural content of radium is high and may cause an excessive effective dose when using the groundwater as drinking water. If used as a source of drinking water, the water needs, as a rule, to be treated and diluted with other water. Raised content of Mn^+, Fe_2^+ and NH_4^+ in water due to natural anaerobic water environment. Intrusion of salty water from the crystalline base rock in areas of intensive abstraction of water poses a danger. According to long-term observation data, no changes in the quality of groundwater have been observed. The quantitative status is not affected by current and planned abstraction of water. Abstraction of drinking water from the water body is expected to decrease due to the chemical composition of the water.

Water of several groundwater bodies does not meet the quality standards for drinking water due to an excessive natural content of iron, ammonium and manganese (Table 5). The raised content is mainly due to natural anaerobic water environment. To assess the status of the groundwater bodies, the groundwater bodies were additionally checked for the content of heavy metals and other dangerous substances, which was found to be lower than the standards established for drinking water, with only a few exceptions.

2 HUMAN IMPACT

2.1 Assessment of pollution from point sources

2.1.1 Situation of municipal sewerage and wastewater treatment

This summary chapter drawn up on the basis of the relevant report by the Estonian Water Consultancy (EWC) [20]. Due to the large volume of work it was not possible to analyse the situation of treatment plants and sewer systems of all small settlements. Under this project the EWC analysed the situation of wastewater treatment plants and sewage systems of all settlements with more than 500 inhabitants in the Viru-Peipsi catchment area.

Unfortunately the data submitted by small water companies are of uneven quality. It is therefore not possible to draw reliable conclusions for small treatment plants on the basis of water use reports.

Public wastewater facilities of all urban regions are in a poor status both as to pipelines and as to pumping stations and treatment plants. Only the areas where sewerage and treatment plants have been newly renovated constitute an exception.

A frequent problem is that even the capacity of newly built treatment facilities is under-utilized.

2.1.1.1 Ida-Viru County

On an average, 78% of the population of urban regions with at least 500 inhabitants are connected to sewerage.

Treated wastewater discharged into recipient waters meets the requirements in only a few wastewater treatment plants of smaller municipalities. The treatment plants of none of the towns in Ida-Viru County and the regional treatment plant of Kohtla-Järve ensure the required degree of purification. The parameters of treated sewage of Sillamäe Town mostly meet the standards but the general state of the treatment plant is poor. The state of the treatment facilities of Aseri can be conditionally regarded as good although the treatment plant commissioned in 1988 and having the standard design of that period needs to be modernised and a phosphorus removal system added.

According to the data of the Environmental Information Centre, the regional wastewater treatment plant at Kohtla-Järve generated approximately 25% of the total pollutant load from the entire territory of Estonia to the Gulf of Finland as of 2003. Full reconstruction of the treatment plant is expected to significantly decrease the concentration of pollutants. At the same time, additional urban regions or city districts (Ahtme, Sompa, Kohtla-Nõmme, Kukruse) will be connected to the treatment plant. Therefore the volumes of pollution from the regional treatment plant will not change substantially but total pollution from all connected urban regions will decrease.

In 2004, pollution loads from the Kohtla-Järve wastewater treatment plant were as follows: BOD_7 – 87.9 t/yr and total phosphorus – 2.7 t/yr.

Implementation of the reconstruction project (planned for 2008–2009) is expected to bring the relevant parameters down as follows: BOD_7 – 64 t/yr and total phosphorus – 3.9 t/yr. The phosphorus content of 0.5 mg/l P is expected in the longer term.

2.1.1.2 Lääne-Viru County

The service of public water supply is available to 70% of the inhabitants of urban regions with over 500 inhabitants in Lääne-Viru County.

In urban regions whose wastewater treatment plant has recently been reconstructed or a new one built – Rakvere, Tamsalu, Väike-Maarja and Kadrina, pollution parameters of wastewater discharged into recipient waters meet the standards for all main components. In other urban regions there are problems with achieving the required parameters of discharged wastewater. Particular pollution hot spots are the poorly functioning wastewater treatment plants in the karst area in the vicinity of Rakvere (plants in Rakvere and in urban regions of Vinni Municipality) and urban regions with no wastewater treatment facilities (impermeability of cesspits is not ensured) – Tudu, Kakumäe, Kadila, Küti, or where the efficiency of treatment plant is very low – Lepna, Roela.

The performance of several treatment plants (e.g. those of Haljala, Sõmeru, Viru-Nigula, Kaarli Farm, Annikvere) was low also according to the water use report of 2004.

Sludge treatment needs to be either improved or introduced in all treatment plants of the area, including Rakvere.

Longer-term plans envisage that also the wastewater of Sõmeru Village be directed to the treatment plant of Rakvere together with the wastewater of the villages of Näpi, Piira, Tõrremäe and Tõrma, which are already connected.

Scarcity of suitable recipient waters with a sufficient flow rate constitutes a big problem. Therefore it is unlikely that a good status of water body can be ensured by 2015 in places where wastewater treated to the minimum requirements is directed into recipient. This concerns in particular the recipient of the treatment plant of Rakvere – the Selja River. In some cases there exists no recipient, which means that appropriately treated wastewater will have to be discharged into the soil also in the longer term in some small urban regions (Kadila Village in Vinni Municipality, etc.)

2.1.1.3 Jõgeva County

60% of households in urban regions with over 500 inhabitants are connected to sewerage. The situation is somewhat better in the town of Jõgeva. In Põltsamaa the service is available to 70% of inhabitants, while the relevant figure for Mustvee is only 35%.

Compliance with standards for discharge of treated effluent has been achieved in the new Jõgeva treatment plant and the reconstructed plant of Põltsamaa. At the same time, both the batch treatment plant of Jõgeva commissioned in 2000, the plant of Mustvee completed in 1998 and the plant of Torma reconstructed in 1997–1998 are under-utilised and the degree of purification is unstable. Also the wastewater treatment plant of Põltsamaa needs further renovation.

Wastewater discharged into recipient waters from the treatment plants of Siimusti, Jõgeva and Palamuse does not meet the standards. Although a new treatment plant with chemical phosphorus removal is functioning in Palamuse, its proper functioning has not been achieved. There is a longer-term plan to direct the wastewater of Siimusti Village and Jõgeva Town to the treatment plant of Jõgeva, whose capacity is currently under-utilised.

Sludge treatment needs to be improved in all treatment plants of the county, including Jõgeva.

In this county, special attention needs to be paid to the villages of Raja, Kükita, Tiheda and Kasepää of Kasepää Municipality, which are located immediately on the shore of Lake Peipsi and lack a sewage system. The total population of these villages is above 1000 inhabitants and it would be feasible to connect these villages to the sewerage of Mustvee.

2.1.1.4 Tartu County

In the city of **Tartu**, nearly 90% of the population is covered with collection, removal and treatment of sewage. The sewage treatment facilities were constructed in 1996–1997 and biological nitrogen removal technology was commissioned in 2004. In recent years, Tartu Water Company has carried out extensive renovation of old sewage pipelines and construction of new ones. Stage II of tunnel collector was commissioned in 2004, whereby most of the former direct discharges into the River Emajõgi were eliminated. The technological process of nitrogen removal in the treatment facilities was improved, resulting in a significant decrease in the concentration of total nitrogen in treated effluent. In 2004, the content of total phosphorus in treated effluent discharged into Emajõgi was 1.3 mg/l and phosphorus load had significantly decreased: from 14.5 tonnes in 2003 to 13.2 tonnes in 2004. Surplus sludge is composted in conformity with the requirements.

In the town of **Elva**, the service of public sewerage is used by 40% of the population. Only the central area of the town is covered with public sewerage.

The wastewater treatment plant of Elva was completed in 1986 and partly renovated in 1996. The present design load is 1800 m^3/d, while in 2003 the average discharge was 310 m^3/d. As of the moment (first half of 2005) only one of the four sections of the treatment plant of Elva is operating. Post-treatment is carried out in four lagoons with the total area of 9000 m^2.

The temporary permit for special use of water issued on 01.02.2005 allows temporary direct discharge of effluent from the treatment plant of Elva into the recipient – the Käo-Kingissepa Stream –for the period of sediment removal from lagoons. The permit is valid until 31.03.2006. According to the latest data, the lagoons have been switched off from the system and effluent is currently discharged directly into the recipient.

In **Kallaste** Town, the service of public sewerage is used by 50% of the population. Wastewater is directed through a pumping station into the wastewater treatment plant of Peipus Fish Ltd. and from there to post-treatment lagoons – 4 lagoons with the total area of 7600 m^2. The treatment plant was constructed in 1984. In 2003 the lagoons were cleaned of sediment and the plant itself was renovated in 2004.

According to the vision of town government, the sewer network should be substantially expanded to connect additional clients to the network (over 95% of the population) and all hidden outlets and leaking cesspits should be eliminated.

The database of the EIC contains data on the total of 63 sewage treatment facilities in Tartu County (including towns), counting also those consisting only of lagoons from which effluent runs into water bodies of the Viru-Peipsi catchment area. Performance of 47 plants (75%) is satisfactory. Standards for nitrogen and phosphorus content in treated effluent have not been established for many small treatment facilities. Therefore, also the facilities who discharged effluent contains over 20 mg/l of nitrogen and over 5 mg/l of phosphorus are regarded as having a satisfactory performance. Unsatisfactory performance of lagoons is mainly due to the fact that lagoons have silted up over the years and have turned into sources of secondary pollution due to pollutant accumulation. The same tendency is observed in lagoons used for post-treatment, with the treatment plant of Elva being the best example.

2.1.1.5 Põlva County

40–80% of the households of urban regions with over 500 inhabitants are connected to sewerage.

The wastewater treatment plant of **Põlva** Town, operated by Põlva Wastewater Treatment Plant Ltd., was constructed in 1976 and renovated in 1997. The plant is operating at an overload and does not ensure the required degree of purification. Overload and proper treatment of surplus sludge constitute the main problems.

Of the 43 treatment plants recorded in the database of the EIC, the performance is unsatisfactory in 16 plants (37%). Lagoons have become sources of secondary pollution.

2.1.1.6 Võru County

In urban regions with 500 and more inhabitants in Võru County, the coverage of sewerage service is 75% in the town of Võru and 60–80% in other settlements.

The state of public sewerage constitutes a problem in Võru Town. There are problems with both the pipelines and pumping stations. Most of the pipelines were constructed in the 1970ies and 1980ies or earlier. Pumping stations and partly also the treatment facilities need reconstruction. The treatment plant was commissioned in 1986 and partly renovated at the end of the 1990ies.

Only a half of the capacity of the plant is currently utilised. Wastewater from the Kose Village in Võru Municipality is directed to the sewerage of Võru Town and is treated in the town's treatment plant. Treatment plants of Väimela and Parksepa need renovation. The sewerage of Vastseliina was renovated in 1999 and is in a satisfactory state, while the sewage pipeline needs partial renovation.

The biggest problems are connected with the reconstruction of sewage pipelines in Võru town and improvement of treatment facilities.

2.1.1.7 Pollution load from wastewater treatment plants

The most important effluent outlets are those of settlements and industries. The impact of an effluent outlet on water quality depends on the volume of effluent (number of inhabitants of settlements and size of industries), efficiency of wastewater treatment and flow rate of recipient waters. Therefore the two biggest cities in the Viru river basin sub-district – Narva and Kohtla-Järve, which direct their treated wastewater into the Narva River and directly to the Gulf of Finland, respectively – have a smaller impact on recipient waters than e.g. Ahtme, which directs its wastewater into the Rausvere River, or Haljala, whose wastewater is discharged into the Haljala Stream. The impact of wastewater on the status of rivers is at its highest during the summer and winter low water periods.

According to a report of the Environmental Information Centre entitled "List of enterprises according to recipient water bodies as of 2004", there are 373 effluent outlets in the Viru-Peipsi area in total, with 217 of them in the Peipsi sub-district and 156 in the Viru sub-district. Of the effluent outlets of Peipsi river basin sub-district, 198 are directed into watercourses and 19 into lakes. In the Viru sub-district, 142 outlets discharge directly into watercourses, 14 into the sea and there are no wastewater discharges into lakes. The summary table of pollution loads in 2004 according to the data of the EIC is presented in Annex 12.

Pollution load from wastewater treatment facilities in the Viru river basin sub-district (t/yr) in 2003 and 2004, respectively, according to the data of the EIC *(List of enterprises according to recipient water bodies)* was as follows:

- 400 t and 320 t BOD_7d;
- 680 t and 370 t of total nitrogen (of which 443 t and 141 t was discharged directly into the sea);
- 38 t and 35 t of total phosphorus (of which 4.9 t and 3.4 t was discharged directly into the sea).

In addition, pollution load from mines was as follows:

- 290 t and 300 t BOD_7d;
- 260 t and 330 t of total nitrogen;
- 4.3 t and 5.7 t of total phosphorus.

Pollution load from wastewater treatment facilities in the Peipsi river basin sub-district in 2003 and 2004, respectively, was as follows:

- 320 t and 190 t BOD_7t
- 250 t and 280 t of total nitrogen;
- 31 t and 28 t total phosphorus.

The sharp decrease in nitrogen load in the Viru sub-district was due to the reduction of effluent from Ökosil Ltd. at Sillamäe.

According to the data of supplementary monitoring carried out on medium-size and big rivers in the course of drawing up the national monitoring and water management programme, a considerable deterioration of chemical status is observed downstream of the following settlements:

- On Võhandu River, downstream of Räpina,
- On Piusa River, downstream of Petseri Town (pollution from the Patskovka River),

- On Orajõe River downstream of Põlva, which affects also the Ahja River,
- On Loobu River, downstream of Kadrina,
- On Purtse, Kohtla and Erra Rivers, downstream of the outlets of Kiviõli and its surroundings,
- On Selja River, downstream of Rakvere (Soolikaoja) and Haljala Stream and other numerous wastewater outlets,
- On Kaave River, downstream of the treatment plant of Saduküla,
- On Pühajõgi River, downstream of Rausvere River (wastewater of Ahtme) and other sewage outlets (Kohtla-Järve, Toila)
- On Kavilda River, downstream of Elva wastewater outlet (Käo-Kingsepa Stream).

There are 50 medium-size and big rivers in the Viru-Peipsi catchment area. In the case of 12 of them, sewage outlets of settlements and industries are one of the main reasons behind the lower than good status. Although there are practically no monitoring data for small rivers, the data of water use reports suggest that the chemical status of eight small rivers with catchment size of 50–100 km^2 (46 rivers in total) can be assessed as moderate namely because of inadequate efficiency of wastewater treatment facilities. Thus, nearly 20 of the 96 bigger rivers of the region (or nearly every fifth river) have a moderate or poor chemical status due to wastewater discharges from settlements and industries. It has to be noted here that wastewater is an important pressure also on several other rivers (e.g. Emajõgi, Pedja, Põltsamaa) but these rivers still maintain a good chemical status also downstream of pollution sources thanks to sufficient dilution due to their size (Figure 11). The efficiency of the treatment plant of Tartu has considerably increased in 2004 and the status of Emajõgi downstream of Tartu can now be assessed as good.

The high content of dangerous substances originating from point pollution sources constitutes a serious problem in the Purtse river basin (rivers of Purtse, Kohtla and Erra), which is contaminated mainly by past pollution from oil shale industries. Although the concentration of oil carbohydrates has significantly decreased compared to earlier years, it was the highest in Estonia in 2003 and 2004 (37–271 mg/l). In 10 out of the 16 samples taken in this period, the content of oil carbohydrates exceeded 50 mg/l, which corresponds to a poor or poor status by the European standards (high – 0 mg/l, good – 20 mg/l, moderate – 50 mg/l). The Kohtla and Erra Rivers are polluted also with phenols, especially during high water periods.

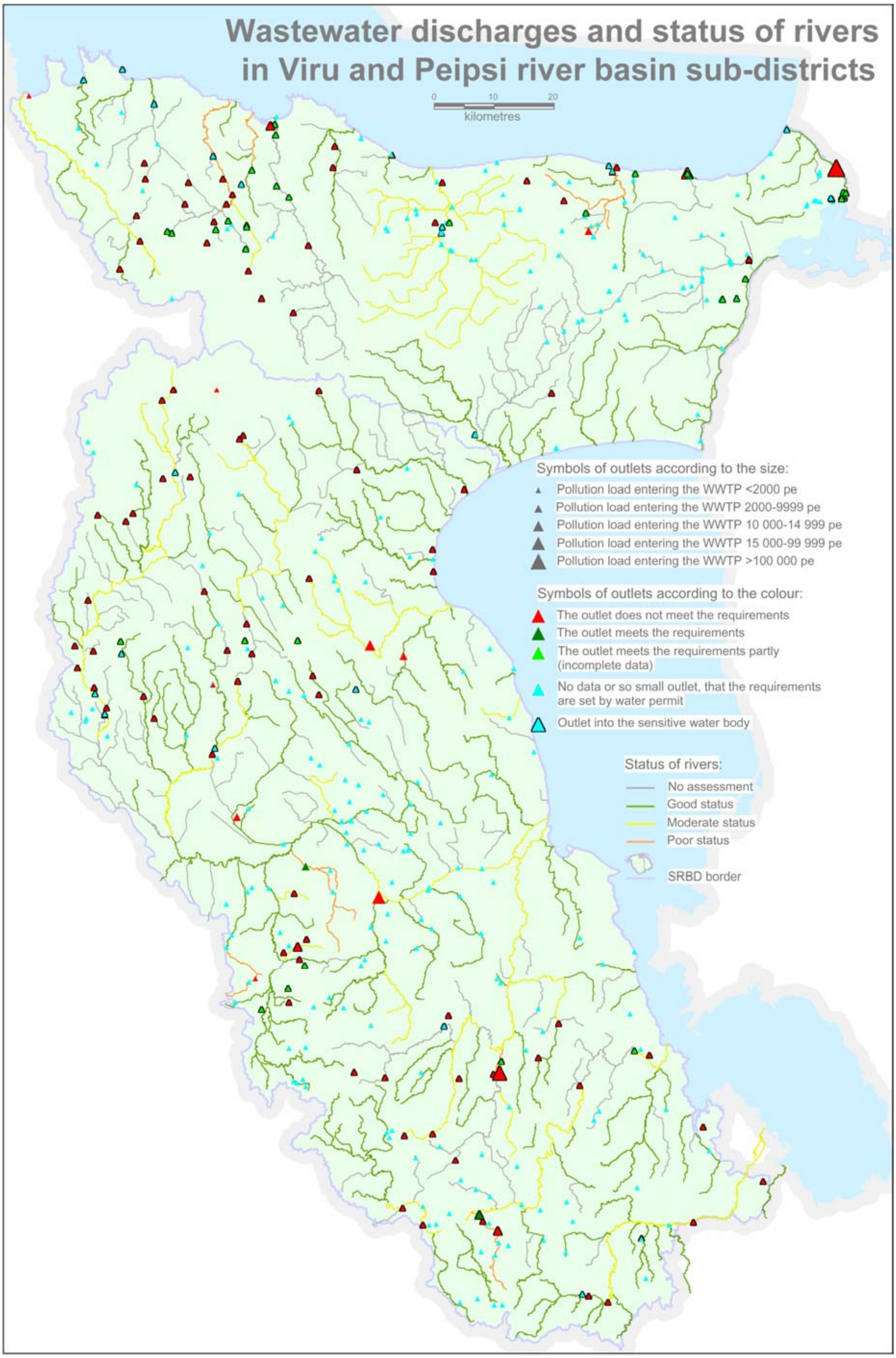


Figure 11 Wastewater discharges (2003) and status of rivers in Viru and Peipsi river basin sub-districts

2.1.2 Livestock farming

The trend of slow decline in the number of cattle has persisted in Estonia also in the 21st century. The number of pigs has stabilised. Mainly small producers have quit dairying (see Table 6) due to the lack of investments, raised requirements for raw milk and difficulties in realising their production. Large-scale producers have been preferred in centralised milk collection schemes and milk collectors often failed to reach small individual producers located further off the bigger roads (especially with snowed up roads in winter or barely passable roads in spring). Total production of milk in 2004 (652 thousand tonnes) was lower than in 2001 but higher compared to 2002 and 2003. Meat production (especially the production of pork and poultry) has increased compared to 2001: the total production in 2004 was 71 thousand tonnes [Agriculture 2004, Statistical Office of Estonia].

Table 6 Number of livestock and poultry in Estonia (thous.)

	31 Dec. 2002	**31 Dec. 2003**	**31 Dec. 2004**
Cattle	253.9	257.9	249.8
incl. dairy	115.6	116.8	116.5
Pigs	340.8	344.6	340.1
Sheep and goats	33.8	34.3	41.7
Poultry	2096.3	1945.2	2183.0

Source: Statistical Office

The potential environmental load of stockfarming is expected to increase or remain the same. Animal load varies between different parts of the Viru-Peipsi catchment area, depending on the intensity of agricultural production, which is significantly higher in Lääne-Viru, Jõgeva and Järva Counties, medium in Tartu and Põlva Counties and low in Ida-Viru, Valga and Võru counties (see Figure 12).

Figure 12 indicates that two counties with a higher animal load, Järva and Viru County, are located further from Lake Peipsi and their agricultural pollution load poses a direct danger to the Gulf of Finland rather than Lake Peipsi.

Concentrated livestock production poses a great danger to water quality in the upper courses of several significant rivers, such as Põltsamaa, Pedja, Avijõgi, Kunda and Selja (Figure 12). Most of these upper courses are good or very good habitats for trout and have been listed as Natura 2000 sites.

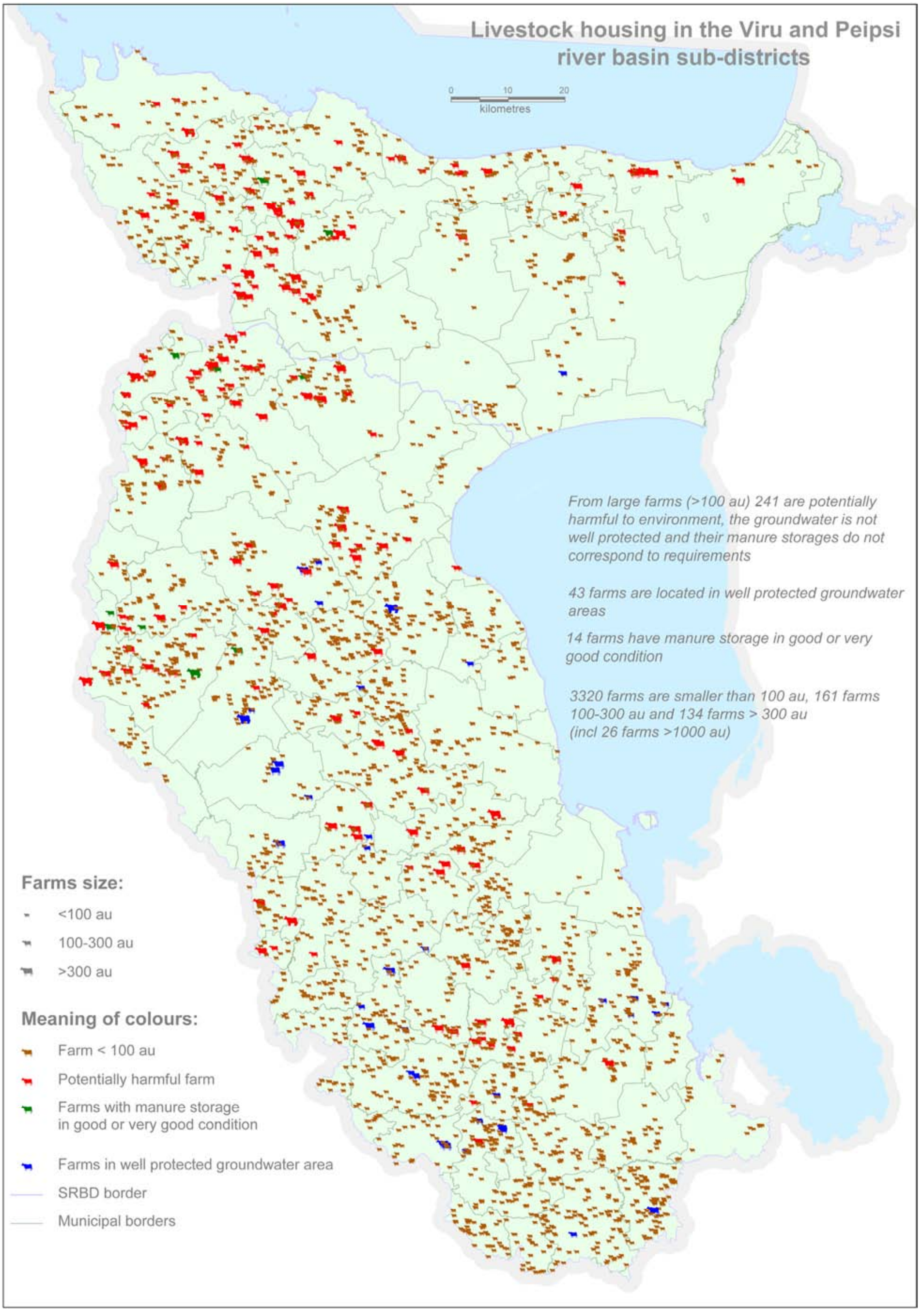


Figure 12 Livestock housing in the Viru and Peipsi river basin sub-districts

2.1.2.1 Number of animals by catchment areas

The figures presented in the following table have been obtained using the data of agricultural census of 2001 (Table7 and Table 8). Additional materials were obtained from the development plans of counties and municipalities. Division of horses between river catchments has not been presented separately because the number of horses is very low in all counties and most of them owned by small producers. Nowhere are they concentrated in one place, which is why their environmental impact is relatively low. However, horses are taken into account as animal units under the total animal load on the basis of proportional area distribution.

Table 7 Animal load in the catchment areas of Viru river basin sub-district as of 2001 (thous. heads)

Name of river	Catch ment area [km^2]	Cattle, incl. dairy cattle	Pigs	Sheep and goats	Hens	Total a/u
Narva (left shore catchment area in Estonia)	814	1.18 / 0.63	0.37	0.32	1.70	980
Kunda	530	5.01/ 3.22	4.08	0.34	7.48	5450
Loobu	308	3.38/ 1.07	9.29	0.17	5.78	3390
Purtse	810	1.50/ 0.81	2.45	0.32	2.42	1455
Selja	410	8.45/ 4.20	7.53	0.20	12.73	7100
Pühajõgi	196	0.99/ 0.53	0.32	0.15	0.39	805
Padajõgi	196	0.84/ 0.33	0.36	0.05	0.39	370
Mustajõgi	418	0.02/ 0.01	-	-	-	10
Sõtke	94	0.07/ 0.03	0.10	0.03	0.18	60
Remaining small rivers	726	1.54/0.81	0.72	0.26	0.61	1280
TOTAL	4502	22.99/ 11.64	25. 22	1.84	31.68	20 900

Table 8 Division of animals in the catchment areas of Peipsi river basin sub-district in 2001 (thous. heads)

Name of river	Catch ment area [km^2]	Cattle, incl. dairy cattle	Pigs	Sheep and goats	Hens	Total a/u
Pedja	2710	13.10/ 6.74	34.72	1.46	12.67	13 550
Põltsamaa	1310	20.54/ 10.42	16.69	0.89	98.30	17 340
Ahja	1070	10.98/ 5.82	8.96	0.57	72.00	9170
Amme	501	6.61/ 2.16	6.58	0.27	43.28	5505
Elva	456	2.51/ 1.60	6.37	0.24	10.06	2815
Emajõgi (rest of catchment area)	2468	7.30/ 3.78	4.48	1.40	6.58	6200
Võhandu	1420	6.07/ 3.21	3.15	0.77	13.24	5165
Piusa	506	1.26/ 0.65	0.94	0.27	4.42	1095
Rannapungerja	601	0.89/ 0.49	0.53	0.34	1.78	790
Kääpa/Kullavere	627	4.68/ 2.57	2.83	0.34	6.79	4010
Avijõgi	393	4.15/ 2.14	2.47	0.28	9.39	3510

Alajõgi	152	0.005/0.002	-	-	-	5
TOTAL	12 210	78.09/39.58	87.72	6.83	278.51	69 055

2.1.2.2 Pollution load from livestock housing

Impact of animal load on the environment is reflected through unused nutrients. It is relatively easy to find the total potential pollution load from livestock buildings but the actually polluting part of it can only be estimated. As the number of livestock has not substantially changed during the last four years (Table 6), such data are sufficient for making the assessments needed for the Management Plan.

Data from the Register of Agricultural Animals (as of the beginning of 2005) of the Agricultural Registers and Information Board (PRIA) were used to draw up Figure 12, which illustrates the division of animal farms in the catchment area. Notably, animals continue to be concentrated in big farms. The database of PRIA does not contain a detailed overview of the environmental performance of farms and should be complemented in cooperation between PRIA and the Estonian Environmental Inspectorate.

As calculated based on the number of animals presented in the above tables, 340 000 tonnes of manure is generated in the Viru river basin sub-district and 1 200 000 tonnes in the Peipsi sub-district annually (1 540 000 tonnes in total). This amount of manure contains 1600 and 5400 tonnes of nitrogen (7000 t in total) and 400 and 1400 tonnes of phosphorus (1800 t in total), respectively.

Total load from livestock housing (emissions from manure and silage) to water bodies has been estimated by Ülo Sults [6]: in the Viru sub-district – 27 tonnes of phosphorus and 147 tonnes of nitrogen; in the Peipsi sub-district – 93 tonnes of phosphorus and 750 tonnes of nitrogen.

2.1.3 IPPC enterprises

There are 48 IPPC enterprises in the Viru-Peipsi region in total, with 22 of them being located in Ida-Viru County and 30 being industrial enterprises, 6 waste management enterprises and 12 large-scale farms. Only 19 of the enterprises possess a permit for special use of water. Eight of them (all in Ida-Viru County) discharge either mine water or cooling water into water bodies and only 11 enterprises discharge wastewater requiring biological treatment.

2.1.4 Past pollution

The overview of past pollution was prepared using the materials of reports on supervision and control of contaminated sites, the latest of which was prepared in 2004 [11]. In the entire Viru-Peipsi catchment area there are 35 contaminated sites (PCS) of national importance (significant environmental impact), with 14 of them in Ida-Viru County, 2 in Jõgeva County, 8 in Lääne-Viru County, 5 in Põlva County, 4 in Tartu County and 2 in Võru County (Figure 13 and Table 9). In addition to these there are contaminated sites of local importance (military sites of former Soviet Union, boiler houses, various fuel storage facilities, old fertiliser and poisonous chemical depositories), whose database needs to be checked as to the status of sites and measures applied.

The sources of past pollution have been closed down and abandoned or taken over by new owners either to continue a similar activity or for some other purpose. There are mainly three types of PSC: waste depositories, military sites of Soviet Union and sites of storage or use of oil and oil shale products (terminals, asphalt concrete factories). PCSs have caused extensive contamination of groundwater with dangerous substances in vulnerable groundwater areas, which has led to loss of water resources and the need for alternative resources. In less vulnerable groundwater areas, past pollution occurs mainly as past contamination of soil and pollution spreading *via* surface water. Near-surface aquifers used for water supply are contaminated in a limited area but the contamination can still affect individual consumers in the area. Some PCSs are accounted for due to non-disposed open residues, which may cause soil or water pollution in the area.

Waste disposal sites. The biggest environmental impact on surface and groundwater comes from the semi-coke depositories of Kohtla-Järve (PCS-28) and Kiviõli (PCS-23) (shale oil, phenols, aromatic hydrocarbons, PAHs) and ash fields of the Baltic (PCS-30) and Estonian (PCS-32) Power Plant (alkaline water and oil products).

PCS-23 is located in a vulnerable groundwater area. Soil contamination exceeds the limit value for industrial zones on 80 ha. Groundwater of Ordovician aquifers is contaminated on 50 ha at the depth of 40 m. The contaminated site has stabilised.

PCS-28 is located in a vulnerable groundwater area. Phenol-contaminated surface water has intruded outside the production territory and cutoff trenches of semi-coke disposal sites of the *Viru Chemistry Group Ltd.,* having flooded the southwestern part of Kohtla-Järve Town in places and intruded into forest drainage ditches to the west, southwest and south of the production territory. The semi-coke depository includes unsealed depositories of fuses (tar), from which phenols continue to be carried into the cutoff trench on the western border of the depository with precipitation water.

Soil contamination exceeds the limit for industrial zones on 400 ha. Groundwater of Ordovician aquifers is contaminated mainly on account of polluted water from cutoff trenches on 900 ha. Also the water of Ordovician-Cambrian aquifers is polluted at the depth of 40...52 m in places. Pollution flow from this PCS into the surrounding environment is steadily high.

PCS-30 is located in a vulnerable groundwater area. Ash fields No. 1 and 2 of the Baltic Power Plant constitute a source of pollution with alkaline water, oil products and phenols to surface waters, incl. the Narva Reservoir. The site has become stable and pollution from the site is decreasing thanks to environmental measures. The content of oil products and phenols in surface water originates from other sources in the territory of the power plant and the chromium content originates from Nakro Landfill.

PCS-31 – radioactive waste depository of Sillamäe – is located in a non-vulnerable groundwater area. Closure works at the depository have entered the final stage. Final sealing of the depository and rehabilitation works are planned for the years 2004–2006. Pollution flow from the body of waste into the Gulf of Finland will ultimately be minimised and liberation of radioactive dust and radone from the depository will cease.

PCS-32 is located in a vulnerable groundwater area. The site has to be tackled jointly with the hazardous waste transfer station at Vaivara, Narva Oil Factory and ash field. Dangerous substances are spreading in near-surface aquifers of the Narva (D2nr) and Lasnamäe-Kunda (O2ls-O1kn) horizons in the area of the ash field, production waste landfill, Narva Oil Factory and Vaivara Hazardous Waste Transfer Station. In addition to the above components of pollution, organochlorines have been found in technological sewerage. The contaminated site has stabilized and is not expanding.

Other important waste depositories include the burned spoil heaps of oil shale industry. Among these, thermal processes and generation of phenols still continue in the spoil dumps of Kukruse (PCS-21) and Sompa (PCS-27). The impact of spoil dumps of Edise (PCS-20), Käva 2 (PCS-22) and Rutiku (PCS-26) on groundwater is unclear (liberation of dangerous substances from the depositories has not been detected, water in this region is undrinkable due to reasons connected with mines).

Soviet military sites. The former soviet military sites with significant environmental impact in this area are the helicopter airfield in Rakvere (PCS-39) and Raadi Airport and rocket base in Tartu (PCS-59).

PCS-39 is located in a vulnerable groundwater area. Groundwater pollution (free oil) is spreading in an area of 2500 m^2 and has stabilized to date. During the spring high water period following snow melt, oily water rises to ground surface in lower places. A risk of groundwater pollution occurs in bore wells of individual consumers.

Figure 13 Past contaminated sites of national importance in Viru and Peipsi river basin sub-districts

PCS-59 is located in a vulnerable groundwater area. Pollution is observed on ca 800 ha. The content of oil products exceeded the limit for industrial zones (5000 mg/kg) on over 11 ha. Pollution of Lake Raadi (oil products a.o. dangerous substances) poses a threat to Meltsiveski Water Intake. The entire area is covered by a detailed plan, which should solve also the problems of cleanup of pollution in different sites.

Sites of storage/use of oil and oil shale products. This group includes the following PCSs of national importance: 14 asphalt concrete factories (ACF), 6 oil product terminals, 2 areas with contaminated groundwater in Moonaküla district of Rakvere (PCS-38) and in the surroundings of the former sleeper factory of Tamsalu (PCS-41) and the oil lake of Laguja (PCS-58). The main problems are related to open residues of dangerous substances in disused storage tanks and leaks of underground storage structures (which are not liquid-proof). In respect to non-disposed residues, which are the first priority in gaining control over past pollution, the most important PCSs in the Ida-Viru County are Soldina Oil Depot (PCS-33) and ACF at Ahtme Road 88 (PCS-25); in Jõgeva County – Viruvere ACF (PCS-34) and Põltsamaa ACF (PCS-71); in Lääne-Viru County – Pahnimäe ACF (PCS-40) and Tamsalu Sleeper Factory (PCS-41); in Põlva County – Kuremäe ACF (PCS-51) and Põlva ACF (PCS-73); in Tartu County – Kärkna ACF (PCS-61) and Kobratu ACF (PCS-60); in Võru County – Umbsaare ACF (PCS-69) and Võru Oil Terminal (PCS-68). Of these PCSs, open residues have been eliminated in the Pahnimäe ACF.

A more detailed overview of the status of PCSs, their dangerousness and priority ranking of clean-up needs is provided in the materials of the report "Control and investigation of dangerous past contaminated sites" (2004), which is available in the archive of the Ministry of the Environment and in county environmental departments.

Table 9 Past pollution sites of national importance

NO.	COUNTY	RIVER BASIN SUB-DISTRICT	NAME ON MAP	TYPE OF DANGEROUS SUBSTANCE
20	Ida-Viru	Viru	Edise spoil dump	oil shale waste, PAH, phenols, oils
21	Ida-Viru	Viru	Kukruse spoil dump	oil shale waste, PAH, phenols, oils
22	Ida-Viru	Viru	Käva spoil dump	oil shale waste, PAH, phenols, oils
23	Ida-Viru	Viru	Kiviõli semi-coke dump	shale oil, phenols, toluene, xylene, styrene, naphthalene, PAH, hydrocarbons of the indene series
24	Ida-Viru	Viru	Ahtme road 86 ACF	shale oil, bitumen, asphalt, fuel oil
25	Ida-Viru	Viru	Ahtme road 88 ACF	shale oil, mazut, oil products, bitumen
26	Ida-Viru	Viru	Rutiku spoil dump	oil shale waste, PAH, phenols, oils
27	Ida-Viru	Viru	Sompa spoil dump	oil shale waste, PAH, phenols, oils
28	Ida-Viru	Viru	Kohtla-Järve semi-coke dump	shale oil, phenols, toluene, xylene, styrene, naphthalene, PAH, hydrocarbons of the indene series, arsenic
29	Ida-Viru	Viru	Narva ACF	oil shale bitumen, fuel oil, mazut, asphalt
30	Ida-Viru	Viru	Balti TPP ash fields	oil shale bottom ash, highly alkaline water, oil products, PAH, phenols, CrVI
31	Ida-Viru	Viru	Sillamäe waste depository	heavy metals, radioactive waste, acids, chlorides, fluorides
32	Ida-Viru	Viru	Eesti TPP ash fields	oil shale bottom ash, oil products, phenols, PAH, VOC
33	Ida-Viru	Viru	Soldina oil depot	oil products, phenols, aromatic compounds
34	Jõgeva	Peipsi	Viruvere ACF	bitumen, mazut, shale oil, kukersool
71	Jõgeva	Peipsi	Põltsamaa ACF	shale oil
37	Lääne-Viru	Peipsi	Laekvere ACF	bitumen, (shale oil) tar
38	Lääne-Viru	Viru	Moonaküla groundwater pollution	diesel fuel, fuel oil, shale oil (phenols, PAH)
39	Lääne-Viru	Viru	Rakvere helicopter airfield	aviation kerosene, diesel fuel a.o. oil products
40	Lääne-Viru	Viru	Pahnimäe ACF	shale oil, fuel oil
41	Lääne-Viru	Peipsi	Tamsalu sleeper factory	shale oil, mazut, bitumen, creosote

NO.	COUNTY	RIVER BASIN SUB-DISTRICT	NAME ON MAP	TYPE OF DANGEROUS SUBSTANCE
45	Lääne-Viru	Viru	Lasila ACF	bitumen, mazut, kukersool, shale oil
46	Lääne-Viru	Viru	Rakvere oil terminal	oil products, petrol, diesel fuel, mazut
47	Lääne-Viru	Viru	Roodevälja ACF	fuel oil, bitumen
48	Põlva	Peipsi	Jaama str. 71 EPT oil depot	light fuels, oil
49	Põlva	Peipsi	Raudtee str. 7 EPT oil depot	
50	Põlva	Peipsi	Põlva mazut depository	mazut
51	Põlva	Peipsi	Kuremäe ACF	bitumen, shale oil, creosote
73	Põlva	Peipsi	Põlva ACF	shale oil, oil shale bitumen, transformer oil
58	Tartu	Peipsi	Laguja oil lake	oil products, PAH
59	Tartu	Peipsi	Raadi airport	oil products, samine
60	Tartu	Peipsi	Kobratu ACF	mazut, shale oil (phenols)
61	Tartu	Peipsi	Kärkna ACF	shale oil, mazut, bitumen, fuel oil
68	Võru	Peipsi	Võru oil terminal	petrol, diesel fuel, engine oils, shale oil
69	Võru	Peipsi	Umbsaare ACF	mazut, shale oil, oil shale bitumen

2.1.5 Other potentially dangerous point pollution sources

Due to the large scope of the project, all potentially dangerous pollution sources, such as storages of oil products or fertilisers, were not addressed separately under the project. Of waste disposal sites, only bigger industrial waste disposal sites were addressed. Nor was the pollution load from fish farms studied.

On the local level there are several other important objects, such as transformer substations, storages for poisonous chemicals, enterprises using dangerous substances, animal burial sites that have been in use until recently. Illegal waste dumps pose a serious threat to water. When new water intakes are constructed, it is important that also the locations of cemeteries and other objects are taken into account. All of the above objects are the responsibility of their owners, while local authorities and county environmental departments must have an overview of their environmental safety.

Ownerless objects are the responsibility of local authorities, who may apply for aid from the water protection or waste management programme of the Environmental Investment Centre.

2.2 Assessment of pollution from non-point sources

2.2.1 Plant production

Significant changes have taken place in plant production during the last five years. Therefore, the earlier assessments based on the data of national agricultural census of 2001 were updated in the frames of this project by Ülo Sults [6].

Contrary to the optimism of 2001, the area of crop cultivation has steadily decreased, which is illustrated in Table 10 [Statistical Office].

Total crop cultivation area has decreased by 61% in the last five years, cultivation area of cereals has decreased by approximately 21%, that of rye by 28% and that of potato – by 52%. Cultivation area of summer cereals has stayed more or less the same. Variations between years have remained below 5%. Cultivation area of rape has increased by nearly 50%. Surprisingly, there has been a 61% decline in the cultivation area of fodder crops. Part of this decline can be attributed to changes in land accounting implemented in 2003, whereby perennial cultivated grasslands aged 5 or more years were transferred under natural grasslands, but annual decline in the cultivation area of fodder crops was even more rapid in earlier years.

Big differences can be observed between counties. For instance, in Ida-Viru County the total area of agricultural land has decreased by 6361 ha (25%) compared to the agricultural census of 2001, crop cultivation area has decreased by 2446 ha (17%) and even natural grasslands have decreased by 3632 ha (33%). There has been a considerable drop in the area of agricultural land also in Tartu County – 10% or 6220 ha, but the drop in the area of crop cultivation has been modest there – only 787 ha (1.7%).

Table 10 Changes in crop cultivation area in Estonia in 2000–2004 (thous. ha)

	2000	**2001**	**2002**	**2003**	**2004**	Change compared to 2001 -/+
Crops in total	809.8	644.2	588.1	517.3	495.4	- 148.8
Cereals	329.3	274.1	259.2	263.2	261.0	- 13.1
… rye	28.9	20.9	17.9	15.2	8.1	- 12.8
… summer cereals	212.3	223.5	208.2	215.2	223.0	- 0.5
Technological crops … rape	28.8	27.5	32.9	46.3	50.4	+ 22.9
Potato	30.9	22.1	16.0	17.0	16.0	- 6.1
Fodder crops	412.8	312.7	274.3	182.6	160.1	- 152.7

A substantial decline in the area of agricultural land took place also in Lääne-Viru (5125 ha or 5.8%), Põlva (4100 ha or 8%) and Jõgeva Counties (3527 ha or 5%). An 8% decline occurred also in Valga County but, as most of this county falls outside the Viru and Peipsi river basin sub-districts, except most of Hellenurme Municipality and half of Otepää Municipality, the decline in the Viru-Peipsi part of the county was only 480 ha. In Võru County the drop was more modest (4.4%), in the Viru-Peipsi part of the county the area of agricultural land decreased by 2006 ha and that of crop cultivation – by 884 ha.

In total, the area of agricultural land in the Viru-Peipsi river basin sub-districts decreased by 31 000 ha compared to 2001.

Crop growing area increased by 3133 ha in Jõgeva County, by 890 ha in the three municipalities of Järva County falling within the Viru-Peipsi catchment area, and slightly declined in Lääne-Viru County (only 535 ha) and Tartu County (790 ha or 1.7%). In total, the crop growing area in the Viru-Peipsi catchment area decreased by 29 300 ha compared to agricultural census data of 2001.

In more intensive agricultural production, fertiliser application rates per one hectare of arable land are 120–140 kg of nitrogen (in active ingredients) and 30–50 kg of phosphorus fertilisers (as P_2O_5). Considering this fact, the calculations of agricultural runoff were made using different runoff coefficients, which were based mainly on research data of E. Loigu and A. Vassiljev. The catchment areas of Pedja, Põltsamaa and Avijõgi Rivers in the Peipsi river basin sub-district and Loobu, Selja and Padajõgi in Viru sub-district were regarded as catchments with intensive agricultural production and the coefficient of 8.7 kg/ha/yr was applied for nitrogen runoff in these catchment areas. The coefficient of 8.4 kg/ha/yr was applied for the catchment areas of Kunda, Pühajõgi and Sõtke Rivers and small rivers flowing into the Gulf of Finland. Runoff coefficient of 6.5 kgN/ha/yr was applied for the catchments of Emajõgi, Elva and Kääpa/Kullavere Rivers, 5.2 kgN/ha/yr for the catchments of Ahja and Amme Rivers, 4.4 kgN/ha/yr for the catchments of Võhandu, Piusa and Rannapungerja Rivers and 4.1 kgN/ha/yr was selected as the runoff coefficient for the catchment area of the Narva River. The coefficient of 2.0–2.3 kgN/ha/yr was used for natural grasslands. The results are presented in Tables 11 and 12.

For phosphorus, the runoff coefficient of 0.24 kgP/ha/yr was used in most cases for cultivated croplands and 0.10 kgP/ha/yr for natural grasslands. Runoff from arable areas and natural grasslands was assessed separately, while no distinction was made between runoff from land under cereal crops and land under perennial grasses because there have been many unclear changes in accounting of the latter during the observed period.

Table 11 Nutrient runoff from agricultural lands in Peipsi river basin sub-district

Catchment area of river	Total area [km²]	Agri-cultural land [km²]	Of which		N and P runoff	
			crops [km²]	natural grass-land [km²]	N tonnes/yr (cult. /nat.)	P tonnes/yr (cult./nat.)
Pedja	2710	753.9	520.5	233.4	452.8/49.0	12.49/2.56
Põltsamaa	1310	522.7	376.3	146.4	327.4/33.6	9.03/1.61
Ahja	1070	237.3	176.9	60.4	91.9/13.9	4.25/0.60
Amme	501	162.4	101.9	60.5	52.0/13.9	2.44/0.60
Elva	456	172.4	96.0	76.4	62.4/22.1	2.30/0.76
Emajõgi	2468	131.0	87.6	43.4	56.9/9.9	2.10/0.43
Võhandu	1420	300.6	236.0	64.6	103.8/14.9	5.66/0.65
Piusa	506	133.0	77.0	56.0	33.9/12.9	1.85/0.56
Rannapungerja	601	40.6	25.0	15.6	17.8/3.6	0.60/0.20
Kääpa/Kullavere	627	101.1	82.8	18.3	65.7/4.2	1.99/0.18
Avijõgi	393	58.1	31.9	26.2	27.8/6.0	0.77/0.26
Alajõgi	152	14.4	8.4	6.0	3.6/2.8	0.20/0.06
TOTAL	**12 210**	**26 27.5**	**18 20.3**	**807.2**	**1480**	**52.15**

According to the assessment made on the basis of data of the Statistical Office of Estonia, total use of mineral fertilisers in the Peipsi river basin sub-district in 2004 amounted to N 9600 t and P 940 t, and in the Viru sub-district – to N 3100 t and P 310 t. The use of mineral fertilisers in Estonia as a whole in 2004 (pure N and P) amounted to 23 255 t N and 2720 t P.

2.2.2 Oil shale mining

Mines. There are two oil shale deposits in the Viru-Peipsi catchment area – Estonian and Tapa. The Tapa deposit is not used, while the Estonian deposit, except its southernmost part, meets the conditions for oil shale deposits and has been entered on the National Register of Mineral Resources. Oil shale has been mined mainly in the Ida-Viru County and, on a small scale, in Lääne-Viru County (Ubja mine and quarry). The total area of mined areas and areas covered with mining permits is 600 km^2, of which 220 km^2 are closed and flooded mines.

Oil shale is mined in two underground mines (Estonia and Viru) and in the quarries of Aidu (incl. Vanaküla Quarry) and Narva of the Estonian Oil Shale Company Ltd., and in the Põhja-Kiviõli Quarry of Kiviõli Chemical Industry Ltd. (Figure 14). Mining permits for the Estonia and Viru mines are valid until the year 2019 and, considering the size of the reserve, mining could continue there even longer. In the Viru Mine, mining will continue for ca 6 more years and removal of water from this mine may continue until the end of 2015, depending on how the issue of establishment of the new Ojamaa mine is solved. Mineral extraction permits for Aidu and Narva Quarries lost validity by 1 July 2005 and the permits will be re-registered. In Aidu Quarry, mining will probably continue until the year 2012. The western part of Aidu Quarry until the

Ojamaa River will probably not be used due to opposition from Maidla Municipality and landowners. In the quarries of Narva, where mining could continue also after 2015, slow extraction of peat is beginning to slow down oil shale production.

Table 12 Nutrient runoff from agricultural lands in Viru river basin sub-district

Catchment area of river	**Total area [km^2]**	**Agri-cultural land [km^2]**	**Of which**		**N and P runoff**	
			crops [km^2]	**natural grass-land [km^2]**	**N tonnes/yr (cult. /nat.)**	**P tonnes/yr (cult./nat.)**
Narva	814	36.6	20.9	15.7	8.5/3.6	0.63/0.16
Kunda	530	287.9	167.1	120.6	140.4/25.2	2.51/0.60
Loobu	308	118.7	80.3	38.4	69.9/8.8	1.93/0.38
Purtse	810	151.2	125.3	25.9	109.0/5.9	2.51/0.26
Selja	410	116.3	98.1	18.2	85.3/4.1	2.94/0.18
Pühajõgi	196	60.6	37.5	23.1	31.5/5.3	1.13/0.23
Pada	196	68.2	49.9	18.3	43.4/4.2	1.50/0.18
Mustajõgi	418	10.1	-	10.1	/2.1	-/0.11
Sõtke	94	8.1	3.2	4.9	2.7/1.0	0.10/0.05
Other smaller rivers	726	111.9	56.0	55.9	47.0/11.7	1.68/0.56
TOTAL	**4502**	**969.6**	**638.3**	**333.1**	**610**	**17.63**

New mining areas in Lääne-Viru County are Ubja oil shale mine in Sõmeru Municipality belonging to Kunda Nordic Cement Ltd. (production is expected to begin in 2006), and in Ida-Viru County – Ojamaa oil shale mine in Mäetaguse Municipality belonging to VKG Aidu Oil Ltd. (time of beginning of production unclear) and Narva II oil shale quarry belonging to Merko Kaevandused Ltd.

Earlier permits for the use of mineral resources lost validity on 1 July 2005 and will be reregistered as mineral extraction permits. This has made many enterprises interested in applying for mineral extraction permits.

Surface waters affected by mines. Water table in closed mines has recovered and water accumulated in workings is moving towards operating mines with lower water tables, and from the northernmost areas also towards the sea or towards places located beneath the level of mine water. Rising water table in closed mines causes problems in areas that were formerly under the draining influence of mines. This creates periodically flooded areas (in the area of Ahtme Mine, but also in high-density areas – Jõhvi Town). On the other hand, the lowering of water table in mines may lead to the drying up of water bodies. This has happened to the upper course of the Kunda River, whose recharge area was originally in Kalina Bog.

Partial spontaneous discharge of groundwater from the mouths of old mine shafts into surface water bodies occurs in the mines of Ubja, Kiviõli, Käva-2 and Tammiku. To lower the water table in Ahtme Mine, which is flooding the low areas of Kose, 4 boreholes have been bored (on the Sanniku Stream).

The water in flooded mines has a raised content of sulphate ions, high minerality and hardness. The concentration of dangerous substances (incl. phenols and heavy metals) in mine water is not so high as to require treatment of discharged water.

The content of suspended solids in water discharges from operating underground mines and quarries is reduced by the use of sedimentation basins, the larger ones of which may be regarded as artificial water bodies with a limited life time. Their lifetime is as long as the operation time of mines and their later use (water body, wetland or filling with earth) is not specified. As closure plans have not been drawn up for the quarries, the properties and use possibilities (depths, bank slope angles) of the artificial water bodies forming in the haul roads after filling of quarries are unclear as yet. The current recultivation of quarries involves mostly afforestation of dumps. When the quarries are closed down, additional earthworks may be necessary for the water bodies forming in the haul roads (this could probably be avoided already during dumping).

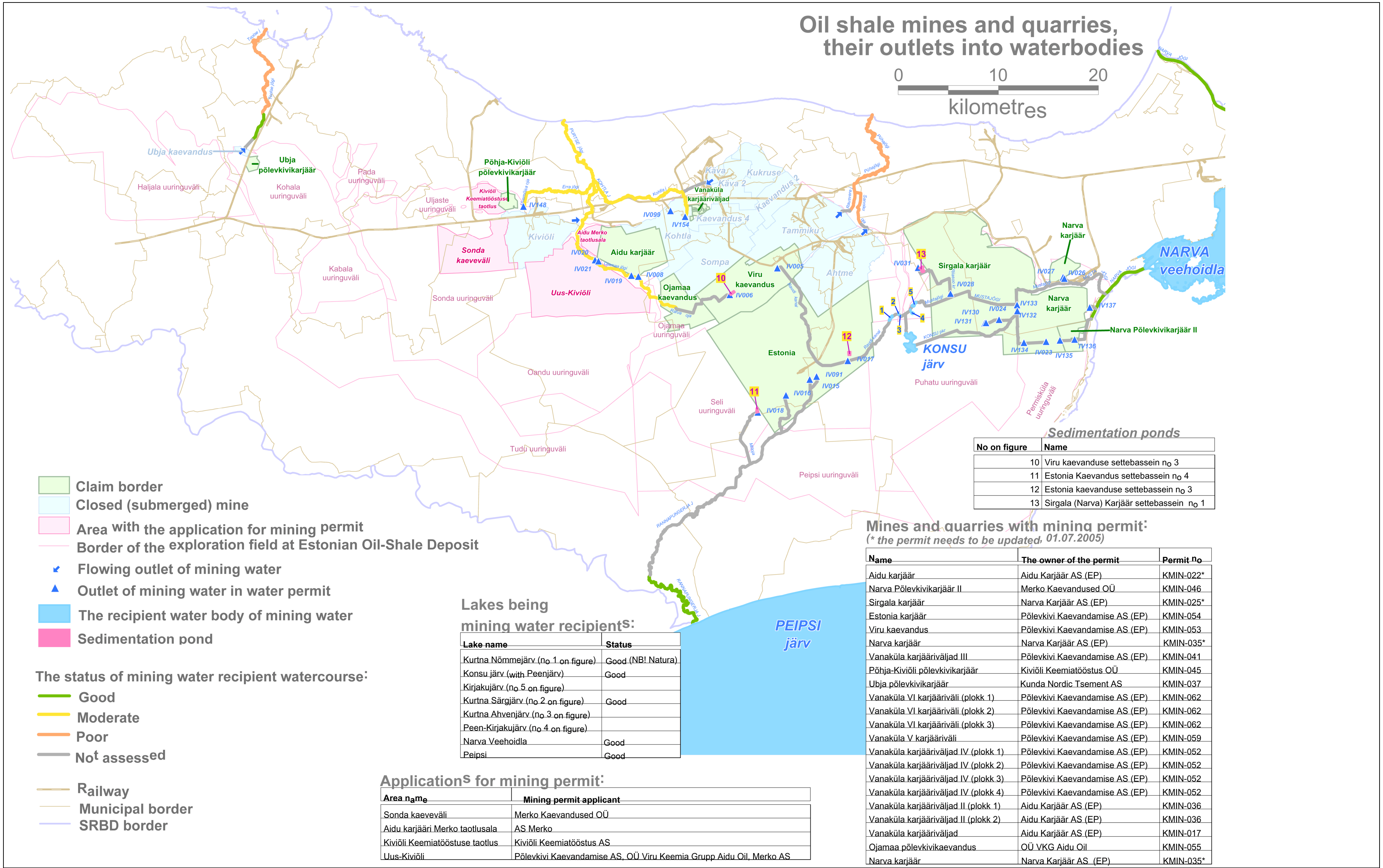
Five natural lakes in the area affected by mine waters (including Lake Kurtna Nõmmejärv, which is a NATURA 2000 lake), as the water directed to Raudi Canal from the Estonian Mine passes through these lakes.

Water table in the operating mines of **Estonian Oil Shale Company Ltd.** is lowered by pumping water out of the mines (400 000…600 000 m^3/d, depending on the level of precipitation) through the total of 34 pumping stations. The volume of water pumped out of operating underground and opencast mines usually increases over the years due to the expanding gathering area and additional inflow from closed mines. For producing one tonne of oil shale, 15 m^3 of water need to be pumped out. Most of the water pumped out of underground and opencast mines is precipitation water that would otherwise evaporate or run off with rivers. Depending on the hydrogeological conditions and the way of mining, 15…65% of the pumped-out water has always reinfiltrated. Therefore the entire quantity of water pumped out of mines cannot be regarded as groundwater. The water quantity that can be regarded as groundwater extraction in terms of its environmental impact is estimated at one fourth of the total mine discharge.

Statistical **pollution load from mines** in 2003 and 2004, respectively, was as follows:

- 290 t and 300 t BOD_7d;
- 260 t and 330 t total nitrogen;
- 4.3 t and 5.7 t total phosphorus.

It has to be taken into account that these amounts include also the background load.



Lakes being mining water recipients:

Lake name	Status
Kurtna Nõmmejärv (no 1 on figure)	Good (NB! Natura)
Konsu järv (with Peenjärv)	Good
Kirjakujärv (no 5 on figure)	
Kurtna Särgjärv (no 2 on figure)	Good
Kurtna Ahvenjärv (no 3 on figure)	
Peen-Kirjakujärv (no 4 on figure)	
Narva Veehoidla	Good
Peipsi	Good

Sedimentation ponds

No on figure	Name
10	Viru kaevanduse settebassein no 3
11	Estonia Kaevandus settebassein no 4
12	Estonia kaevanduse settebassein no 3
13	Sirgala (Narva) Karjäär settebassein no 1

Mines and quarries with mining permit:
(* the permit needs to be updated, 01.07.2005)

Name	The owner of the permit	Permit no
Aidu karjäär	Aidu Karjäär AS (EP)	KMIN-022*
Narva Põlevkivikarjäär II	Merko Kaevandused OÜ	KMIN-046
Sirgala karjäär	Narva Karjäär AS (EP)	KMIN-025*
Estonia karjäär	Põlevkivi Kaevandamise AS (EP)	KMIN-054
Viru kaevandus	Põlevkivi Kaevandamise AS (EP)	KMIN-053
Narva karjäär	Narva Karjäär AS (EP)	KMIN-035*
Vanaküla karjääriväljad III	Põlevkivi Kaevandamise AS (EP)	KMIN-041
Põhja-Kiviõli põlevkivikarjäär	Kiviõli Keemiatööstus OÜ	KMIN-045
Ubja põlevkivikarjäär	Kunda Nordic Tsement AS	KMIN-037
Vanaküla VI karjääriväli (plokk 1)	Põlevkivi Kaevandamise AS (EP)	KMIN-062
Vanaküla VI karjääriväli (plokk 2)	Põlevkivi Kaevandamise AS (EP)	KMIN-062
Vanaküla VI karjääriväli (plokk 3)	Põlevkivi Kaevandamise AS (EP)	KMIN-062
Vanaküla V karjääriväli	Põlevkivi Kaevandamise AS (EP)	KMIN-059
Vanaküla karjääriväljad IV (plokk 1)	Põlevkivi Kaevandamise AS (EP)	KMIN-052
Vanaküla karjääriväljad IV (plokk 2)	Põlevkivi Kaevandamise AS (EP)	KMIN-052
Vanaküla karjääriväljad IV (plokk 3)	Põlevkivi Kaevandamise AS (EP)	KMIN-052
Vanaküla karjääriväljad IV (plokk 4)	Põlevkivi Kaevandamise AS (EP)	KMIN-052
Vanaküla karjääriväljad II (plokk 1)	Aidu Karjäär AS (EP)	KMIN-036
Vanaküla karjääriväljad II (plokk 2)	Aidu Karjäär AS (EP)	KMIN-036
Vanaküla karjääriväljad	Aidu Karjäär AS (EP)	KMIN-017
Ojamaa põlevkivikaevandus	OÜ VKG Aidu Oil	KMIN-055
Narva karjäär	Narva Karjäär AS (EP)	KMIN-035*

Applications for mining permit:

Area name	Mining permit applicant
Sonda kaeveväli	Merko Kaevandused OÜ
Aidu karjääri Merko taotlusala	AS Merko
Kiviõli Keemiatööstuse taotlus	Kiviõli Keemiatööstus AS
Uus-Kiviõli	Põlevkivi Kaevandamise AS, OÜ Viru Keemia Grupp Aidu Oil, Merko AS

Figure 14 Oil shale mines and quarries

Peat production

Leaching of suspended solids and dissolved substances from drained peatlands is higher as compared to natural areas, taking place mainly during spring the high water period and summer and autumn showers. According to a study on peat production areas in the Oulu region of Finland, average pollution load from peat production areas in 1986–1991 was as follows: total phosphorus 0.3 kg/ha; total nitrogen 9 kg/ha, ammoniacal nitrogen 4.0 kg/ha; suspended solids 78 kg/ha.

Phosphorus runoff from peat production areas is insignificant compared to that from agricultural lands, being 3–4 times lower than the latter.

The biggest damages from suspended solids occur in rivers and streams acting as recipients for peat production areas and in small lakes connected therewith. Suspended solids deteriorate the living environment of fish. E.g. reproduction of trout may be hindered, habitats become silted up and food resources decline. Suspended solids deposited on the bottom of a water body will cover the surface of fish eggs and lower their oxygen supply conditions, leading to the death of eggs. A high content of suspended solids impairs the feeding conditions of fish.

Ammonium ions contained in runoff from peat bogs are oxidised into nitrates, reducing the oxygen content of water. Oxygen reserve in water is reduced also by humus. However, reduction of oxygen content of water due to peat production is a secondary problem compared to the impact of suspended solids.

The living conditions of crayfish are affected by the same factors as in trout. Fish fauna is affected when the content of suspended solids in water exceeds 25 mg/l. In a bathing water body the same parameter should not exceed 15 mg/l.

Peat dust may cause environmental damage in the immediate vicinity of bogs. The scale of the dust problem depends on the degree of decomposition of peat and on the production technology. Dust falling into water increases the pollution load of suspended solids and organic substances [18].

2.2.3 Forestry

As forest not fertilised in Estonia, forest nutrients originate mainly from the air and from decomposition of parent rock. According to national monitoring data for the Viru-Peipsi catchment area, the average load of mineral nitrogen from precipitation is 4 kg/ha [28] and average phosphorus load from precipitation – 0.5 kg/ha [29]. Nitrogen and phosphorus load from forest increases in the periods following clear cutting or forest fires and decreases again after once the vegetation recovers.

Leaching of nitrogen from clearcut areas makes up 4% and that resulting from forest fires – 0.15% of the calculated total leaching in forests of the Viru-Peipsi catchment area (1400 tonnes/yr)

Leaching of phosphorus from clearcut areas makes up 3.5% and leaching from forest fires – 0.01% of the calculated total leaching in forests of the Viru-Peipsi catchment area (76 tonnes) [17]

Thus, additional load from forestry is insignificant and establishment of restrictions may be considered first of all for water and sanitary protection zones.

2.3 Impact of pressures on groundwater bodies

The level of threat to groundwater bodies from various pressures (Table 13) was assessed on the basis of criteria established by Regulation No 47 of 10 May 2004 of the Minister of Environment *Status classes of groundwater bodies, values of qualitative parameters corresponding to status* *classes of groundwater bodies and the procedure for determining status classes*. This Regulation establishes also the groundwater quality standards in respect to indicator substances.

Significant pressures include all pressures that, either individually or in combined action, may bring a groundwater body into a low status class. Where a pressure was assessed as alone capable of causing a low ecological status of a groundwater body, this factor was not taken into account when assessing the combined action of the remaining pressures.

The possibility of the potential impact of pressures being realised in over 10% of the area of a groundwater body (impact of high-density areas, combined impact of point pollution sources) was used as an additional criterion in assessing the significance of pressures.

Table 13 List of pressures posing a risk to the status of groundwater bodies

Significant pressures	**Very significant /significant/less significant**
Non-point pollution, incl.	
Agricultural activity	A significant pressure for the following upper groundwater bodies: Ordovician Ida-Viru groundwater body (5); Ordovician groundwater body of Ida-Viru oil shale basin (6); Silurian-Ordovician aggregated groundwater body (9.2); Middle Devonian groundwater body (11); Middle Lower Devonian (10) groundwater body; Upper Devonian groundwater body (12); Sadala (15.9), Laiuse (15.8), Saadjärve (15.7), Elva (15.6), Piigaste-Kanepi (15.4) and Võru (15.3) areas of Quaternary aggregated groundwater body. The biggest risk occurs in the part of the Silurian-Ordovician groundwater body (9.2) overlapping with the nitrate sensitive area. Groundwater in the Pandivere-Adavere nitrate sensitive area contains plant protection products (MCPA) [31] but the concentrations have so far remained below the limit values. In big farms there are problems with environmentally sound use of liquid manure. Agricultural activity may cause a poor qualitative status of the above groundwater bodies independently of other pressures.
Households not connected to collection systems	Very significant pressure on the Quaternary Meltsiveski groundwater body (14). May cause a poor qualitative status of the groundwater body independently of other pressures. Significant pressure in the Elva (15.6) and Võru (15.3) areas of Quaternary aggregated groundwater body. May cause a poor qualitative status of the groundwater body independently of other pressures Less significant pressure for the following upper groundwater bodies: 5; 6; 9.2, 10; 11; 12 and Sadala (15.9), Laiuse (15.8), Saadjärve (15.7) and Piigaste-Kanepi (15.4) areas of Quaternary aggregated groundwater body. Impact is confined to high-density areas.
Land use in urban areas	Significant pressure for Quaternary Meltsiveski groundwater body (14), may cause a poor qualitative and quantitative status independently of other pressures. Less significant pressure for the following upper groundwater bodies: 5; 6; 9.2, 10; 11 and Elva (15.6) and Võru (15.3) areas of Quaternary aggregated groundwater body. Impact is confined to high-density areas.
Point pollution, incl.	
Leakages from contaminated areas	Very significant pressure for Ordovician groundwater body of Ida-Viru oil shale basin (6). Impact on groundwater is confined to the immediate vicinity of contaminated areas (< 500 m) but the latter are large and numerous. Significant pressure for Quaternary Meltsiveski groundwater body (14); Ordovician Ida-Viru groundwater body (5); East-Estonian area of Silurian-Ordovician aggregated groundwater body (9.2); Middle Devonian groundwater body (11); Middle Lower Devonian groundwater body (10); and Võru area (15.3) of Quaternary aggregated groundwater body. Impact is confined to the immediate vicinity of contaminated area (< 300 m).
Leakages from waste disposal sites (landfills, agricultural waste)	Significant pressure for Ordovician groundwater body of Ida-Viru oil shale basin (6), where groundwater is contaminated in the immediate vicinity of industrial waste landfills (< 500 m). Less significant pressure for the following near-surface groundwater bodies: 5, 9.2, 10, 11, 12, 15.3.
Leakages from infrastructures of oil	Significant pressure for Ordovician groundwater body of Ida-Viru oil shale basin (6). Three shale oil industries are located within the area: in the towns of Kiviõli

Significant pressures	Very significant /significant/less significant
industry	and Kohtla-Järve and in Vaivara Municipality (oil industry of Narva Power Plants Ltd.). Groundwater in these industrial areas is contaminated. Less significant pressure for the following near-surface groundwater bodies: 5, 9.2, 10, 11, 12, 14, 15.3 and 15.6.
Discharges of mine water	Significant pressure for Ordovician groundwater body of Ida-Viru oil shale basin (6). Two large oil shale quarries and two large oil shale mines are operating in the area. Significant pressure for Quaternary Vasavere groundwater body (13). Less significant pressure for East-Estonian area of Silurian-Ordovician aggregated groundwater body (9.2) (at Karinu, Nordkalk discharges 2000 m^3/d into karst from a limestone quarry).
Discharges into the soil, percolation of wastewater	Less significant pressure. In the East-Estonian area of Silurian-Ordovician aggregated groundwater body (9.2) there are three direct outlets: Karinu Village, Karinu hennery and quarry of Nordkalk at Karinu p (2000 m^3/d from limestone quarry into karst). Discharges from these direct outlets and percolation of wastewater into the soil in 51 locations in low-density areas (1411 m^3/d in total) does not cause a poor qualitative status of groundwater bodies without combined action with other pressures. Percolation of wastewater is prohibited in high-density areas but violations of this prohibition are frequent in coastal summer-house areas.
Abstraction of water, incl.	
Abstraction for the purpose of public water supply	Significant pressure on Ordovician-Vendian Voronka (2) and Gdov (1) groundwater bodies and Quaternary Vasavere (13) and Meltsiveski (14) groundwater bodies in Sillamäe, Kohtla-Järve, Jõhvi and Kiviõli towns and their immediate vicinity in Ida-Viru County. Abstraction of water for public water supply has created depression cones in Cambrian-Vendian groundwater bodies and inflowing water from the sea and the underlying saltier aquifers may have a significant impact on groundwater quality in water intakes. May cause a poor qualitative and quantitative status of the above groundwater bodies independently of other pressures.
IPPC enterprises	Significant pressure on Cambrian-Vendian Voronka (2) and Gdov (1) groundwater bodies in the towns of Kohtla-Järve, Sillamäe, Kiviõli and Jõhvi.
Non-IPPC enterprises	Less significant pressure on Cambrian-Vendian Voronka (2) and Gdov (1) groundwater bodies in Ida-Viru and Lääne-Viru Counties.
Water removal from mines	Very significant pressure on Ordovician groundwater body of Ida-Viru oil shale basin (6), has caused a hopelessly bad quantitative status of the groundwater body and significantly influenced also the qualitative status. According to pumping data, the amount of water removed for the purpose of oil shale mining (556 139 m^3/d) is roughly equal with groundwater increment. Due to the large area of mines and quarries, the pumped-out water is largely precipitation water. Part of the water pumped out and measured reinfiltrates into mines and quarries. The amount of water that can be equalised with groundwater abstraction as to its environmental impact is estimated at a quarter of the total discharge. Quantitative status of the Ordovician groundwater body of Ida-Viru oil shale basin (6) influences also the quantitative status of the Quaternary Vasavere (14) groundwater body. Underwater sand extraction in Pannjärve sand quarry in Ida-Viru County as a single pressure does not cause a poor quantitative status of the Quaternary Vasavere groundwater body but it may have an impact on the status of groundwater-dependent ecosystems (the nearest of them being the NATURA areas of the Kurtna Lakes). Drainage of and removal of water from former peat mines in Ida-Viru County have affected the status of the Kurtna Lakes (incl. the NATURA lakes) decades ago but do not cause a poor quantitative or qualitative status of the Quaternary Vasavere groundwater body at present. Of the limestone quarries operating in the area of the East-Estonian part of the Silurian-Ordovician aggregated groundwater body (9.2), water removal from Aru-Lõuna Quarry of Kunda Nordic Cement Ltd. constitutes a significant pressure but neither it nor the remaining smaller operating limestone, sand of peat mines cause a poor quantitative status of groundwater bodies.

Significant pressures	Very significant /significant/less significant
Regeneration of groundwater	
Flooding of mines	Very significant pressure. As removal of water from oil shale mining stops (11 closed mines), poorer-quality groundwater formed in mines and quarries (raised minerality and hardness, raised content of sulphates and in places also dangerous substances) may affect also the status of the Ordovician Ida-Viru groundwater body (5) and the Quaternary Vasavere groundwater body (14). Mining has also increased the risk of groundwater pollution and groundwater vulnerability in mined areas has increased.
Intrusion of sea water, incl.	
Impact of sea water on groundwater	Significant potential pressure for Cambrian-Vendian Voronka (2) and Gdov (1) groundwater bodies in coastal areas. Impact of sea water has not been observed to date.
Impact of other water on groundwater	Significant pressure on the Cambrian-Vendian Voronka (2) and Gdov (1) groundwater bodies. The basement rocks in the substratum of the Cambrian-Vendian Gdov (1) groundwater contain salty water in places. Where there exists no aquifuge in areas of intensive water abstraction, the saltier water may endanger the current water quality in the groundwater body in the area of hydrogeological "windows". As salinity of the Cambrian-Vendian Gdov (1) groundwater body is higher than that of the Cambrian-Vendian Voronka (2) groundwater body, Gdov groundwater may affect the qualitative status of Voronka groundwater body in a situation where the potentiometric surface of Voronka lies lower than that of Gdov (as is currently the case in Jõhvi).

2.3.1 Significant non-point pollution sources

In assessing the impact of non-point pollution on groundwater, non-point pollution sources were considered to include agriculture (plant production), transport, urban areas and industrial territories. Transport was regarded as a significant pressure only in the territory of towns. Important pollutants are described in Table 15.

Operating and closed oil shale quarries are regarded as non-point sources of groundwater pollution. At the same time, water discharges (pumping stations) of quarries are handled as point pollution sources of surface water. The groundwater body of Ida-Viru oil shale basin influenced by 15 flooded or operating oil shale mines or quarries.

Extensive peat mines are located mostly in areas with protected groundwater and have little significance as non-point sources of groundwater pollution.

Significant non-point pollution sources were defined as pollution sources that, either alone or in combined action with another non-point pollution source, are potentially capable of causing an exceedance of groundwater quality standards in more than 10% of the area of a groundwater body or 10% of bore holes/wells/springs.

Non-point pollution sources with significant impact on groundwater bodies are agriculture, urban areas and industrial territories.

Table 14 Land use above groundwater bodies in Viru-Peipsi catchment area

No. of GWB	Name of groundwater body (GWB)	Natural	Crop field	Settle-ment	Industry
4	Ordovician-Cambrian groundwater body	74%	16%	8%	2%
5	Ordovician Ida-Viru groundwater body as the first aquifer (Quaternary water bodies separated)	85%	12%	2%	1%
6	Ordovician groundwater body of Ida-Viru oil shale basin	70%	17%	5%	8%

No. of GWB	Name of groundwater body (GWB)	Natural	Crop field	Settle-ment	Industry
9.2	East-Estonian area of Silurian-Ordovician aggregated groundwater body (Quaternary water bodies separated)	68%	29%	2%	1%
10	Upper Devonian groundwater body	68%	29%	2%	1%
11	Middle Devonian groundwater body as the first aquifer (Quaternary and D_3 water bodies are separated)	65%	31%	3%	1%
12	Middle Lower Devonian groundwater body as the first aquifer (Quaternary and D_2 water bodies are separated)	79%	17%	1%	3%
13	Vasavere groundwater body	83%	5%	1%	11%
14	Meltsiveski groundwater body	9%	4%	65%	22%
15.9	Sadala area of Quaternary aggregated groundwater body	*20%*	*74%*	*6%*	*0%*
15.8	Laiuse area of Quaternary aggregated groundwater body	*24%*	*70%*	*5%*	*1%*
15.7	Saadjärve area of Quaternary aggregated groundwater body	*31%*	*62%*	*6%*	*1%*
15.6	Elva area of Quaternary aggregated groundwater body	*39%*	*11%*	*50%*	*0%*
15.4	Piigaste-Kanepi area of Quaternary aggregated groundwater body	*63%*	*34%*	*3%*	*0%*
15.3	Võru area of Quaternary aggregated groundwater body	*70%*	*17%*	*13%*	*0%*

Land use above the groundwater bodies (Table 14) was characterised on the basis of map layers of the base map of Estonia M 1:50 000. Areas presented on map layers were grouped as follows:

- Natural area (forest + wetlands + inland waters)
- Arable land
- Populated areas (residential buildings + gardens, settlements, towns)
- Industrial area (mines + peat production areas + oil shale related production areas + airfields + waste disposal sites + sedimentation basins).

Data on nitrogen balance in plant production, on types of pesticides and on the impact of urban areas on the chemical status of upper aquifers (near-surface aquifers have mostly been abandoned as a source of water supply in towns) are insufficient for assessing the impact of agriculture.

An expert analysis of the impact of non-point pollution was drawn up based on water protection schemes (incl. nitrogen balances) of former holdings dating back to 15 years ago, groundwater surveys, reports on nitrate-sensitive areas and groundwater monitoring data, taking into account the pollution vulnerability of groundwater bodies [31].

Of 19 groundwater bodies located in the area (incl. six detached areas of the Quaternary aggregated groundwater body), 13 may be at risk from non-point pollution. These groundwater bodies are nearest to the surface and their groundwater is vulnerable to pollution in large areas. The following groundwater bodies are at risk from non-point pollution: Ordovician Ida-Viru groundwater body (5), Ordovician groundwater body of Ida-Viru oil shale basin (6), East-Estonian area of Silurian-Ordovician aggregated groundwater body (9.2), Middle Lower Devonian groundwater body (10), Middle Devonian groundwater body (11), Upper Devonian groundwater body (12), Quaternary Meltsiveski groundwater body (14), Võru area of Quaternary aggregated groundwater body (15.3), Piigaste-Kanepi area of Quaternary aggregated groundwater body (15.4), Elva area of Quaternary aggregated groundwater body (15.6), Saadjärve area of Quaternary aggregated groundwater body (15.7), Laiuse area of Quaternary aggregated groundwater body (15.8), Sadala area of Quaternary aggregated groundwater body (15.9).

Table 15 Major pollutants posing a threat to groundwater bodies

Pollutant	Content in groundwater
Organic load	Average permanganate oxidation value is below 5 mg/l O_2 in all groundwater bodies, COD values above 5 mg/l have been detected in less than 10% of groundwater sampling points (exceedances of permanganate oxidation value in over 10% of sampling points in groundwater bodies 5 and 10 are due to natural anaerobic water environment and the surrounding mires)
NH_4^+ and NO_3^-	In all groundwater bodies the average content of NO_3^- is below 30 mg/l and the content of NH_4^+ in aerobic groundwater is below 0.5 mg/l and in naturally anaerobic groundwater – below 1.5 mg/l. Natural anaerobic water environment prevails in Estonia in aquifers located deeper than 30 m. Exceedances in the observed nitrogen compounds occur in less than 10% of groundwater sampling points.
Dangerous substances	The concentration of plant protection products in the groundwater bodies does not exceed 0.1 µg/l in any of the sampling points (yet information is insufficient, being based on 57 up-to-date analyses from 2003 + earlier analyses on historical plant protection products). Concentrations of the remaining dangerous substances, as specified in Regulation No. 44 of 21 August 2001 of the Minister of Environment *Lists 1 and 2[1] of substances dangerous to the aquatic environment,* must not exceed the limit values established by Regulation No. 12 of 2 April 2004 of the Minister of Environment *Limit values for the content of dangerous substances in soil and groundwater.* Exceedances of these limit values have been observed in the contaminated areas of the Ordovician groundwater body of Ida-Viru oil shale basin (6), in other groundwater bodies only in the immediate vicinity of pollution sources.
Others	The use of chlorides for snow control in towns may constitute a potential pressure for the Quaternary Meltsiveski area (14). As the mines are large in territory, also the groundwater with a raised SO_4^{2-} content forming in closed mines can be regarded as non-point pollution.

2.3.2 Significant pollution from point pollution sources

Large point pollution sources (including past pollution) capable of causing a poor status of groundwater bodies are located in the areas of the Ordovician groundwater body of Ida-Viru oil shale basin and Quaternary Meltsiveski groundwater body.

In other groundwater bodies, point pollution constitutes a potential risk in the case of combined effect of all point pollution sources.

The following groundwater bodies are potentially at risk from summary impact of point pollution sources: Ordovician Ida-Viru groundwater body (5), East-Estonian area of Silurian-Ordovician aggregated groundwater body (9.2), Middle Lower Devonian groundwater body (10), Middle Devonian groundwater body (11), Upper Devonian groundwater body (12), Võru area of Quaternary aggregated groundwater body (15.3), Piigaste-Kanepi area of Quaternary aggregated groundwater body (15.4), Saadjärve area of Quaternary aggregated groundwater body (15.7), Laiuse area of Quaternary aggregated groundwater body (15.8), Sadala area of Quaternary aggregated groundwater body (15.9). These are upmost groundwater bodies and their groundwater is mostly vulnerable to pollution.

The number of potentially dangerous point pollution sources in the Viru-Peipsi catchment area is estimated at 400. Detailed information exists on direct outlets into groundwater (three direct outlets in the area of the Silurian-Ordovician aggregated groundwater body – Karinu Village, Karinu Hennery and Karinu limestone quarry of Nordkalk) and on wastewater percolation in 51 locations in low-density areas. In total, 38 areas with contaminated soil or groundwater and dangerous past contaminated sites of national importance are accounted. Spreading of pollution from point sources over extensive areas is fastered by oil shale mining. Pollutants flown into quarries and underground mines reach the pumping stations draining the mining fields and are pumped into surface water bodies in a diluted form.

According to an expert assessment, 50 of the 238 former landfills or animal burial sites can be regarded as point pollution sources posing a potential risk. The landfills of Koeravere, Tamsalu, Ussimäe, Koeru and Väike-Maarja are regarded as dangerous point pollution sources in the catchment area management plans of the Pandivere area. There are 240 bigger (over 100 a/u) farms in the Viru-Peipsi area. These may constitute point pollution sources due to their non-conforming manure storages. In addition, there are 50 fertilizer or other chemical storages in the area.

The numbers for old landfills and animal burial sites, farms, fertilizer and chemical storages are estimated. They were obtained on the basis of data from the relevant surveys of the Pärnujõe and Pandivere river basin sub-districts by applying the principle of analogy.

Direct outlets cause the following types of groundwater pollution:

- Summary load of BOD_5 from percolation is lower than 7.2 tonnes/yr;
- Summary load of N_{tot} from percolation of is lower than 2.8 tonnes/yr;
- Summary load of P_{tot} from percolation is lower than 0.6 tonnes/yr.

Thus, the impact of direct discharges on groundwater is insignificant. Direct outlets influence groundwater quality only in the immediate vicinity of the outlets.

According to an inventory of dangerous discharges carried out in 2000–2002, direct discharges of priority dangerous substances were found for phenols and lead, with the total discharge of these substances not exceeding 0.2 kg/yr. No discharges of mercury, trichloroetylene and tetrachloroetylene into groundwater through direct outlets have been detected, as is the case for emissions of other dangerous substances (as listed in Regulation No. 44 of 21 August 2001 of the MoE *Lists 1 and 2 of substances dangerous to the aquatic environment*)

In addition to direct discharges, pollutants are emitted into groundwater from contaminated areas, with the calculated volumes exceeding those from direct discharges hundreds or thousands of times.

2.3.3 Significant abstraction of water

Groundwater abstractions on which water reports are submitted to issuers of permits were regarded as significant abstractions. All water abstractions are presented as of 2003 on the basis of data from the Groundwater Cadastre.

Water removals from mines and quarries were excluded from the data of groundwater abstraction since up to three quarters of the pumped-out water is precipitation water or pumped-out water that has reinfiltrated into mines or quarries. Water removals regarded as significant are presented in *italics* for informative purposes, as the high figures for pumped-out water do not express the actual impact on groundwater bodies.

<u>Significant groundwater abstraction poses a risk to the Cambrian-Vendian Gdov (1) and Cambrian-Vendian Voronka (2) groundwater bodies</u>. Total abstraction from the 151 wells of these two groundwater bodies amounted 20 865 m^3/d. In Ida-Viru County, the wells of most water intakes open both of the Cambrian-Vendian groundwater bodies at a time. Abstraction of water from the Cambrian-Vendian Voronka (2) groundwater body amounts ca 7000 m^3/d and from the Cambrian-Vendian Gdov groundwater body (1) – 14 000 m^3/d. Groundwater abstraction makes up 60–80% of the actual water resource of the groundwater bodies.

The status of the Ordovician-Cambrian (4) groundwater body is not at risk from water abstraction. Dispersed abstraction is restricted by the approved water resource. This is necessary for protecting the interests of all users of the aquifer both at present and in future. Groundwater abstraction makes up 15–20% of the actual resource. The current approved water resource would allow abstract three times more water.

Abstraction from the Ordovician Ida-Viru groundwater body makes up less than 5% of the actual resource of this aquifer.

Total abstraction from the 4 wells of the Ordovician groundwater body of Ida-Viru oil shale basin (6) amounted 69 m^3/d. *Compared to water removal from mines and quarries (total removal 556 139 m^3/d from 7 accounted locations in the conditions of extraordinarily high precipitation in 2003), abstraction of groundwater from water intakes is insignificant in this groundwater body. The impact of water removal from mines and quarries on the water resource equals to the impact of up to a quarter of the pumped-out water. Water removal from mines and quarries makes up 50–90% of the actual water resource of this groundwater body, depending on accounting of the reinfiltrating water.*

Total abstraction from the 87 wells of the Silurian-Ordovician groundwater body beneath Devonian layers (8.2) amounted 10 014 m^3/d, making up 10–20% of the actual resource.

In the East-Estonian area of the Silurian-Ordovician aggregated groundwater body (9.2), abstraction from the total of 194 wells amounted 7204 m^3/d. *Of the limestone quarries operating in the East-Estonian area of the Silurian-Ordovician aggregated groundwater body (9.2), the biggest quantities of water (25 000 m^3/d) are removed from the Aru-Lõuna Quarry of Kunda Nordic Cement Ltd. The actual impact of water removal on the water resource of the groundwater body is several times smaller. Abstraction of groundwater makes up less than 10% of the actual resource of the groundwater body.*

Abstraction from the 60 wells of the Middle Lower Devonian groundwater body (10) in the boundaries of the Viru, Peipsi and Võrtsjärve river basin sub-districts totalled 4127 m^3/d. The groundwater body falls within the area of responsibility of the East-Estonian river basin district. Together with the part of the groundwater body falling within the West-Estonian river basin district, abstraction from this groundwater body totalled 5222 m^3/d from the total of 116 wells. Groundwater abstraction makes up 10–20% of the actual resource of this groundwater body.

Groundwater abstraction from the Middle Devonian groundwater body in the Viru, Peipsi and Võrtsjärve river basin sub-districts amounted 10 685 m^3/d from the total of 297 wells. App. 10% of the actual resource of the groundwater body is abstracted.

Water of the Upper Devonian groundwater body (12) is abstracted in the Viru-Peipsi area only from small wells of individual consumers, which are not accounted for. Estimated abstraction from these few dozen wells is below 50 m^3/d. The groundwater body falls within the area of responsibility of the Koiva river basin district and summary abstraction from the Upper Devonian groundwater body (12) is between 100 and 200 m^3/d (total registered abstraction from the five wells of the Koiva river basin district is 63 m^3/d). Abstraction from this groundwater body makes up only a few per cent of its total resource.

From the Quaternary Meltsiveski groundwater body (14), water was abstracted at the Meltsiveski intake only (5405 m^3/d in total). Groundwater abstraction makes up 50% of the actual resource of the groundwater body.

From the Quaternary Vasavere groundwater body (13), the total of 5588 m^3/d of water was abstracted through 13 bore wells (with 12 of them belonging to the Vasavere water intake). Abstraction of groundwater makes up 15–25% of the actual resource of this groundwater body.

In the Sadala area of the Quaternary aggregated groundwater body (15.9), water was abstracted through 5 wells in the total amount of 78 m^3/d. In the Laiuse area of the same groundwater body (15.8), water was abstracted from one well in the amount of 4 m^3/d. Elsewhere in the East-Estonian detached areas of the Quaternary aggregated groundwater body, water is abstracted through private wells, which are not accounted for. The estimated abstraction from these few dozen wells is below 50 m^3/d. Outside the Quaternary groundwater bodies, water permits have been issued for 4 wells of the Quaternary aquifer (45 $m^{3/}d$ in total).

2.3.4 Possible impact of sea water and salty groundwater

Intrusion of sea water into groundwater bodies has not been observed. A potential risk exists in the near-coast water intakes of the Cambrian-Vendian Voronka (2) and Cambrian-Vendian Gdov (1) groundwater bodies. The basement rocks in the substratum of the Cambrian-Vendian Gdov groundwater body (1) contain salty water. In areas of intensive abstraction of water, saltier water may pose a risk to the current water quality in the groundwater body (in the area of hydrogeological "windows" in case the clayey weathering crust does not isolate the Cambrian-Vendian fresher aquifers).

As water salinity in the Cambrian-Vendian Gdov (1) groundwater body is higher than in the Cambrian-Vendian Voronka (2) groundwater body, Gdov groundwater may affect the qualitative status of the Voronka groundwater body in cases where the potentiometric surface of Voronka lies lower than that of Gdov (as is currently the case in Jõhvi). Intrusion of saltier water from the Gdov groundwater body into the Voronka groundwater body has not been observed yet.

The above two groundwater bodies are only potentially at risk. Their status is being assessed under the relevant monitoring programmes and also by ground water modelling.

The water of groundwater bodies is used until monitoring reveals intrusion of salty water. In such cases a programme of measures will be drawn up (switching to other sources of water, changes in the location and intensity of abstraction). When the first signs of intrusion of saltier water appear, there remains 10–20 years for taking countermeasures.

2.3.5 Summary of human impact on groundwater

Due to the great share of natural and seminatural and extensively farmed areas and due to a low population density, abrupt changes affecting an entire groundwater body are unlikely.

The poor status of the Ordovician groundwater body of Ida-Viru oil shale basin (6) has been caused by the long-term combined effect of water removal from oil shale mines and large sources of pollution. Lower environmental objectives need to be established for this groundwater body.

In the remaining groundwater bodies, more attention should be paid to higher-density areas so as to avoid the risk of pollution of water intakes.

The status of none of the groundwater bodies at risk (except the Ordovician groundwater body of the Ida-Viru oil shale basin) is likely to change from good to bad during the first two cycles of the Management Plan. However, appearance of negative trends and features in specific water intakes of the groundwater bodies at risk cannot be excluded.

Changes in the water table of the Ordovician groundwater body of Ida-Viru oil shale basin (6) may pose a risk to the qualitative status of the Ordovician Ida-Viru groundwater body (5) and Quaternary Vasavere groundwater body (13) (polluted water may reach the above two groundwater bodies).

Changes in the water table of the Ordovician groundwater body of Ida-Viru oil shale basin (6) may pose a risk to surface water bodies and water-dependent ecosystems located in the area of the groundwater body at risk or its immediate vicinity.

Changes in the water table of the Quaternary Vasavere groundwater body (13) pose a risk to the Natura lakes in the vicinity of the Vasavere water intake (Lakes Martiska and Kuradi and, in case the intake is extended, also Lake Liivjärv)

Changes in the groundwater table of the remaining groundwater bodies do not pose a risk to any surface water body or ecosystem.

Changes in the chemical composition of groundwater bodies at risk may pose a threat to water quality in the upper courses of rivers, as the inflow of groundwater makes up most of the discharge of surface water bodies there in minimum flow periods. Removal of water from the Ordovician groundwater body of Ida-Viru oil shale basin (6) poses a threat to water quality in the receiving water bodies.

Changes in the status of groundwater bodies at risk do not necessitate the relocation of the population and industries. The limited nature of water resources has to be taken into account in further development of industries and towns. The poor status of the Ordovician groundwater body of Ida-Viru oil shale basin (6) has created a need for construction of complex water supply systems also in rural areas and has contributed to the relocation of people to towns and smaller settlements.

2.3.6 Additional description of groundwater bodies at risk; problematic groundwater bodies

The following types of groundwater body were differentiated:

1. Groundwater bodies that will clearly achieve a good status (groundwater bodies 4 and 8.2, Figure 15);
2. Groundwater bodies at risk of failing to achieve a good status (Figure 16). For these water bodies, additional information needs to be gathered for further specification of the risk;
3. The Ordovician groundwater body of Ida-Viru oil shale basin (groundwater body 6, Figure 17), which will clearly fail to achieve a good status by the year 2015.

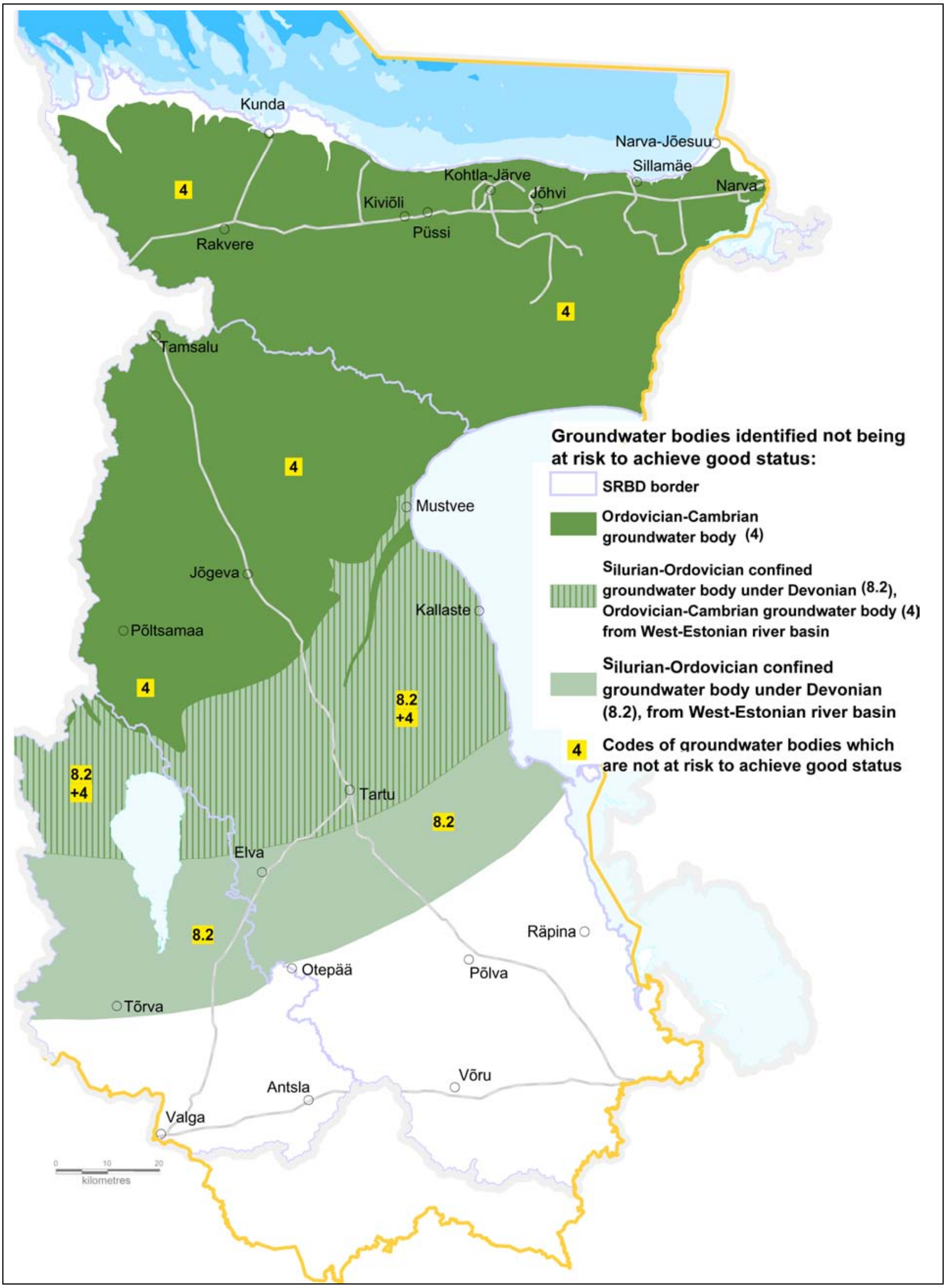


Figure 15 Groundwater bodies that will clearly achieve a good status

The use of the Silurian-Ordovician groundwater body beneath Devonian layers (8.2) as a source of drinking water is expected to decrease due to an anomalously high natural fluoride content.

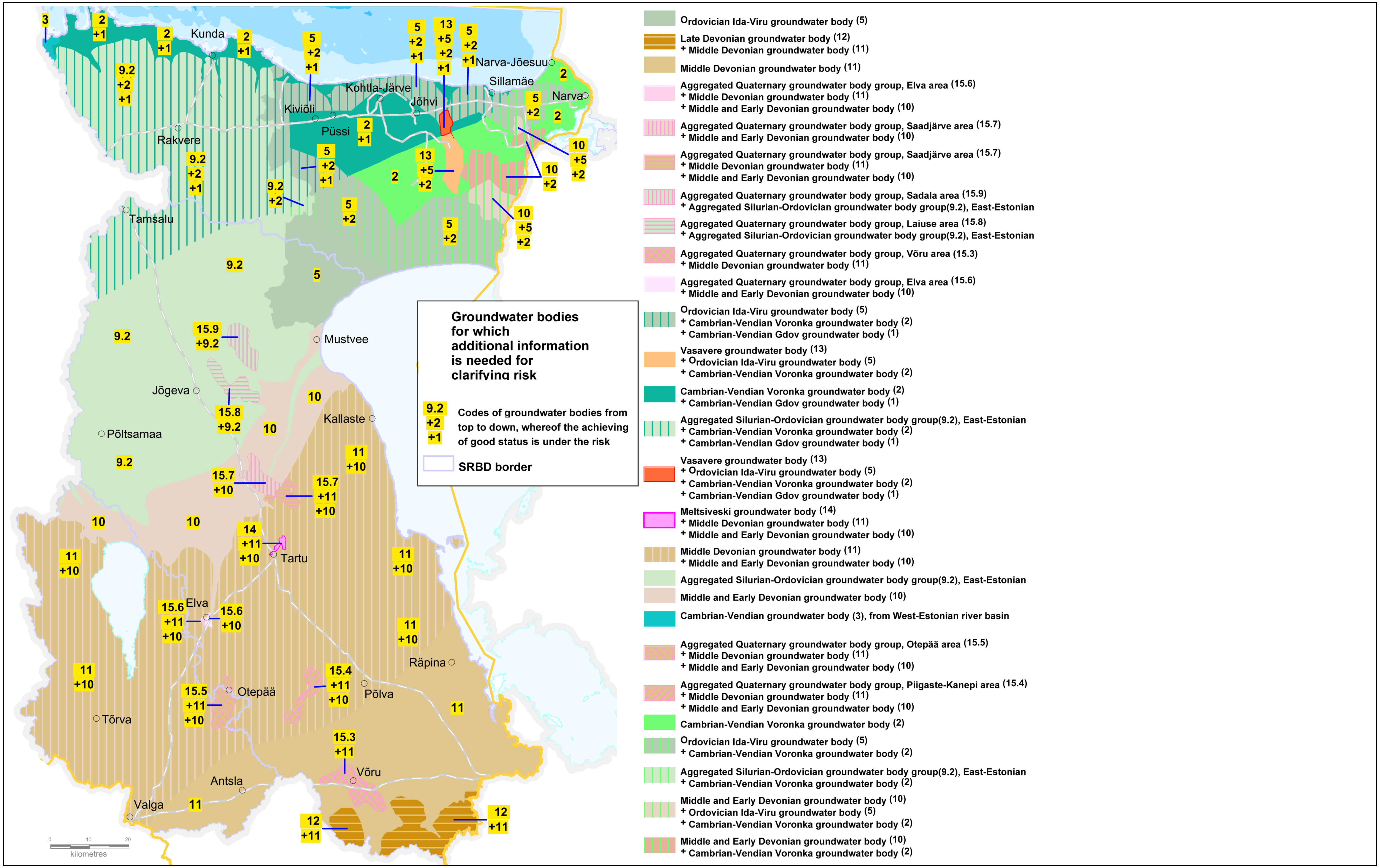


Figure 16 Groundwater bodies for which additional information is needed

For the following groundwater bodies (groundwater bodies at risk), additional information is needed to specify the risk of failing to achieve a good status:

1. Cambrian-Vendian Gdov groundwater body (1). *Water-bearing rocks are 40–60 m thick sandstones and aleurolites of the Gdov (V_2gd) series of Cambrian and Vendian systems. Groundwater is confined and not vulnerable to pollution. Hydraulic conductivity of the sandstones of the groundwater body is 5…8 m/d, water moves in the pores of the water-bearing rock. The groundwater body receives its recharge from water infiltrating from the Voronka groundwater body (2) through an aquifuge consisting of aleurolite and clay of the Kotlin series. In case water is abstracted from this groundwater body, also a transit flow from other Cambrian-Vendian groundwater bodies, including their submarine parts, is added from a certain abstraction volume on. The actual groundwater resource of this groundwater body is 10 000–20 000 m^3/d. If the confined water of this groundwater body is not consumed, the water table will rise and recharge will decrease. There are no valuable habitats and surface water bodies associated with the groundwater discharge area. When the water is used as drinking water, there are problems with its natural content of mangane, chloride, barium, dissolved gases and isotopes of radium (226Ra and 228Ra often cause an excessive effective dose when the water is used as drinking water). The groundwater contains no anthropogenic pollutants. A raised content of NH_4^+, Mn^+ and Fe_2^+ in groundwater occurs in places. In the underlying Lower Proterozoic (PR_1) crystalline baserock there are patches of areas where metamorphic and igneous rocks and the weathering crust contain small quantities of salty water with a raised radium content (Lower Proterozoic groundwater is not used).*
2. Cambrian-Vendian Voronka groundwater body (2). *Water-bearing rocks are sandstones and aleurolites with the thickness of 30-50 m of the Voronka (V_2vr) series of Cambrian and Vendian systems. Groundwater is confined and not vulnerable. Hydraulic conductivity of sandstones of the groundwater body is 2…5 m/d, water moves in the pores of rock. The groundwater body receives its recharge from precipitation water infiltrating through Quaternary deposits at ancient valleys and from water infiltrating from the Ordovician-Cambrian groundwater body (4) through the Lükati-Lontova aquifuge. Where water is abstracted from this groundwater body, also a transit flow from other Cambrian-Vendian groundwater bodies, including their submarine parts, and from Russia is added from a certain abstraction volume on. The actual resource of the groundwater body is between 15 000 and 30 000 m^3/d. When the water is used as drinking water, the following natural components cause problems: iron, mangane, dissolved gases and isotopes of radium (226Ra and 228Ra often cause an excessive effective dose when the water is used as drinking water). Water with excessive salinity occurs in the Cambrian-Vendian Gdov layers beneath this groundwater body in the eastern part of Ida-Viru County (the water is not used for water supply).*

The Cambrian-Vendian Voronka and Gdov groundwater bodies are very important sources of water supply in Virumaa. Although 60–80% of the resource is consumed, the biggest problem is the lower quality of recharged water (intrusion of saltier water) compared to the water pumped out at present. The use of Cambrian-Vendian groundwater in the present quantities means that we have knowingly counted on future deterioration of the chemical composition of the water. When used as drinking water, Cambrian-Vendian water causes problems also due to its high natural content of radium (^{226}Ra and ^{228}Ra), primarily in the Gdov groundwater – annual effective doses from water consumption are between 0.16 and 0,33 mSv, thus exceeding the limit value for drinking water. The use of Cambrian-Vendian water as drinking water needs to be restricted in places due to the natural radium content, or the water has to be mixed with water from other sources.

3. Ordovician Ida-Viru groundwater body (5). *Water-bearing rocks are 20–80 m thick carbonate rocks of the Ordovician system. The groundwater body receives its recharge from precipitation water infiltrating through the overburden in the outcrop area and, in its eastern part, also water of the Middle Lower Devonian groundwater body (10). Groundwater is mostly unconfined and vulnerable to pollution. The limestones and dolomites of the water-bearing rocks are strongly karsted and fissured in places (the upper 30 m thick part). Water moves in the fissures of rock. Hydraulic conductivity in the upper up to 20 m thick part of the carbonate rocks of the groundwater body is 5…30 m/d, at the depth of 20–50 m – 3…5 m/d and deeper than 50 m 1…2 m/d. Groundwater is infiltrating into the underlying Ordovician-Cambrian groundwater body (4) and moving as a transit flow into the Ordovician groundwater body of Ida-Viru oil shale basin (6) (until pumping of water out of this groundwater body continues) and also into the Quaternary Vasavere groundwater body (13). Groundwater discharges into surface water bodies. Water-bearing rocks of the Ordovician Ida-Viru groundwater body lie on the Silurian-Ordovician regional aquifuge formed by the limestones, marls, aleurolites, clays and argillites of the Lower Ordovician Volhov (O_1vl), Latorp (O_1lt), Varangu (O_1vr) and Pakerort (O_1pk) horizons. The outcrop area of the water-bearing rocks of the groundwater body is overlain by a mainly 2–10 m thick glacial, fluvioglacial and limnoglacial overburden, whose thickness may amount to 80 m in ancient valleys. The eastern part of the groundwater body overlain by patches of the Middle Lower Devonian groundwater body. The actual water resource of the groundwater body is estimated at up to 600 000 m^3/d. The groundwater body is surrounded by the poor-status Ordovician groundwater body of Ida-Viru oil shale basin (6) and is therefore at risk.*
4. Silurian-Ordovician aggregated groundwater body, East-Estonian area (9.2). *Water-bearing rocks are 100–200 m thick carbonate rocks of the Ordovician and Silurian system. The groundwater body receives its recharge from precipitation in the outcrop area, from water infiltrating from the Laiuse 15.8 and Sadala 15.9 areas of the Quaternary aggregated groundwater body, in karst areas also from watercourses in places. Groundwater is mostly unconfined and vulnerable to pollution. Water-bearing rocks are limestones and dolomites (interlayers with a more clayey composition occur), whose 30–40 m thick upper part is fissured and karsted, with water moving in the fissures of rock. Hydraulic conductivity in the upper up to 20 m thick part of the carbonate rocks of the groundwater body is 5…30 m/d, at the depth of 20–50 m – 3…5 m/d and deeper than 50 m 1…2 m/d. Deeper than 100–150 m the rock is less fissured and contains practically no water, thus the Silurian or Ordovician carbonate rocks there constitute part of the Silurian-Ordovician regional aquifuge. The outcrop area of the water-bearing rocks of Viru and Peipsi parts of the Silurian-Ordovician aggregated groundwater body is overlain by a glacial overburden, whose thickness is mostly 2–6 m but may amount to 50–60 m in drumlin areas. Groundwater is inflitrating into the underlying Ordovician-Cambrian groundwater body to a small extent (through the Silurian-Ordovician regional aquifuge), other outflow points are surface water bodies and, in the lower areas, also fens. The resource of the groundwater body is estimated at up to 1 500 000 m^3/d. The most important anthropogenic compound in the groundwater is nitrate.*
5. Middle Lower Devonian groundwater body (10). *Water-bearing rocks are 30–60 m thick sandstones and aleurolites of Lower and Middle Devonian systems, with interlayers of clayey and dolomite-cemented sandstone in places. Groundwater moves in the pores and, in places, also in fissures of rock. The groundwater body receives its recharge from precipitation in outcrop areas, from water infiltrating from the Saadjärve (15.7) area of Quaternary aggregated groundwater body and, in the southern parts, also from water infiltrating from the Middle Devonian groundwater body. Groundwater is infiltrating into the underlying Silurian-Ordovician groundwater body beneath Devonian layers (8.2) to*

some extent, discharge points are surface water bodies and, in lower parts of the relief, also fens. Groundwater is mostly confined (potentiometric surface lies above the ground surface in lower places) and not vulnerable, being unconfined and thus also vulnerable to pollution only in outcrop areas. Hydraulic conductivity of the sandstones and aleurolites is 2…6 m/d. The Middle Lower Devonian rocks lie over Silurian and Ordovician limestones. The outcrop area is overlain by a predominantly 4–10 m thick overburden (often several dozens of metres thick). To the south of the outcrop area, the water-bearing rock of the Middle Lower Devonian groundwater body is overlain by the sandstones and aleurolites of the Middle Devonian groundwater body (11). The actual groundwater resource of this groundwater body within the East Estonian river basin district is estimated at up to 300 000 m^3/d. The most important anthropogenic compound is nitrate.

6. Middle Devonian groundwater body (11). *Water-bearing rocks are 50–200 m thick sandstones and aleurolites (with clayey interlayers and lenses) of the Gauja (D_2gj), Burtniek (D_2br) and Aruküla (D_2ar) horizons of the Middle Devonian series. Groundwater moves in the pores of water-bearing rock. The groundwater body receives its recharge from precipitation in the outcrop area, from water infiltrating from the 15.5, Otepää (15.5), Piigaste-Kanepi (15.4) and Võru (15.3) areas of the Quaternary aggregated groundwater body and, in the southern part, also from water infiltrating from the Upper Devonian groundwater body (12). Water of the groundwater body is predominantly free (unconfined) and vulnerable, being confined and not vulnerable only beneath the thick Quaternary deposits. No karst phenomena occur in the groundwater body. Hydraulic conductivity of the sandstones and aleurolites of the groundwater body is 1…3 m/d. The Middle Devonian water-bearing rock lies over Middle Lower Devonian sandstones. The water-bearing rocks of the Middle Devonian groundwater body are overlain by a predominantly 4–10 m thick (often several dozens of metres thick) glacial overburden and, in the southern areas – by karsted and fissured dolomites and sandstones of the Upper Devonian groundwater body. Groundwater infiltrates into the underlying Middle Lower Devonian groundwater body, discharge points are surface water bodies and, in the lower parts of the relief, also fens. The actual groundwater resource in the East Estonian river basin district is estimated at up to 1 000 000 m^3/d. The most important anthropogenic compound in groundwater is nitrate.*
7. Upper Devonian groundwater body (12). *Water-bearing rocks are 15–30 m thick karsted and fissured dolomites and dolomitized limestones of Upper Devonian Dubnik (D_3db) and Plavinas (D_3pl) horizons, water flows in fissures of water-bearing rock. Hydraulic conductivity varies between 1 and 50 m/d due to karsting. Water is either free or confined depending on the relief. Confined water is overlain by thick Quaternary deposits and is protected from pollution. Groundwater infiltrates through the local aquifuge (aleurolites with marl-clay interlayers of lower part of the Plavinas horizon – Snetnaja Gora layers) into the underlying Middle Devonian groundwater body (11), discharge points are surface water bodies and, in the lower parts of the relief, also fens. The actual groundwater resource of this groundwater body in the East Estonian river basin sub-district is up to 50 000 m^3/d. The most important anthropogenic compounds are nitrates.*
8. Quaternary Vasavere groundwater body (13). *Water-bearing rocks are 20–80 m thick fluvioglacial sands of the Quaternary system, lying upon glacial clays or basement rocks. Hydraulic conductivity of the sands varies between 2 and 20 m/d. The groundwater body receives its recharge from precipitation in the outcrop area, in places also from the water of the Ordovician groundwater body of Ida-Viru oil shale basin (6), from water of the Ordovician Ida-Viru groundwater body (5) and from surface water. Water of the groundwater body infiltrates into the underlying Ordovician Ida-Viru groundwater body (5) and in places also into the Ordovician groundwater body of Ida-Viru oil shale basin*

(6), discharge points are surface water bodies and springs. The groundwater is free (unconfined) and vulnerable to pollution. The actual resource of the groundwater body is 20 000 m³/d. Impact of anthropogenic compounds has not been observed. The quantitative status of the Quaternary Vasavere groundwater body has an impact on the status of the groundwater-dependent Natura areas of the Kurtna Lakes.

9. <u>Quaternary Meltsiveski groundwater body (13).</u> *Water-bearing rocks are 20–60 m thick fluvioglacial sands of the Quaternary system overlying glacial sands or Middle Devonian sandstones. Hydraulic conductivity of the sands varies between 2 and 20 m/d. Groundwater flows in the pores of water-bearing rocks and receives its recharge from precipitation in the outcrop area and from transit flow from the Middle Devonian groundwater body. Water is discharged into surface water and infiltrates partly into the Middle Devonian groundwater body. Groundwater is mostly vulnerable to pollution, except in the area of distribution of clays in ancient valleys. The actual groundwater resource is estimated at 10 000 m³/d. The most important anthropogenic compounds are nitrates but also dangerous substances have been found in single samples. Longer-term planning of water supply from this groundwater body is risky, as the location in town would necessitate unreasonably high expenditures on improvement of water quality.*
10. <u>Sadala (15.9), Laiuse (15.8) Saadjärve (15.7), Elva (15.6), Piigaste-Kanepi (15.4) and Võru (15.3) areas of the Quaternary aggregated groundwater body.</u> *Water-bearing rocks are 20–50 m thick fluvioglacial sands of the Quaternary system lying on glacial clays or basement rocks. Hydraulic conductivity of the sands is 1-10 m/d. Detached areas of the Quaternary aggregated groundwater body receive their recharge from precipitation and the water infiltrates into the underlying Silurian-Ordovician aggregated (9.2), Middle Lower Devonian (10) or Middle Devonian (11) groundwater body. Discharge points are surface water bodies. Groundwater is mostly free (unconfined) and vulnerable to contamination. Confined and non-vulnerable groundwater is found in places in ancient valleys and in drumlin areas with thick clayey soils. The actual resource of the detached areas falling within the East-Estonian river basin district is estimated at 90 000 m³/d.*

<u>The Ordovician groundwater body of Ida-Viru oil shale basin in the Viru river basin sub-district will fail to achieve a good status. Separate objectives need to be established and an additional programme of measures drawn up for this water body.</u>

Water-bearing rocks are Ordovician carbonate rocks with the thickness of 20–80 m. The groundwater body receives its recharge from precipitation water infiltrating through the overburden in outcrop areas, in the eastern part also from water of the Middle Lower Devonian groundwater body (10). Groundwater is mostly unconfined and vulnerable to contamination. Water-bearing rocks are limestones and dolomites, which are karsted and fissured in places (the upper 30 m thick part). Hydraulic conductivity in the upper up to 20 m thick part of the carbonate rocks of the groundwater body is 5…30 m/d, at the depth of 20–50 m -3…5 m/d and deeper than 50 m – 1…2 m/d. Groundwater infiltrates into the underlying Ordovician-Cambrian groundwater body (4) to a small extent and moves also into the Ordovician Ida-Viru groundwater body (5) and Quaternary Vasavere groundwater body (13) with transit flow in places. The movement directions of water in the groundwater body are currently determined by removal of water from oil shale mines. After the mines are closed down, the groundwater body will discharge into surface water bodies, possibly leading to the recovery of fens, which have disappeared due to water removal from mines (former fen areas are currently densely populated and problems with overmoisture are arising).

Water-bearing rocks overlie the Silurian-Ordovician regional aquifuge, which consists of limestones, marls, aleurolites, clays and argillites of Lower Ordovician Volhov (O_1vl), Latorp (O_1lt), Varangu (O_1vr) and Pakerort (O_1pk) horizons. The outcrop area of the water-bearing rocks of the groundwater body is overlain by a predominantly 2–10 m thick glacial, fluvioglacial *and limnoglacial overburden, whose thickness may amount to 80 m in ancient valleys. The eastern part of the groundwater body overlain also by the Middle Lower Devonian groundwater body in patches. The actual groundwater resource is estimated at 500 000–600 000 m^3/d.*

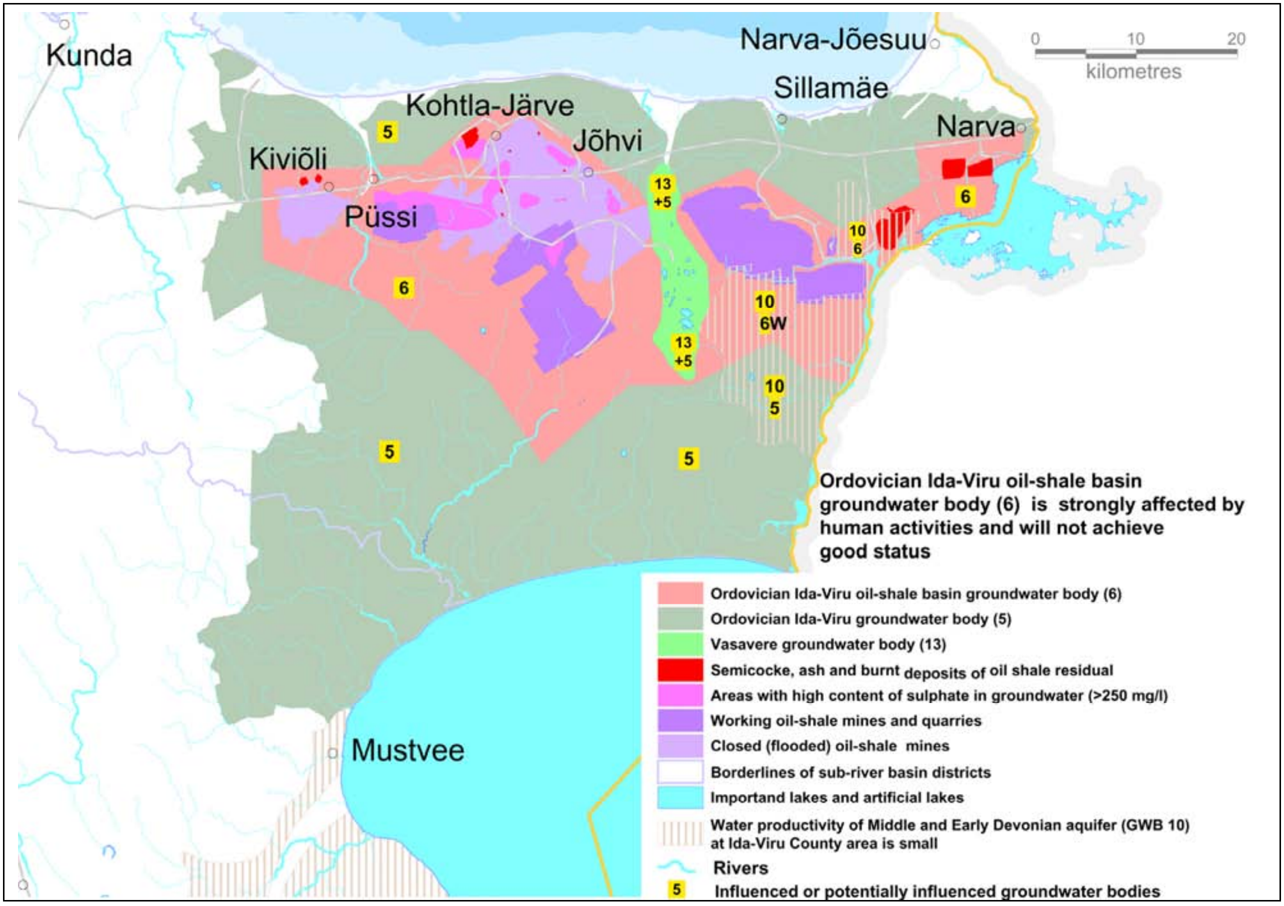


Figure 17 Achievement of a good status of the Ordovician groundwater body of Ida-Viru oil shale basin (6) is impossible

Of anthropogenic components, SO_4^{2-} content, minerality and hardness are significantly raised, first of all due to drainage associated with oil shale mining and non-natural conditions of groundwater formation in closed mines. Also dangerous substances (mainly phenols) originating from oil shale chemical industry and burned spoil dumps have been found in the groundwater.

The qualitative and quantitative status of the groundwater body has become bad due to human activity and achievement of a good status is unrealistic until oil shale mining continues. Modifications in the groundwater body affect mainly the surrounding Ordovician Ida-Viru groundwater body (5) and less significantly the Quaternary Vasavere groundwater body (13).

The water of the Ordovician groundwater body of Ida-Viru oil shale basin (1168 km^2**)** has no prospects as a source of drinking water because oil shale mining and chemical and power industry have contaminated the groundwater body and its water table has been lowered by removal of water from mines and quarries. The negative impact is spreading to the surrounding groundwater bodies: currently in the form of lowering of water tables (Figure 18), while upon the closure of the mines pollution may spread also into other groundwater bodies. The status of the Ordovician groundwater body of Ida-Viru oil shale basin (6) has a direct impact on the status of terrestrial ecosystems and surface water.

The Ordovician groundwater body of Ida-Viru oil shale basin is influenced primarily by drainage of oil shale mines. Removal of water has created extensive drawdown cones. In the uppermost, Nabala-Rakvere aquifer, the impact is observed in an app. 1–2 km radius from the mines, in the deeper Keila-Kukruse aquifer – in the radius of up to 7 km, and still deeper, in the Lasnamäe-Kunda aquifer – within more than 25 from the mines.

The groundwater that will form initially when mining activity ceases will have a sulphate content of 300–600 mg/l, minerality of 0.6–1.1 g/l, and hardness of 8–15 mg-eq/l. The content of sulphates in the water of flooded mines is at its highest immediately after the flooding of mines and decreases thereafter.

Water from the mines flooded already decades ago will remain problematic as a source of drinking water due to too high risks. The water also poses a risk to water quality in the existing wells and aggravates the water supply problems of the population of exhausted areas.

If the water from the mines of the Estonian Oil Shale Deposit is taken into use as a source of drinking water, this must be preceded by elimination of past pollution. Studies have revealed that pollutants from these sites are carried into groundwater with precipitation and snowmelt runoff.

The flow routes of underground waters have not stabilised yet, as they will be influenced by the closure of the Aidu Quarry and Viru Mine within the coming decade, and also by the solutions of removal of surplus water from Jõhvi Town and water removal from the new Ojamaa Mine.

The water of the Estonia Mine, which is better protected from pollution originating from the ground surface, is questionable as a source of drinking water due to fires that have occurred in the mine.

2.3.7 Data reliability and insufficient data

57 detailed water analyses (covering 90% of substances dangerous to the water environment) have been made for all groundwater bodies in the Viru-Peipsi catchment area in total [31]. Data on the content of pesticides applied in Estonia are insufficient. The databases of the Environmental Register do not include the relevant research data from scientific institutions, as the flow of these data has not been organised.

The out-dated (more than 15 years old) water chemistry analyses in the groundwater database are of uneven quality and can be used only with certain reservations due to changes in sampling and laboratory analysis methods. Most of the information originates from water analyses taken at the time of construction of the wells and thus not always reflects the stabilised chemical status of groundwater. For the uppermost groundwater bodies, data are available mostly for their deeper parts and insufficient data exist for the upper, aerobic parts of aquifers.

Groundwater databases are part of the Estonian Environmental Register. It is planned that an Internet-based data entry module will be added to the Register to improve data flow and reliability of data. To ensure verification of self-monitoring by enterprises under permits for special use of water, control sampling by county environmental departments or the Environmental Inspectorate needs to be arranged.

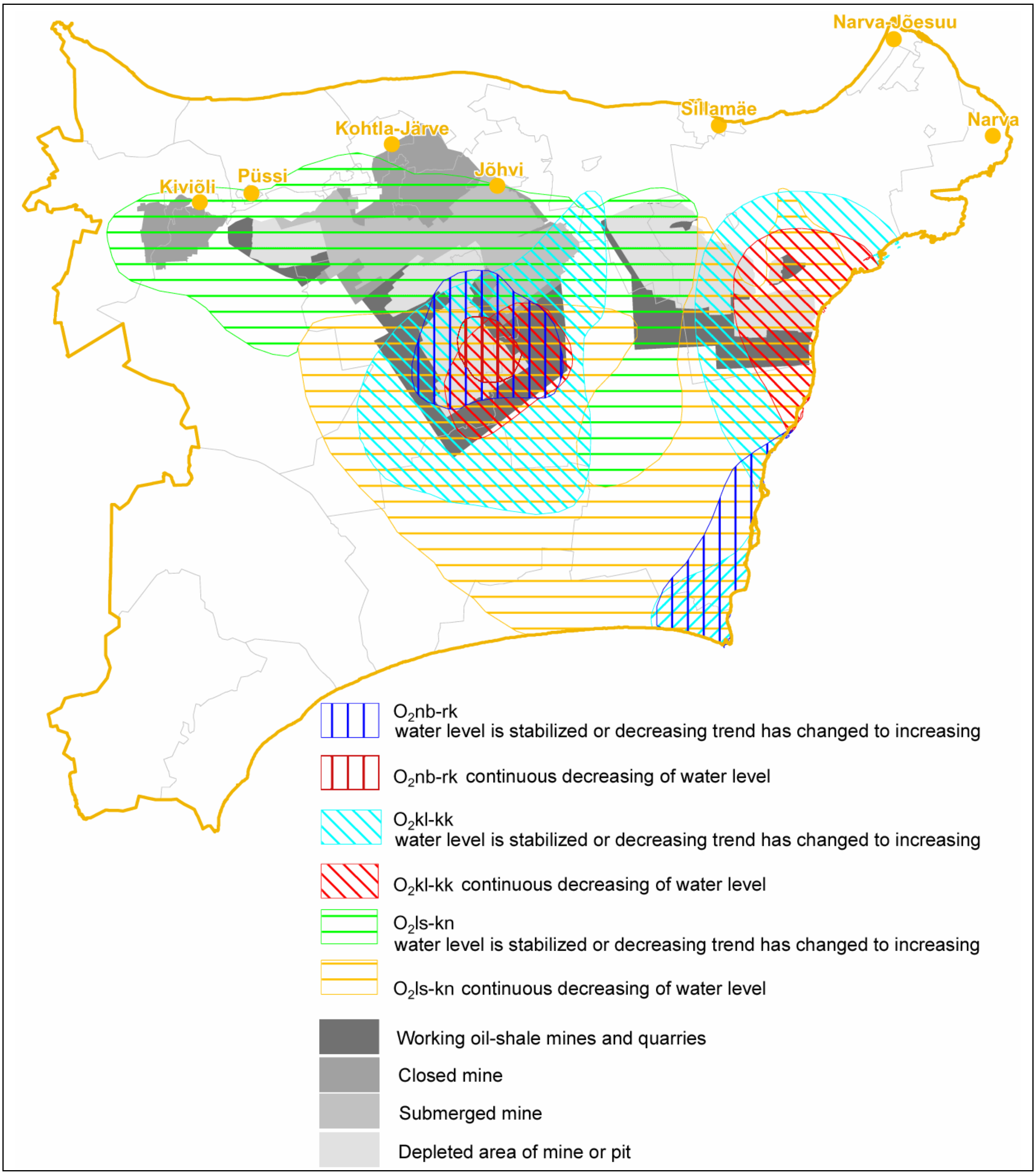


Figure 18 Impact of oil shale production on water table in Ordovician aquifers

2.4 Pressures on surface water

The following main problems occur in relation to the chemical status of surface water bodies:

- excessive concentrations of nutrients causing eutrophication (nitrogen and phosphorus),
- in some cases, low oxygen content and high BOD due to organic pollution,
- mineral substances and suspended solids originating from drained areas,
- drainage of mined areas in the Viru river basin sub-district,
- contamination with dangerous substances in the Viru river basin sub-district (phenols and oil products),
- secondary pollution of poorly maintained reservoirs.

2.4.1 Pressures having an impact on water quality

Definitions:

- *Leaching* – "washing out" of substances from soil layer. Leaching into groundwater means the part of pollution that reaches aquifers;
- *Load* is a general term. The following more specific terms should be used to avoid misconception:
    - *Potential load* – total quantity of substances entering the natural nutrient cycle within the observation area;
    - *Gross load* – theoretical load at the measuring section of a river in absence of retention. Gross load = point pollution + non-point pollution + background load;
    - *Net load* – (measured) actual load at the measuring section of a river reflected in monitoring data;
    - *Point pollution* – load from point pollution sources. Manure and silage storages are regarded as point pollution sources for the purposes of this report although the load originating from them is presented as estimated values;
    - *Non-point pollution* – environmental pollution load from anthropogenic sources without a fixed location;
    - *Background load* – load from precipitation and natural areas.
- *Retention* is the share of nutrients that exit the nutrient balance in surface water – mostly through deposition and volatilization. Losses into soil and groundwater are not regarded as part of retention. Net load = gross load – retention (upstream of the measuring section concerned).

2.4.1.1 Nitrogen and phosphorus entering the nutrient cycle

The assessment of gross load to water bodies is based on balance calculations and monitoring data. Balance calculations are based on potential loads, which are found by adding up all quantities of phosphorus and nitrogen entering the nutrient cycle within the observation area. The figures presented in Table 16 reflect the total amount of N and P annually released in the observation area. The assessment was made based on statistical data.

Table 16 N and P entering the nutrient cycle in the Viru-Peipsi catchment area

Tonnes/yr	N	N	P	P	**N**	**P**
Area	Viru s-d	Peipsi s-d	Viru s-d	Peipsi s-d	**V-Peipsi**	**V-Peipsi**
Population	**1000**	**1200**	**160**	**200**	**2200**	**360**
Animal farms and silage	1600	5400	400	1400	7000	1800
Plant production – use of mineral fertilizers	3145	9600	313	940	12 745	1253
Plant production – release from soil due to cultivation	1250	3500	600	1500	4750	2100
Total agriculture	**6995**	**19 700**	**1473**	**4040**	**26 695**	**5513**
Precipitation	**2100**	**4200**	**260**	**520**	**6300**	**780**
Additional leaching from forest (clear cutting and fires)	30	120	3	7	**150**	**10**

Tonnes/yr	N	N	P	P	N	P
Additional leaching from peat production	25	33	1	1	**58**	**2**
Additional load from oil shale mining	150	0	0	0	**150**	**0**
Total in tonnes of N and P per year	**8300**	**22 853**	**1577**	**4368**	**31 153**	**5945**

Although the volume of agricultural production has decreased nearly by half as compared to the socialist period, the nitrogen and phosphorus flows circulating in this sector are still dominating. Reduced release of nutrients from the soil has to be compensated in future by increased use of mineral fertilizers, improved use of manure and green manures.

In addition to the fertilizers applied, P and N are released also from soil humus in the course of cultivation. The highest share of released soil nutrients in the nutrient balance is observed in non-fertilized arable lands. 30% of arable land is not fertilized at present. Additional amounts of nutrients are released from soil in connection with the use of fertilizers. A long-term nutrient balance of soils has probably not been reached yet.

Prognosis until 2015: the population and number of livestock will remain in the same order of magnitude but abandoning of peripheral areas and concentration of agriculture in more rapidly developing regions will continue. The use of mineral fertilizers will increase, while no significant changes in the composition of precipitation are expected.

2.4.1.2 Assessment of loads to water bodies

The following calculations of runoff load [6] were made using the Wennerblom-Kvarnäs model (computational model developed for calculating pollution loads in the catchment area of Lake Vänern in Sweden and recommended in the Guidance Document on development of water management plans). The same model was used, in principle, also in assessing agricultural pollution for the water management plan of the Pandivere area. Loads from plant production are described in chapter 2.2.1 and loads from livestock farming – in chapter 2.1.2. The following assessment of agricultural loads is so conservative that the results can essentially be viewed as net loads. Average net load of N in the Peipsi catchment area in 2002–2004 (at entrance to Peipsi) was 5–6 kgN/ha.

The least precise part of the calculations concerns nitrogen and phosphorus runoff from manure storages and manure windrows. It is difficult to estimate the amount of nitrogen volatilized from manure (as it depends on the duration of windrowing and volatilization conditions), and also the amounts carried directly into rivers with surface runoff and the amounts infiltrating into groundwater. Due to the above considerations, and considering the location of big animal farms (their distance from rivers), nutrient runoff from manure storages and manure and silage windrows was estimated at 10–20% of the potential summary load. The latter were calculated separately for each type of livestock and then added up.

The following tables (17; 18) and graphs 1–4 illustrate the distribution of net loads of nitrogen and phosphorus (adjusted on the basis of data from 2004) by river basin sub-districts and pollution sources [6]. A more detailed overview of pollution load assessment is presented in the previous chapters on human impact and in annexes 7, 9 and 12.

Table 17 Distribution of net load of nitrogen in Viru and Peipsi river basin sub-districts (t/yr)

N load	**Viru sub-district**	**Peipsi sub-district**
From arable land	610	1296
From natural grasslands	72	187
From manure and silage storages	147	748
Agriculture in total	**829**	**2231**

N load	Viru sub-district	Peipsi sub-district
From forest lands	297	879
From wetlands	51	149
From other lands	128	220
From wastewater treatment facilities	370	280
From mines	330	0
Total	**2005**	**3759**

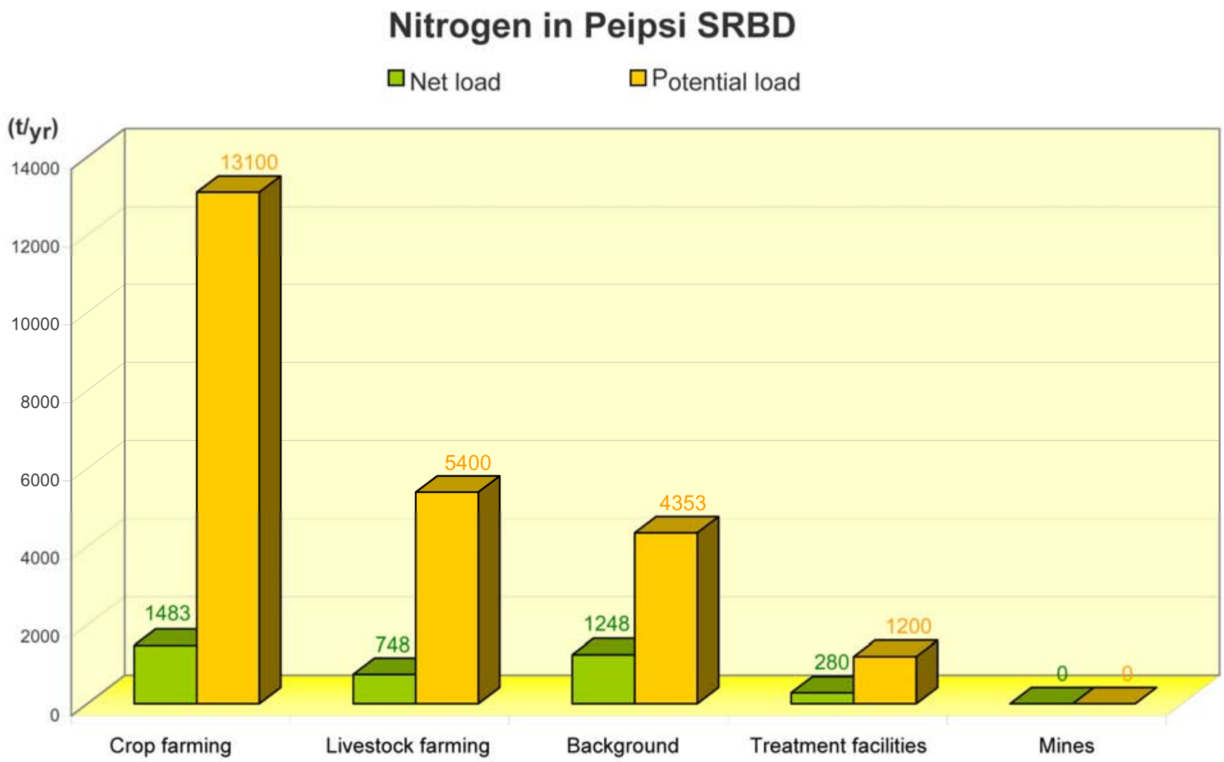
Calculated load of nitrogen amounts to 2000 tonnes/yr in the Viru river basin sub-district, 4000 tonnes in the Peipsi sub-district and 6000 t in the Viru-Peipsi catchment area in total. This is close to the sum of net nutrient loads at river mouths (7500–8500 t N in 2002–2004 from rivers to Lake Peipsi and the sea).

The share of agriculture in the net nitrogen load in the Viru and Peipsi river basin sub-districts was 40% and 60%, respectively.

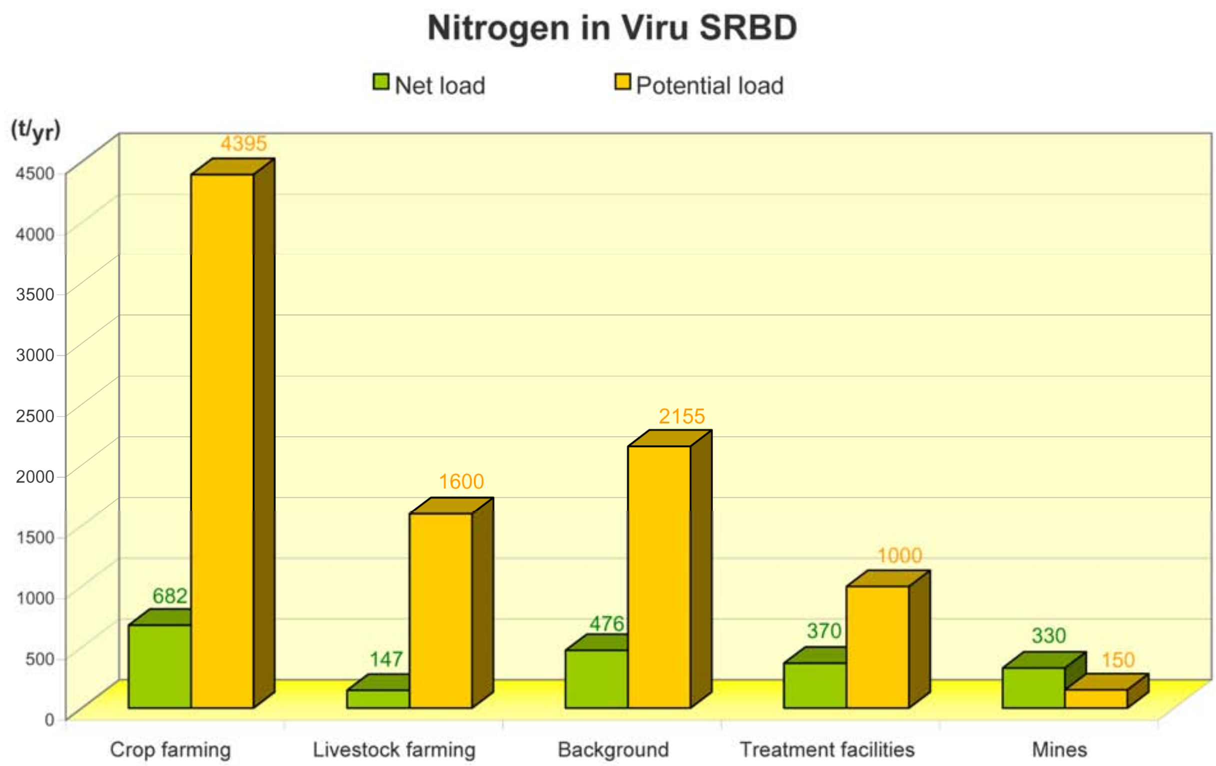
Table 18 Distribution of net load of phosphorus in Viru and Peipsi river basin sub-districts (tonnes/yr)

P load	Viru sub-district	Peipsi sub-district
From arable land	15	52
From natural grasslands	3	8
From manure and silage storages	28	93
Agriculture in total	**46**	**153**
From forest lands	16	61
From wetlands	2	6
From other lands	2	10
From wastewater treatment facilities	35	28
From mines	6	0
Total	**107**	**258**

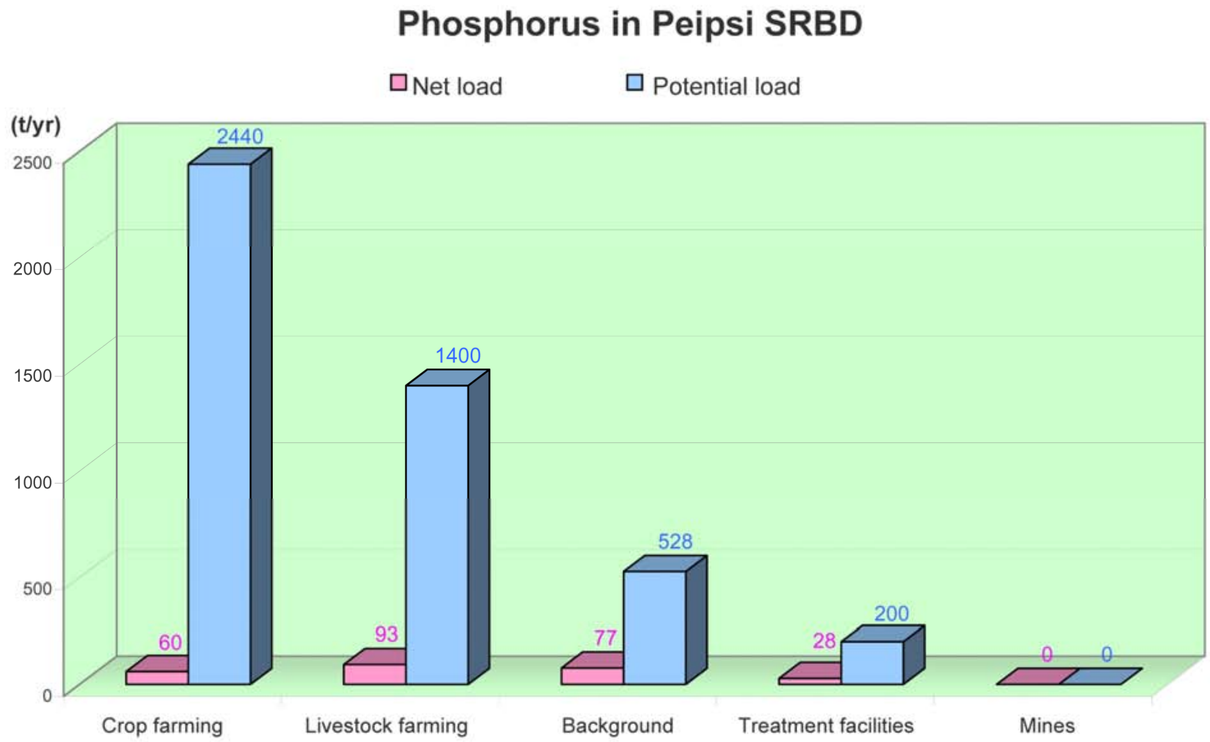
Wastewater treatment facilities account 33% of net phosphorus load of the Viru river basin sub-district, while agriculture accounts for 43%. In the Peipsi river basin sub-district, a big part of net phosphorus load originates from manure and silage storages and agriculture in total accounts for 60% of net phosphorus load.



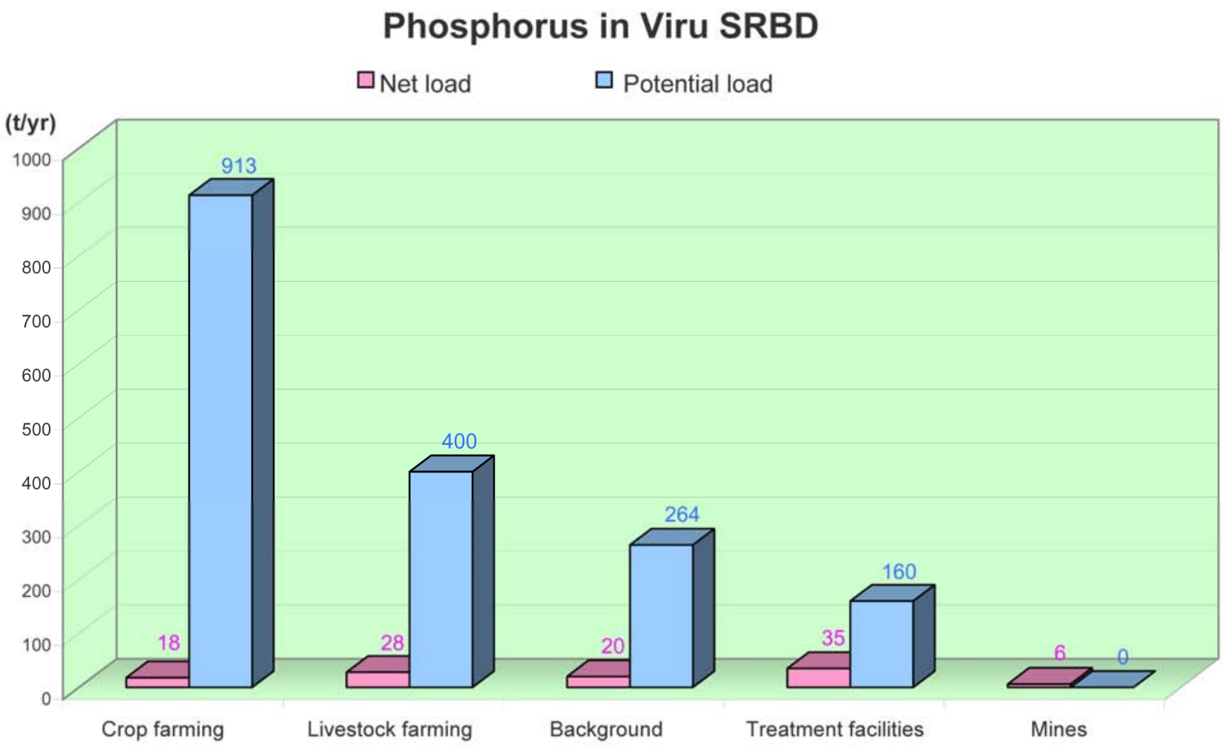
Graph 1 Nitrogen entering the nutrient cycle and net nitrogen load in Peipsi river basin sub-district



Graph 2 Nitrogen entering the nutrient cycle and net nitrogen load in Viru river basin sub-district



Graph 3 Phosphorus entering the nutrient cycle and net phosphorus load in Peipsi river basin sub-district



Graph 4 Phosphorus entering the nutrient cycle and net phosphorus load in Viru river basin sub-district

2.4.1.3 Net load to the sea and Lake Peipsi

The measured net loads (EEIC) to the sea and Lake Peipsi (without the Võrtsjärv drainage basin and Narva River) in the Viru-Peipsi catchment area in 2002–2004 amounted 7500–9500 t N and 270–320 t P.

A comparison of the above-mentioned measured loads and the estimated loads presented in the previous sub-chapter reveals that loads from sources of pollution load are somewhat underestimated and do not cover the actual measured loads to Lake Peipsi and the sea, in particular for nitrogen. A higher coincidence occurs in phosphorus loads.

The assessment of gross loads by Ülo Sults made by division of the average river net load. The actual gross load to upper courses of water bodies and to ditches should exceed the net load by the value of retention. The degree of retention in small and medium-size water bodies is a separate issue. Small lakes with transit flow probably play a role here, while the nutrient retention capacity of reservoirs has largely been exhausted.

Gross nitrogen load to the sea is lower than gross nitrogen load to Lake Peipsi from the Estonian side.

2.4.1.4 Possibilities for specifying pollution loads

It is complicated to assess the impact of loads from the catchment areas of Lake Võrtsjärv and Lake Peipsi on Lake Peipsi separately, as the catchment area principle implies that only the nutrient balances related to an entire catchment area can be assessed. An attempt was still made to draw an artificial distinction between the Võrtsjärv catchment area and the Peipsi catchment area by means of the PolFlow model, taking into account also the retention of nutrients in the River Emajõgi, which keeps the load exiting Lake Võrtsjärv from fully reaching Lake Peipsi. The model revealed that 5950 tonnes of N and 265 tonnes of P of the total of 6942 tonnes of N and 283 tonnes of P flowing into Lake Peipsi in 2003 originated from the Peipsi catchment area and the remaining load originated from Lake Võrtsjärv. To develop the water management plan based on more accurate data, the catchment areas of Lake Peipsi and Lake Võrtsjärv need to be addressed as one whole.

In order to calculate more accurate nutrient balances, it is essential that the amount of nutrients removed from the field with crops be taken into account as accurately as possible.

The water and nutrient balance of Lake Peipsi should be specified to ascertain the summary output of nutrient processes taking place in Lake Peipsi and its catchment area.

It is also important to specify the actual rate of retention in water bodies. According to a modelled calculation by Tallinn University of Technology, retention of N at the mouth of the River Emajõgi was estimated at 77.8% and retention of P – at 95.5%. Thus, according to this assessment, only 22.2% of the total nitrogen load and 4.5% of phosphorus load reach Lake Peipsi, implying that retention would have a greater role in reduction of non-point loads than control of emissions would. At the same time, Table 4.45 of the same report suggests that retention of P in River Emajõgi is 30%!

Single measurements for some rivers (e.g. Võhandu) imply that P retention is either completely absent or exceeds 100%. In rivers with a muddy bottom, internal load plays an important role in P load. Phosphorus deposited on the bottom may be re-suspended into water. It seems that the self-purification capacity of at least some rivers has been exhausted and significant retention occurs in stagnant waters, especially in Lake Peipsi.

Specification of theoretical issues does not constitute an obstacle for advancing with practical tasks of pollution control in parallel. The impact of major pollution sources is known with a sufficient precision to take the necessary measures in the short run. Storage and use of manure has to be brought into compliance with the requirements and renovation of treatment facilities needs to be completed. In parallel with that, the database of pollution sources by water bodies should be updated.

2.4.2 Possible impact of climate change

An assessment of the impact of climate change was made under a LIFE project [27], yielding the following conclusions:

1. Winter runoff of rivers will increase; spring highwater period will shorten and shift to an earlier time; spring floods will decrease.
2. An increase in the amount of precipitation in autumn will increase autumn floods, which may become nearly equal to spring floods.
3. A significant reduction in runoff should take place in April and May, possibly accompanied by a lengthening of the summer minimum runoff period toward the spring and drying up of streams and ditches with a small catchment area in the first half of summer.
4. Lengthening of the summer minimum runoff period may lead to deterioration of the sanitary status of rivers, proliferation of aquatic vegetation and intensive overgrowing of the streambeds of slow-flowing rivers.
5. In general, a more even seasonal distribution of runoff compared to the present situation will facilitate the use of rivers in water management.

The summer cloudbursts of the last few years and the associated flooding of farmlands and lower urban and industrial areas seem to confirm the trends in climate change. Flooding of farmlands aggravated by intensive overgrowing of polluted rivers in North Estonia. Floods in towns and industrial areas necessitate additional expenditures on increasing the capacity of stormwater drainage and ensuring the safety of depositories of dangerous substances. The dangerousness of floods is reduced by the fact that the flood areas of big rivers in this region are mostly natural floodplain areas with a sufficient regulative capacity.

2.4.3 Hydromorphological pressures

The quantitative status of water is influenced by changes in climate, regulation of water bodies by damming and dredging, extraction of minerals, expansion of cities and industrial areas. Leaving aside the global climate change, human impact on the quantitative status of water in our circumstances has a regional character. This is due to our humid climate and a big share of natural areas.

The physical status of rivers influenced by the following main pressures:

- Dredging and straightening of rivers in the course of land improvement;
- Damming of watercourses;
- Drainage of mined areas in the Viru river basin sub-district;
- Excessive numbers of beaver in small rivers.

2.4.3.1 Dredged and straightened watercourses

The main aim of dredging of water bodies has been to lower the water level and ensure a sufficient water-carrying capacity in recipients of drainage networks.

Dredging and straightening of rivers along with the lowering of their water levels and sediment load from ditched catchment areas has led to a decline in habitat diversity and a danger of smaller rivers and streams drying up during low water periods. In particular, the share of the most valuable habitat types for fish fauna – rapids, gravel-bottomed fast-flowing stretches, oxbows and floodplains – has decreased. Dredging of rivers and construction of land improvement systems took place decades ago and rivers have begun to recover from the worst consequences in many cases.

Nearly 300 thousand hectares of drained land has been taken out of agricultural use in recent years in Estonia and the demands for the water-carrying capacity of their receiving waters are lower than before, which makes it possible to build bottom dams and weir rapids on them, to restore the meandering of watercourses, establish spawning grounds for fish, etc. [16]

A list of state maintained public recipients has been established by Order No. 423-L of 2 July of 2003 of the Government of the Republic. The total length of state maintained public receiving waters in Ida-Viru, Jõgeva, Lääne-Viru, Põlva, Tartu and Võru Counties listed in this Regulation is 1931 kilometres.

There are 395 watercourses with a catchment size of over 10 square kilometres in the Viru-Peipsi area, with 34 of them being ditches, 100 main ditches, 1 canal (Raudi Canal) and 260 rivers and streams. In addition to ditches and mains, which have been completely reshaped by land improvement, also 97 rivers and streams were identified as heavily modified water bodies due to dredging, straightening and damming. Thus, human activity has caused significant physical changes in the status of 232 watercourses (60%) (Figure 24).

A completely new landscape with artificial water bodies has been shaped in oil shale mining areas.

2.4.3.2 Impact of dams

General deterioration of the physical quality and hydrological regime of rivers has made the existence of uninterrupted aquatic systems increasingly important for fish. The less there are rapids, oxbows and floodplains on a river, the more important it is to ensure favourable migration conditions for fish. Where different stretches of river are isolated from each other by dams, there remains little hope that all fish species that formerly inhabited the river can survive there. Construction of dams reduces the number of rapid stretches because rapids upstream of the dam are flooded and those downstream of the dam may dry up partly, in particular where a hydropower station is concerned. River stretches downstream of dams constructed for hydropower purposes periodically suffer from the lack of water. The river stretch downstream of the dam often fails to continuously receive the amount of water necessary for the preservation of aquatic habitats. The impact of dams on fish fauna is described in Annex 11.

According to an assessment by the Estonian Nature Conservation Centre, there are 83 impassable and 12 hardly passable migration barriers on 28 rivers of the Viru-Peipsi area (Annex 2). In assessing the ecological status of rivers, removal of dams was by far not always set as a requirement for achieving a *good* status. In cases where a dam has an important cultural, landscaping, hydropower of some other function of public importance, preservation of the dam was envisaged. The Põltsamaa River is an example of a river whose ecological status was identified as *moderate* regardless of *good* water quality. Several of the dams built on the Põltsamaa River have had an extremely negative effect on the fish fauna and hydromorphological status of the river. At present there are 6 dams constituting an impassable migration barrier for fish on the Põltsamaa River: Ao upper and lower dam (112 and 113 km from mouth), Rutikvere (63 km), Põltsamaa (38 km), Kamari upper and lower dam (33 km). The dams divide the river into seven isolated stretches. The greatest damaging effect to the river's fish stock is caused by the dams of Kamari, which cut the upstream parts of river off both the lower course and the entire extensive Emajõgi-Peipsi-Võrtsjärv aquatic system. As there are extremely few fast-flowing river stretches available for fish in the River Emajõgi and most of its bigger tributaries, the rapids of Põltsamaa River upstream of Kamari would constitute important spawning grounds for several fish species inhabiting the Emajõgi River, Lake Peipsi and Lake Võrtsjärv (dace, chub, ide, rissle minnow). Eel, dace, rissle minnow and bream are absent in the middle and lower course of the Põltsamaa River, largely due to the Kamari dams. The existing dams reduce also the numbers of trout, chub, ide, gudgeon, bleak, stoan loach, burbot and bullhead in the river.

The dams of Kunda in the lower course of the Kunda River (Kunda Hydropower Plant and the old dam of the cement factory) are the best examples of adverse impact on the ecological status of river. The dams cut migratory fishes off from most of their historical spawning grounds and isolate the lower course populations of salmonids and other species from the middle and upper course populations. The dams also pose a constant danger to the hydrological regime and physical quality of the lower course of the river, and some of the best spawning and nursery grounds of fish in Estonia have been submerged under reservoirs.

The hydropower potential of the Kunda River is marginal compared to the damage to fish fauna caused by dams and power production. The capacity of the HPP is up to 200 kW but full capacity is only periodically available. At the same time, the dams reduce the river's reproduction potential up to fivefold for salmon, up to tenfold for sea trout and lamprey and significant damage is caused also to the stock of brown trout, grayling a.o. fish species. The absence of migratory fishes (lamprey, salmon, sea trout, vimba bream) in the Kunda River upstream of the Kunda HPP dam implies that the status of fish fauna in a 60 km stretch of the river is only *moderate* at the very best.

Annual productivity of the salmon population of the Kunda River is estimated at 1000–2000 descending fish per year, while the potential productivity of the river has been estimated at up to 5000 descending fish/yr. The annual number of descending individuals of sea trout has stayed in the same order of magnitude as in salmon (1000–2000), while the potential number could be considerably higher than in salmon, amounting to 10 000 to 20 000 per year. The cost price of raising one two-year (descending) fish of salmon or sea trout on a fish farm is app. 30 kroons. Thus, the benefit from full realisation of the fisheries potential of the Kunda River could be 300–600 000 kroons/yr.

2.4.3.3 Reservoirs posing a flood risk

The following reservoirs have been assessed as posing a flood risk (the assessment is not final for all reservoirs): Obinitsa; Kentsi; Laviku; Oruveski I (Muike); Oruveski II; Pikapõllu; Ojaäärse and Alatskivi. In addition, it has been pointed out that the lower regulator dams on the cascades of reservoirs on the Sõtke and Võsu Rivers are incapable of carrying emergency flows from the upstream dam. The hydraulic structures are not prepared for carrying heavy floods (like those in 2003 and 2005). It is necessary to appoint operators for all regulator dams and draw up user manuals explaining also the action in emergency situations [8].

2.4.3.4 Impact of beaver on the status of fish fauna of rivers

The impact of beaver on the fish fauna of rivers is similar to that of man-made dams. The main difference lies in the fact that while man builds dams mostly on bigger rivers, beaver is capable of damming up only smaller rivers and streams (minimum discharge in low water periods <0,3 m^3/s and annual average discharge <$3m^3/s$). The number of beavers in Estonia are increasing already for the second decade on end and the rising trend continues, facilitated by the "retreat" of man from riversides: abandoning of riverine hay meadows and lack of maintenance of receiving waters.

The optimum level of beaver population in Estonia is by far exceeded by now and beaver has become one of the main sources of impact on our small and medium-sized rivers. Important spawning grounds of fish are often located namely on small rivers. Thus, if the breeding and nursery grounds are not available or if young stages perish, also the fish fauna of big rivers, lakes and coastal sea will suffer.

In at least 35 of the 81 rivers assessed by the Nature Conservation Centre, the number of beavers have been identified as a pressure on fish fauna.

Beavers build dams also on ditches, thus contributing to floods mostly in forest lands but also causing overmoisture in arable lands.

2.4.4 Pressures on small lakes

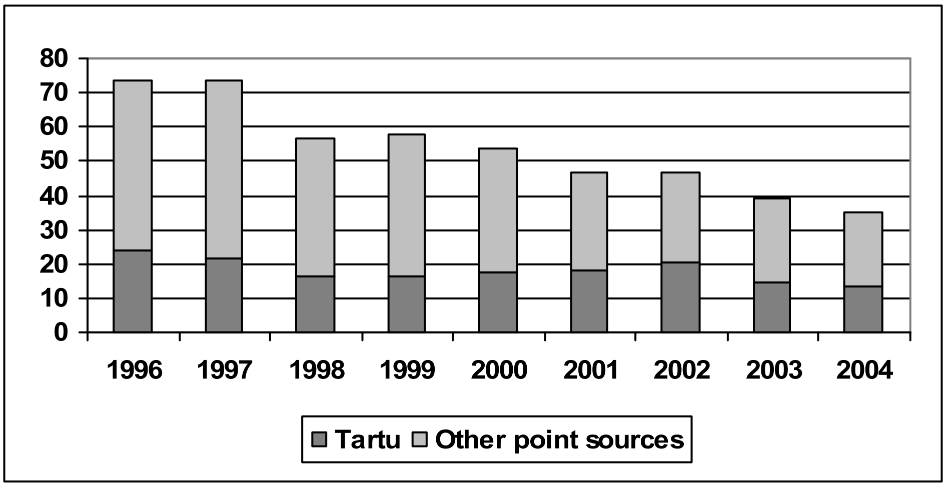
Pressures on small lakes are the same as for rivers. The main difference lies in the fact that the after-effect of a single pollution incident or periodical pollution reaching a river is shorter than in lakes. Untreated wastewater directed into a lake or liquid manure or silage effluent reaching a lake will lead to long-term deterioration of the status of the lake. The status will improve to some extent when pollution ceases but the lake will never again achieve the pre-pollution status. In naturally vulnerable lakes, pollution load from precipitation, too, has posed a significant impact. The latter pollution load depends on air pollution generated in the vicinity of lakes (e.g. N-compounds from livestock farming) and on long-range pollution.

Lowering of water level has accelerated the irreversible overgrowing of many lakes.

Human impact on lakes is described in brief in Table 25. It is important to emphasize that it is not complicated to spoil the lakes that have been in a high status to date, while restoration of the high status will be impossible or extremely expensive.

2.4.5 Pressures on Lake Peipsi

Human impact is reflected first of all in a raised nutrient load originating mainly from agriculture and municipal wastewater. Nutrient load data for the Estonian catchment area of Lake Peipsi suggest top load periods in the 1970ies and 1980ies, followed by a sharp decline in the 1990ies. The latter was partly due to a drier period in the 1990ies, but the main reason was the decline in agricultural production and use of fertilizers. Commissioning of several new wastewater treatment plants and reconstruction of old ones in the past decade significantly contributed to the reduction in loads. Graph 5 reveals the great share of Tartu City (30–40%) in phosphorus load from point sources on the Estonian side.



Graph 5 Dynamics of phosphorus load from the settlements and industries in the catchment area of Lake Peipsi (t/yr)

Some of the harbours of Lake Peipsi are in a poor environmental condition. For example, Mustvee Harbour lacks permits for water use and waste management. There are neither oil absorbents nor sock booms in the harbour. At the moment the harbour has neither an administration nor employees. Bilge water is not received. The same problems occur in the harbour of Piirissaar Island. Mehikoorma Harbour receives bilge water and various wastes but lacks means for blocking or eliminating oil pollution. The situation is better in Kallaste Harbour, which possesses a waste management permit, has got means for oil pollution control and receives dangerous and municipal waste [22].

Lake Pihkva differs from Lake Suurjärv in several respects due to differences in morphology and catchment size. The drainage basin of Lake Pihkva is 2.5 times larger than that of Lake Suurjärv in relation to the surface area of the lake and fivefold larger in relation to the volume. The average depth of Lake Pihkva is more than twice lower than that of Lake Suurjärv. Thus, the relative nutrient load to Lake Pihkva is already naturally much higher than to Suurjärv. The Velikaja River runs into the lake in the south of Lake Pihkva, with the town of Pihkva with 200 000 inhabitants located at its mouth. The discharge of the Velikaja River makes up over a half of the total inflow into the entire Peipsi Lake System and most of the inflow into Lake Pihkva. The location of Pihkva town in the immediate vicinity of the lake implies that practically all of the pollution generated in the town reaches the lake.

Lake Lämmijärv constitutes a connection channel between Lake Pihkva and Lake Suurjärv, with the status of the lake depending on water quality in the two neighbouring lakes and on wind-driven currents. Although water ultimately moves from the south to the north (from Lake Pihkva to Suurjärv), winds may induce also opposite movement of water (currents of up to 1m/s have been observed). There occur also situations where water moves in one direction in the eastern part of Lämmijärv and in the opposite direction in the western part. Also the Võhandu River, which flows into the south of the lake, has a certain impact on the lake's water quality.

2.4.6 Pressures on coastal sea

2.4.6.1 Impact of rivers and open sea

The biggest inflows into the coastal sea of the Viru and Peipsi river basin sub-districts are the Narva River (by far the biggest inflow) and Purtse, Kunda, Seljajõgi, Loobu and Pühajõgi Rivers.

It has been shown on the basis of model calculations made under the EISEMM project that different scenarios of nutrient load from the inland would allow an only 20% improvement in water quality of Narva Bay (somewhat more in only a very narrow strip of coastal sea near the mouth of Narva River). These results clearly refer to a great dependence of the status of Narva Bay on the quality of water entering the open bay from other parts of the Gulf of Finland (transboundary impact). Pollution load analyses by HELCOM suggest that approximately 70% of the nitrogen and phosphorus load of the Gulf of Finland originates from Russia (in particular the Neeva River and St. Petersburg). Thus, the status of the Gulf of Finland (incl. Narva Bay) could be most effectively improved by improving wastewater treatment in St. Petersburg.

In addition, the status of the Gulf of Finland is greatly dependent on its internal phosphorus load, which is related to liberation of phosphorus from bottom deposits in the event of oxygen deficit in the bottom layer. According to different estimates, annual internal phosphorus load of the Gulf of Finland may be equal to the amount of phosphorus carried into the Gulf by rivers. Internal phosphorus load, which is largely dependent on natural factors, can be influenced to some extent by a general reduction of primary production and thereby also the amount of depositing materials in the entire Gulf of Finland [4].

A high nitrogen load to the coastal sea (thousands of tonnes of N annually) generated by the Chemical Industry of Sillamäe in earlier years. These emissions are under control now and the construction of the Sillamäe waste depository has reached the final stage.

2.4.6.2 Harbours

The morphology of coastal sea in the Viru-Peipsi region has been affected in 2000–2004 by dredging, filling, dumping and excavation works connected with harbour development. In Aseri Harbour, where large-scale dredging and dumping works were planned, only the filling of sea area was carried out in this period. Dredging and dumping works were conducted in connection with harbour development in Kunda. In Sillamäe, excavation works were carried out to obtain materials for sealing the Sillamäe waste depository and harbour development commenced (with the construction of a mole and piers).

Dredging, excavation and dumping works are similar in their effect on the environment. The most important long-term effect is related to suspended solids generated in the course of the works. Sea biota (fish fauna, zoobenthos, phytobenthos) recovers from the impact of suspended solids associated with dredging works within 2–3 years, as a rule. The scale of negative impact is largely determined by the existence of pollutants in relocated soil. In addition, filling and building works alter the coastline, which may lead to significant changes in sediment transport and other coastal processes in the longer term.

Assessment of pollutant content in soils has so far been based on Regulation No. 58 of 16 June 1999 of the Minister of Environment *Limit values for the content of dangerous substances in soil and groundwater*.

Dumping works have been carried out in the course of development of the Aseri, Kunda and Sillamäe Harbours but no significant pollution has been observed in dumped soil [4].

In addition to the above dumping areas, there is a dumping area near Narva-Jõesuu but it falls within the area controlled by the Russian Federation. There is a plan to start the reconstruction of Narva-Jõesuu harbour in near future. The reconstruction works will probably involve also dredging and dumping. A relevant study needs to be carried out to ensure proper site selection for the dredging and dumping works.

An indicative amount of EEK 15 billion has been planned for prevention of harbour accidents and improvement of waste management in small harbours.

Figure 19 Harbours and boat landings in Viru and Peipsi river basin sub-districts

3 PROTECTED AREAS

The Nature Conservation Act (RTI[1], 2004, 38, 258) passed by the Riigikogu on 21 April 2004. According to this Act, protected natural objects include **protected areas** and **special conservation areas**.

For the purposes of the Act, **protected areas** are areas maintained in a state unaltered by human activity or used subject to special requirements in order to preserve, protect, restore, investigate or introduce the natural environment. Protected areas are established for the protection of well-preserved and extensive natural landscapes and also cultural landscapes (national parks, nature reserves, landscape conservation areas).

Data on protected areas (as of 10 June 2005) were obtained from the Environmental Register – Estonian Nature Information System (Environmental Information Centre).

The total of 250 000 ha or over 10% of the territory of the Viru-Peipsi catchment area is protected. The bigger protected areas here are Lahemaa National Park (39 693 ha within the Viru river basin sub-district), Alam-Pedja Nature Reserve (25 846 ha), Emajõe-Suursoo Nature Reserve/Landscape Conservation Area (18 131 ha), Muraka Nature Reserve (13 059 ha), Haanja Nature Park (12 349 ha), Puhatu Nature Reserve (12 320 ha), Agusalu Landscape Conservation Area (10 052 ha), Vooremaa Landscape Conservation Area (9882 ha), Otepää Nature Park (9835 ha), Endla Nature Reserve (7591 ha), Sirtsi Nature Reserve (4558 ha), Mustoja Landscape Conservation Area (2830 ha), Meenikunno Landscape Conservation Area (2651 ha) and Uhtju Nature Reserve (2429 ha).

The protected areas are part of the pan-European network of special areas of conservation and special protection areas called Natura 2000. The Natura 2000 network has been established for the protection of endangered plant and animal species and their habitats across the European Union. By the beginning of 2005, the proposed Sites of Community Importance (proposed Natura areas) were identified but have not been given a legal status yet.

Natura 2000 sites are divided into protected areas, special conservation areas and species protection sites. By 01 January 2007 at the latest, the proposed Sites of Community Importance selected for the protection of forests and wetlands will be designated as landscape conservation areas or nature reserves. The existing protected areas will maintain the current protection regime established by their statutory protection rules.

The Natura areas selected for the protection of marine and coastal areas, rivers and lakes and seminatural grasslands will be designated as **special conservation areas** with a less stringent protection regime than that of protected areas. For example, the purpose of the Avijõgi Special Conservation Area is to protect a habitat type listed in Annex I of Council Directive 92/43/EEC – rivers and streams (3260) – and habitats of species listed in Annex II of the Directive – Bullhead and Green Club-tailed Dragonfly. In special conservation areas it is prohibited to destroy or damage protected habitats and cause significant disturbance to protected species. Also the activities posing a danger to the favourable status of protected habitats and species are prohibited.

In the Viru and Peipsi river basin sub-districts, 139 special areas of conservation, 24 special protection areas and 22 river areas have been proposed as Natura 2000 Sites of Community Importance, with 162 of the areas located outside the existing protected areas (areas with temporary restrictions). By 10 June 2005, 16 special conservation areas had been designated in Jõgeva and Ida-Viru Counties. Revision of the protection rules of the existing protected areas in connection with the designation of Natura 2000 sites, including the expansion of the boundaries

[1] RT – Riigi Teataja (State Gazette)

of the areas, is underway. Also the lists of species, communities and habitats found in the protected areas are being specified.

There are the total of 244 **species protection sites** in the Viru-Peipsi area (as of 10 June 2005). According to the Nature Conservation Act adopted in 2004, species protection sites are the living, breeding and growth sites of endangered plant and animal species outside the protected areas:

- Breeding grounds or places of other periodic concentration of protected animals;
- Natural habitats of protected plants or fungi;
- Spawning grounds of salmon or lamprey.

In the Viru-Peipsi area, species protection sites have been designated mostly for the protection of birds (greater and lesser spotted eagle, white-tailed eagle, osprey, golden eagle, black stork and capercaillie), but also for the protection of the flying squirrel and a beetle species *Boros schneideri.* Lek sites of capercaillie (143) have been delineated separately, with most of them located within other protected areas.

Single objects. The Viru and Peipsi river basin sub-districts host the total of 29 protected single natural objects (as of 10 June 2005), including a group of lakes (Lake Jaani and Lake Linajärv in Tartu County), 16 springs or spring areas, one karst area (Kalina Karst Area in Ida-Viru County) and 2 waterfall cascades (Aluoja and Tõrvajõe).

3.1 Groundwater protection areas

Groundwater protection areas include the sanitary protection zones of groundwater intakes, the Pandivere-Adavere Nitrate Sensitive Area and the Pandivere National Water Protection Area – a water protection oriented programme area.

Sensitive groundwater protection areas as defined in the Urban Wastewater Directive 91/271/EC have not been designated in Estonia, as the entire groundwater of Estonia is regarded as sensitive receiving waters.

The Pandivere National Water Protection Area as a water protection oriented programme area (initial area 350 875 ha) was established by Regulation No. 586 of 13 December 1988 of the Council of Ministers of the Estonian SSR. The condition of water in the Pandivere area had become critical as a consequence of intensive agricultural activity in the years 1974–1985 [3]. The Pandivere National Water Protection Area was established primarily for the protection of groundwater but also for protecting the upper courses of rivers, for ensuring the preservation of surface water in North Estonia and for protecting rare elements of landscape – springs and karst areas. The Pandivere National Water Protection Area still exists under the legal acts of the socialist period.

The volume of pollutants released into the environment increased more than twofold during the socialist period (nitrogen content in groundwater increased more than tenfold compared to the 1960ies). Water pollution was generated also by several military facilities. In the Water Protection Area, 20 water conservation areas were designated (1708 ha) and excempted from land tax.

At present, part of these water conservation areas are protected areas under the Nature Conservation Act and Natura areas, while part of them have not been re-designated because the Pandivere Water Protection Area is lacking a management plan. The Water Protection Area coincides with the northern part of the Pandivere-Adavere Nitrate Sensitive Area.

The **Nitrate Sensitive Area** of Pandivere and Adavere-Põltsamaa (Figure 20) was established by Regulation No. 17 of 21 January 2003 of the Government of the Republic *Protection Rules of the Pandivere and Adavere-Põltsamaa Nitrate Sensitive Area* (RT I 2003, 10, 49) pursuant to the requirements of the EU Nitrates Directive (91/676/EEC). The Nitrate Sensitive Area was established taking into account the intensive agriculture in the area, the high vulnerability of groundwater and the special significance of the Pandivere Upland as a recharge area of the groundwater resources of the entire country [21]. The above Regulation regulates and restricts agricultural activity in limestone and karst areas with vulnerable groundwater, in the surroundings of springs and in other pollution sensitive places, establishing also the boundaries of the Nitrate Sensitive Area and a list of springs located within the Nitrate Sensitive Area along with the relevant protection zones. The total area of the Nitrate Sensitive Area is 3048 km^2, of which 1806 km^2 or 59% fall within the Viru-Peipsi catchment area.

An short-term action plan has been set out for the Nitrate Sensitive Area by Order No. 318-k of 30 April 2004 of the Government of the Republic *Approval of the Action Plan of the Pandivere and Adavere-Põltsamaa Nitrate Sensitive Area for the years 2004–2008*.

Sanitary protection zones of groundwater intakes are established, as a general rule, within a 50 m radius of a bore well or within 50 m to either sides of the axis of a series bore wells and within a 50 m radius of the outermost bore wells of a series of bore wells. The size of sanitary protection zones of groundwater intakes depends on the vulnerability of the exploited aquifer and on the amount of water consumed, ranging from 10 m to 50 m (in exceptional cases – up to 200 m) of the abstraction site. The boundaries of sanitary protection zones of groundwater intakes are entered on a map of the National Land Cadastre or in the Land Register upon the construction of a water intake.

Two over 50 m sanitary protection zones of groundwater intakes, with the total area of 0.3 km^2, have been established: for the Tartu Meltsiveski water intake and for the water intakes of Felix Ltd. at Põltsamaa. No more sanitary protection zones extending further than 50 m of the water intake have been established. The total area of sanitary protection zones of the 900 wells operating under permits for special use of water in the Viru and Peipsi river basin sub-districts is app. 0.3 km^2.

The total area of groundwater protection areas with protection requirements implemented in practice is 5–6 km^2 in the Viru and Peipsi river basin sub-districts, plus the Pandivere-Adavere Nitrate Sensitive Area.

The protection of intakes for near-surface groundwater requires more attention. Establishment of minimum-sized sanitary protection zones does not ensure the long-term preservation of groundwater quality. To clarify the problem, a study on sanitary protection zones of water intakes and groundwater recharge areas in nitrate sensitive areas will be completed by the end of 2005, including recommendations for the protection of water quality.

Springs protection. There are many practically natural springs in the river basin sub-districts. Such springs have become very rare across Europe. The springs often host relic biota from the Ice Age and many of them are surrounded by spring fens of high conservation value. Although part of the springs fall within other protected areas and Natura areas, the current protection measures do not ensure their long-term preservation in a natural state. An updated database of springs located outside the Pandivere Water Protection Area is absent. 85 springs or spring areas of the Viru-Peipsi catchment area have been listed in the Virgin Nature Book of Estonia and 16 have been designated as protected single natural objects.

3.2 Surface water protection areas

Water protection zones. The Nature Conservation Act establishes restrictions to the use of shores and banks of surface water bodies with the aim of limiting the adverse impact of human activity on shores and banks. The extent of and restrictions to the use of limited management zones and building exclusion zones of shores and banks are established by the Nature Conservation Act, while the extent of and restrictions to use of water protections zones of shores and banks are established by the Water Act.

Protection of spawning grounds and habitats of salmonids. Regulation No. 58 of 9 October 2002 of the Minister of Environment established a list of water bodies protected as key habitats of salmonids and cyprinids and quality and control requirements for the water of these water bodies. The following rivers of the Viru-Peipsi area are listed as water bodies protected as key habitats of salmonids and cyprinids:

- Rivers protected as habitats of salmonids: Ahja River, Avijõgi River, Kunda River, Kääpa River, Loobu River, Narva River, Oostriku River, Piusa River, Preedi River, Põltsamaa River, Pühajõgi River, Seljajõgi River, Tagajõgi River, Võhandu River;
- Rivers protected as habitats of cyprinids: Emajõgi River, Narva River, Pedja River.

The list of spawning grounds and habitats of salmon, brown trout, sea trout and grayling, established by Regulation No. 73 of 15 June 2004 of the Minister of Environment, includes 48 rivers or parts of river in the Viru and Peipsi river basin sub-districts (see Figure 20). These water bodies or stretches of water body are subject to the prohibition of building new dams and reconstruction of the existing dams entailing a rise in the water level so as to protect the spawning grounds of fish. It is also prohibited to alter the natural streambed and hydrological regime of the water bodies.

The territory of **Lake Peipsi** encompasses 3 Natura areas: Natura area from Raadna to Kalmaküla (designated as Sahmeni Special Conservation Area by Regulation No. 93 of 05 May 2005 of the Government of the Republic), which covers a big part of the northern part of Lake Peipsi; Lake Peipsi bird area (designated as the Special Conservation Area of North-West Peipsi by Regulation No. 49 of 14 March 2005 of the Government of the Republic); and the Lahepera Natura area to the south of Kallaste. In addition, the estuary of the River Emajõgi and the special area of conservation and bird area of Piirissaar Island fall partly within the territory of Lake Peipsi.

Two extensive protected areas – Alam-Pedja Nature Reserve and Emajõe Suursoo Landscape Conservation Area – are associated with the **Emajõgi River**. In total, the Viru-Peipsi area includes 22 river areas designated as Natura 2000 areas. A significant part of small lakes in the Viru-Peipsi area are Natura 2000 water bodies, mostly falling within the existing protected areas but e.g. the Special Conservation Area of Uljaste Lakes has been designated separately (05 May 2005).

Connections between nature conservation and water protection are still largely unclear. Although some rivers and lakes have been included in the Natura 2000 network, a specific action plan broken down by water bodies and protected areas is still to be defined (Figure 20). Great attention needs to be paid to updating of protection rules of the existing protected areas to ensure that the protection objectives of Natura 2000 sea areas or surface water bodies falling within their territory can be achieved. Fishing restrictions may need to be established in Natura 2000 areas for the nesting period of birds. In bird areas it may also be necessary to restrict boating and other water traffic on water bodies during the bird nesting period to protect the bird fauna. Adverse effect of human activity on the integrity of Natura 2000 sites should be avoided. Some of the necessary measures are presented below, under the description of Natura 2000 sites located in the coastal areas of the Viru-Peipsi catchment area.

3.3 Natura areas in coastal sea

The coastal sea area of the Viru river basin sub-district includes 6 proposed Natura 2000 areas, with three of them proposed as special protection areas (bird areas) and three as special areas of conservation.

Natura 2000 Special Protection Areas (Bird Areas) in the coastal sea area

Selection of areas and listing of species was based on the following criteria:

1) Species of Annex I of the EU Birds Directive. All species of Annex I of the Birds Directive occurring in Estonia were listed, except occasional visitors and a few species with a very low

or fluctuating abundance whose habitats in Estonia are not permanent and whose effective long-term protection cannot be ensured;
2) Regular migrants;
3) Other reasons: red listed in Estonia, rare, sharply decreased population, endangered habitat, importance as game, inadequate conservation status in Europe.

Protected species were categorized as follows:
1) Category **C1:** congregations of globally threatened species. Criterion: *sites that regularly hold significant numbers of a globally threatened species or other species of global conservation concern*
2) Category **C2:** congregations of species endangered at the European Union level. Criterion: *sites that regularly hold at least 1% of the total flyway or EU population of a threatened species*
3) Category **C3:** migratory species non-threatened at the European Union level. Criteria: *sites that regularly hold at least 1% of the total flyway or EU population of a migratory species non-threatened in the European Union*
4) Category **C4:** Congregation sites – large congregations. Criteria: *sites that regularly hold at least 20 000 migratory waterbirds or at least 10 000 pairs of migratory waterbirds of one or more species*
5) Category: **C5:** Congregation sites – flyway "bottlenecks". Criterion: *sites where at least 5000 storks (Ciconiidae) or at least 3000 migratory raptors (Accipitridae) or cranes (Gruidae) regularly pass during the spring or autumn migration*
6) Category **C6:** Species threatened at the European Union level. Criterion: *sites belonging among the five most important areas in the region in question established for the protection of a species or subspecies threatened in the European Union*

Three Natura 2000 Bird Areas are located in the coastal sea area of the Viru and Peipsi river basin sub-districts: Lahemaa, Kunda and Vaindloo (Figure 20). Of the above categories, C1, C2, C3 and C6 are represented here. Waterfowl of categories C2, C3 and C6 are represented.

Table 19 Waterbird species meeting the criteria in Lahemaa

Species	Period	Numbers	Category
Bewick's swan	P	1000 i	C2
Whooper swan	P	500 i	C2
Pintail	P	723 i	C3
Merganser	P	2000 i	C3
Dunlin	B	10–20 p	C6
Ruf	B	5–8 p	C6
Arctic stern	B	>140 p	C6

B – breeding, P – staging or moulting. i – individuals, p – pairs.

Most important threats to the bird fauna of Lahemaa:
- ✓ Intensifying forestry;
- ✓ Decline in land use;
- ✓ Urbanisation, industrialisation;
- ✓ Recreation;
- ✓ Fishing.

Additional measures arising from designation as the Lahemaa Bird Area:
- ✓ When making an environmental impact assessment for works to be carried out in or works having an impact on the Natura 2000 bird area of Lahemaa, the factors of noise, dust, dangerous substances released into water need to be taken into account.
- ✓ Restrictions to the time and volumes of fishing should be established in consideration of the waterbirds inhabiting the Lahemaa Bird Area.

Table 20 Waterbird species meeting the criteria in Vaindloo

Species	Period	Numbers	Category
Common tern	B	140–150 p	C6
Arctic tern	B	140–150 p	C6

B – breeding. p – pairs.

Most important threats to the bird fauna of Vaindloo Island:

- ✓ Recreation;
- ✓ Natural processes;
- ✓ Infrastructures.

Additional measures arising from designation as Vaindloo Bird Area:

- ✓ When making an environmental impact assessment for works to be carried out in or works having an impact on the Natura 2000 Bird Area of Vaindloo, the factors of noise, dust and dangerous substances released into water need to be taken into account.

Table 21 Waterbird species meeting the criteria in Kunda

Species	Period	Numbers	Category
Bean goose	P	6000 i	C3

P – staging or moulting. i – individuals.

Most important threats to the bird fauna of Kunda:

- ✓ Natural processes;
- ✓ Urbanisation, industrialisation;
- ✓ Recreation;
- ✓ Fishing.

Additional measures arising from designation as Kunda Bird Area:

- ✓ When making an environmental impact assessment for works to be carried out in or works having an impact on the Natura 2000 Bird Area of Kunda the factors of noise, dust, dangerous substances released into water need to be taken into account.
- ✓ Restrictions to the time and volumes of fishing should be established in consideration of the waterbirds inhabiting the Kunda Bird Area.

Natura 2000 special areas of conservation in the coastal sea area

Three Special Areas of Conservation of the Natura 2000 network are located in the coastal sea area of the Viru and Peipsi river basin sub-districts: Lahemaa, Toolse, Uhtju.

The Lahemaa Special Area of Conservation for the protection of Annex I habitat types and habitats of an Annex II species of the Habitats Directive. Located in Läähe-Viru and Harju Counties, area 2429 ha. Habitat types protected: sandbanks which are slightly covered by seawater (1110), mudflats and sandflats not covered by seawater at low tide (1140), coastal lagoons (1150), large shallow inlets and bays (1160), reefs (1170), annual vegetation of drift lines (1210), perennial vegetation on stony banks (1220), islets and small islands (1620), coastal meadows (1630), sandy beaches with perennial vegetation (1640), embryonic shifting dunes (2110), white dunes (shifting dunes along the shoreline) (2120), gray dunes (fixed coastal dunes) (2130), decalcified fixed dunes with *Empetrum nigrum* (2140), wooded dunes (2180), humid dune slacks (2190). Species whose habitats are protected: salmon.

Measures arising from designation as Lahemaa Special Area of Conservation:

- ✓ Restrictions to the time and volume of fishing need to be established for the protection of salmon habitats.
- ✓ Building permits or permits for special use of water in the relevant areas need to be issued in due consideration of protected habitat types. Particular attention should be paid to issuing of permits for dredging and other works having an impact on the sea bottom and coast.

Toolse Special Area of Conservation established in the Lääne-Viru County for the protection of Annex I habitat types and habitats of Annex II species of the Habitats Directive. Area 384 ha. Habitat types protected: islets and small islands (1620).
Measures arising from designation as Special Area of Conservation:

- ✓ Building permits or permits for special use of water in the relevant areas need to be issued in due consideration of protected habitat types. Particular attention should be paid to issuing of permits for dredging and other works having an impact on the sea bottom and coast.

Uhtju Special Area of Conservation established in the Lääne-Viru County for the protection of an Annex I habitat type and habitats of Annex II species of the Habitats Directive. Area 2429 ha. Habitat type protected: islets and small islands (1620). Species whose habitats are protected: gray seal *(Halichoerus grypus)*, Baltic ringed seal *(Phoca hispida bottnica)*.
Measures arising from designation as Uhtju Special Area of Conservation:

- ✓ Building permits or permits for special use of water in the relevant areas need to be issued in due consideration of protected habitat types. Particular attention should be paid to issuing of permits for dredging and other works having an impact on the sea bottom and coast.

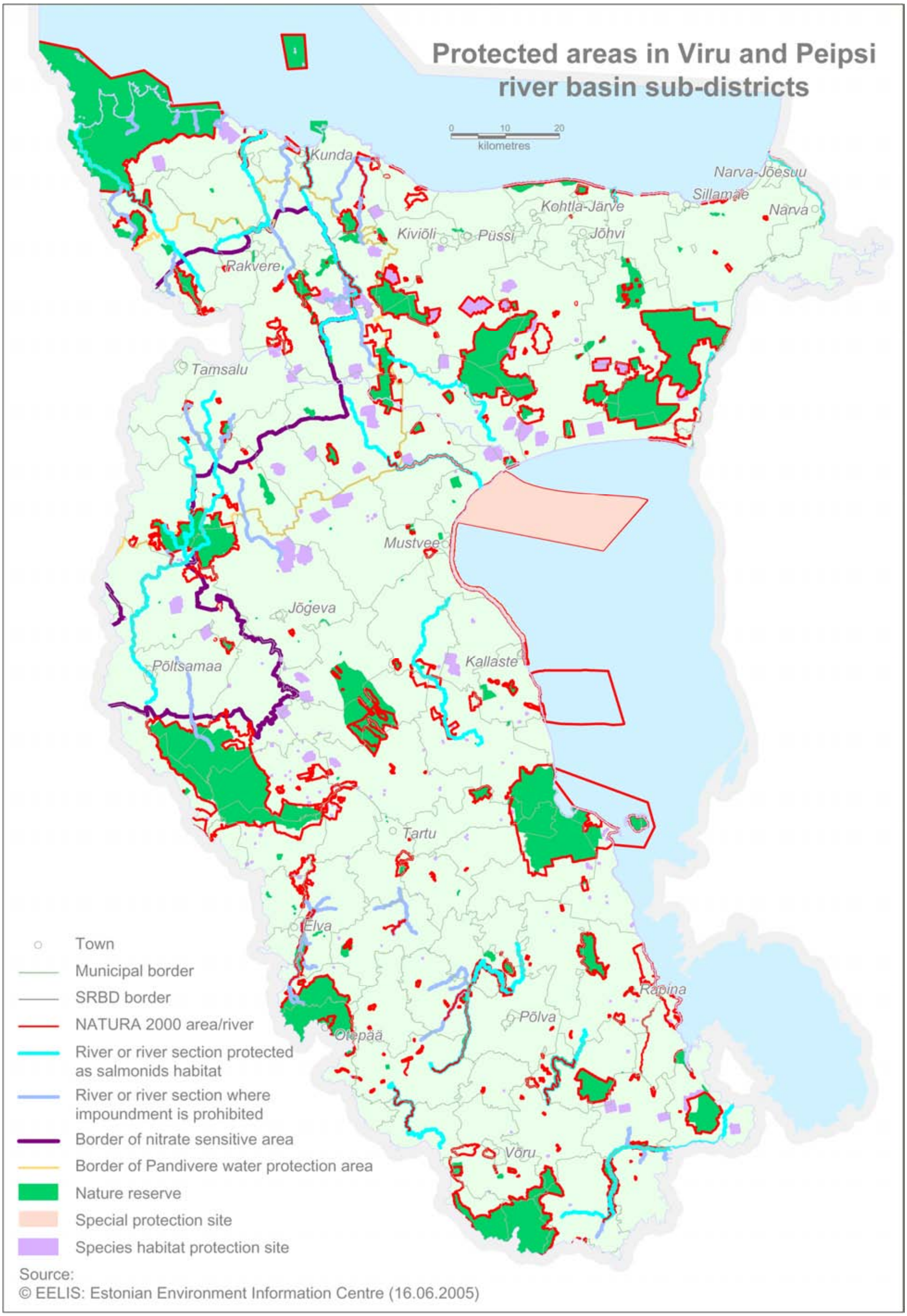


Figure 20 Protected areas in Viru and Peipsi river basin sub-districts

4 MONITORING AND STATUS ASSESSMENT

The Framework Directive on Water Policy envisages a combined approach to water policy, under which it is essential that environmental quality standards and emission limit values be applied in parallel. This approach views the status of water bodies as a measure of effectiveness of water protection measures, and regards control of compliance with emission limit values and technical requirements for environmentally dangerous objects as a means for achieving the goal.

4.1 Environmental requirements

Minimum environmental requirements for reducing the impact of pressures have been established by legislation. Legal acts, e.g. for control of emissions or restriction of blocking of watercourses, are usually established after negative changes in the environment have already taken place. Compliance with the minimum requirements established by legislation may be insufficient to ensure a good status of water bodies. The most important legal acts are listed below together with a brief description of their effect towards the goals of this Management Plan.

- *Nature Conservation Act* (RT I 2004, 38, 258), supplemented by Regulation No. 73 of 15 June 2004 of the Minister of Environment *List of spawning grounds and habitats of salmon, brown trout, sea trout and grayling*. The Regulation establishes a list of water bodies or stretches of water body identified as spawning grounds or habitats of salmon, brown trout, sea trout or grayling, on which it is prohibited under subsection 51(1) of the *Nature Conservation Act* to build new dams and reconstruct the existing dams to the extent which would raise the level of water, and to alter the natural streambed or water regime of the water body;
- Regulation No. 342 of 26 November of 2004 of the Government of the Republic *Requirements for blocking of watercourses* regulates the issues concerning alteration of water level by blocking facilities, requires that fish bypasses and sanitary flow rates be ensured, envisages the construction of barriers on the main flows of turbines for the protection of fish, etc.;
- Regulation No. 269 of 31 July 2001 of the Government of the Republic *Procedure for discharge of wastewater into water bodies or soil* (RT I 2001, 69, 424) establishes limit values for pH, content of dangerous substances and other pollutants and BOD of wastewater and also the required degree of purification. For the Viru and Peipsi river basin sub-districts, the most critical requirements are those concerning the content of total phosphorus and total nitrogen and BOD in wastewater;
- Regulation No. 65 of 16 November 1998 of the Government of the Republic *Approval of the list of water bodies or parts thereof used as recipients of wastewater ranked by to their degree of pollution vulnerability* (RTL 1998,346/347, 1432; 1999, 167, 2446);
- Regulation of 28 August 2001 of the Government of the Republic *Water protection requirements for fertilizer and manure storages and silage depositing sites and requirements for the use and storage of manure, silage effluent and other fertilizers.* The purpose of this Regulation is, *inter alia*, to reduce the anthropogenic pressure on watercourses. The Regulation establishes standards and other requirements for the use of mineral nitrogen fertilizers, water protection requirements for storages of liquid and solid mineral fertilizers, requirements for the handling of solid and liquid manure, for silage depositing sites, for silage effluent and whey, etc.;
- Regulation No. 172 of 16 May 2001 of the Government of the Republic *Water protection requirements for oil product storage facilities* (RT I 2001, 47, 262; RT I 2001, 99, 628);

- Regulation No. 38 of 29 April 2004 of the Minister of the Environment *Requirements for the construction, use and closure of landfills* (RTL 2004, 56, 938; RTL 2004, 108, 1720);
- Regulation No. 171 of 16 May 2001 of the Government of the Republic *Water protection requirements for sewerage facilities* (RT I 2001, 47, 261);
- Regulation No. 64 of 24 December 1996 of the Minister of Environment *Establishment of water protection requirements for the selection, construction and exploitation of land improvement systems.* To reduce negative effects on the natural environment, the Regulation envisages measures to localise the possible nutrient runoff, maintain ecological stability and protect agricultural lands from the negative consequences of production;
- List of proposed Natura 2000 sites (proposed Sites of Community Importance) drawn up under the EU Habitats Directive (92/43/EEC; 21 May 1992), incl. proposed Natura water bodies. The document does not directly specify the protection requirements for water bodies but the relevant requirements based on environmental requirements of protected species will be established by management plans or other similar documents.

Compliance with legislation is a minimum environmental requirement in controlling pressures on the environment. The above Regulations regulate the loads from point and non-point pollution sources and physical alteration of rivers.

In the catchment areas of water bodies of moderate or poor quality, it may be necessary to establish more stringent requirements in case compliance with the minimum requirements does not ensure achievement of a good status of water body.

As there is a danger that a good status cannot be achieved by the year 2015 for small lakes and Lake Peipsi, additional requirements for phosphorus need to be established for wastewater treatment facilities having an impact on these water bodies. In future it may be necessary to apply additional requirements also to handling of manure in areas with vulnerable groundwater and in the surroundings of small lakes.

In addition to preventing the construction of new dams, better migration and breeding conditions need to be ensured for fish in their spawning rivers.

4.1.1 Quality requirements for drinking water

Pursuant to the EU Drinking Water Directive (98/83/EC, 03 November 1998), quality requirements for drinking water have been established by Regulation No. 82 of 31 July 2001 of the Minister of Social Affairs *Quality and control requirements and analysis methods for drinking water* (RTL 2001, 100, 1369; 2002, 84, 1299; hereinafter: Regulation No. 82) and quality requirements for sources of drinking water have been established by Regulation No. 1 of 2 January 2003 of the Minister of Social Affairs *Quality and control requirements for surface or groundwater used or planned to be used for the production of drinking water* (RTL 2003, 9, 100; hereinafter: Regulation No. 1).

Drinking water is regarded as safe to human health when its microbiological and chemical quality parameters do not exceed the established limit values. Of chemical parameters, exceedances of limit values are more frequent for nitrate (limit value 50 mg/l), nitrit (0.50 mg/l) and fluorides (1.5 mg/l).

Drinking water is regarded as meeting the quality requirements when its microbiological, chemical and radiological quality parameters and quality parameters influencing the organoleptic properties and characterising the general pollution level (hereinafter: indicators) do not exceed the limit values. The best known indicators are iron, ammonium, electrical conductivity, chloride and sulphate. Water does not meet the quality requirements when its turbidity, taste, odour and colour are unacceptable for the consumer. For the Cambrian-Vendian aquifer, also the radionucleide content is of importance. The permitted effective dose according to Directive

98/83/EC is 0.1 mS/yr.

Limit values have been legally established only for more widespread ions and dangerous substances. Safety to human health in terms of other possible natural ions (e.g. Ba) and dangerous substances (e.g. phenols) has to be ensured by proper supervision.

Prior to taking measures, it is necessary to specify whether water is undrinkable in the aquifer or gets spoiled on its way to the consumer. To ascertain the reason, samples need to be taken from the bore well, from the water main and from the consumer's tap.

Most important limit values for the content of pollutants in drinking water

- Microbiological pollution – Coli CFU/100 ml in public water supply has to be 0
- Fluoride 1.5 mg/l
- Nitrates 50 mg/l
- Benzene 1 microg/l
- Phenol (originating from oil shale) 1 microg/l
- Effective dose 0.10 mSV per year
- Iron 0.2 mg/l
- Chlorides 250 mg/l
- Ba 2 mg/l

4.1.2 Environmental standards for the status of groundwater

Environmental standards for the status of groundwater have been established by Regulation No. 47 of 10 May 2004 of the Minister of Environment *Status classes of groundwater bodies, values of qualitative parameters corresponding to status classes of groundwater bodies and the procedure for determining status classes*.

The qualitative and quantitative status of a groundwater body expressed by the following status classes:

- Good – natural and close to natural water;
- Poor – polluted or strongly affected by human activity.

A groundwater body is in a poor status class by its physico-chemical quality parameters if the values of quality parameters obtained from less than 90% of observation points of the monitoring network for this water body meet the following qualitative parameters for the good status class of groundwater bodies.

Quality standards for the good status class of groundwater body (conformity of at least 90% of analyses is required):

1) Concentration of dissolved substances, measured as electrical conductivity, does not indicate anthropogenic pollution or intrusion of salty water;
2) The content of chloride-ion does not indicate anthropogenic pollution or intrusion of salty water;
3) The content of nitrate-ion does not exceed 50 mg/l and the upward trend of nitrate content does not cause significant deterioration of the status of groundwater-dependent ecosystems
4) The content of ammonium-ion does not exceed 0.5 mg/l in naturally aerobic groundwater or 1.5 in naturally anaerobic groundwater or, in case the value of this quality parameter is exceeded, the natural content of ammonium in groundwater is proven;
5) The content of plant protection products does not exceed 0.1 μg/l;

6) pH is 6–9;
7) The content of dissolved oxygen does not show a downward trend due to human activity or oxidizability of water is <= 5 mg/l O_2;
8) Substances dangerous to the water environment are absent or their concentrations do not exceed the limit values for substances dangerous to the water environment as listed in Regulation No. 12 of 2 April 2004 of the Minister of Environment "Limit values for the content of dangerous substances in soil and groundwater" (RTL 2004, 40, 662) or, in case any of the dangerous substances listed in the above Regulation in groundwater are present in groundwater, the natural origin of the substances is proven.

A groundwater body belongs to a good status class of groundwater bodies by its **quantitative status** when the values of its quantitative parameters conform to all of the following quantitative standards:

1) Groundwater consumption is lower than the approved groundwater resources or lower than the natural resource of the groundwater body determined in the course of drawing up a catchment management plan;
2) Changes in the flow direction of groundwater due to changes in groundwater table do not cause the intrusion of salty water into the groundwater body;
3) Groundwater table does not show a long-term descending trend and lowering of groundwater table does not cause a significant deterioration of the status of groundwater-dependent ecosystems;
4) Human-induced lowering of groundwater table has been observed in less than 10% of the observation points of the monitoring network of the groundwater body.

The status class of a groundwater body is determined by the value of its qualitative or quantitative parameters corresponding to the lowest of the status classes.

4.1.3 Environmental standards for the quality of surface water according to the purpose of use

Requirements for water quality of watercourses according to their purpose of use established by the Water Act and the following secondary legal acts:

- Regulation No. 1 of 2 January 2003 of the Minister of Social Affairs *Quality and control requirements for surface water or groundwater used or planned to be used for the production of drinking water* (RTL 2003, 9, 100);
- Regulation No. 247 of 25 July 2000 of the Government of the Republic *Health protection requirements for beaches and bathing water* (RT I 2000, 64, 407).

4.1.4 Environmental standards for water quality established by legislation

Water quality standards for watercourses and the procedure for protecting the water quality established by the Water Act and the following secondary legal acts:

- Regulation No. 58 of 9 October 2002 of the Minister of Environment *List of water bodies protected as key habitats of salmonids and cyprinids and quality and monitoring requirements for the water of these water bodies and national environmental monitoring stations for the monitoring of salmonids and cyprinids*. (RTL 2002, 118, 1714);
- Regulation No. 33 of 22 June 2001 of the Minister of Environment *Status classes of surface water bodies, values of qualitative parameters corresponding to status classes of surface water bodies and the procedure for determining status classes* (RTL 2001, 81, 1108) – different from this Regulation, the required frequency of nutrient concentrations

corresponding to good status has been lowered from 90% to 50% for the purposes of this project;

- Regulation No. 12 of 2 April 2004 of the Minister of Environment *Limit values for the content of dangerous substances in soil and groundwater* (RTL, 16.04.2004, 40, 662);
- Regulation No. 17 of 11 March 2005 of the Minister of Environment *Limit values for dangerous substances in surface water and seawater* (RTL, 22.03.2005, 32, 447).

4.2 Environmental monitoring

Environmental monitoring is part of environmental control and supervision. Its aim is to obtain basic data for assessing and forecasting the state of the environment and for taking measures as appropriate. Monitoring has to ascertain whether the preventive measures taken and supervision performed are sufficient to maintain or improve the state of the environment. According to the Environmental Monitoring Act, environmental monitoring in Estonia is carried out on the basis of the National Environmental Monitoring Programme and environmental monitoring programmes of municipalities and enterprises.

The Viru and Peipsi river basin sub-districts are currently subject to mainly national environmental monitoring. Local level monitoring has been performed on a limited scale and in relation to current topical problems (e.g. state-supported monitoring in Maidla Municipality in 2001 and monitoring in Jõhvi town in connection with surplus water). On the enterprise level, environmental monitoring is performed by bigger enterprises (such as Viru Chemistry Group, Narva Power Plants, Estonian Oil Shale Company) within the area of impact of their activity, while in the remaining enterprises monitoring is limited to the scope specified in environmental permits (in bigger water companies).

National monitoring is divided between surveillance monitoring and operational monitoring. Surveillance monitoring is performed in permanent monitoring stations in characteristic points of water body over a longer period of time with the aim of ascertaining the status of water and trends of changes therein. Operational monitoring is performed in the form of periodical measuring on water bodies in a lower than good status. Operational monitoring has to allow assessment of the efficiency of measures taken to improve the status. Investigative monitoring (incl. scientific research) is carried out mainly to ascertain the reasons behind the lower than good status of water. Background monitoring belongs primarily under surveillance monitoring. Where necessary, the background monitoring points added under a specific monitoring programme. Supplementary monitoring performed by water companies and concerns drinking water abstraction sites, but also water monitoring in protected areas for habitats and species. Most of the monitoring programmes have shortcomings in terms of definition of goals, and identification of indicators and their thresholds. The outcomes of monitoring programmes need to be further elaborated before the measures under the Management Plan are implemented. The inflow of research data into the databases of the Environmental Register is of random character at present.

4.2.1 Groundwater monitoring

Groundwater monitoring in Estonia is comprised of the groundwatermonitoring sub-programme under the National Environmental Monitoring Programme and monitoring performed under the conditions established by environmental permits (mostly permits for special use of water). Monitoring under environmental permits has so far been used to a limited extent because not all data have been entered on the Environmental Register (mostly the data of large water companies and partly those of the Estonian Oil Shale Company, Viru Chemistry Group and Narva Power Plants have been submitted).

Three state-financed groundwatermonitoring sub-programmes are being implemented in the Viru and Peipsi river basin sub-districts. The biggest of them, *Monitoring of the groundwater basic network*, is implemented by the Geological Survey of Estonia, while implementation of the two smaller ones – *Monitoring of groundwater quality in Pandivere and Adavere-Põltsamaa Nitrate Sensitive Area* and *Monitoring of organic compounds in groundwater in the industrial region of North-East Estonia* – is the responsibility of the Estonian Environmental Research Centre.

Surveillance monitoring of groundwater should be comprised mostly of monitoring of the groundwater support network. According to Regulation No. 50 of 30 July 2002 of the Minister of Environment *Designation of national environmental monitoring stations and plots*, there are 230 groundwater monitoring stations in the Viru and Peipsi river basin sub-districts, including both specially constructed monitoring wells and exploited water abstraction wells, springs and karsts (120 monitoring stations in the Ida-Viru observation area, 62 monitoring stations in the Pandivere area, incl. those in the Nitrate Sensitive Area of Pandivere, 37 groundwater background monitoring stations and 11 groundwater monitoring stations in the Tartu observation area). Important monitoring activities are being or have been carried out in these 230 monitoring stations and the stations are subject to protection measures. Surveillance monitoring is carried out in about a half of the monitoring stations.

Operational monitoring is comprised of *Monitoring of groundwater quality in Pandivere and Adavere-Põltsamaa Nitrate Sensitive Area* and *Monitoring of organic compounds in groundwater in the industrial region of North-East Estonia*, of environmental monitoring performed by enterprises in compliance with the requirements of permits, and of environmental monitoring by local authorities.

The Estonian Oil Shale Company, Viru Chemistry Group and Narva Power Plants carry out water monitoring under their monitoring programmes. E.g. the Estonian Oil Shale Company self-monitors the impact of oil shale production through 104 bore holes/wells, measures surface water levels in 7 points and submits water reports for 26 outlets of mine water. Viru Chemistry Group and Narva Power Plants order the works under their monitoring programmes from competent companies. Part of the monitoring stations listed in the regulation *Designation of national environmental monitoring stations and plots* are included in the monitoring programmes of enterprises and monitoring in these stations is carried out by enterprises. Observation networks have been established around pastpollution sites in earlier years (Tapa military airport, Rakvere helicopter airfield and Moonaküla district of Rakvere). Pastcontaminated sites are monitored irregularly but in future they will have to be monitored at least once during each cycle of the Management Plan.

For monitoring the status of the Ordovician groundwater body of Ida-Viru oil shale basin (a poor status groundwater body), a separate investigative monitoring programme needs to be drawn up to fill the possible gaps between the existing surveillance monitoring (groundwater support network) and operational monitoring. Among earlier monitoring activities, the state financed programme "Monitoring of heavy metals in Cambrian-Vendian groundwater of North-East Estonia and Kunda", carried out in 1996–1998 and later transformed into separate research programmes, can be regarded as investigative groundwater monitoring. Also *Monitoring of organic compounds in groundwater in the industrial region of NorthEast Estonia* would be included in this investigative monitoring programme. The monitoring network of the poor-status Ordovician groundwater body of Ida-Viru oil shale basin currently includes all of the important sources of impact on water status, which perform monitoring pursuant to the conditions of permits for special use of water, as an integral programme for monitoring the status of this groundwater body is absent.

It is planned that monitoring by water companies under permits for special use of water will be used primarily for obtaining data on the qualitative status of groundwater, as it is not important to ascertain groundwater tables for smaller water companies (no significant impact), and it would also be complicated due to ambiquity of the results (unlevelled measuring points, no special bore holes).

As groundwater needs to be addressed by separate groundwater bodies in water management plans, the total of 496 groundwater monitoring stations have been designated for assessment of the qualitative status of groundwater bodies in Estonia, with 222 of the stations falling within the Viru and Peipsi river basin sub-districts. Of the 496 national monitoring points for groundwater quality monitoring, 172 coincide with those listed in the regulation *Designation of national environmental monitoring stations and plots,* and in the remaining 324 stations the requirements for groundwater quality monitoring will be implemented in the required scope through the conditions of permits for special use of water.

Monitoring of the quantitative status of groundwater is based on the sub-programme *Monitoring of groundwater support network* implemented by the Geological Survey of Estonia. Groundwater tables are measured in 284 measuring points under this programme (as of 2004), mostly with a 5-day interval. Regular monitoring of water tables performed also by the Estonian Oil Shale Company from all of its groundwater monitoring boreholes (mostly once a month). Quantitative groundwater monitoring is concentrated in the area of influence of major sources of impact (water removal from oil shale mines and large groundwater intakes). Monitoring of the impact of groundwater intakes on the quantitative status of groundwater bodies focuses mainly on the monitoring of water table in aquifers with limited resources (first of all, Cambrian-Vendian and Ordovician-Cambrian aquifers). Also the monitoring of water tables in the Quaternary Vasavere and Meltsiveski water intakes should be mentioned.

Improvement of groundwater monitoring.

a) The sub-programme of monitoring of groundwater quality in Pandivere and Adavere-Põltsamaa Nitrate Sensitive Area, which best reflects the impact of agriculture on groundwater, should be supplemented with the requirement of examining the content of plant protection products in groundwater. As this is the area with the most intensive agriculture in Estonia, it will make no sense to check groundwater for the content of plant protection products elsewhere for the time being.
b) Inflow of monitoring data to the Environmental Register from local authorities needs to be dealt with and ensured in the near future in connection with the transfer of closed mines and spoil heaps to local municipalities. It is unclear whether all local governments have fully acknowledged their responsibility for the state of the environment in the spoiled areas transferred to their ownership.
c) Where groundwater is used for the production of drinking water (>10 m^3/d), the requirement of surveillance of the source of drinking water (groundwater, surface water) should be added. Data from surveillance monitoring of sources of drinking water are submitted to issuers of permits for special use of water (county environmental departments) and inflow of the results from there to the Environmental Register needs to be ensured.
d) The necessary changes should be made in the requirements of permits for special use of water issued for monitoring stations necessary for assessing the qualitative status of groundwater (324 monitoring points across the country), as appropriate. As permits for special use of water are issued by county environmental departments, it is assumed that regional (county) monitoring programmes will be drawn up and that county environmental departments will need to verify the monitoring data submitted under permits for special use of water or some other environmental permits and enter the data on the Environmental Register. It is necessary to monitor the groundwater bodies used as recipients of direct discharges, incl. with respect to dangerous substances, where necessary (in Tamsalu in the Peipsi river basin sub-district; wastewater discharge into karst in the Harju sub-district). The most important tasks for the coming few years are related to entering of the results of groundwater monitoring carried out under permits for special use of water on the Environmental Register, harmonisation of the programmes for

surveillance monitoring of sources of drinking water, avoidance of overlap, analysing of the results obtained and specification of data needs.

e) To monitor the status of the poor-status Ordovician groundwater body of Ida-Viru oil shale basin, a separate investigative monitoring programme needs to be drawn up to fill the possible gaps between the existing surveillance monitoring (groundwater support network) and operational monitoring. The outcome of investigative monitoring of the Ordovician groundwater body of Ida-Viru oil shale basin will provide a basis for designing more specific measures for improving the status of the water body.

f) Transboundary impacts on groundwater need to be reflected in both Estonian and Russian monitoring programmes. Once the joint monitoring programme for transboundary impacts on groundwater receives a principal approval (by the Estonian-Russian Joint Commission on Transboundary Waters, which should deal also with groundwater), special boreholes in the monitoring network of the Cambrian-Vendian Voronka and Ordovician-Cambrian aquifers will be designated for international cooperation in control of transboundary impacts on these aquifers. As the water of Ordovician carbonate rocks is used in Russia in parallel with the Ordovician-Cambrian aquifer, and considering the fact that the Ordovician-Cambrian aquifer is more vulnerable on the Russian side, 2–3 observation bore holes for the monitoring of Ordovician carbonate rocks should be added to the international monitoring network on the Estonian side in the area between the Baltic Power Plant and the Narva River (1–2 additional bore holes will need to be drilled for this purpose).

g) Requirements for surface and groundwatermonitoring need to be established with IPPC permits for big farms and appliers of liquid manure. It is recommend that a relevant methodology be prepared for determining the scope of monitoring, taking into account the possible impact of production on groundwater bodies and surface water.

4.2.2 Monitoring of surface water

4.2.2.1 Monitoring of watercourses

Discharges of the rivers measured by the Estonian Meteorological and Hydrological Institute in 18 monitoring stations. Cross profiles of rivers are examined at least twice a year and new profiles are created if modifications of river bottom exceed 5 cm. Discharges are measured 2–3 times a month, more frequently in summer. Only at the hydrometric station of Narva Quarry on Mustjõgi and the station of Narva City on the Narva River are discharges measured less frequently and are mostly calculated.

There are 15 hydrochemical stations of the HELCOM monitoring network in Estonia, with 6 of them – Narva River in Narva; Pühajõgi, Purtse, Kunda and Selja Rivers at their mouths, and Loobu River at Vihasoo measuring section – belonging to the Viru-Peipsi catchment area. Rivers with an average discharge of >5m^3/s need to be monitored continuously.

According to the *Agreement between the Government of the Republic of Estonia and the Government of the Republic of Finland on cooperation in the field of water protection (Tallinn, 12 February 1999*), wastewater from urban regions with over 2000 inhabitants should be purified from organic substances and phosphorus to the average degree of 90% by the end of 2005. The average content of organic substances in effluent discharges into water bodies has to be ≤ 15 mg/l (measured as BOD_7) and average content of total phosphorus – ≤ 1,0 mg/l, including emergency outlets and overfalls. In settlements with over 10 000 inhabitants, wastewater discharged into nitrate-sensitive water bodies has to be treated with at least 50% average efficiency of nitrogen removal by the end of 2005.

As a general rule for Estonia, industrial wastewater is treated together with municipal wastewater in municipal wastewater treatment plants. Only a few industrial enterprises have separate on-site treatment plats. There are 46 municipal wastewater treatment plants for the pollution load of over

2000 p/e in Estonia, with 18 of them located in the Viru-Peipsi catchment area. Twelve treatment plants discharge their effluent directly into the coastal sea, with 12 of them located in the Viru-Peipsi area – Kohtla-Järve, Sillamäe, Aseri and Kunda. All of them possess a permit for special use of water, including the obligation of monitoring their effluent composition and water quality in the recipient water body and submitting annual water use reports. According to the Estonian legislation, the data are to be submitted to county environmental departments, who communicate them to the national water cadastre.

The *Agreement between the Government of the Republic of Estonia and the Government of the Russian Federation on cooperation in the field of protection and sustainable use of transboundary water bodies (Moscow, 20 August 1997, Article 7, Monitoring)* stipulates that, for ensuring a continuous flow of information on the status of transboundary water bodies and forecasting possible changes therein, the parties shall finance and carry out monitoring in their national territory in compliance with the programmes approved by the Joint Commission. To date, the Joint Commission has approved a monitoring programme for rivers based on the national monitoring programmes of both countries.

The Estonian-Russian joint monitoring programme for transboundary water bodies includes 8 monitoring stations on 7 rivers on the Estonian side: Piusa River under the bridge of Värska-Saatse Road, Võhandu River downstream of Räpina, Emajõgi at Kavastu, Rannapungerja River under the bridge of Iisaku-Avinurme Road, Mustjõgi River at Mustajõe, Narva River at Vasknarva and Narva River at the Narva measuring section. Hydrometric measuring is carried out under the programme in 5 hydrometric stations: Võhandu-Räpina, Tagajõgi-Tudulinna, Rannapungerja-Roostoja, Emajõgi-Tartu and Narva-Vasknarva.

The *Agreement between the Ministry of the Environment of the Republic of Estonia and the Ministry of the Environment of Latvia on cooperation in protection and sustainable use of transboundary watercourses (Palanga, 24 October 2003)* sets out that parties shall harmonise their monitoring programmes and laboratory sampling methods for international river basins and shall exchange information and data necessary for cooperation in establishing and managing the Koiva/Gauja international river basin district. A Joint Working Group shall specify the procedure for exchange of the above information and data.

According to the *Agreement between the European Community and the Republic of Estonia concerning Estonia's participation in the European Environmental Agency and the European Environment Information and Observation Network,* national monitoring programmes should include 5 reference stations + 40 representative stations on rivers and 3 reference stations and 23 representative stations on lakes. For rivers, stations on the largest and most important rivers (catchment size > 2500 km^2) and flux stations (for assessment of transboundary loads) must be selected additionally. For lakes, stations on the largest and most important lakes (area > 100 km^2) must be identified.

The European Environment Agency's Monitoring and Information Network for Inland Water Resources includes 53 river hydrochemistry monitoring stations of the Estonian National Monitoring Programme, with 34 of them in the Viru-Peipsi region. Considering the EU directives and Estonian and international legislation, surface water monitoring in Estonia can be conditionally divided into five types:

1. <u>Surveillance monitoring</u> assesses the general status of water bodies in the country, encompassing monitoring of transboundary loads and transboundary water bodies (a state-financed continuous support network (basic network) that is changed as little as possible over time, and a supplementary network for periodical monitoring at regular intervals). The Estonian national basic monitoring network includes 61 hydrochemical monitoring stations on rivers, with 34 of them located in the Viru-Peipsi region and 12 of these, in turn, being load monitoring stations at river mouths. For biological monitoring of rivers, the National Monitoring Programme includes 55 monitoring sections on 5 rivers (incl. bigger tributaries), where monitoring is performed at a 5-year interval.

Zoobenthos is monitored under the national programme on rivers of the Gulf of Finland drainage basin since 1997.

2. Operational monitoring allows for assessment of the extent and scale of human impact from both point and non-point sources in catchment areas of water bodies, also meeting the needs for control and reporting of compliance with the requirements under the EU directives and Estonian legislation (a network for monitoring of receiving waters reflecting the periodically changing human impact and financed by the state, local governments and/or enterprises). A nitrate sensitive area of app. 3000 km^2 has been designated in the Pandivere and Adavere-Põltsamaa regions of Estonia for the protection of groundwater and surface water from non-point pollution. Water quality is monitored in 4 rivers: Võisiku Main Ditch at Võisiku measuring section, Põltsamaa River at Rutikvere section, Alastvere Main Ditch at its crossing with Põltsamaa-Jõgeva Road and Jänijõgi River at Jäneda measuring section. The watercourses of Võisiku, Põltsamaa and Alastvere are representative of the status of surface water in the Adavere-Esku region of the Viru-Peipsi catchment area. As regards point pollution, the requirement of environmental self-monitoring by enterprises under the Urban Wastewater Directive should be applied to urban regions with the pollution load exceeding 2000 p/e. There are 18 such urban regions in the Viru-Peipsi area (9 urban regions with the pollution load of 2000–10 000 p/e – Aseri, Kadrina, Väike-Maarja, Tamsalu, Räpina, Otepää, Elva, Kunda, Jõgeva; Võru with the load of 10 000–15 000 p/e; and Põltsamaa, Rakvere, Ahtme, Sillamäe, Põlva, Kohtla-Järve (incl. Püssi, Jõhvi, Kiviõli), Tartu and Narva (incl. Narva-Jõesuu) with the pollution load of 15 000–150 000 p/e). Thus, the permits for special use of water issued for their wastewater outlets should include also the requirement of monitoring of receiving waters.
3. Investigative monitoring (incl. scientific research) is connected with a specified short-term period of time and has essentially two objectives: to support the identification of stations for the above monitoring network and provide a basis for making changes therein in case new factors appear or former factors disappear, and to create a monitoring network of water bodies not covered with the above network in order to identify the causes of modifications in water bodies, to establish a monitoring network sufficiently representative of a catchment area for the purposes of drawing up a catchment management plan or some other project, and to reveal conflicts between the existing situation, natural state of water bodies and human uses, which would provide a basis for drawing up an economically and socially justified programme of water protection measures. According to Article 4 of the WFD, member states shall protect, improve and restore all bodies of surface water so as to achieve their good status by the year 2015 at the latest. If surveillance monitoring indicates that achievement of this goal is unlikely, investigative monitoring is applied. There are 13 such rivers or stretches of river in the Viru and Peipsi river basin sub-districts.
4. Monitoring of unspoilt nature or background water monitoring assesses the natural, characteristic state of water bodies unaffected by man, providing a comparison basis for assessing deviations from the natural state and the scale of human impact (national continuous reference network). In the Viru-Peipsi catchment area, the following rivers are regarded as close to natural: Tagajõgi, upper course of Õhne and Ahja Rivers, Võhandu River at the ouflow from Lake Vagula.
5. Supplementary monitoring or, according to the WFD, additional monitoring of drinking water abstraction sites and habitats and species protection areas. Supplementary monitoring is carried out 12 times a year at the drinking water intake of Narva City. The water is monitored for the content of priority substances and any other substances that may affect the status of the water body and are controlled under the Drinking Water Directive. The intake is monitored for 20 parameters in accordance with the current

legislation and Narva Water Company's programme for surveillance of raw and drinking water. Sampling frequency varies between hourly and monthly sampling. Supplementary monitoring of habitat and species protection areas is carried out in Natura 2000 sites if environmental impact assessment and surveillance monitoring reveal that the areas might not meet the environmental objectives established under Article 4 of the WFD.

4.2.2.2 Fish monitoring on the rivers of the Peipsi and Viru river basin sub-districts

The aim of fish monitoring in catchment areas under the EU Framework Directive on Water Policy is to provide a holistic overview of fish fauna as a biological element characterising the ecological status of water bodies. In addition to the requirements of the WFD, monitoring of the fish fauna of watercourses has to ensure also the necessary monitoring of protected fish species in Natura 2000 sites (obviously, it makes no sense to maintain several partly overlapping monitoring systems).

In order for monitoring to provide adequate information on the status of fish fauna of watercourses, the following conditions have to be met:

- Monitoring has to cover all watercourses of fisheries importance
- Monitoring has to be based on a recognised methodology
- Monitoring has to be carried out by adequately qualified persons.

Monitoring of fish fauna on the rivers of Estonia is performed as part of hydrobiological complex monitoring under the National Environmental Monitoring Programme since 1994 by the Working Group of River Biology of the Institute of Zoology and Botany of the Estonian Agricultural University [9].

Another two regular monitoring activities/projects are indirectly related to the monitoring of fish fauna of rivers:

1) *Emajõgi as the spawning area and migration route of the fish of Lake Peipsi (carried out by the Estonian Marine Institute, University of Tartu)*: investigation of spawning and migration of bream and, to a smaller extent, also other commercial species of Lake Peipsi in the River Emajõgi;

2) *State of migratory fishes in the economic zone of Estonia (stock of salmon and sea trout) (Estonian Marine Institute, University of Tartu*: the abundance of young stages of salmon and sea trout in sampling stretches of the spawning rivers of salmon and trout are observed.

The above two types of monitoring are monitoring of fish as a fisheries resource. In addition, part of the applied fisheries research carried out on the watercourses of Estonia in 2000–2003 by the Estonian Nature Conservation Centre is indirectly related to fish monitoring, as the data gathered from this research can be used for optimisation of fish monitoring on rivers.

Fish monitoring under the hydrobiological complex monitoring sub-programme of the National Environmental Monitoring Programme involves 7 rivers in the Peipsi river basin sub-district and 3 rivers in the Viru sub-district. As can be seen from the tables, smaller watercourses of fisheries importance are subject to monitoring in neither of the sub-districts. No river shorter than 25 km is monitored.

The volume of fish monitoring on bigger rivers of fisheries importance in the Peipsi river basin sub-district is as follows:

- On rivers of 26–50 km, 1 river out of 19 is monitored; average monitoring density: 1 station per 90 km of watercourse;
- On rivers of 51–100 km, two rivers out of 7 are monitored; average density: 1 station per 36 km of watercourse;

- On rivers of over 100 km, 3 rivers out of 4 are monitored; average density: 1 station per 21 km of watercourse.

The average density of fish monitoring in the Peipsi river basin sub-district is 1 monitoring station per 53 km of length of rivers of fisheries importance.

The volume of fish monitoring on bigger rivers of fisheries importance in the Viru river basin sub-district is as follows:

- On rivers of 26–50 km, 2 rivers out of 6 are monitored; average monitoring density: 1 monitoring station per 17 km of watercourse;
- On rivers of 51–100 km, 1 river out of 3 is monitored; average density: 1 station per 22 km of watercourse;
- There are no rivers of over 100 km in the Viru river basin sub-district.

The total average density of fish monitoring in the Viru river basin sub-district is 1 station per ca 37 km of length of watercourses of fisheries importance.

Monitoring is carried out at a 5-year interval.

4.2.2.3 Monitoring of lakes

There are four lakes qualifying as the largest and most important surface water bodies (area > 100 km^2) within or at the boundary of the Viru and Peipsi river basin sub-districts: Lake Peipsi Suurjärv, Lake Lämmijärv, Lake Pihkva and Narva Reservoir. Thus, there should be 4 reference stations of the National Environmental Monitoring Programme in the Viru and Peipsi sub-districts. Considering the fact that less than 100 km^2 of the Narva Reservoir and Lake Pihkva fall within the territory of Estonia, a joint reference station with Russia can be established there.

The National Environmental Monitoring Programme of Estonia includes 19 inland water-monitoring stations in the Peipsi Lake System (16 on Lake Peipsi Suurjärv, 2 on Lake Lämmijärv, 1 on Lake Pihkva) and 6 stations on the Narva Reservoir.

In addition to the above lakes of over 100 km^2, there are 25 lakes of over 50 ha in the Viru and Peipsi river basin sub-districts. These should be subject to either surveillance monitoring, operational monitoring or investigative monitoring under national programmes. The National Environmental Monitoring Programme of Estonia includes five small monitoring stations for small lakes in the Viru and Peipsi river basin sub-districts (on Lake Viitna Pikkjärv, Lake Uljaste, Rõuge Suurjärv, Nohipalu Mustjärv and Nohipalu Valgejärv).

Investigative monitoring is needed also on the lakes of Meelva, Pangodi, Tamula, Uljaste and Otepää Valgjärv. The total of 13 lakes of over 50 ha in the Viru-Peipsi area are in a moderate status.

In addition to the above lakes, there are two reservoirs of over 50 ha in the region (Kentsi and Saesaare). These reservoirs and the small lakes of less than 50 ha addressed in this Management Plan are subject to either operational monitoring or investigative monitoring at least once during the cycle of the Management Plan. The following lakes should be subject to investigative monitoring: Ihamaru Palojärv, Kaarna, Karsna, Kavadi, Kurgjärv, Laiuse Kivijärv, Lauga, Listaku Soojärv, Peresi Umbjärv, Pikamäe, Pilkuse, Partsi Saarjärv, Tilsi Kõrbjärv, Tilsi Pikkjärv, Vaskna and Viitna Pikkjärv).

As Lake Uljaste and Lake Viitna Pikkjärv already covered by monitoring of small lakes, the planned investigative monitoring essentially means reorganisation of the current monitoring.

4.2.2.4 Monitoring of oil shale mining

Permits for special use of water issued to the **Estonian Oil Shale Company Ltd.** regulate groundwater abstraction and wastewater discharges and set out monitoring requirements. The permit for special use of water of Põlevkivi Kaevandamise AS (Oil Shale Mining Ltd.) obligates the company to measure water levels, take water samples from groundwater and 26 mine water outlets and to take wastewater samples 4 times a year. The water samples are analysed for suspended solids, pH, BOD_7, COD, P-tot, N-tot, mono- and dibasic phenols, oil products, SO_4, Cl, dry residue, Ca, Mg, total hardness, total alkalinity. In addition, 52 water samples in total are taken from 14 points located in recipient waters of discharged wastewater for determining primarily BOD_7, PO_4, NH_4, N-tot, phenols and oil products and less often O_2, pH, SO_4, Cl, Ca, Mg, total hardness, total alkalinity and dry residue. The monitoring programme of the company includes measuring of water level in surface water bodies in 7 points, measuring of water table in 104 bore holes and determination of groundwater chemistry in 10 points (general analysis, oil products and phenols). The current monitoring programme does not include the monitoring of water levels and water chemistry in the area between Narva Quarry and Narva River (Figure 21).

According to the conditions of permit for special use of water issued to **Kiviõli Chemical Industry Ltd.**, the company must monitor water tables and water quality (NH_4, NO_2, NO_3, Fe-tot, SO_4, Cl, dry residue, turbidity, oil products, monobasic phenols, dibasic phenols, total alkalinity, total hardness, pH, colour) on an annual basis in 4 bore wells, 2 bore holes and 8 dug wells. The quality of pumped-out water is monitored as to wastewater parameters and mono- and dibasic phenols on a quarterly basis. In addition to outlet monitoring, the receiving Erra River is monitored for wastewater parameters and mono- and dibasic phenols upstream and downstream of the mouth of Uuemõisa Stream

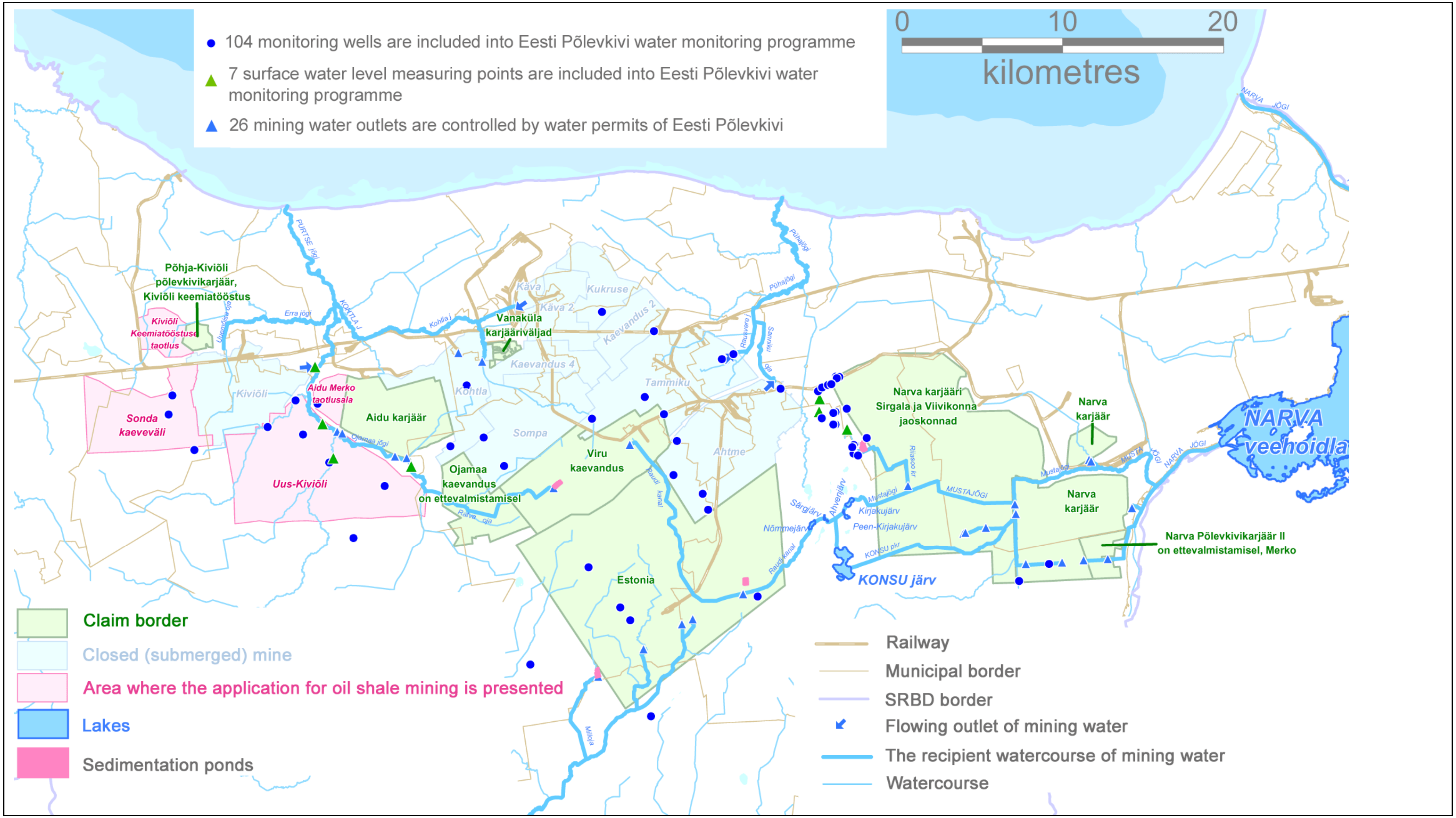


Figure 21 Water monitoring by Estonian Oil Shale Company

4.2.2.5 Recommendations for improvement of surface water monitoring

Considering the important role of county environmental departments in organising the monitoring of receiving water bodies and discharges of dangerous substances (establishment of requirements for subjects to be monitored), it is assumed that regional (county) monitoring programmes will be drawn up and that county environmental departments will need to verify the monitoring data submitted under permits for special use of water or some other environmental permits and to enter the data on the Environmental Register.

In principle, the requirements for recipient monitoring should be specified on the basis of a relevant water survey. Quality requirements for recipient waters and monitoring requirements are currently addressed to a very varied degree in permits for special use of water or have been omitted completely. The requirement of water quality monitoring in recipient waters is set out in a third of permits for special use of water (municipal treatment plants with the load of over 2000 p/e). Recipient water bodies should be monitored with the frequency of 2 to 4 times a year and the parameters to be monitored are selected from among chargeable pollutants, in most cases BOD_7, Ntot, Ptot a.o. In two cases – in Narva and Võru, monitoring is required both upstream and downstream of effluent outlets.

The following contradictions requiring harmonisation were identified when screening the legislation and base material for this report:

- According to the Urban Wastewater Directive, the entire territory of Estonia has been designated as a sensitive area. However, the Regulation of the Minister of Environment “Approval of the list of water bodies or parts thereof used as recipients of wastewater ranked by their pollution sensitivity” designates only certain water bodies or parts thereof as sensitive areas.
- According to the Agreement between the Government of the Republic of Estonia and the Government of the Republic of Finland on cooperation in the field of water protection, wastewater from urban regions with over 2000 inhabitants should be purified from organic substances and phosphorus to the average degree of 90% by the end of 2005. The average content of organic substances in effluent discharges into water bodies has to be $\leq$ 15 mg/l (measured as BOD_7) and average content of total phosphorus – $\leq$ 1,0 mg/l, including emergency outlets and overfalls. The Regulation of the Government of the Republic “Procedure for discharging wastewater into water bodies or soil” establishes a higher threshold for the relevant parameters for phosphorus: the required degree of purification from phosphorus is $\geq$ 80% and the limit value for phosphorus content in effluent – 1.5 mg/l. These requirements of the Regulation are in force since the beginning of 2005.

Recommendations for improvement of surface water monitoring:

- A clearly defined requirement of taking samples from wastewater directed to treatment plants and determining treatment loads should be added to all permits for special use of water, since otherwise it is not possible to check the degree of purification. (As an alternative, the requirement of determining the degree of purification could be discarded in water permits of smaller treatment plants and only the requirements concerning monitoring of wastewater outlet parameters could be specified (mg/l, t/yr)).
- The requirement of recipient monitoring should be included in permits for special use of water at least for settlements with a pollution load of $\geq$ 2000 p/e in the form of self-monitoring by local water companies. It is recommended that the requirements of recipient monitoring should be specified on the basis of the relevant water survey. Where no water survey exists, the required recipient monitoring should cover at least the same parameters and be performed with at least the same frequency as end-of pipe monitoring.

Also the requirement of reporting the results of self-monitoring of receiving waters to the issuer of the permit for special use of water should be included.

- The national monitoring programme for lakes should be specified to ensure the implementation of investigative monitoring programmes during the first cycle of the Management Plan.

Recommendations for improving implementation of the provisions of the Framework Directive on Water Policy, the Water Act and water management plans

1. The Environmental Monitoring Act should be supplemented by adding the regional (county) level of monitoring. The monitoring results obtained under the requirements of permits for special use of water (to be entered on the Environmental Register) require specialist attention (selection of parameters for both groundwater and surface water), data processing and sample checking of data submitted by enterprises. Thereafter the results can be used for assessing the state of the environment and human impact thereon as part of the electronic Environmental Register. This is easier to organise if the regional level of environmental monitoring is specified separately in the monitoring and control requirements of all environmental permits.
2. County environmental departments should be strengthened to impose on them the additional obligation of drawing up and implementing county environmental monitoring programmes (which would consist mainly of monitoring of the area of impact of enterprises and monitoring of receiving waters under environmental permits).
3. Basic guidelines should be prepared for recipient monitoring to ensure that the data are of high quality and comparable with data from the national monitoring programme.
4. The fishmonitoring programme should be specified taking into account the proposals from the Nature Conservation Centre (Annex 13).
5. The possibility of establishing (a) monitoring station(s) with 100% natural catchment area (forestland) should be considered.
6. Establishment of unified monitoring requirements in permits for special use of water issued for peat bogs should be arranged and gathering of data for the Environmental Register ensured.
7. All monitoring programmes of protected areas should be reviewed and harmonised with the objectives of the WFD.

4.2.3 Monitoring of coastal sea

The current coastal sea monitoring programme does not take fully into account the WFD requirements and the conclusions drawn are often statistically unreliable. Within the Viru river basin sub-district, pelagic parameters (nitrogen and phosphorus content, Secchi depth, chlorophyll a content) have been measured in 2001–2003 with a sufficient frequency in summer months in the vicinity of Narva-Jõesuu (station N8) and near Sillamäe (station 38) and only once in 2001 near Saka (station 15), Purtse (station 12c) and Kunda (station G). Zoobenthos data exist for all of the above stations from all the three years. Phytobenthos data from coastal sea monitoring exist only for Eru Bay [4].

Proposals: In addition to the three monitoring stations in Narva Bay (N8, N12 and 38), monitoring should be more frequent in three more stations – near Purtse, near Saka and near Kunda. This would allow for more precise assessment of water quality in the area and would help to clarify whether it is expedient to leave the entire type of Narva Bay as one water body or divide it into two.

Participation in international cooperation for assessing the reference conditions of water quality in the open part of the Gulf of Finland (HELCOM project EUTRO) needs to continue. As one of the outcomes, compatibility of the classification system used in this analysis with the principles suggested under the international project will be clarified.

4.3 Environmental supervision

The aim of environmental supervision is to prevent environmental damage and inspect compliance with environmental standards. Direct environmental supervision is responsibility of the Environmental Inspectorate, the Land Board and local government bodies as well as other authorities that have been assigned the relevant functions.

Supervision related to environmental aspects is exercised also by the Health Protection Inspectorate, Plant Production Inspectorate, Labour Inspectorate, county environmental departments, Chemicals Notification Centre, Technical Inspectorate, rescue services, land improvement bureaus, etc. Most of them have got a special supervision structure or procedure necessary for performing their direct functions.

Supervision has to be aimed at prevention of environmental damage and it should involve regular inspection of dangerous objects and activities. Regular environmental auditing and application of environmental management systems in enterprises has to be promoted.

According to *Regulation No. 82 of 31 July 2001 of the Minister of Social Affairs,* health protection services take water samples for inspection of drinking water quality, mostly from the consumer's tap or water mains. Health protection authorities inspect a groundwater body when, for instance, the epidemiological situation in water main samples gives reason to suspect groundwater pollution. Groundwater is inspected also when complaints from a certain area or other signs give reason to suspect groundwater pollution (e.g. in a region of private wells).

The quality of bathing waters is inspected at public beaches. Bacteriological monitoring of the water of public beaches is carried out by health protection services.

Supervision includes the control of wastewater quality and groundwater quality by enterprises under permits for special use of water.

According to the conditions of permits for special use of water, special users of water must submit the analysis results on wastewater discharged into the environment with the frequency and in the scope determined by water permit. The analysis results together with the results of surveillance monitoring of wastewater are used for calculating justified pollution charges. Wastewater control by enterprises also includes an overview of discharges of dangerous substances. When wastewater analyses show significant amounts of dangerous substances, application of the requirement of recipient monitoring may be considered.

Enterprises check the quality of groundwater in accordance with their permits for special use of water on an annual basis. Where necessary, the additional requirement of water level monitoring is established.

Recommendations for further development of environmental supervision:

- The Environmental Inspectorate as a supervision body has to ensure an overview of the compliance status of wastewater treatment facilities, manure storages, damming structures, etc. The effectiveness of supervision and sanctions has to be brought into accordance with pollution loads and environmental risks.
- When drawing up supervision plans for objects with a regional or local impact, the impact of the object on a water body or groundwater has to be taken as a basis.

4.4 Assessment of the status of water bodies pursuant to the Wter Framework Directive

Earlier assessments, in particular for rivers, were based on hydrochemical parameters. The WFD lays more emphasis on aquatic biota or biological parameters and establishes the objective of achieving a good ecological status. The WFD provides the following definitions related to assessment of the status of water bodies:

- *Surface water status* – general expression of the status of a body of surface water, determined by the poorer of its ecological status and its chemical status;
- *Good surface water status* – the status which a surface water body has achieved when both its ecological status and its chemical status are at least *good*;
- *Ecological status* – an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters;
- *Good ecological status* – the status of a body of surface water in which only slight deviations from the type-specific natural state of the water body occur in the water biota, water quality and hydromorphological characteristics of the water body,
- *Good surface water chemical status* – the chemical status in which a good status of aquatic biota is achievable and the physico-chemical parameters and the content of toxic substances do not exceed the environmental quality standards at the EU and national level

When assessing the status of a water body, its condition is compared with that of a water body of the same type that is in a natural state or practically unaffected by human activity – a reference water body. Only human-induced changes are regarded as deterioration of the status of a water body. Surface water bodies are divided into five classes on the basis of their status:

1. *High* – the water body is in a natural state, unaffected by human activity or with very small anthropogenic impacts;
2. *Good* – the water body has small deviations from the high status;
3. *Moderate* – deviations due to human impact are moderate;
4. *Poor* – deviations are big, water is polluted;
5. *Bad* – deviations are very big, water is heavily polluted.

4.5 Assessment of the status of rivers

The following quality elements are used for classifying the ecological status of rivers in accordance with Annex V of the WFD:

- <u>Biological elements</u> – the composition and abundance of aquatic flora; composition and abundance of benthic invertebrate fauna; composition, abundance and age structure of fish fauna;
- <u>Hydromorphological elements supporting the biological elements</u> – hydrological regime; river continuity; morphological conditions (river depth and width variation, structure and bedrock of riverbed, structure of riparian zone);
- <u>Chemical and physico-chemical elements supporting the biological elements</u> – are divided into general conditions (thermal conditions, oxygenation conditions, salinity, acidity, nutrient content) and content of specific pollutants (both the ones listed as priority substances in the WFD and other dangerous substances discharged into water bodies in *significant quantities*).

The above implies that high water quality alone is not sufficient for assessing a river as being in a good status. Also the biota of the river has to be in a good status, with water quality being only a supporting element.

The main assessment criteria for good status are as follows:

- River is morphologically diverse (close to natural)
- Movement of migratory fish is not obstructed

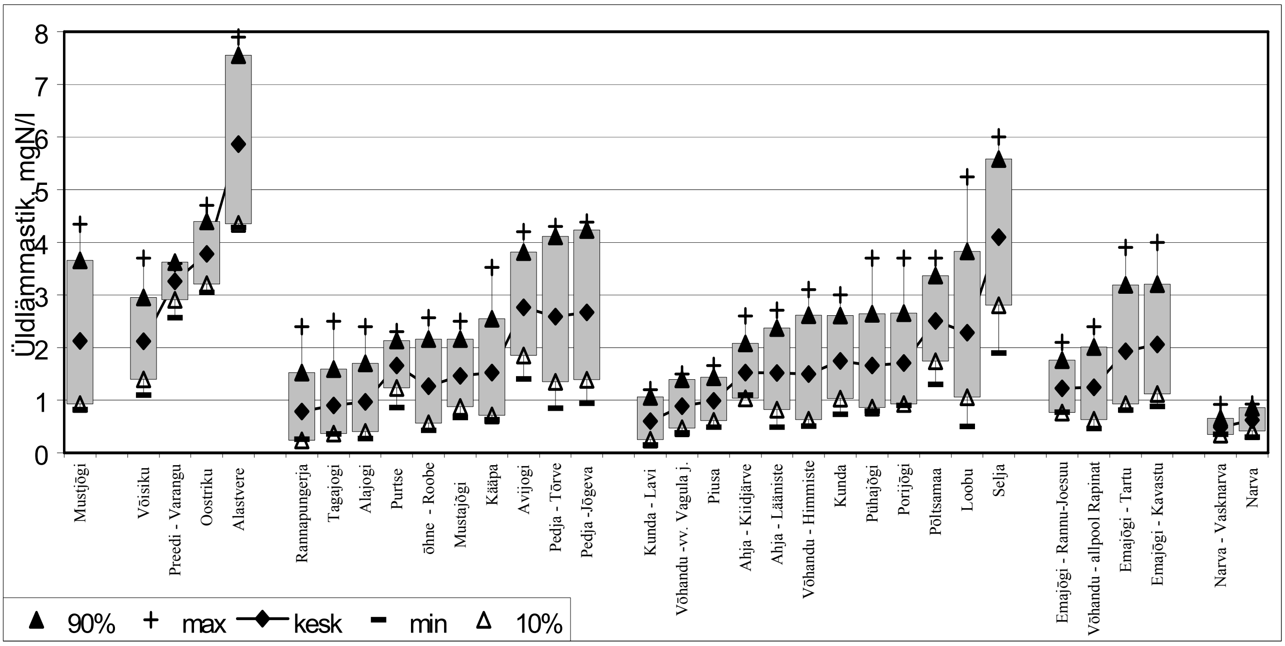
- Water is usable for production of drinking water by means of standard technologies
- Water quality is sufficient for fishes characteristic of this type of river
- Water quality at beaches is suitable for bathing
- Flood risks are eliminated

The following chemical description of quality objectives is based on Regulation of the Government of the Republic *Status classes of surface water bodies, values of qualitative parameters corresponding to status classes of surface water bodies and the procedure for determining status classes*. Biological criteria will be based on the outcome of the process of intercalibration of the quality criteria EU water bodies. Physical quality elements are based on Annex V of the Framework Directive on Water Policy. Environmental quality elements and descriptions of their good status are summarised in Table 22.

Table 22 Environmental quality elements and criteria for their good status

Quality elements	Criteria for good status
Physical quality elements	
Number of successive barriers blocking the movement and spoiling the spawning grounds of fish on a river of fisheries value	Only those structures are permitted whose removal is impossible due to economic, technical, heritage protection or other reasons. In such cases the structures have to be preserved/reconstructed in such a form that migration of fish is ensured in the best possible way.
Number and share of neglected and silted-up reservoirs in a drainage basin of river	Reservoirs are in a good status and ensure a good status of the river only in a situation where their sedimentation/re-suspension balance is not negative.
Physical status of spawning grounds of fish	Spawning grounds are accessible for fish at least on the level corresponding to a natural river. The nature of streambed ensures the growing up of fish on at least the natural level.
Share of natural stretches in relation to regulated, dredged and straightened stretches	General appearance of the river is natural
Chemical quality elements (as appropriate)	
BOD_5	Equal with or lower than 3 mg/l (for the purposes of this report, with 50% probability)
O_2 %	60% of degree of saturation or higher (90% probability)
NH_4^+	Equal with or lower than 0.3 mgN/l (90% probability)
Oil shale phenols	Up to 5 ug/l (90% probability)
P content	Up to 80 ug/l (for the purposes of this report, with 50% probability)
N content	Up to 3 mg/l (for the purposes of this report, with 50% probability)
N content in rivers with catchment size of up to 100 km^2	Up to 5 mg/l (50% probability)
Biological quality elements	
Macro-zoobenthos	Boundaries between the good and moderate class of the ICM index for the Baltic region will be specified under the process of intercalibration of EU rivers.
Fishes	Boundaries between the good and moderate class will be specified under the process of intercalibration of EU rivers.

The average content (50% of samples) of total nitrogen in the water of rivers with a catchment area of up to 100 km^2 has to be below 5 mg/l. Maximum nitrate content (90% of samples) in upper courses of rivers and in springs has to stay below 50 mg/l. These standards are based on the Water Management Plan for Pandivere and a relevant study by Tallinn University of Technology (Graph 6) [7]. There is no reason to expect that nitrogen content in rivers will remain at the 2002–2003 level, as a rise in nitrogen content has already begun in groundwater.



Graph 6 Total nitrogen content in the monitoring sections of rivers of Peipsi and Viru river basin sub-districts in 2002–3 [7]

4.5.1 Data and methods used in assessing the status of rivers in the Viru-Peipsi catchment area

4.5.1.1 Chemical status

Hydrochemical monitoring is carried out annually under the National Environmental Monitoring Programme on 20 rivers of the region from the total of 28 measuring sections (all of the rivers have a catchment size of > 100 km^2, except the Oostriku River) and the same rivers are subject to biological monitoring with a 6-year interval. Local monitoring is practically non-existent and recipient monitoring by enterprises has not started yet. There are nearly no data at all on the status of small rivers, streams and ditches. Considering the financial and time constraints and the volume of work in preparing this Management Plan, it was decided to carry out a more detailed assessment of the chemical and ecological status of all rivers with a catchment size of over 100 km^2 (medium-size, big and very big rivers, 50 in total) (see Figure 22). To supplement the national monitoring, the Institute of Environmental Technology of TUT performed additional hydrochemical monitoring under this project on 31 rivers (at 51 measuring sections, ca 460 samples in total), measuring at 12 times the following parameters: temperature, pH, BOD_7, permanganate oxidation value, NH_4, total nitrogen and total phosphorus. In addition, agricultural loads were studied in six small catchment areas, determining also the content of plant protection products in addition to nutrient content (Annex 5)

In addition to monitoring data, the assessment of river water quality was based on water use reports of enterprises compiled by the EIC, data on animal farms from PRIA and the Ministry of Agriculture, land use data of CORINE and the base map of Estonia and an overview of past contaminated sites by Maves Ltd.

Chemical status of rivers was assessed on the basis of hydrochemical parameters established in Regulation No. 33 of 22 June 2001 of the Minister of Environment *Status classes of surface water bodies, values of qualitative parameters corresponding to status classes of surface water bodies and the procedure for determining status classes* (see Table 23).

Table 23 Status classes of water

Quality element	Unit	I High status class	II Good status class	III Moderate status class	IV Poor status class	V Bad status class
Dissolved oxygen	Saturation %	> 70	70–60	60–50	50–40	< 40
Biochemical oxygen demand (BOD)	mg/O_2	< 3.0	3.0–5.0	5.0–8.0	8.0–10.0	> 10
Ammonium content (NH_4)	mgN/l	< 0.1	0.1–0.3	0.3–0.45	0.45–0.6	> 0.6
Nitrogen content (N_{tot})	mgN/l	< 2.0	2.0–3.0	3.0–4.0	4.0–5.0	>5.0
Phosphorus content (P_{tot})	mgP/l	< 0.05	0.05–0.08	0.08–0.12	0.12–0.16	> 0.16
pH		6–9	6–9	6–9	6–9	< 6 or > 9

According to this Regulation, determination of status classes should be based on the occurrence of a value of the relevant quality element with at least 90% probability, i.e. the value of the quality element concerned (except the content of dissolved oxygen) has to be lower than the maximum value established for the status class concerned in 90% of the analyses taken. The content of dissolved oxygen has to be higher than the minimum value established for the status class concerned in 90% of the analyses taken.

The requirement of 90% is fully justified for the content of oxygen, ammonium nitrogen and pH, while single high values of phosphorus and total nitrogen during a low water period are not dangerous to river biota and, due to the low discharge of rivers in low water periods, do not impose a high pollution load on lakes and the sea. In the course of drawing up this Management Plan, additional monitoring was carried out in 2003, the first quarter of which was extremely dry (one of the driest in a century according to the estimates of hydrologists). Therefore the dilution of wastewater was low also in many medium-size rivers and the content of phosphorus and nitrogen exceeded the standards established by the Regulation. Thus, in the case of nutrients it is expedient rather to take the average values as a basis. In rivers emanating from the Pandivere Upland, the chemical status was regarded as good in cases where the content of total nitrogen was below 5 mg/l and other parameters met the requirements for the good status class.

Monitoring data allowed the assessment of the status of 50 biggest rivers only. Small rivers were assessed as being in a moderate or poor status in case significant quantities of inadequately treated wastewater are discharged into them or in case the experts had solid data on their low water quality.

4.5.1.2 Ecological status

The main biological elements taken as a basis in assessing the ecological status were the status of zoobenthos and fish fauna. Vegetation was taken into account in rivers where overgrowing of streambed has had a significant impact on the status of river (e.g. Võhandu River downstream of the mouth of Koreli Stream, Selja River downstream of Rakvere town and Soolikaoja Stream).

The status of zoobenthos was assessed using the British ASPT-index, which is a good indicator of organic pollution and responds also to other types of pollution and physical damage to habitats of benthic fauna. The above index is included among the methods used in national monitoring under the supervision of the University of Tartu. Other popular indicators of the status of watercourses, such as the diversity of taxa and other indices clearly depending thereon (e.g. the Danish index) were discarded due to different sample sizes.

In the close to natural watercourses of Estonia, the ASTP value of ≥ 6 in EN 27828 samples from rivers or river stretches with a catchment size of over 100 km^2 may express a high status, the value of 5–6 – a good status, the value of 4–5 – a moderate status and values below 4 – a poor status. Measurements were made on the total of 131 different stretches of 37 rivers [23].

The status of fish fauna was determined on the basis of species composition and relative abundance of different species. Reference conditions for the species composition of fish fauna were identified as the number of type-specific fish species likely to occur in the monitored stretch of river in the case of absence of negative human impact. The status of fish fauna was assessed as high in terms of species composition when catch sampling revealed the occurrence of >85% of type specific fish species in the monitoring stretch. The limit for good status was set at 70–85%, for moderate status – at 50–70% for poor status – at 30–50% and for poor status – at <30% of the number of type specific fish species.

Relative abundance of species was estimated on a three-point scale: high, moderate and low abundance. The status of fish fauna was estimated as high on the basis of the abundance of species when the average abundance of the species present in the monitoring stretch was not lower than the expected abundance. The status was estimated as good when the abundance was lower than the expected abundance by no more than 1 degree, and as moderate when the average abundance was lower than the expected abundance by more than 1 degree.

According to preliminary estimates of the Nature Conservation Centre, there are 160 rivers of fisheries value or valuable as fish habitats in the Viru-Peipsi area. More than a half of them have never been investigated, some data exist on 1/3 of the rivers and only 10% are covered with reliable information. In order to ascertain the fisheries value of rivers, the Nature Conservation Centre carried out additional fish research on 43 rivers in the framework of the Viru-Peipsi Catchment Area Management Plan. The data allowed to assess the status of fish fauna on the total of 82 rivers. Among rivers with a catchment area of over 100 km^2, a reliable overview is absent for the Purtse River only. Fieldwork on the Purtse River was planned for the end of summer 2003 but proved impossible due to extensive floods in North-East Estonia in August 2003.

The main hydromorphological elements taken into account in assessing the ecological status of rivers were dredging/straightening of rivers in the course of land improvement and blocking of rivers by dams and the associated changes in flow regime. In cases where achievement of a good ecological status is impossible due to the above factors, the rivers were provisionally assessed as heavily modified water bodies. Identification as *heavily modified water body* thus refers to not only the status but also the type and category of water body.

The impact of dams on rivers varies depending on the type of river. Where a dam has been built on e.g. a salmon river flowing into the sea, causing the absence of salmon and sea trout in the river upstream of the dam, and in case establishment of a functioning fish bypass is unlikely to be possible (e.g. on the Kunda River), the alteration has to be regarded as significant and such rivers were provisionally identified as heavily modified water bodies. Dams have significantly impoverished also the fish fauna of the Põltsamaa River but this is not a salmon river and restoration of a good status of fish fauna through the establishment of fish bypasses and removal of some dams without a specific function is likely to be possible. The same concerns e.g. the Võhandu River. In such cases the rivers were not assessed as heavily modified water bodies but as rivers in a moderate ecological status, for which a programme of measures needs to be drawn up to improve the status (see the section on programmes of measures for rivers). The status of fish fauna of e.g. the Piusa River was assessed as good regardless of numerous dams because the extremely good hydromorphological conditions of the river have still prevented the impoverishment of fish fauna.

Another criterion in assessing the ecological status was the chemical status, which has to be good or high in order for the ecological status to be at least good. Thus, rivers and river stretches in a moderate or poor chemical status were excluded from among rivers in a *good* ecological status.

4.5.2 Chemical status of medium-size and big rivers

The chemical status of medium-size and big rivers and the Narva River, as assessed on the basis of monitoring data, is presented in Table 24, Figure 22 Of the 50 studied rivers, 36 rivers are in a good chemical status over their entire length.

Table 24 Main rivers of Viru-Peipsi catchment area and their status

	River	Length km	Catchment area km^2	Chemical status Source/Mouth		Ecological status Source/ Mouth	Reason for moderate or poor status
1	Võhandu	162	1420				P, dams
2	Põltsamaa	135	1310				dams
3	Pedja	122	2710				dams
4	Piusa	109	796				P,
5	Emajõgi	100	9960				
6	Ahja	95	1070				P, dams
7	Narva	77	56 200				dams
8	Elva	72	456				dams
9	Kunda	64	530				dams
10	Loobu	62	308				P, NH_4 , dams
11	Amme	59	501				
12	Kullavere	53	627				N, dams
13	Rannapungerja	52	601				dams
14	Purtse	51	810				phenols, oil
15	Avijõgi	48	393				
16	Kääpa	46	366				
17	Lutsu	45	226				P
18	Selja	44	410				P, N, O_2, BOD,
19	Preedi	41	290				
20	Tagajõgi	40	262				
21	Orajõgi	39	176				P, BOD, dams
22	Kaave	38	138				P,
23	Porijõgi	38	298				dams
24	Laeva	37	163				
25	Leevi	37	163				dams
26	Mustvee	36	180				
27	Pikknurme	35	172				
28	Umbusi	34	159				
29	Padajõgi	33	196				
30	Kargaja	31	190				
31	Onga	30	109				
32	Ojamaa	29	231				
33	Kohtla	29	189				O_2, NH_4, phenols
34	Pühajõgi	28	196				P, NH_4, O_2,
35	Mustoja	28	135				dams
36	Mädajõgi	27	246				
37	Kalli	26	105				
38	Piilsi	24	103				
39	Ilmatsalu	23	116				P,N, BOD
40	Mustajõgi	23	418				
41	Luutsna	22	125				
42	Hirmuse	22	108				dams
43	Gorodenka	21	120				
44	Alajõgi	20	150				
45	Peeda	19	100				
46	Nõmme	14	149				
47	Ädara	14	119				dams
48	Koosa	11	205				
49	Soolikaoja	6	136				P,N, BOD, NH_4
50	Vahujõgi	6	115				

	River	Length km	Catchment area km^2	Chemical status Source/Mouth		Ecological status Source/ Mouth	Reason for moderate or poor status

	Good status	P – excessive phosphorus content
	Moderate status	N – excessive nitrogen content
	Poor status	NH_4 – excessive content of ammonium nitrogen
	Heavily modified water body	BOD – excessive content of organic substances
		O_2 – low oxygen content

The Lutsu River was assessed as being in a moderate status over its entire length and **four (Selja, Pühajõgi, Ilmatsalu, Soolikaoja) –were assessed as poor over their entire length**. "Over the entire length" does not mean that the upper course of the river is necessarily polluted but that there are no data confirming the good status of the upper course. The Orajõgi River downstream of Põlva and the upper course of the Kaave River were identified as polluted stretches of river.

On seven rivers there exist stretches in a good, moderate and poor chemical status [2]. **The status of the lower course of the Purtse River along with Kohtla and Erra Rivers was assessed as poor.**

In 12 cases out of 14, the moderate or poor chemical status of river was caused by an excessive concentration of phosphorus, with phosphorus being the only non-complying parameter in five of the cases. In four rivers, non-compliance occurred also as to the content of total nitrogen, in five cases as to the ammonium nitrogen content, and in four rivers as to the content of organic substances.

Hydrochemical monitoring data clearly indicate that the main reason behind a moderate or poor chemical status of rivers is inadequately treated municipal wastewater, with the situation being the worst in terms of phosphorus removal. According to the data of 2004, phosphorus content in treated effluent exceeded 2 mgP/l in over a half of wastewater treatment plants [2].

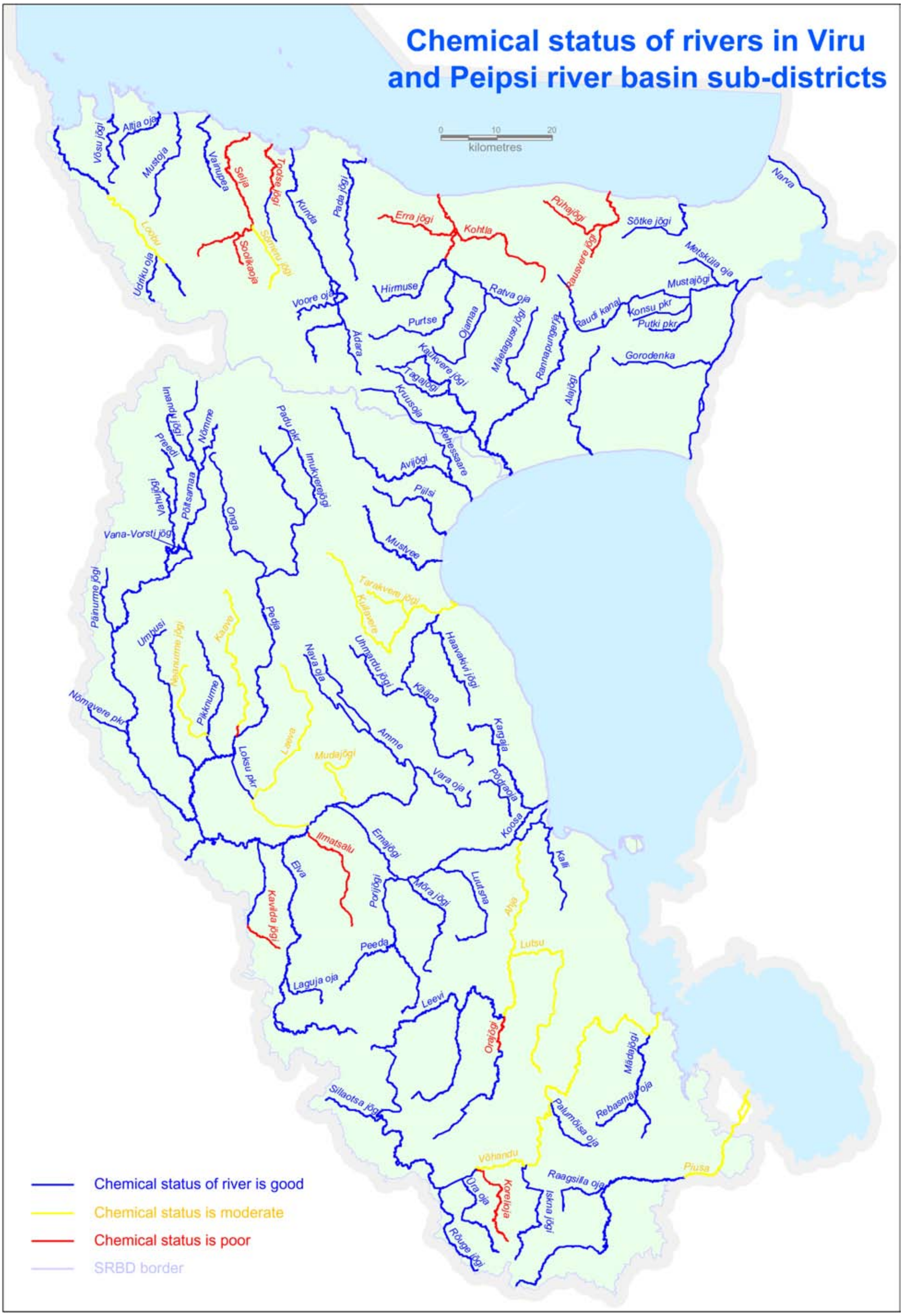


Figure 22 Chemical status of rivers in Viru and Peipsi river basin sub-districts

The impact of agricultural pollution on rivers is more difficult to distinguish due to its irregular nature and changing location. Raised nitrogen contents caused by agricultural pollution are observed in the upper courses of rivers emanating from the Pandivere Upland. Due to a low phosphorus content, excessive nitrogen does not cause eutrophication of rivers until additional phosphorus from wastewater (or liquid manure) is discharged. However, agricultural pollution still has often a decisive role in the formation of water quality in small rivers and streams.

The impact of agricultural non-point pollution on river water quality differs in its nature from the impact of point pollution. Urban wastewater enters a river as a relatively even flow all the year round and in a fixed location and has therefore a significant impact on water quality, especially if it is inadequately treated or during low water periods with a lower dilution ratio in rivers. Diffuse pollution from crop fields seeps into rivers more evenly and the biggest part of it is released during spring or autumn high water period when the dilution ratio is high. Therefore, e.g. one tonne of diffuse phosphorus or nitrogen has a weaker impact on river water quality than one tonne of phosphorus or nitrogen discharged with wastewater at a fixed point. However, the load to the receiving lake or the sea is the same.

Thus, point pollution from larger urban areas and big farms has a greater impact on the water quality of rivers than non-point pollution does, while agricultural pollution accounts for a considerably larger share of pollution load to lakes and the sea. Occasional contamination of small lakes with liquid manure or silage effluent is important from the point of view of fish fauna, being reflected as the absence of some stages of fish in water bodies.

A good chemical status of rivers can often be achieved just by appropriate treatment of wastewater. In the case of rivers formerly suffering from a heavy pollution load (Võhandu River downstream of the mouth of Koreli stream, Pühajõgi River, Selja River and Soolikaoja, Loobu River downstream of Kadrina, Kohtla River), it is probably necessary to remove also the pollutant-rich sediments deposited on the river bottom over the years.

<u>The impact of agricultural non-point pollution</u> needs further clarification in areas of concentrated livestock farming. Although periodical shock loads from manure and silage storages do not cause irreversible changes in river ecosystems, they are destructive for lakes and can also cause a rise in the internal load of P in reservoirs.

4.5.3 Chemical status of small rivers

As there are practically no monitoring data for small rivers, their status was assessed on the basis of the condition of treatment plants, pollution load reports and data on livestock sheds and big farms. The chemical status of main ditches designated as heavily modified water bodies, of some small rivers and of ditches identified as artificial water bodies was not assessed.

The chemical status of six small rivers in their natural state was assessed as poor: Toolse, Rausvere and Kavilda Rivers and Kose, Sanniku and Koreli Streams. The chemical status of ten rivers and streams was assessed as moderate. The above assessments have to be regarded as provisional, as they are yet to be either confirmed or refuted by monitoring.

4.5.4 Ecological status of medium-size and big rivers

Of the medium-size and big rivers assessed, the ecological status of 24 rivers is good over the entire length of river (Table 24). The main reason for assessing the ecological status as poor (in 2 entire rivers and 4 rivers partly) is water quality. Moderate ecological status is due to water quality in 4 cases, due to dams in 3 cases and due to both dams and water quality in 3 rivers. Six entire rivers have been identified as heavily modified water bodies and 11 rivers have got heavily modified stretches or water bodies.

According to an estimate by the Estonian Nature Conservation Centre, there are 83 impassable and 12 hard-to-pass fish migration barriers in the form of dams on 28 rivers of the Viru-Peipsi area. In 24 cases the ecological status of river cannot be assessed as good due to dams.

4.5.5 Ecological status of small rivers

The Viru-Peipsi catchment area includes the total of 345 small rivers, streams, ditches and main ditches. 25 ditches have been identified as artificial water bodies and 199 rivers, streams and main ditches – as heavily modified water bodies (together with medium-size and big rivers, there are 216 heavily modified water bodies in the area). In lack of better data it can be assumed that the above water bodies are not in a good ecological status. Adding the 16 natural small rivers in a poor or moderate chemical status, we can assume that the ecological status of 240 small rivers, streams and ditches is lower than good. Consequently, 105 small rivers should be in a good ecological status. However, it is likely that part of them spoilt by beaver dams and the actual number of small rivers in a good ecological status is lower. Regulation of the numbers of beaver and mapping of beaver dams is necessary for future assessment and improvement of the status of small rivers.

4.5.6 Status of rivers protected as fish habitats

When assessing the ecological status of rivers, their fisheries status and conservation status need to be taken into account. The list of water bodies protected as salmonid and cyprinid habitats includes the following rivers of the Viru-Peipsi area:

- rivers protected as salmonid habitats: Ahja, Avijõgi, Kunda, Kääpa, Loobu, Narva, Oostriku, Piusa, Preedi, Põltsamaa, Pühajõgi, Seljajõgi, Tagajõgi, Võhandu;
- rivers protected as cyprinid habitats: Emajõgi, Narva, Pedja.

Of the rivers protected as salmonid and cyprinid habitats, the rivers Ahja, Kunda, Loobu, Piusa, Põltsamaa, Pedja, Pühajõgi, Selja and Võhandu are in a lower than good ecological status.

Water quality is currently the limiting factor for fish fauna only in a small number of rivers and in most cases the adverse impact is confined to short stretches of river. The absence of organic pollution in rivers and the related normal oxygen regime are far more important for fish. The quantity of nitrogen or phosphorus compounds in rivers has usually no direct importance for the fish fauna of watercourses, which is why a river strongly polluted with nitrates may be of very high biological quality or a reference river (e.g. some rivers emanating from the Pandivere Upland).

4.5.7 Reservoirs posing a flood risk

In addition to blocking the migration of fish, many dams are in disrepair and pose a flood risk. According to a preliminary assessment (assessment of all reservoirs has not been completed), the following reservoirs pose a flood risk: Obinitsa Reservoir; Kentsi Reservoir; Laviku Reservoir; Oruveski I Reservoir (Muike); Oruveski II Reservoir; Pikapõllu Reservoir; Ojaäärse Reservoir and Alatskivi Reservoir. In addition, it has been pointed out that the lower regulator dams located on the cascades of reservoirs on the Sõtke and Võsu Rivers are incapable of carrying emergency flows from the upstream dam. The hydraulic structures are not prepared for carrying heavy floods (like those in 2003 and 2005). It is necessary to appoint operators for all regulator dams and draw up user manuals explaining *inter alia* the necessary action in emergency situations [8].

4.5.8 Regulated watercourses

The main aim of dredging of water bodies has been to achieve their maximum water-carrying capacity. The biota of dredged and straightened watercourses is poor and the watercourses are often in danger of drying up during draught periods. Nearly 300 thousand hectares of drained land has been taken out of agricultural use in recent years in Estonia and demands for the water-carrying capacity of their receiving waters are lower than earlier, which makes it possible to build on them bottom dams and weir rapids, restore the meandering of watercourses, establish spawning grounds for fish, etc. [16]

A list of state maintained public recipients has been established by Order No. 423-L of 2 July of 2003 of the Government of the Republic. According to this list, the total length of state maintained public receiving waters in Ida-Viru, Jõgeva, Lääne-Viru, Põlva, Tartu and Võru Counties is 1931 kilometres (Figure 24).

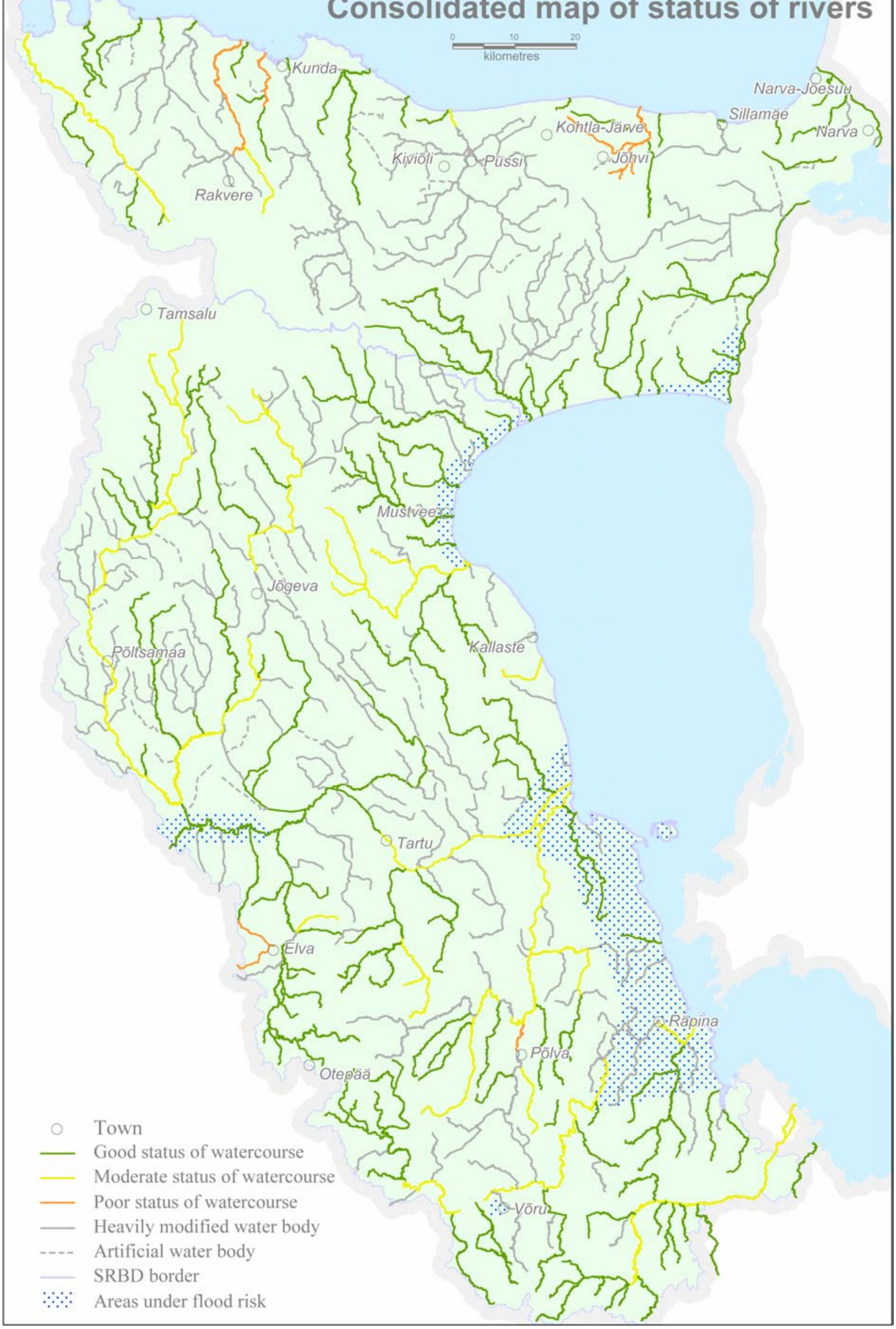


Figure 23 Consolidated map of status of rivers

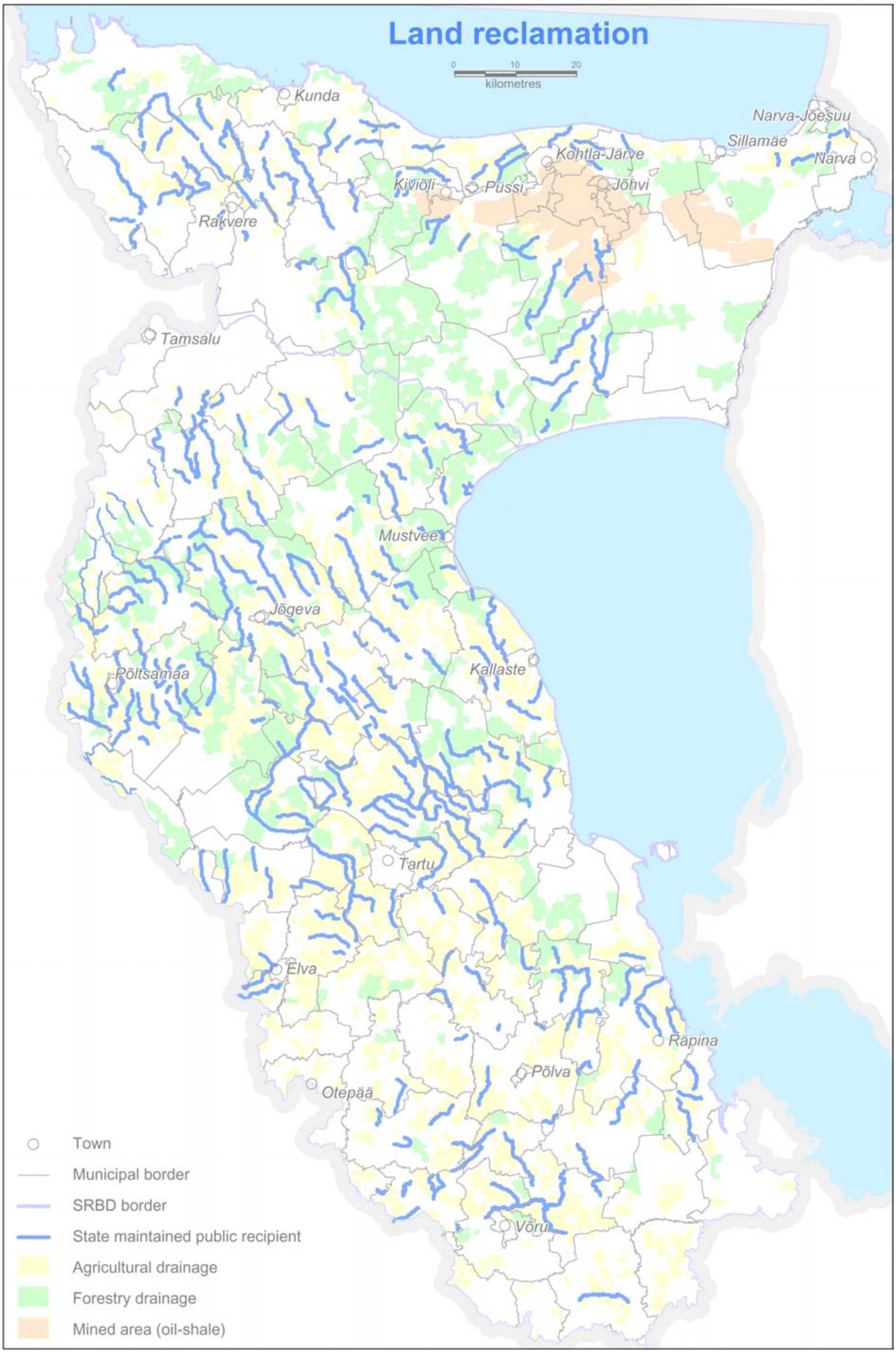


Figure 24 Land reclamation

4.6 Status of lakes

The following quality elements are used for classifying the ecological status of lakes in accordance with Annex V of the WFD:

- biological elements – the composition, abundance and biomass of phytoplankton; composition and abundance of other aquatic vegetation; composition and abundance of zoobenthos; composition, abundance and age structure of fish fauna;
- hydromorphological elements supporting the biological elements – hydrological regime (water flow rate and flow dynamics, retention time); morphological conditions (alternation of depth, character of lake bottom, structure of riparian zone);
- chemical and physico-chemical elements supporting the biological elements – divided into general conditions (transparency, temperature conditions, oxygen content, salinity, acidity, nutrient content) and content of toxic substances (both the ones listed as priority substances in the WFD and other dangerous substances discharged into the water body in *significant quantities*).

Different from rivers, important parameters for lakes are transparency and the composition, abundance and biomass of phytoplankton. The status of lake is determined not only by the type of lake but also by retention time of water (an indicator of water exchange). The status of lakes with a rapid water exchange recovers faster upon the decrease or cessation of human impact than is the case in lakes with a slow water exchange.

4.6.1 Data and methods used in assessing the status of lakes in the Viru-Peipsi area

Additional studies carried out on 8 lakes (Imatu, Jõksi, Karsna, Kõvera, Laiuse Kivijärv, Puhatu, Räätsma, Viisjaagu) in the course of creating the limnological database of ZBI and this Management Plan allowed the type assessment of 126 lakes, with 32 of them smaller than 10 ha. Data for the assessment of status of lakes were available for 103 small lakes, the Peipsi Lake System and Narva Reservoir. Thus, the type of 44 lakes and the status of 63 lakes with the area of over 10 ha remained undetermined.

The boundaries of status classes of lakes have been developed on the basis of an analysis of the limnological database. Apart from very many European countries, in particular the other Baltic countries, Estonia has got a long-term and comprehensive database, which allows to ascertain the frequencies of values of parameters that have occurred at different time periods. Therefore, in most cases the boundaries of status classes have been established on the basis of results of statistics of values at different periods of human impact. The final result is expressed as an expert assessment [11]. The following parameters were used in determining the status of lakes: pH, total nitrogen, total phosphorus, transparency, species richness of plant community, macrophyte coverage (% of lake volume), phytoplankton communities, refractive index and biomass (chlorophyll a) of phytoplankton and extent of metalimnion. The status was assessed using the 2/3 rule, which allows the status of a lake to be assessed as, e.g., good also in cases where 1/3 of its parameters correspond to moderate or poor status. Although the WFD requires that the final status be determined by the value of the lowest quality element, this requirement has not been followed in this Management Plan because different quality elements, especially biological ones, have a different informativity, different temporal variability, different importance in different types of lake, etc.

The status of zoobenthos was not taken into account for the time being because the boundaries of classes in terms of zoobenthos are still under development. Fish fauna was excluded too due to a lack of data. Regulation No. 33 of 22 June 2001 of the Minister of Environment *Status classes of surface water bodies, values of qualitative parameters corresponding to status classes of surface* *water bodies and the procedure for determining status classes*, which establishes also the class boundaries for lakes, is out of date and was therefore not taken into account.

If the results of the ongoing palaeolimnological work and also other studies should be used in future, the existing system needs to be improved. In particular the assessments based on macrophytes need to be specified. Problems occur also with brown water lakes, which belong to the mixotrophic type according to the Estonian lake typology. In these lakes, the value of transparency cannot be used as a type assessment criterion. Yet brown water hardwater lakes currently belong to the same type as light water lakes. Additional studies on these lakes are necessary prior to suggesting their conservation measures.

4.6.2 Ecological status of small lakes

Of the small lakes assessed, 9% are in a high, 48% in a good, 39% in a moderate and 4% in a poor status class (Table 25, Figure 25).

According to the present data, high-status lakes are Lake Saadjärv (Vooremaa Landscape Conservation Area), Lake Leegu (Emajõe-Suursoo Mire Reserve/Landscape Conservation Area), Lake Viisjaagu (Natura 2000 temporary restriction area), Lake Kooraste Kõverjärv (Natura 2000 temporary restriction area), Lake Räätsma (Kurtna Landscape Conservation Area) and Rõuge Suurjärv (Haanja Nature Park, Haanja limited management zone).

Of lakes with the area of over 50 ha, the status of Lake Kooraste was not assessed. The authors of this Management Plan have assumed on the basis of analogy that the status of Lake Koosa could be *good*.

Moderate or poor status of lakes is caused by point pollution in 11 cases, by agricultural pollution in 4 cases, by lowering of water level in 3 cases, by both point pollution and lowering of water level in one case and by both point pollution, non-point pollution and lowering of water level in two cases.

In the case of sensitive lakes (types 4 and 5), the moderate status of 14 lakes is probably due to background pollution load from the atmosphere. The status of these lakes was assessed as moderate because their status has considerably changed within the last decades. Measures for improving their status are absent, as reduction of atmospheric background pollution within the frames of the Management Plan is impossible and prohibition of bathing would be pointless. Therefore, lower environmental objectives should be set for these lakes in accordance with Article 4(5) of the WFD and the objectives should be regarded as achieved.

The reasons of deterioration of the status of eight lakes are unknown and require further investigation.

The moderate status of several lakes of the Vooremaa Drumlin Field (Elistvere, Kaiavere, Raigastvere, Soitsjärv, Kaarepere Pikkjärv) should be noted. A joint programme of measures should be drawn up for the lakes of Vooremaa to ensure the preservation of the high status of Lake Saadjärv and the good status of lakes Prossa, Kuremaa and Laiuse Kivijärv.

It is extremely important that conservation management plans be drawn up for Kurtna Lakes, Rõuge Lakes and Kooraste Lakes, which are mostly in a good status at present. In particular, the high status of the deepest lake of Estonia – Lake Rõuge Suurjärv – is to be maintained.

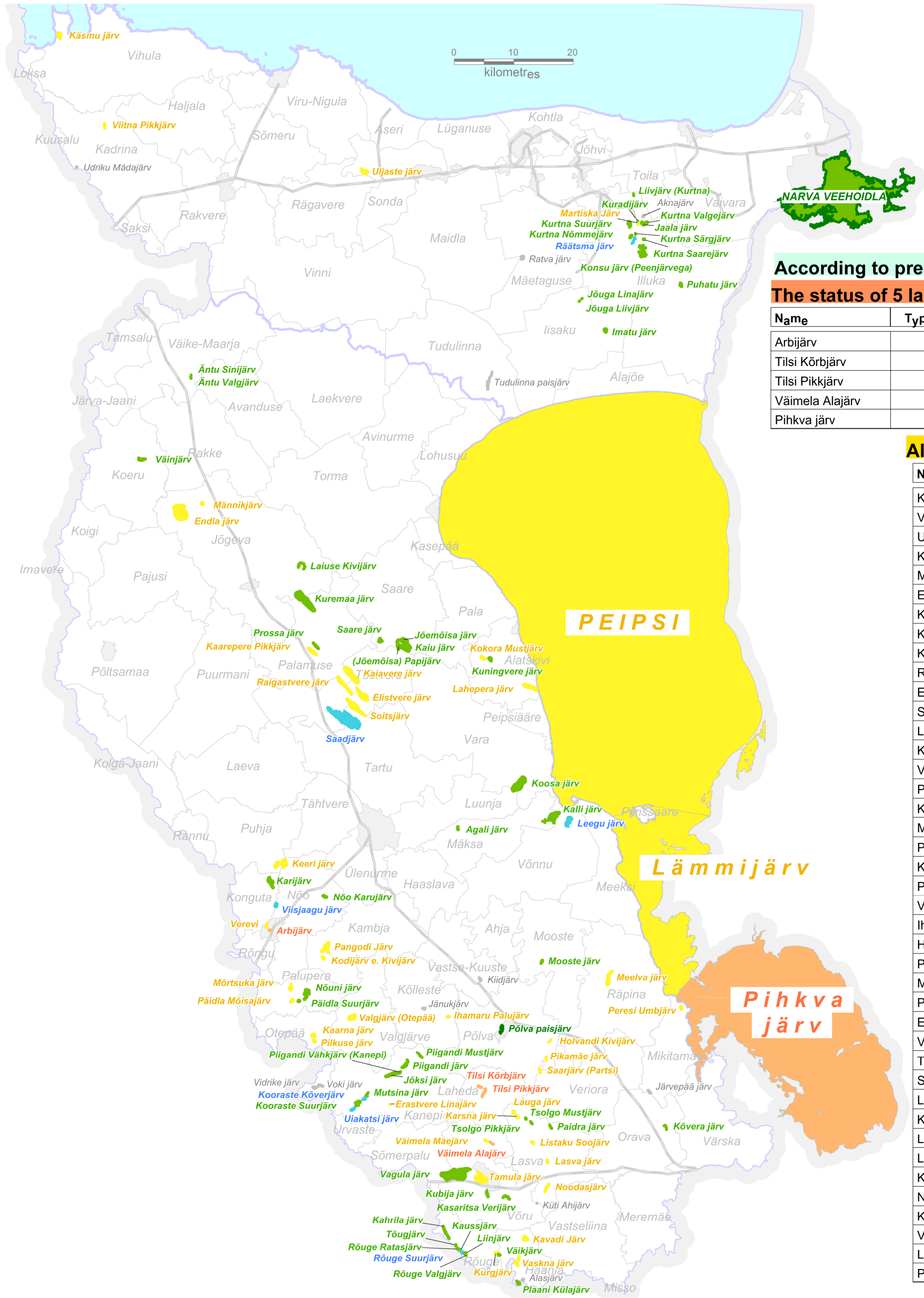
Table 25 Type and status of lakes of the Viru-Peipsi area

Code of lake	Name of Lake	Area (ha)	Municipality	Type	Status	Reason for moderate or poor status
200110	Käsmu	48.38	Vihula	4	moderate	Background load
200380	Viitna Linajärv	3.34	Kadrina	5	undetermined	
200390	Viitna Pikkjärv	14.17	Kadrina	5	moderate	Background load
201410	Uljaste	60.14	Sonda	5	moderate	Background load

201500	Liivjärv (Kurtna)	4.25	Illuka	5	good	
202420	Ratva	25.83	Mäetaguse	2	undetermined	
202490	Pannjärv	1.85	Illuka	2	undetermined	
202560	Aknajärv	8.64	Illuka	5	undetermined	
202570	Kuradijärv	1.01	Illuka	5	good	
202580	Kurtna Suurjärv	33.55	Illuka	3	good	
202590	Kurtna Valgejärv	8.20	Illuka	5	good	
202600	Jaala	18.83	Illuka	5	good	
202610	Kurtna Martiska	1.95	Illuka	5	Moderate	Lowering of water level
202620	Kurtna Ahnejärv	4.29	Illuka	5	good	
202650	Kirjakujärv	14.05	Illuka	2	undetermined	
202670	Niinsaare	6.30		2	undetermined	
202740	Kurtna Nõmmejärv	11.88	Illuka	2	good	
202750	Kurtna Saarejärv	6.28	Illuka	5	good	
202760	Räätsma	15.04	Illuka	3	high	
202790	Konsu (together with Peenjärv)	143.90	Illuka	3	good	
203430	Tudu	27.59	Vinni	4	undetermined	
203490	Jõuga Linajärv	1.03	Iisaku	5	good	
203510	Jõuga Liivjärv	1.64	Iisaku	5	good	
203530	Imatu	28.23	Iisaku	4	good	
203600	Puhatu	20.53	Illuka	4	undetermined	
204360	Äntu Sinijärv	3.78	Väike-Maar	1	good	
204370	Äntu Valgjärv	1.17	Väike-Maar	1	good	
205030	Väinjärv	33.97	Koeru	3	good	
205260	Männikjärv	15.89	Jõgeva	2	moderate	Earlier fertilizing of polder
205280	Endla	394.39	Jõgeva	2	moderate	Lowering of water level, restored by now
205520	Laiuse Kivijärv	27.07	Jõgeva	2	good	
205540	Kuremaa	374.26	Palamuse	3	good	
205680	Prossa	23.93	Palamuse	2	good	
205690	Kaarepere Pikkjärv	53.48	Palamuse	2	moderate	Point pollution, non-point pollution, Lowering of water level
205710	Kaiavere	235.88	Tabivere	2	moderate	Point pollution, non-point pollution, Lowering of water level
205730	Saare	26.96	Saare	3	good	
205760	Jõemõisa	70.06	Saare	2	good	
205761	Papijärv	40.73	Saare	2	good	
205770	Jõemõisa Särgjärv	6.25	Saare	2	undetermined	
205780	Kaiu	130.90	Saare	2	good	
205870	Kokora Mustjärv	23.00	Alatskivi	3	moderate	Non-point pollution
205880	Kuningvere	24.12	Alatskivi	3	good	
206500	Raigastvere	112.44	Tabivere	2	moderate	Probably past and present pollution from farms
206510	Elistvere	140.37	Tabivere	2	moderate	Needs investigation
206520	Soitsjärv	194.44	Tartu	2	moderate	Lowering of water level
206530	Saadjärv	698.07	Tartu	3	high	
206560	Lahepera	99.15	Alatskivi	2	moderate	Point pollution, lowering of water level
207550	Koosa	285.82	Vara	2	undetermined	
208410	Keeri	127.36	Puhja	2	moderate	Earlier wastewater discharge from Elva town
208430	Karijärv	77.28	Konguta	3	good	

208470	Agali	12.07	Mäksa	3	good	
208540	Kalli	196.68	Võnnu	2	good	
208550	Leegu	84.85	Võnnu	2	high	
208580	Lääniste Ahijärv	33.49	Võnnu	4	undetermined	
209240	Viisjaagu	22.30	Konguta	1	high	
209320	Verevi	11.30	Elva	3	moderate	Earlier wastewater discharge from Elva town
209330	Arbijärv	5.67	Elva	1	poor	Earlier wastewater discharge from Elva town
209511	Mehikoorma Umbjärv	11.92	Meeksi	2	undetermined	
209520	Rasina Orujärv	27.54	Mooste	4	undetermined	
210060	Pangodi	88.81	Kambja	3	moderate	Needs investigation
210090	Kodijärv or Kivijärv	14.99	Kambja	2	moderate	Pollution from elderly house
210120	Mõrtsuka	23.47	Palupera	3	moderate	Point pollution
210130	Nõuni	81.95	Palupera	3	good	
210200	Päidla Mõisajärv	16.03	Palupera	3	moderate	Point pollution
210210	Päidla Suurjärv	11.10	Palupera	2	good	
210360	Kaarna	25.09	Otepää	2	moderate	Needs investigation
210420	Pilkuse	12.28	Otepää	3	moderate	Needs investigation
210480	Mäha	13.42	Otepää	4	undetermined	
210770	Valgjärv (Otepää)	62.29	Valgjärve	2	moderate	Needs investigation
210840	Piigandi	42.33	Kanepi	5	good	
210850	Piigandi Vähkjärv (Kanepi)	8.67	Kanepi	4	good	
210940	Jänukjärv	11.11	Kõlleste	3	undetermined	
210990	Ihamaru Palujärv	7.95	Kõlleste	5	moderate	Background load
211030	Piigandi Mustjärv	12.84	Kanepi	4	good	
211070	Kiidjärv	12.45	Vastse-Kuuste	5	undetermined	
211110	Mooste	11.34	Mooste	2	good	
211200	Holvandi Kivijärv	5.41	Põlva	4	moderate	Point pollution
211290	Pikamäe	7.34	Põlva	4	moderate	Background load
211360	Meelva	75.74	Räpina	4	moderate	Background load
211390	Peresi Umbjärv	17.71	Mikitamäe	5	moderate	Background load
211400	Lüübnitsa Umbjärv	11.20	Mikitamäe	2	undetermined	
212010	Voki	16.28	Otepää	3	undetermined	
212020	Lambahanna	4.31	Otepää	3	undetermined	
212030	Vidrike	13.88	Otepää	3	undetermined	
212240	Jõksi	62.29	Kanepi	3	good	
212280	Erastvere	15.20	Kanepi	4	moderate	Point pollution
212310	Mutsina	12.30	Kanepi	2	good	
212320	Kooraste Kõverjärv	11.66	Kanepi	3	high	
212360	Kooraste Suurjärv	40.29	Kanepi	3	good	
212380	Uiakatsi	17.38	Kanepi	3	undetermined	
212470	Tilsi Kõrbjärv	12.18	Laheda	5	poor	Needs investigation
212480	Tilsi Pikkjärv	25.87	Laheda	5	poor	Needs investigation
212530	Väimela Mäejärv	12.67	Võru	3	moderate	Point pollution. Väimela settlement
212540	Väimela Alajärv	7.08	Võru	2	poor	Point pollution, Väimela settlement
212610	Vagula	604.60	Võru	3	good	
212620	Tamula	211.20	Võru	2	moderate	Needs investigation, possible impact of Võru town
212630	Saarjärv (Partsi)	11.94	Veriora	4	moderate	Background load

212740	Lauga	13.95	Lasva	4	moderate	Background load
212750	Karsna	16.40	Lasva	5	moderate	Background load
212800	Tsolgo Mustjärv	5.66	Lasva	4	good	
212820	Tsolgo Pikkjärv	7.84	Lasva	5	good	
212840	Paidra	10.29	Lasva	5	good	
212860	Listaku Soojärv	9.34	Lasva	4	moderate	Background load
212900	Lasva	11.65	Lasva	3	moderate	Point pollution
212980	Nohipalu Mustjärv	21.39	Veriora	4	undetermined	
213040	Orava	11.62	Orava	3	undetermined	
213780	Kubija	16.00	Võru	2	good	
213810	Kasaritsa Verijärv	23.29	Võru	3	good	
213910	Kahrila	38.75	Rõuge	3	good	
214000	Tõugjärv	4.70	Rõuge	3	good	
214010	Rõuge Ratasjärv	7.01	Rõuge	3	good	
214020	Kaussjärv	2.42	Rõuge	1	good	
214030	Rouge Suurjärv	13.99	Rõuge	3	high	
214040	Liinjärv	4.12	Rõuge	1	good	
214050	Rõuge Valgjärv	5.49	Rõuge	3	good	
214080	Kurgjärv	10.94	Rõuge	4	moderate	Background load
214090	Väikjärv	9.19	Rõuge	4	good	
214270	Noodasjärv	26.81	Lasva	2	moderate	Agricultural pollution
214370	Kavadi	27.23	Haanja	5	moderate	Background load
214430	Vaskna	39.04	Haanja	5	moderate	Background load
214490	Alasjärv	7.09	Haanja	5	undetermined	
214530	Plaani Külajärv	21.64	Haanja	5	good	



Status of lakes in Viru and Peipsi river basin sub-districts

- Moderate
- Poor
- The lake is dealt within reports but not assessed due to scarce data
- Good
- Good, two impounded lakes (Põlva, Narva veehoidla)
- Very good
- SRBD border

According to present data the status of 7 lakes is high and 54 lakes is good

The status of 5 lakes is assessed as poor

Name	Type	Worse than good are:
Arbijärv	2	P=B, N=B, Secchi=M, flora=M, biodiversity=M, Chl=P, Fütopl=B, FKI=M,
Tilsi Kõrbjärv	5	Ph=M, Secchi=P, flora=M, biodiversity=M, PVI=M, Chl=B, Fütopl=P, FKI=M, Metalimn=P
Tilsi Pikkjärv	5	Ph=P, Secchi=B, flora=M, PVI=P, Fütopl=P, FKI=B,
Väimela Alajärv	2	P=B, N=B, Secchi=P, flora=M, PVI=M, Fütopl=P, FKI=M,
Pihkva järv	2	pH=M, Secchi=M, P=B, N=P, Org mat M, COD=M, Chla=P (mud, self contaminating Suur-Peipsi)

Tables' legend:
H= Very good
G= good
M= moderate
P= poor
B= bad

Altogether 41 lakes are assessed as moderate

Name	Type	Worse than good are:
Käsmu järv	2	P=M, N=P, Secchi=M, flora=M, PVI=M,
Viitna Pikkjärv	5	P=M, N=M, Secchi=M, biodiversity=M, PVI=P,
Uljaste järv	5	P=M, N=P, Secchi=M, biodiversity=M, FKI=M,
Kurtna Martiska järv	5	Ph=M, N=M, flora=P, biodiversity=M, PVI=P,
Männikjärv	2	N=M, Secchi=M, flora=M, PVI=M, FKI=M,
Endla järv	2	Ph=M, N=M, Secchi=M, flora=M, PVI=M,
Kaarepere Pikkjärv	2	N=M, Secchi=P,flora=M, PVI=M, Chl=M,
Kaiavere järv	2	P=M, N=M, Secchi=M, flora=M, FKI=M,
Kokora Mustjärv	3	P=B, N=M, Secchi=M, Chl=B, Fütopl=B,
Raigastvere järv	2	P=M, N=P, Secchi=M, Fütopl=P,
Elistvere järv	2	flora=M, PVI=M, FKI=M,
Soitsjärv	2	Ph=M, P=M, N=B, flora=M, PVI=M,
Lahepera järv	2	P=B, N=P, Secchi=M, flora=M, PVI=M, Chl=B, FKI=M,
Keeri järv	2	N=B, Secchi=M, flora=M, PVI=M, Chl=P,
Verevi	3	P=B, N=B, Secchi=M, flora=M, PVI=M, Chl=M, FKI=M, Metalimn=B
Pangodi järv	3	N=B, Secchi=M, PVI=M,
Kodijärv e. Kivijärv	3	P=M, N=B, Secchi=M, flora=M, PVI=M, Chl=B, Fütopl=P, FKI=M,
Mõrtsuka järv	3	N=M, PVI=M, Chl=M,
Päidla Mõisajärv	3	P=B, N=B, Secchi=M, flora=M, Chl=B, Fütopl=P, FKI=M,
Kaarna järv	2	Secchi=M, flora=M, Fütopl=B, FKI=M,
Pilkuse järv	2	N=B, Secchi=M, flora=M, PVI=M, Chl=M,
Valgjärv (Otepää)	2	P=P, N=B, Secchi=M, flora=M, Chl=M, FKI=M,
Ihamaru Palujärv	5	flora=M, biodiversity=M, PVI=M,
Holvandi Kivijärv	4	P=M, N=B, biodiversity=M, Chl=P, Fütopl=P,
Pikamäe järv	4	P=P, biodiversity=M, Chl=P, Fütopl=P, FKI=P,
Meelva järv	4	P=M, N=M, biodiversity=M, Chl=M, FKI=M,
Peresi Umbjärv	5	Ph=M, Secchi=P, flora=P, PVI=B,
Erastvere Linajärv	5	Secchi=P, flora=M, PVI=P, FKI=P, Metalimn=B
Väimela Mäejärv	3	P=B, N=B, Secchi=M, flora=M, Fütopl=P, FKI=M,
Tamula järv	3	P=B, N=M, Secchi=M, flora=M, PVI=M, FKI=B,
Saarjärv (Partsi)	4	P=P, N=M, biodiversity=M, Chl=M, Fütopl=P,
Lauga järv	4	flora=M, biodiversity=M, Chl=P, Fütopl=P, FKI=M,
Karsna järv	5	Secchi=M, biodiversity=M, FKI=M,
Listaku Soojärv	2	Secchi=M, flora=M, biodiversity=M, FKI=M,
Lasva järv	3	P=B, N=B, Secchi=M, flora=M, Chl=M, Fütopl=P, FKI=M,
Kurgjärv	5	P=M, Secchi=M, PVI=M, FKI=M,
Noodasjärv	2	P=B, N=B, Secchi=P, flora=M,
Kavadi järv	5	P=B, N=B, Secchi=M, flora=M, PVI=P, FKI=M,
Vaskna järv	5	P=M, N=M, Secchi=M, flora=M, PVI=P, FKI=M,
Lämmijärv	2	pH=M, Secchi=M, P=P, N=M, Org mat M, COD=M, Chla=P, (mud, self contaminating Suur-Peipsi)
Peipsi	2	pH=M, Secchi=M, P=M, Chla=M/P, (mud, self contaminating Suur-Peipsi)

Figure 25 Status of lakes in Viru and Peipsi river basin sub-districts

4.6.2 Peipsi Lake System

Lake Peipsi Suurjärv is in a moderate status, the status of Lake Lämmijärv and Lake Pihkva varies between moderate and poor. The status of Lake Pihkva was assessed as poor for the purposes of this report. An analysis of the status of the Peipsi Lake System on the basis of chemical and biological parameters from 2002 indicates deterioration of the status: a general trend of eutrophication is obvious. The ecological disaster of 2002 may be repeated in the lake system in the event of favourable weather and hydrological conditions. A more detailed analysis of the status is presented in the following subchapters.

4.6.2.1 Lake Suurjärv

Hydrochemistry and phytoplankton. According to the WFD, the boundaries of status classes have to be identified on the basis of the so-called Ecological Quality Ratio or deviation from natural reference conditions. For Lake Peipsi Suurjärv there are no suitable reference water bodies, i.e. big lakes with similar characteristics and biota, in a natural condition and free of human impact. Therefore the reference conditions were identified by means of modelling. Increased nutrient load, in particular phosphorus load, should be regarded as the main indicator of human impact on lakes. Therefore it is necessary to estimate first of all the likely phosphorus concentration in lakes prior to the onset of significant human impact. This was done using the morphoedaphic index (MEI) of Vighi & Chiaudani (1985), which is calculated as the ratio between total alkalinity (mgEq./l) and average depth of lake (m).

The reference concentration of total phosphorus (P_{tot}) in Lake Suurjärv calculated using the morphoedaphic index should be 18–23 mg/m^3, which refers to the mesotrophic class. The borderline between good and moderate status classes is P_{tot} = 34 mg/m^3, while the long-term median value for Lake Suurjärv is 44 mg/m^3. As the current median value of P_{tot} in Lake Suurjärv exceeds the limit between good and moderate status, Lake Suurjärv has to be classified into the moderate status class in terms of phosphorus – the main pressure on its ecosystem.

Both chemical and biological parameters may be subject to seasonal variation, which is why even the status of a natural water body may undergo seasonal shifts from one class to another. Therefore the boundaries of status classes were calculated separately for each month, which shuts out the influence of seasonality in assessing the ecological status of water body. For Lake Suurjärv, status classes were identified as to many parameters (e.g. total phosphorus, BOD7, chlorophyll a, ratio between the biomasses of zooplankton and phytoplankton, biomass of diatoms, etc.) but the best correlation with expert assessment and best reflection of the actual ecological status of the lake was obtained with the classification based on chlorophyll concentration. According to changes in chlorophyll concentration, Lake Suurjärv reached a poor ecological status by the end of the 1980ies. A clear improvement took place in 1990–1996, when the status of the lake could be regarded as good during several years. Since 1997, however, the status has been deteriorating constantly and even with an increasing speed, falling back within the limits of the poor status class by 2002.

Three periods of different trophicity can be distinguished in the changing ecological status of Lake Suurjärv on the basis of **zooplankton data** (1965–2002):

- An oligo-mesotrophic period in 1965–1966 can be viewed as type-specific reference conditions because differences from the lake's status at the beginning of the 20th century were basically absent at the time.
- The years 1985–1992 can be viewed as the culmination period of eutrophication in Lake Suurjärv. The ecological quality of the lake was moderate in this period according to zooplankton indicators.

- In the last decade (1993–2001) there was a fall in nutrient loads. Zooplankton data of this period indicate a good water quality or water quality at the boundary between good and moderate.

Eutrophication signs in the **macrophytes** of Lake Peipsi Suurjärv have gradually spread from the south towards the north over the last 40 years. Based on macrophytes there occur stretches of bank both in good and in poor condition in Lake Suurjärv. The main changes in macroflora are connected with the spreading of reeds, which suppress other plant species due to their shading effect and lead to accumulation of sediments in the littoral zone. No significant changes have been observed in the depth of spreading of aquatic vegetation.

Fish fauna. As fishing has influenced the fish fauna of our big lakes already for centuries, it is difficult to estimate the likely abundance, species composition and age structure of fish in the lack of human impact. Fishery is thus the most important factor of impact on the fish fauna of Lake Peipsi Suurjärv.

Lake Suurjärv, the lower courses of its inflows and the Narva River host the total of 37 fish species. The species composition has remained practically the same over the centuries. Only one species has disappeared (*Abramis ballerus*), with man's role in its disappearance being questionable. The following main changes have take place in the fish fauna:

- The natural population of **eel** has disappeared from Lake Suurjärv, having been replaced by an introduced population from Lake Võrtsjärv. The disappearance was probably caused by the construction of a dam of hydro-power plant on the Narva River in 1956.
- The abundance of **vendace** decreased sharply since 1990. In 1991–1994 vendace was not caught at all. The prospects of recovery of the vendace population are low due to eutrophication of Lake Suurjärv (the fry of vendace gets buried under mud) and, on the other hand, due to the increased abundance of pikeperch.
- The abundance of many fish species, especially **pikeperch** and **perch**, has been strongly influenced by fisheries policy and by direct fishing pressure. Representation of older age classes of especially pikeperch is low due to fishing pressure but, as pikeperch prefers waters with low transparency, eutrophication of Lake Suurjärv seems to have a favourable impact on the species.
- The abundance of **sparling** and **ruff** can be strongly influenced by summer algal blooms.

The above changes in fish fauna are still relatively small and the condition of fish fauna can be assessed at least as good. Yet attention should be paid to significant shifts in the abundance of dominant species:

- The biomass of predatory fish (mainly pikeperch, >10 cm perch and pike) in Lake Suurjärv is extraordinarily high at present, forming over a half of the total biomass of fish fauna but only a fifth of the lake's total production.
- Production of the main benthos-eating fish (bream, ruff) was rather small (10%).
- Plankton-eating fish made up the biggest share of total production (68%). In earlier years their share in Lake Suurjärv was considerably higher.

Adverse human impact on the fish fauna of Lake Suurjärv is increasing. As trophicity has exceeded the optimum level, no increase in fish catches can be expected. The stock of several fish species (e.g. perch) is suffering from obvious overfishing.

4.6.2.2 Lake Pihkva

Although **Lake Pihkva** belongs to the same lake system as Lake Peipsi Suurjärv, it is still different in several respects due to its morphology and the size of catchment area. The catchment area of Lake Pihkva is 2.5 times larger than that of Lake Peipsi in relation to the surface area and 5 times bigger in relation to the volume of the lake. The average depth of Lake Pihkva is more than twice smaller than that of Lake Peipsi. Relative nutrient load of Lake Pihkva is thus already naturally much higher than in Peipsi. The Velikaja River runs into Lake Pihkva in the south of the lake, with the town of Pihkva with 200 000 inhabitants located at its mouth. The discharge of the Velikaja River makes up over a half of the total inflow into the entire Peipsi Lake System and most of the inflow into Lake Pihkva. The location of Pihkva Town in the immediate vicinity of the lake implies that practically all of the pollution generated in the town reaches the lake.

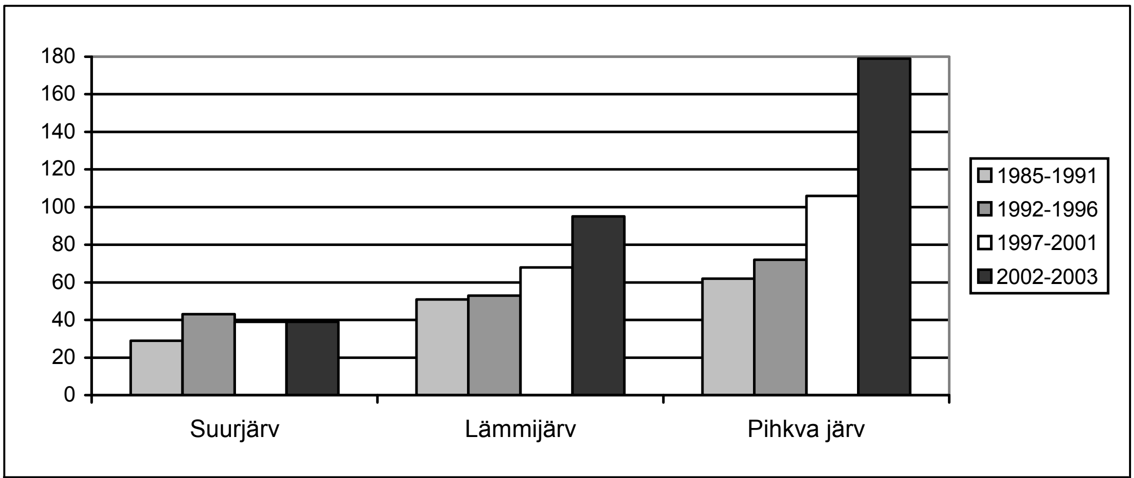
Considering the above, the status of Lake Pihkva cannot be assessed on the basis of the reference conditions determined for Lake Suurjärv using the morphoedaphic index. The boundary between good and moderate status in terms of phosphorus content has unfortunately not been calculated for Lake Pihkva yet. For Lake Võrtsjärv, which is similar to Lake Pihkva in its depth, the scientists of ZBI have suggested that the limit between good and moderate ecological status in terms of P_{tot} concentration should be 46 mgP/l (for Lake Suurjärv – 34 mgP/l). The morphoedaphic index takes into account the lake's average depth and hardness of water but not the relative size of catchment area, which is 2.5 times larger in Lake Pihkva than in Lake Võrtsjärv in relation to the lakes' volume. Therefore the phosphorus load and the associated trophicity level of Lake Pihkva would be higher than in Lake Võrtsjärv and even more higher compared to Lake Suurjärv even in complete lack of human impact. In Lake Pihkva the limit between good and moderate ecological status in terms of phosphorus concentration could probably be somewhere between 50 and 60 mgP/l.

4.6.2.3 Lake Lämmijärv

Lake Lämmijärv constitutes a connection channel between Lake Pihkva and Lake Suurjärv, with the status of the lake depending on water quality in the two neighbouring lakes and on wind-driven currents. Although water ultimately moves from the south to the north (from Lake Pihkva to Suurjärv), winds may induce also opposite movement of water (currents of up to 1m/s have been observed). There occur also situations where water moves in one direction in the eastern part and in the opposite direction in the western part of Lämmijärv. Also the Võhandu River, which flows into the southern part of the lake, has a certain impact on the lake's water quality.

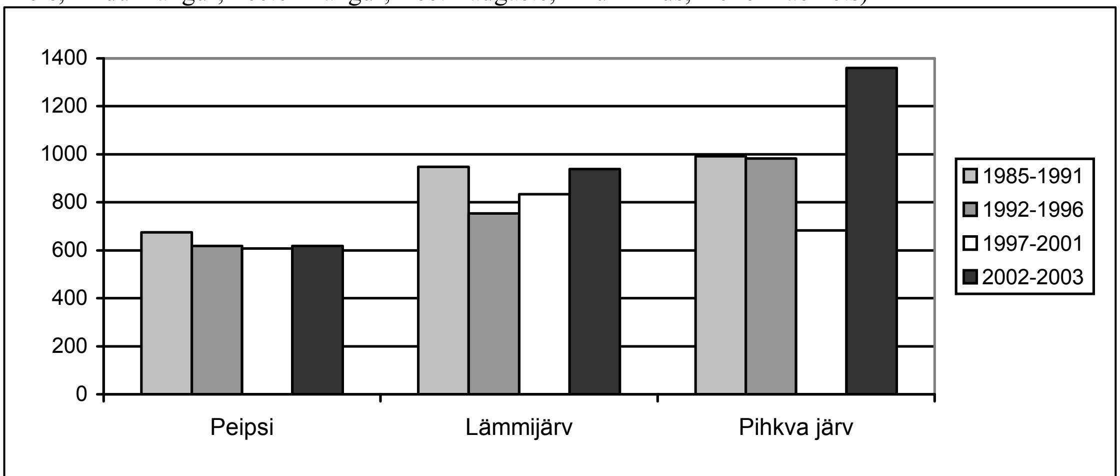
4.6.2.4 Dynamics of the status of the Peipsi Lake System

7 and 8 show considerable differences in the status of Lake Suurjärv, Lake Pihkva and Lake Lämmijärv. While the status of Suurjärv has stabilised in the last decade in terms of both phosphorus and nitrogen, the phosphorus concentration in Lake Pihkva has increased nearly threefold during the same period. This can be due to a sharp increase in phosphorus load (on which there are no data) or the impact of bottom deposits on water quality. It is likely that both reasons are involved, as algal blooms caused by a small increase in load and by favourable weather conditions lead, in turn, to liberation of phosphorus from bottom sediments, i.e. the so-called self-pollution of the lake.



Graph 7 Dynamics of the content of total phosphorus in Lake Suurjärv, Lake Lämmijärv and Lake Pihkva (mgP/m3, geometric average)

Source: Presentation by Külli Kangur at a seminar on assessment of the status of Lake Peipsi, 22.01.2004 (Environmental status of Lake Peipsi based on the existing data and results of joint expeditions. Külli Kangur, Tõnu Möls, Andu Kangur, Peeter Kangur, Reet Laugaste, Anu Milius, Helle Mäemets)



Graph 8 Dynamics of the content of total nitrogen in Lake Suurjärv, Lake Lämmijärv and Lake Pihkva (mgP/m3, geometric average)

Source: Presentation by Külli Kangur at a seminar on assessment of the status of Lake Peipsi, 22.01.2004 (Environmental status of Lake Peipsi based on the existing data and results of joint expeditions. Külli Kangur, Tõnu Möls, Andu Kangur, Peeter Kangur, Reet Laugaste, Anu Milius, Helle Mäemets)

4.6.2.5 Status of Narva Reservoir

Judged by biological and hydrochemical data, the chemical and ecological status of Narva Reservoir is good and has stayed stable during the study period (2000–2003) (see Table 26). The concentration of heavy metals, oil products and phenols in water samples was mostly below the detection limits of the measuring methods used.

Table 26 Overview of the status of Narva Reservoir according to chemical and biological parameters

Parameter	Value in Narva Reservoir	Status class
pH	8.1	good (8–8,3)
Ptot, mg/l	0.039 mg/l	good (30–60)
Ntot, mg/l	0.59 mg/l	good (500–700)

Parameter	Value in Narva Reservoir	Status class
Transparency of water, measured with Secchi disk, m	1.7 m	moderate (1–2)
Plant community	*Potamogeton, Nymphaea*	moderate
Abundance of vegetation	Strongly overgrown with vegetation	moderate (4–5)
Chlorophyll a, µg/l	8.7 µg/l	high (<10)
Phytoplankton community	A	good

The Narva Reservoir is poor in phytoplankton, which may be partly due to competition with macrophytes. Zooplankton is probably suppressed in the reservoir by abundant young fish. Species-rich zoobenthos and, in particular, the abundance of the zebra mussel indicate a relatively clean water body. Proliferous macroflora acts as a biofilter for various pollutants, yet it inhibits the use of the water body for fisheries.

Up-to-date data on the fish fauna of the reservoir are absent. Being rich in vegetation, the reservoir is a suitable habitat first of all for pike but also for perch and roach. As a big part of the reservoir's zoobenthos consists of chironomid larvae, the conditions here should be favourable for benthos-eating fish, such as bream, red-eye and tench.

Considering the fact that Narva Reservoir has been designated as a heavily modified water body, it can be assumed that it has essentially achieved its good ecological potential already.

4.7 Assessment of the status of coastal sea

4.7.1 Data and methods used in assessing the status of coastal waters

Table 1.2.4 of Annex V of the WFD defines the high, good and moderate ecological status of coastal waters for biological, hydromorphological and physico-chemical quality elements. According to this approach, the basic element of the ecological classification system is the *undisturbed status* or reference conditions, which have to be type-specific, i.e. defined separately for each type. Reference conditions have to take into account both the spatial and temporal variability that would occur in undisturbed nature. In the case of the Baltic Sea it is unfortunately not possible to find sea areas consistent with reference conditions for each type [4].

The classification of ecological status is based on the status of biological, hydromorphological and physico-chemical quality elements. The elements to be used in the classification are presented in section 1.1.4 of Annex V of the WFD. Hydromorphological and physico-chemical elements are also referred to as supporting elements.

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Biological elements include the composition, abundance and biomass of phytoplankton; composition and abundance of phytobenthos; composition and abundance of zoobenthos. Water transparency, salinity and nutrient content are mentioned as chemical and physico-chemical elements supporting the biological elements.

The data gathered in the frames of coastal sea monitoring until the year 2000 have been analysed for the purpose of establishing ecological status classes for the coastal sea of Estonia. For the western part of the Gulf of Finland, the Estonian-Danish joint project EISEMM has proposed a classification system based on monitoring data from open sea stations 2 and F3 of the Gulf of Finland (sea area with low human impact), from stations K5 and K21 in Pärnu Bay (area with high human impact) and from a strongly eutrophied Danish coastal area (Skive Fjord). It was assumed that in the open sea stations 2 and F3 of the Gulf of Finland the measured values of quality elements were consistent with background conditions in 20% of measurements. As the levels of quality elements vary considerably between different sea areas, ecological status classes had to be established individually for each type of coastal water. For other types of coastal water, the characteristic values of quality elements were found using correction for salinity (by comparing the salinity in the western part of the Gulf of Finland with that in the study area) and for open sea conditions (by comparing the values of quality elements in the open sea of the western part of the Gulf of Finland with those in the open sea of the study area). The values of quality elements characteristic of the status classes of coastal water of Narva Bay (type I) and the western part of the Gulf of Finland (type I) are presented below (Table 27, Table 28).

Table 27 Type-specific values of physico-chemical and biological quality elements corresponding to ecological status classes of coastal water of Narva Bay

Quality element	Ecological status class				
	High	Good	Moderate	Poor	Bad
Nitrogen content – N_{tot} (µmol N / l)	< 20	20 - 30	30 - 55	55 - 100	> 100
Phosphorus content – P_{tot} (µmol P / l)	< 0.6	0.6 - 1.1	1.1 - 2.5	2.5 - 8	> 8
Water transparency – Secchi depth (m)	> 4.5	4.5 - 3	3 - 2	2 - 1.5	< 1.5
Content of chlorophyll *a* (µg/l)	< 2	2 - 6.5	6.5 - 16	16 - 40	> 40
Maximum depth of distribution of phytobenthos (m)	> 9	9 - 6	6 - 4	4 - 3	< 3
Biomass of *Macoma balthica* (g/m^2)	< 20	20-40	>40	–	–

Table 28 Type-specific values of physico-chemical and biological quality elements corresponding to ecological status classes of coastal water of western part of the Gulf of Finland

Quality element	Ecological status class				
	High	Good	Moderate	Poor	Bad
Nitrogen content – N_{tot} (µmol N / l)	< 12.5	12.5 - 18	18 - 32.5	32.5-60	> 60
Phosphorus content – P_{tot} (µmol P / l)	< 0.38	0.38 - 0.7	0.7 - 1.6	1.6 - 5	> 5
Water transparency – Secchi depth (m)	> 6	6 - 4	4 - 2.5	2.5-1.75	< 1.75
Content of chlorophyll *a* (µg/l)	< 1.25	1.25 - 4	4 - 10	10 - 25	> 25
Maximum depth of distribution of phytobenthos (m)	>12	12 - 8	8 - 5	5 - 3.5	< 3.5
Biomass of *Macoma balthica* (g/m^2) – soft substratum	< 25	25 - 150	> 150	–	–
Biomass of *Mytilus edulis* (g/m^2) – hard substratum	< 20	20 - 50	> 50	–	–

4.7.2 Characterisation of the chemical status of coastal sea on the basis of dangerous substances

The most important enterprises having a potential impact on rivers and thereby also on the coastal sea in the Viru-Peipsi catchment area are Viru Chemistry Group Ltd., Estonian Power Plant, Narva Water Company and Baltic Power Plant. Also the Pljussa River, with an upper course located in Russia and running into the Narva Reservoir, may be a potential source of pollution for the Estonian coastal sea. Concentrations of different dangerous substances were studied in 2003 in the following sampling points:

- in the Narva River basin: on Narva River downstream of Narva, on the outflow canal of the Baltic Power Plant, at the mouth of Pljussa River and on Mustajõe River.
- in the Purtse River basin: on Kohtla River and Purtse River.

The content of dangerous substances was determined both in bottom sediments of rivers and in surface water. The concentration of polyaromatic hydrocarbons (PAH) in bottom sediments remained below the established limit value in all samples. The content of phenols exceeded the limit value twice in the bottom sediments of cooling water outflow canal of the Baltic Power Plant but it never exceeded the limit in residential zones. Nor did the content of polyaromatic hydrocarbons in surface water exceed the limit values currently in effect in Estonia.

As the content of phenols and polyaromatic hydrocarbons in the immediate vicinity of pollution sources is below the limit value, it is highly unlikely that significant quantities of dangerous substances from the power industry could reach the coastal sea.

The biggest problems are related to dangerous substances accumulated in soil as a consequence of intensive pollution loads from 10 years ago. A similar tendency is likely to occur also in ports that have been in use for a longer time. The mooring and anchorage areas of ports usually contain oil or some other dangerous substances. The studies carried out in the coastal sea of Estonia in the course of port development works have, as a rule, assessed such pollution as being of local character. Polluted soil usually poses no threat to the surrounding sea areas. Dredging and dumping works in such areas should come under increased attention. Contaminated soil broken loose from sea bottom can have a strong impact on the marine environment.

The sub-programme "Dangerous substances" under the Estonian coastal sea monitoring programme includes biotic sampling from Narva Bay (from the areas of Kunda and Narva). The content of heavy metals (Hg, Cd, Cu, Pb, Zn) is determined in the tissues of *Macoma balthica* and *Saduria entomon* (see Table 29) and in Baltic herring caught from the Kunda area (liver or muscular tissue). The content of organochlorines (HCH – hexachlorocyclohexane, DDT and its isomers, PCB – polychlorobiphehyls) is measured in biotic samples taken from the same areas (see Table 30). The concentration of cadmium, mercury, lead, copper and zinc in the organisms of the Estonian coastal sea (incl. in the Viru-Peipsi catchment area) is comparable to the average values for the entire Baltic Sea. The concentrations of practically all of the studied heavy metals in organisms were lower in 2001–2003 than in 1991. In general, the results for the content of dangerous substances in organisms are not in discord with the quality objective established in the EU water protection legislation, according to which the content of dangerous substances must not significantly increase with time. The content of dangerous substances in the organisms of Viru-Peipsi coastal sea is comparable with other regions of Estonia. Monitoring results of 2004 from the Kunda and Narva-Jõesuu areas are presented in the following tables.

Table 29 Contents of heavy metals in the tissues of Macoma balthica *and* Saduria entomon *according to monitoring data of 2004*

Parameter (mg/kg wet weight)	Kunda		Narva-Jõesuu	
	Macoma	*Saduria*	*Macoma*	*Saduria*
Cd	0.11	0.04	0.17	0.03
Hg	0.008	0.007	0.011	0.36
Pb	0.33	0.36	0.87	0.009
Cu	14.9	14.5	11.1	9.7
Zn	98.2	38.2	111	19.1

Table 30 Average contents of organochlorines in muscular tissue of Baltic herring (mg/kg of lipids) in the Kunda area according to marine monitoring data of 2003 and 2004.

Parameter	2003	2004
α-HCH	0.009	0.004
γ-HCH	0.032	0.012
p,p'DDE	0.23	0.04
p,p'DDD	0.14	0.02
p,p'DDT	0.05	0.01
sDDT	0.47	0.08

4.7.3 Impact of rivers and the open part of the Gulf of Finland on the coastal sea

Among the rivers having an impact on the Viru-Peipsi coastal sea, the most important source of impact is our biggest river – the Narva River, whose status has been assessed as good. Of other rivers, the Kunda River is in a good chemical status, Purtse River in a moderate and the Selja River and Pühajõgi River in a poor status. However, due to their relatively low discharges these rivers have no significant impact on the status of coastal sea.

It has been shown on the basis of model calculations under the EISEMM project that different scenarios of nutrient load from the inland would allow an only 20% improvement in water quality of Narva Bay (somewhat more in only a very narrow strip of coastal sea near the mouth of Narva River). These results clearly refer to a great dependence of the status of Narva Bay on the quality of water entering the open bay from other parts of the Gulf of Finland (transboundary impact). Pollution load analyses by HELCOM suggest that approximately 70% of the nitrogen and phosphorus load of the Gulf of Finland originates from Russia (in particular the Neeva River and St. Petersburg). Thus, the status of the Gulf of Finland (incl. Narva Bay) could be most effectively improved, as shown by e.g. Kiirikki *et al.* (2003), by commissioning of the wastewater treatment facilities of St. Petersburg.

In addition, the status of the Gulf of Finland is greatly dependent on its internal phosphorus load, which is connected with liberation of phosphorus from bottom deposits in the event of oxygen deficit in the bottom layer. According to different estimates, annual internal phosphorus load of the Gulf of Finland may be equal to the amount of phosphorus carried into the Gulf by rivers. Internal phosphorus load, which is largely dependent on natural factors, can be influenced to some extent by a general reduction of primary production and thereby also the amount of depositing materials in the entire Gulf of Finland.

4.7.4 Description of the status on the basis of morphological quality elements

The status of coastal sea in the Viru-Peipsi area is mostly good or high in terms of quality elements set out in section 1.2.4 of Annex V of the WFD. The morphology of Viru-Peipsi coastal sea has been affected in 2000–2004 by dredging, filling, dumping and excavation works connected with port development. In Aseri Harbour, where large-scale dredging and dumping works were planned, only the filling of sea area was carried out in this period. Dredging and dumping works took place in connection with harbour development in Kunda. In Sillamäe, excavation works were carried out to obtain materials for sealing the Sillamäe waste depository and harbour development commenced (with the construction of a mole and piers).

Dredging, excavation and dumping works are similar in their effect on the environment. The most important long-term effect is the suspended solids generated in the course of the works. Sea biota (fish fauna, zoobenthos, phytobenthos) recovers, as a rule, from the effects of suspended solids associated with dredging works within 2–3 years. The scale of negative impact is largely determined by the existence of pollutants in relocated soil. In addition, filling and building works alter the coastline, which may lead to significant changes in sediment transport and other coastal processes in the longer term.

Determination of pollutant content in soils has been based on Regulation No. 58 of 16 June 1999 of the Minister of Environment *Limit values for the content of dangerous substances in soil and groundwater*. This Regulation establishes standards for dangerous substances in the form of limit values and targets. When the content of a dangerous substance exceeds the limit value, the soil is regarded as contaminated and dangerous to human health and the environment. When the content of a dangerous substance is equal to or lower than the target, the status of soil is regarded as good, i.e. safe to human health and the environment. When the content of a dangerous substance is between the target and the limit value, the status of soil is regarded as moderate. Limit values are different for residential and industrial zones, being more stringent in the former.

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A large sea area was filled during the filling works in Aseri in the year 2000. Dredging works involving the removal of 1.1 million cubic metres of soil from the sea are still planned. The soil to be removed was analysed for contaminating components on the basis of 10 samples. The content of heavy metals remained below the target in all 10 samples, nor was the soil contaminated with oil products (Estonian Marine Academy, 2002). The dredged soil is planned to be dumped in a designated dumping area (59° 28' N, 26° 55' E), which has not been in use yet.

During the dredging works in the aquatorium of Kunda Harbour in 2003, 7 samples were taken from sea bottom and analysed for contaminating components. Six of the seven samples were free of contaminants. This is natural, as most of the dredged sediments lay in an area of natural deposition and were thus inaccessible to pollutants. Only in one sample, which was taken from the bottom of shallow sea overgrowing with reeds in an area nearest to the coast, was the content of oil products somewhat higher than the limit value for residential zones. Knowing the problems related to exploitation of the area of Kunda Harbour, there is reason to believe that this sample reflects local pollution probably connected with the storage and use of boats by local recreational fishermen. It is namely in this sampling area that local inhabitants store, launch and land their water vehicles (Estonian Marine Institute of UT, 2003). Thus, the dredged soil was largely clean and the share of suspended solids of moderate quality was small. The volume of dredging totalled app. 800 000 m^3. The dredged material was dumped in a designated dumping field (59°36' N, 26°32' E).

In 2003, 620 000 m^3 of soil was removed from the sea bottom in the aquatorium of Sillamäe Harbour. These works constituted *mining*, not *dredging*, as the soil was extracted for final sealing of the Sillamäe waste depository. Despite the fact that no sea dumping was involved, suspended solids affected the sea area adjacent to Sillamäe Harbour. The EIA report conditionally regarded the mining area as an industrial zone, which is justified in case the dredged material is deposited in the territory of future harbour as designated in a general plan, or in utilised as sealing material for the waste depository (which was the case). Bottom samples for pollution analysis were taken from three different locations. The content of heavy metals remained below the target in all samples, as did the quantity of phenols. The content of oil products exceeded the limit value for residential zones in all samples but remained below the limit for industrial zones.

In addition to the above areas, soil has been dumped in a dumping area near Narva Jõesuu, which currently falls within the area controlled by the Russian Federation. Reconstruction of Narva-Jõesuu Harbour is planned for the near future and will probably involve also dredging and dumping. Selection of a new dumping area will require the relevant studies.

4.7.5 Ecological status of coastal sea of the Viru river basin sub-district

To assess the ecological status of coastal sea, ecological status classes need to be determined individually for each stretch of coastal sea (or water body) identified and regarded as being of water management importance in the water management plan of the sub-district concerned. In order to eliminate the impact of natural spatial and temporal variability of quality elements in determining the ecological status class, a relevant monitoring procedure has been proposed. Chlorophyll *a*, nitrogen and phosphorus content and water transparency are recorded in at least three monitoring stations at least 6 times from June to August. The maximum depth of distribution of phytobenthos is determined once, in August-September, in at least six stations. Biomass of *Macoma balthica* or of *Mytilus edulis* (in the case of hard substratum in coastal waters of type III) is determined once, in May, in at least three monitoring stations for each coastal water body. For determining the ecological status class, the median values of each parameter, recorded during the entire monitoring period in all monitoring stations or plots of the coastal water body concerned, are compared with the type-specific values of quality elements. The status class is determined by the quality element with the lowest value.

Stretches of coastal water (or water bodies) of water management importance for the purposes of this Management Plan were identified mainly on the basis of differences in influencing factors. The proposal is to distinguish only one waterbody for the entire type of Narva Bay (type III) (Figure 8). Also the entire type of western part of the Gulf of Finland could be identified as one water body.

This report gives a brief overview of the ecological status of coastal sea of the Viru river basin sub-district on the basis of data gathered in 2001–2003 under the coastal seamonitoring programme. It has to be noted that the requirements of the WFD are not fully incorporated into the current monitoring programme yet and the conclusions are therefore often statistically unreliable. Pelagic parameters (nitrogen and phosphorus content, Secchi depth and chlorophyll *a* content) have been measured in summer months with a sufficient frequency in the vicinity of Narva-Jõesuu (station N8) and near Sillamäe (station 38), and only once (in 2001) near Saka (station 15), near Purtse (station 12c) and near Kunda (station G). Zoobenthos data exist for all of the above stations and for all three years. Phytobenthos data exist only for Eru Bay [4].

According to the content of chlorophyll *a* in phytoplankton, coastal water in the vicinity of Narva-Jõesuu and Sillamäe belonged to the good ecological status class in all three years – median values were 5.6 µg/l in 2001, 5.8 µg/l in 2002 and 6.1 µg/l in 2003. According to Secchi depth, the above coastal areas belonged to the moderate status class in 2001 (Secchi depth 2.2 m) and stayed on the border between good and moderate class in 2002 and 2003 (3.0 m). For the remaining coastal waters of the Viru river basin sub-district there are no data on chlorophyll *a* content and Secchi depth from the last three years.

According to nitrogen content, the results for the coastal water areas of Narva-Jõesuu and Sillamäe were as follows: in 2001 – good ecological status (26.7 µmol/l and 24.2 µmol/l) and in 2002 – moderate ecological status (31.9 µmol/l and 30.2 µmol/l). The coastal waters near Saka, Purtse and Kunda were classified into the good status class according to their nitrogen content in 2001 (median concentration 22,6 µmol/l). According to phosphorus content, the coastal waters of Narva-Jõesuu and Sillamäe belonged to the good ecological status class in 2001 (0.76 µmol/l and 0.66 µmol/l) and also in 2002 (0.69 µmol/l and 0.85 µmol/l) and the coastal waters near Saka, Purtse and Kunda belonged to the good status class in 2001 (median concentration 0.70 µmol/l).

A provisional assessment of water quality based on zoobenthos made by summarising the data of three years for each station and finding the average biomass of *Macoma balthica*. Based on such analysis, the sea areas in the vicinity of monitoring stations would belong to the following ecological status classes: near Narva-Jõesuu – moderate (63 g/m^2), near Sillamäe – good (21 g/m^2), near Saka – moderate (70 g/m^2) and near Purtse – high (19 g/m^2). The latter result needs to be supported by other measurements because the low biomass may be connected with oxygen deficit or some other type of pollution. The median value for the stations of Narva-Jõesuu and Sillamäe together is 52 g/m^2, which still refers to moderate ecological status class. Summary data for the entire region yield the median value of 37 g/m^2, which falls within the limits of good status class. According to phytobenthos monitoring data from Eru Bay, this region with its 12-metre maximum distribution depth of phytobenthos falls on the borderline between the good and high ecological status classes (in the case of the coastal water type of the western part of the Gulf of Finland).

According to the Guidance Document on Typology, Reference Conditions and Classification Systems for Transitional and Coastal waters [34] the ecological status of coastal waters of the Viru area should be assessed as moderate, as the Guidance Document requires that the status class be determined by the poorest quality element. The status of the areas of Narva-Jõesuu and Sillamäe was assessed as moderate according to transparency data from 2001, nitrogen data from 2002 and data on the biomass of zoobenthos from 2001–2003. Data for drawing conclusions for the remaining sea areas are inadequate. Moderate ecological status in those areas cannot be excluded, considering e.g. the high biomass of zoobenthos at the Saka monitoring station. It would be expedient to carry out additional surveys in sea areas adjacent to sources of pollution load in order to prepare the maps characterising the ecological status of coastal sea as required for the implementation of the WFD. According to a preliminary proposal, the ecological status across the entire coastal water type of Narva Bay can be classified as being between good and moderate and that of the water body to the west of Cape Vainupea could be classified as good.

The status of rivers and lakes has been assessed using a somewhat less stringent approach, which would allow the ecological status of the entire coastal water to be assessed as good. The final assessment will probably depend on the outcome of work of the international working group for assessment of the status of the Baltic Sea and Gulf of Finland. The ecological status of the Viru coastal sea currently depends mainly on the status of the open part of the Gulf of Finland, not the pollution load from the territory of Estonia. If the status of the Gulf of Finland as a whole is assessed as moderate, it would be logical to place also the coastal sea of the Viru area in the same class. At the same time, Estonia has no realistic possibilities for improving the status of coastal sea through water management plans. Thus, the environmental objectives to be established for the coastal sea should be initially less stringent either in terms of time limits (Article 4.4 of WFD) or quality requirements (Article 4.5) and they should be regarded as already achieved for the coastal sea of the Viru area. Consequently, there is no need for planning any measures to supplement those required by the directives listed in Annex VI of the WFD (Urban Wastewater Directive, Plant Protection Products Directive, Nitrates Directive, Major Accidents Directive, etc.).

4.8 Public beaches and non-designated bathing sites

4.8.1 Compliance with bathing water quality with health protection requirements

4.8.1.1 Public beaches

According to the data of the Health Protection Inspectorate, there were 23 designated beaches under their supervision in Estonia as of 25 August 2004 (Annus, 2004) (see Table 31), with 12 of them falling within the Viru and Peipsi river basin sub-districts. The division of the beaches between counties, the names and locations of beaches and the number of samples taken for water quality analysis are presented in Table 31 [5].

All beaches checked by the Health Protection Inspectorate in 2004 and complied with the health protection requirements for bathing waters (Annus, 2004).

Water quality has been checked in 2003–2004 on 10 beaches at the total of 99 times. No samples have been taken from the beaches of Narva Joaoru and Kauksi. Also at other beaches has sampling frequency been lower than envisaged by health protection requirements – once prior to the bathing season and at a two-week interval during the bathing season (15 May to 15 September), which makes 8–10 samples per season. The required sampling frequency was pursued only at the beach of Narva-Jõesuu during the bathing season of 2003.

The water of all of the checked beaches met the effective health protection requirements as to the microbiological parameters. The highest contents of coliform bacteria (between 1000 and 2000 bacteria per 100 ml of water) were measured in the summer of 2003 at the beaches of Emajõgi River in Tartu, Lake Väinjärv and Lake Tamula. All of the above values are still significantly lower than the limit values (10 000 bacteria/100 ml).

Table 31 Designated public beaches in Viru and Peipsi river basin sub-districts

County	Water body	Location of beach	Water samples taken	
			2003	2004
Ida-Viru	Gulf of Finland	Narva-Jõesuu	18	4
	Narva River	Joaoru in Narva	0	0
	Lake Peipsi	Kauksi	0	0
Lääne-Viru	Gulf of Finland	Võsu	2	4
Järva	Lake Väinjärv	Koeru Municipality	20	0
Jõgeva	Lake Kuremaa	Kuremaa	8	7
Tartu	Emajõgi River	Linnaujula in Tartu (Supilinn district)	4	4
	Emajõgi River	Vabaujula in Tartu (Kvissental district)	4	4
	Anne Canal	Tartu town	4	4
	Lake Verevi	Elva town	4	4
Põlva	Põlva Artificial Lake	Põlva town	5	3
Võru	Lake Tamula	Võru town	3	4
	Lake Kubija	Võru town	3	4

The water of all beaches met the requirements also by the organoleptic properties. The water displayed no unusual changes in colour there were no blotches of oil, no specific smell of phenols, nor any persistent foam. Water surface was clean. In the Põlva Reservoir and at the beaches of Tartu on the Emajõgi River, the natural colour of water was 70 and even more degrees. Transparency of water at the beach of Narva-Jõesuu in summer 2004 still remained below 30 cm, which may have been due to unfavourable weather conditions at the time of sampling. In such cases deviations are permitted.

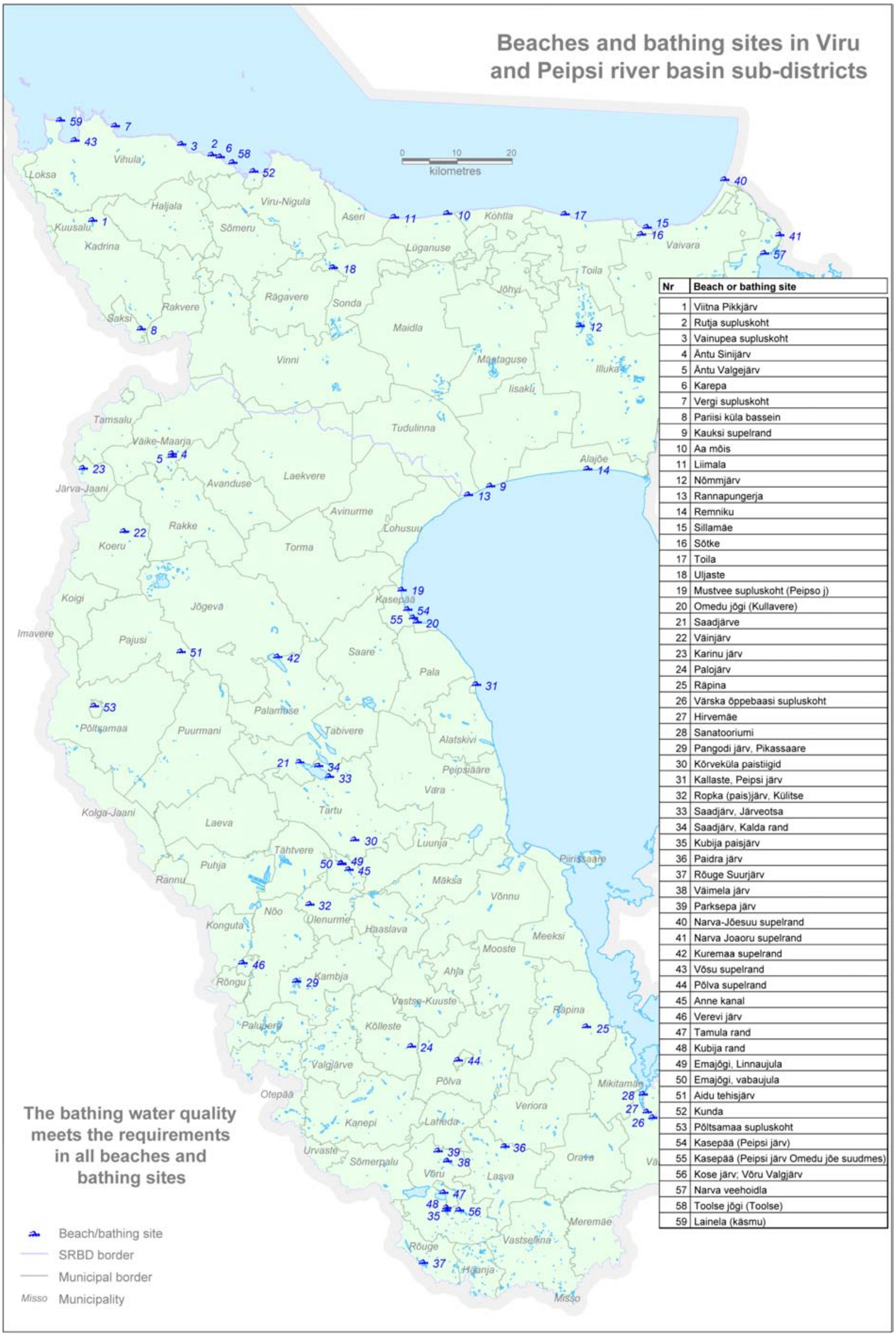
The pH of water was within the permitted limits at all beaches. Oxygen saturation in water fell down to 56% in the summer of 2004 at the beaches of Emajõgi in Tartu, which is lower than the permitted limit (80%). Yet pollution parameters were not determined there. Chemical pollution parameters (ammonium ions, BOD_7) have been determined only in the water of Narva Jõesuu beach, where they have never exceeded the permitted limit values.

4.8.1.2 Non-designated bathing sites

According to the data of the Health Protection Inspectorate, there were the total of 124 non-designated bathing sites under their supervision in Estonia as of 25 August 2004 (Annus, 2004), with 47 of them located in the Viru and Peipsi river basin sub-districts (Figure 26). The division of bathing sites between counties, the names and locations and the number of water samples taken are persented in Table 32.

Table 32 Non-designated bathing sites in Viru and Peipsi river basin sub-districts [5]

County	Water body	Location of bathing sites	Water samples taken	
			2003	2004
Ida-Viru	Gulf of Finland	Aa Manor	11	2
	Gulf of Finland	Liimala	2	2
	Gulf of Finland	Toila	4	2
	Gulf of Finland	Sillamäe	5	2
	Narva Reservoir	Narva city	7	2
	Lake Nõmmjärv	Illuka-Edivere	2	2
	Lake Peipsi	Rannapungerja	7	2
	Lake Peipsi	Remniku	2	2
	Sõtke River	Sillamäe	2	2
	Lake Uljaste	Uljaste-Sonda	2	2
Lääne-Viru	Gulf of Finland	Karepa	0	0
	Gulf of Finland	Kunda	0	0
	Gulf of Finland	Lainela (Käsmu)	0	0
	Gulf of Finland	Rutja	0	0
	Gulf of Finland	Toolse	0	0
	Gulf of Finland	Vainupea	0	0
	Gulf of Finland	Vergi	0	1
	Pool of Pariisi Village	Pariisi	0	0
	Lake Viitna Pikkjärv	Viitna	0	0
	Lake Antu Sinijärv	Ebavere	0	0
	Lake Äntu Valgejärv	Ebavere	0	0
Järva	Järva-Jaani Artificial Lake	Järva-Jaani	3	2
	Lake Karinu	Karinu	0	3
	Lake Väinjärv	Ervita, Koeru munic.	0	2
Jõgeva	Aidu Artificial Lake	Aidu	4	2
	Omedu River	Omedu	0	1
	Lake Peipsi	Kasepää	0	1
	Lake Peipsi	Mustvee	4	2
	Põltsamaa River	Põltsamaa town	4	2
	Lake Saadjärv	Tabivere	4	2
Tartu	Kõrveküla Ponds	Kõrveküla	0	1
	Lake Pangodi	Pikassaare	2	2
	Lake Peipsi	Kallaste	2	2
	Lake Ropka	Külitse	2	2
	Lake Saadjärv	Järveotsa Beach	2	2
	Lake Saadjärv	Kalda Beach	2	2
Põlva	Lake Palojärv	Kõlleste munic.	3	2
	Võhandu River	Räpina	3	2
	Värska Bay	Hirvemäe	3	2
	Värska Bay	Sanatooriumi Beach	3	2
	Lake Värska	Study base of TU	3	2
Võru	Lake Kose	Kose village	1	2
	Kubija Reservoir	Võru town	1	2
	Lake Lõõdla	Lõõdla	1	2
	Lake Paidra	Paidra	1	2
	Lake Parksepa	Parksepa	1	2
	Lake Väimela	Väimela	1	2



Nr	Beach or bathing site
1	Viitna Pikkjärv
2	Rutja supluskoht
3	Vainupea supluskoht
4	Äntu Sinijärv
5	Äntu Valgejärv
6	Karepa
7	Vergi supluskoht
8	Pariisi küla bassein
9	Kauksi supelrand
10	Aa mõis
11	Liimala
12	Nõmmjärv
13	Rannapungerja
14	Remniku
15	Sillamäe
16	Sõtke
17	Toila
18	Uljaste
19	Mustvee supluskoht (Peipso j)
20	Omedu jõgi (Kullavere)
21	Saadjärve
22	Väinjärv
23	Karinu järv
24	Palojärv
25	Räpina
26	Värska õppebaasi supluskoht
27	Hirvemäe
28	Sanatooriumi
29	Pangodi järv, Pikassaare
30	Kõrveküla paistiigid
31	Kallaste, Peipsi järv
32	Ropka (pais)järv, Külitse
33	Saadjärv, Järveotsa
34	Saadjärv, Kalda rand
35	Kubija paisjärv
36	Paidra järv
37	Rõuge Suurjärv
38	Väimela järv
39	Parksepa järv
40	Narva-Jõesuu supelrand
41	Narva Joaoru supelrand
42	Kuremaa supelrand
43	Võsu supelrand
44	Põlva supelrand
45	Anne kanal
46	Verevi järv
47	Tamula rand
48	Kubija rand
49	Emajõgi, Linnaujula
50	Emajõgi, vabaujula
51	Aidu tehisjärv
52	Kunda
53	Põltsamaa supluskoht
54	Kasepää (Peipsi järv)
55	Kasepää (Peipsi järv Omedu jõe suudmes)
56	Kose järv; Võru Valgjärv
57	Narva veehoidla
58	Toolse jõgi (Toolse)
59	Lainela (käsmu)

Figure 26 Beaches and non-designated bathing sites in Viru and Peipsi river basin sub-districts

In reality there are certainly more non-designated bathing sites in the region. No health protection or maintenance requirements have been established for such bathing waters (except the requirements for water quality). Thus, there is no supervision over their status and the relevant data are absent.

According to the data of the Health Protection Inspectorate supplied with the dates of sampling, bathing water quality meets the requirements in all of the 47 bathing sites presented in the above table (Annus, 2004). For this project, water quality data were available only for 37 bathing sites – the results of 165 samples in total. Sampling frequency was inadequate in all locations, except the bathing sites of Aa Manor during the season of 2003.

All samples met the requirements by their microbiological parameters, except the one taken in Mustvee on Lake Peipsi on 21 July 2003, where the number of faecal streptococci was higher than 150 100 ml/s (limit value 100). At the same time, the content of coliform bacteria and faecal coliform bacteria was very low in the same sample (80 and 16, respectively). High contents of coliform bacteria were found in the bathing sites of Sillamäe and Aa Manor in July 2003 (9000 and 3000, respectively) but remained still lower than the permitted limit.

Water in the bathing sites was usually transparent (mostly over 30 cm) or slightly turbid (Lake Peipsi at Remniku, Sõtke River at Sillamäe, Lake Uljaste). No unusual changes in colour were observed. The natural colour was higher at the Räpina bathing site on Võhandu River and at the bathing sites of Värska Bay, and lakes Ropka, Parksepa and Väimela, where it often exceeded 70 degrees. Blotches of mineral oil, persistent foam and specific smell absent, water surface clean. Blotches of oil occurred only once (21.07.2003) at the Mustvee bathing site on Lake Peipsi, of which the local government was notified. The same sample contained also excessive quantities of faecal streptococci. Percent saturation of dissolved oxygen was somewhat lower than the limit value in the bathing sites of Remniku (69–77% in July 2003), Värska Bay (50% on 12 August 2004) and Lake Ropka (59%).

In summary of the above, water in the bathing sites under the supervision of the Health Protection Inspectorate was of high quality, meeting the health protection requirements in respect to microbiological, organoleptic and physico-chemical parameters. At the same time, the frequency of water quality monitoring (sampling) was much lower than required and by far not all frequently visited bathing sites were monitored.

4.8.2 Conclusions and proposals

The furnishing, status, maintenance and water quality of bathing waters in Estonia is regulated by Regulation No. 247 of 25 July 2000 of the Government of the Republic *Health protection requirements for beaches and bathing water*, which is in full conformity with the EU Bathing Water Directive (76/160/EEC). In addition to water quality, the Estonian legislation regulates also the planning, furnishing and maintenance of beaches and the obligations of owners or operators of beaches related to monitoring of water quality and notification of visitors.

Water quality at beaches and bathing sites under the supervision of the Health Protection Inspectorate met the health protection requirements in 2003–2004 in respect to all parameters. Water monitoring at beaches is the responsibility of the owner or operator of the beach, in non-designated bathing sites – of the Health Protection Inspectorate. Frequency of water quality monitoring at beaches and bathing sites was considerably lower than required: the actual sampling frequency was only 2–4 times per season in most cases, while the frequency of 16–18 samples per season is required.

Strict requirements have been established for the furnishing and maintenance of beaches, imposing a number of obligations on the operators and requiring great expenditures. This has led to a situation where only a few official beaches exist and there is no willingness to open new ones. The existing beaches are being turned into non-designated bathing sites so as to avoid the obligations. Therefore, beaches are absent e.g. in the towns of Sillamäe, Kallaste, Mustvee, Põltsamaa, Räpina, a.o., but also on popular bathing water bodies such as Lake Saadjärv at Järveotsa, Lake Lõõdla, etc.

Only a small part of bathing sites are being inspected by health protection services, while there are many more popular and frequently visited bathing sites. The bigger ones among them should be subjected to supervision.

No requirements other than quality and control requirements for bathing water have been established for bathing sites. Therefore there is nobody taking care of the furnishing and maintenance of the sites. It would be expedient to establish certain general requirements (much less stringent than those for official beaches) also for bathing sites so as to ensure their basic maintenance (access to changing cabins, presence of toilet, etc.). It is recommendable to cooperate more closely with the State Forest Management Centre, who has established numerous pleasantly maintained rest areas in naturally beautiful places.

4.9 Assessment of groundwater status

All of the groundwater bodies falling within the Viru and Peipsi river basin sub-districts, except the Ordovician groundwater body of Ida-Viru oil shale basin, are in a good qualitative and quantitative status. Achievement of a good status of the Ordovician groundwater body of Ida-Viru oil shale basin will not be possible within the next few decades.

All groundwater bodies, except the Ordovician-Cambrian groundwater body and Silurian-Ordovician groundwater body beneath Devonian aquifers belong to the so-called risk group. This means that regardless of a good status of the groundwater bodies there exist pressures which may affect their good status in future (see Table 33).

Table 33 Status classes of groundwater bodies

No.	Name of groundwater body	Good status is at risk	Status assessment		
			By physico-chemical quality elements	By quantitative parameters	TOTAL
1	Cambrian-Vendian Gdovi groundwater body	YES	GOOD	GOOD	GOOD
2	Cambrian-Vendian Voronka groundwater body	YES	GOOD	GOOD	GOOD
4	Ordovician-Cambrian groundwater body	NO	GOOD	GOOD	GOOD
5	Ordovician Ida-Viru groundwater body	YES	GOOD	GOOD	GOOD
6	Ordovician groundwater body of Ida-Viru oil shale basin	Good status not achievable	BAD	BAD	BAD
8.2	Silurian-Ordovician groundwater body beneath Devonian layers	NO	GOOD	GOOD	GOOD
9.2	East Estonian area of Silurian-Ordovician aggregated groundwater body	YES	GOOD	GOOD	GOOD
10	Middle Lower Devonian groundwater body	YES	GOOD	GOOD	GOOD
11	Middle Devonian groundwater body	YES	GOOD	GOOD	GOOD
12	Upper Devonian groundwater body	YES	GOOD	GOOD	GOOD
13	Quaternary Vasavere groundwater body	YES	GOOD	GOOD	GOOD
14	Quaternary Meltsiveski groundwater body	YES	GOOD	GOOD	GOOD
15	Quaternary aggregated groundwater body	YES	GOOD	GOOD	GOOD
15.3	Võru area of Quaternary aggregated groundwater body	YES	GOOD	GOOD	GOOD

No.	Name of groundwater body	Good status is at risk	Status assessment		
			By physico-chemical quality elements	By quantitative parameters	TOTAL
15.4	Piigaste-Kanepi area of Quaternary aggregated groundwater body	YES	GOOD	GOOD	GOOD
15.6	Elva area of Quaternary aggregated groundwater body	YES	GOOD	GOOD	GOOD
15.7	Saadjärve area of Quaternary aggregated groundwater body	YES	GOOD	GOOD	GOOD
15.8	Laiuse area of Quaternary aggregated groundwater body	YES	GOOD	GOOD	GOOD
15.9	Sadala area of Quaternary aggregated groundwater body	YES	GOOD	GOOD	GOOD

4.10 Drinking water supply

Water resources for the development of drinking water supply are mostly secured. The prospects of use of Cm-V aquifers with a high content of radionucleides in Kunda, Rakvere, Kohtla-Järve and Jõhvi are still to be clarified. The situation is the most complicated in Kunda, where it is difficult to find a new source of water.

Problems occur also with the selection of a source of water for the industrial region of Kohtla-Järve. It is unclear as yet to what extent the use of Q resources of the Vasavere area can be increased in future without compromising the objectives of the landscape conservation area and Natura area. To solve the problem, resources have been planned for the relevant research and groundwater protection. The measures supported also by the programme of protection measures for the Kurtna Lakes.

In the remaining water supply regions, renovation of public water supply systems has to be preceded by a survey of groundwater intakes and, where necessary, also groundwater quality, to identify an optimal source of water and the need for purification of raw water. A perfunctory decision in favour of complex treatment of water may entail high fixed costs as compared to the non-recurring costs of finding and commissioning a better source of water (e.g. groundwater resource of a near-surface aquifer).

4.10.1 Problems of water supply

This chapter deals mostly with urban regions with over 500 inhabitants [20]. The following general recurring problems are not described below:

- poor condition of water pipelines due to their age, building quality and siltation due to overly large cross section;
- poor condition of valves;
- excessive iron content;
- old and overly big pressure tanks.

In addition to problems related to public water supply systems in bigger settlements, there exist smaller areas with contaminated groundwater where neither public water supply nor deeper bore wells with high quality water have been constructed to date. Rural households using dug wells experience periodical drying up of wells during dry periods.

4.10.1.1 Ida-Viru County

The urban regions of Ida-Viru County are relatively well covered with public water supply service (roughly 70–90%). In the towns of Narva, Jõhvi, Kohtla-Järve (Järve and Ahtme districts), Sillamäe a.o., water supply service is available to even 95–100% of consumers [20].

More extensive renovation of pipelines started in late 1990ies and by now the situation has partly improved (in Narva, Kohtla-Järve) but a lot of work is still to be done to ensure a good technical condition of water pipelines.

Pumping stations have been periodically maintained and renovated by water companies with their own resources. Most of the pumps of soviet origin have been replaced by now and automatic control devices have been partly modernized.

Surface water is used as municipal water only in Narva City, yet over a third of the population of the entire county lives there. The **Narva** Water Purification Plant ensures microbiological compliance and health safety of water but compliance of water quality in terms of organoleptic parameters – colour, turbidity, odour and taste – is not ensured. Construction of a new water purification plant is planned for the near future.

In public water supply systems using groundwater as a source of drinking water, the main water quality problems are related to an excessive content of total iron across the entire country. Due to these problems, **instalment of iron removal equipment is envisaged for practically all of the public water supply water intakes where they are missing as yet.** According to representatives of the municipal government of Iisaku and the Public Water Supply and Sewerage Development Plan for Iisaku (Projektikeskus Ltd.), problems with excessive concentrations of total iron in drinking water are absent only in the villages of Iisaku and Sonda, Introduction of water purification is therefore not planned for these villages. Groundwater quality meets the standards for total iron also in the water intakes of Sillamäe but water purification is still envisaged there due to the length of raw water pipelines and feeding pipelines to ensure long-term preservation of water quality.

Water of the Quaternary water complex of Vasavere buried valley will be treated in the water treatment plant to be constructed in Ahtme. In addition to total iron, also the mangane content has to be determined there. Compared to total iron, removal of mangane requires considerably bigger quantities of oxygen for achieving compliance with standards, which has to be taken into account when designing the water treatment facilities.

Iron removal equipment has been commissioned to date in the public water supply systems of Kiviõli (under the 17 municipalities project), Voka and Aseri.

Due to the properties of the Cambrian-Vendian Gdov aquifer in this region, **chloride content in groundwater exceeds the limit for drinking water in the water intakes of Jõhvi Town and Ahtme district of Kohtla-Järve**. Therefore the water in the water supply systems of both towns is diluted with groundwater from the Quaternary Vasavere intake established in the above mentioned buried valley and such dilution is required also in future.

Problems occur with **raised content of radionucleides in Cambrian-Vendian (Cm-V) groundwater** in North Estonia. Effective doses exceeding the established indicator value (0.1 mS/yr) more than twofold have been measured in 3 cases in Ida-Viru County.

Approximately 90% of consumers of the public water supply system of Ida-Viru County are supplied with drinking water that does not meet the requirements but is mostly safe to human health.

4.10.1.2 Lääne-Viru County

65–90% of the population is covered with public water supply. The only settlement with 100% coverage is Väike-Maarja. Access to public water supply service is somewhat better in towns – Rakvere, Kunda, Tamsalu – than in the urban regions of smaller municipalities.

A big part of water supply pipelines in Rakvere Town have been expanded and renovated. In the service area of Rakvere Water Company in Rakvere Town, the share of unsold water in the total quantity of water supplied to the network has been reduced from 40% to 13% between 1999 and 2004, which is a very good rate.

Most of the deepwell and booster pumps of soviet origin replaced by now in the above urban regions and part of the automatic control devices modernized.

At the same time, households not connected to water supply systems are still supplied with water by truck because of the excessive nitrate content in practically all of the private wells in town. Approximately 3500 inhabitants of Rakvere were not connected to municipal water supply as of 1 January 2005.

Cases of illness and epidemic due to poor-quality drinking water have occurred in earlier years in Tamsalu and Väike-Maarja. Today there is no direct threat from drinking water to the health of the inhabitants of these settlements.

Effective doses more than twofold exceeding the established indicator value have been measured in Rakvere on three occasions. In Kunda, exceedances of 4–10(!) times have been measured in 3 samples.

As of today, iron removal equipment has been installed only in Rakvere and in the intake supplying water for most of Kunda Town.

The only known exceedance of standards for fluoride content in the Lääne-Viru County has been measured in tap water of Lasila Basic School in Rakvere Municipality.

4.10.1.3 Jõgeva County

The degree of provision with public water supply service ranges from 50% to 95% but the latter concerns only the county centre Jõgeva, while coverage of the service is considerably lower in other towns of the county having a municipal water supply system – in Põltsamaa and Mustvee, being 70% and 55% there, respectively. Coverage of the service in most of the urban regions with public water supply systems is between 50% and 70%.

Water supply pipelines have been reconstructed more extensively in Jõgeva compared to elsewhere in the county.

Water supply pumping stations are in a considerably better condition than pipelines. Most of the soviet-origin deepwell and booster pumps in the above settlements have been replaced by now, many pumping station buildings have been renovated and automatic control devices modernized.

Of bigger water supply systems, **excessive contents of ammonium,** probably of anthropogenic origin, have been measured in samples from Õunaaia bore well of Adavere (once also from the water supply network of Adavere), and in the water of Pargi bore well of Torma Town. Excessive ammonium contents, caused by agricultural activity in the case of low (up to 60 m) bore wells, have occurred also in smaller villages of Põltsamaa and Torma Municipalities – Kamari, Söödi, a.o. An excessive **coli-index** has been measured in single samples from Kruusa bore well of Jõgeva Town and Neanurme farm’s bore well in Põltsamaa Municipality. Instalment of a chlorator is envisaged for Kruusa bore well’s pumping station upon request of the representatives of Jõgeva Water Company but the well will be left in reserve.

Due to pollution with nitrogen compounds in Õunaaia bore well of Adavere, it is recommended in the Public Water Supply and Sewerage Development Plan of Põltsamaa Municipality (Maves Ltd., 2004) that a new bore well be constructed and the required sanitary protection zone ensured around the bore well (Maves Ltd. 2004).

Problems occur with **excessive fluoride content** in Jõgeva County. Among the urban regions studied under this project, excessive fluoride contents occurred in the service area of the bore wells of Võisiku care home and Torma residential area (1.9 and 2.18 mg/l, respectively; A. Saava, E. Indermitte, 2005). Excessive fluoride content constitutes a problem also in Lustivere, in Tuuliku bore well of Adavere and in tap water of Voore Basic School. The total number of consumers of drinking water with excessive fluoride content amounts to app. **1350 people.**

As one of the solutions to the fluoride problems, the water supply and sewerage development plans of both municipalities envisage the **boring of new, shallower bore wells,** since instalment and exploitation of fluoride removal devices is overly expensive for smaller water companies.

Iron removal equipment is missing in all towns of the county – Jõgeva, Põltsamaa and Mustvee. According to a representative of the water company of Põltsamaa, Melior Ltd., there are no problems with iron in bored wells nor in network water in Põltsamaa. The consultant therefore did not envisage water purification for Põltsamaa.

As of today, iron removal equipment has been installed in Tabivere Village and Jõgeva Town.

4.10.1.4 Tartu County

Over 90% the population of **Tartu** City is provided with public water supply. Water quality in the supply network meets the established requirements.

In **Elva** Town, approximately 40% of the households are connected to public water supply network. The quality of pumped-out and treated bore well water meets the requirements, except for the content of total iron, which amounts to 0.3–0.4 mg/l. However, in most cases the water directed to municipal supply network from the treatment plant contained no more than 0.05 mg/l of iron as a result of treatment.

Raised **fluoride content** constitutes a problem in places (in Ülenurme, Tõrvandi, Laeva, Ulila, Uula, Kärkna, Lähte, Kambja). Many settlements lack water treatment facilities.

4.10.1.5 Põlva County

Urban regions have a satisfactory coverage of public water supply service (50–90%).

Iron removal equipment exists in the new water treatment plat of Põlva Town, which was constructed in the framework of the 17 municipalities project. Fully automatic iron removal filters have been installed in bore well pumping stations of several settlements.

Excessive content of fluoride, which is rather widespread in Estonia and regarded as a threat to human health, has not been observed in the public water supply systems of Põlva County. Raised fluoride contents occur in the water of deep mineral water wells of Cm-V aquifer.

4.10.1.6 Võru County

Public water supply service is provided to 75% of the population of Võru Town and 60–80% of the population of smaller settlements of Võru and Vastseliina Municipalities.

The water treatment plants and water tower of Võru need renovation.

The water supply system of Vastseliina Village was reconstructed in 1998. Nearly 50% of the network consists of plastic pipelines, while the remaining 50% need further renovation.

Fully automatic iron removal filters have been installed in Väimela and Vastseliina.

4.11 Assessment of compliance

Drinking water supply. Health protection authorities exercise state supervision only over larger public water supply systems (mostly with over 100 consumers). Information on water quality in smaller water supply systems and private wells is sporadic.

Approximately 2000 people (mostly in the Peipsi river basin sub-district) still use water with an excessive fluorine content.

Water supply of individual consumers in areas with contaminated groundwater has not been resolved (an overview of the number of consumers of unsafe water among individual consumers is missing).

Water with an excessive radionucleide content is used in the towns of North Estonia.

Water of nearly a half of water consumers does not meet the water quality requirements.

There exists no overview as to how many people in low-density areas still suffer from the lack of water due to the drying up of dug wells (mostly in the Peipsi river basin district) or lower bore wells (mostly in the Viru sub-district by action of mines) in dry periods.

Treatment facilities. Of the 329 wastewater outlets in the region, 186 did not meet the requirements for discharge of wastewater in 2002/3 [7]. Wastewater treatment facilities of farms have mostly abandoned, wastewater is directed to manure storage, transported to fields or discharged directly into the environment.

Livestock farming. Manure management is extremely underdeveloped. The existence and status of manure storages has not been inventoried. According to the database of the Agricultural Registers and Information Board (PRIA), less than 20% of manure storages are in a good status (as of 2004). Farms that lack a manure storage with a sufficient capacity haul their liquid and semi-liquid manure to field storages. Wet silage storages do not meet the environmental requirements in most cases.

Use of manure as fertilizer. Part of agricultural enterprises leave most of their manure (up to 90%) unspread. Manure is still spread at unsuitable times and often not ploughed into the ground as required. In places manure is hauled to non-harvested lands for the removal purposes. The necessary spreading equipment is missing. Liquid manure application schemes are either absent or primitive and do not reflect water protection requirements.

Dangerous substances and past pollution. Uncontrolled emissions of dangerous substances into surface and groundwater occur in the surroundings of past contaminated sites of national importance associated with oil shale power industry and shale oil industries and a danger of uncontrolled emissions occurs in the surroundings of all non-remedied past contaminated sites.

There is no regular **supervision** over the compliance of objects posing an environmental risk (incl. fuel storage facilities, manure and silage storages) with environmental requirements and over the handling and transport of dangerous substances. This poses a high risk of accidental pollution of groundwater (incl. water intakes using near-surface aquifers).

Groundwater. The groundwater bodies in the Peipsi river basin sub-district are mostly in a good status. Near-surface aquifers are at risk of contamination in high-density areas and in areas of intensive agricultural production. Groundwater is polluted in limited areas (no larger than 10 ha) around past contaminated sites. Contamination of near-surface aquifer with nitrate ions is proven for fields in the surroundings of Adavere–Esku. In fields with vulnerable groundwater, groundwater is at risk of contamination with plant protection products and also the relevant monitoring is insufficient.

In the Viru river basin sub-district, the Ordovician groundwater body of Ida-Viru oil shale basin (1168 km^2) is in a poor status and the bad-status area may be expanded with the expansion of mined territories. In the surroundings of pastcontaminated sites this groundwater body is contaminated with dangerous substances, which have spread over a broad area through oil shale mines. Changes in groundwater table of the Ordovician groundwater body of Ida-Viru oil shale basin may pose a risk to surface water bodies located above or in the immediate vicinity of the groundwater body and to groundwater-dependent ecosystems.

Changes in the groundwater table of Quaternary Vasavere groundwater body pose a risk to Natura lakes (Lake Martiska and Lake Kuradi and, in case the water intake is expanded, also Lake Liivjärv).

Surface water sources of drinking water. In the entire Viru-Peipsi catchment area, the only surface water body used as a source of drinking water is the Narva River, from where the city of Narva abstracts its drinking water upstream of Narva Reservoir. Water quality of the Narva River at Vasknarva measuring section (outflow from Lake Peipsi) meets the quality requirements for drinking water source of class I.

Bathing waters. The Health Protection Inspectorate exercises supervision over 12 public beaches in the Viru and Peipsi river basin sub-districts, with three of the beaches located on watercourses (Joaoru in Narva and two beaches on the Emajõgi River in Tartu). All beaches had been checked by the Health Protection Inspectorate and the owners in 2004 and met the health protection requirements for public beaches. According to the data of the Health Protection Inspectorate, bathing water quality meets the requirements at all bathing sites. Yet the frequency of monitoring is lower than required in many places and compliance of beaches and other bathing sites with the requirements is therefore not fully confirmed.

Natura rivers. The total of 37 Natura areas on 37 watercourses in the Peipsi river basin sub-district and 14 areas on 13 watercourses have been provisionally proposed as Natura areas. The following fish species of Estonian watercourses are species requiring protection according to Annex II of the Habitats Directive: river lamprey, brook lamprey, asp, spined loach, loach, bullhead. In addition to fish species, the following invertebrate species are listed in Annex II: freshwater pearl mussel, thickshelled river mussel and green club-tail (dragonfly whose larvae live in flowing waters). Also one semi-aquatic mammal occurring in the region – otter – is listed in Annex II (a derogation has been granted to Estonia for beaver). As all of the areas are newly selected, they should be in conformity with the objectives of their selection. A more detailed analysis is missing yet and conflicts between economic development and conservation objectives are likely to arise.

Watercourses protected as salmonid and cyprinid habitats. The ecological status of the following rivers protected as salmonid and cyprinid habitats does not conform with the requirements: Ahja, Kunda, Loobu, Piusa, Põltsamaa, Pühajõgi, Seljajõgi and Võhandu. Water quality constitutes a problem for fish only in the polluted (poor status) Selja River and Pühajõgi River. In other cases the reasons for non-conformity are dams blocking the migration of fish. The Purtse River, a former very good salmon river, is no longer regarded as salmon river due to long-term contamination with shale oil. In addition, a dam without fish bypass was constructed on this river a few years ago.

Conformity of river water quality with the requirements for good ecological status class. In 2002/3 only 13 of the 84 measuring sections of the National Environmental Monitoring Programme and supplementary monitoring programme were in conformity with the requirements for good status class as defined by Regulation No. 33 of 22 June 2001 of the Minister of Environment *Status classes of surface water bodies, values of qualitative parameters corresponding to status classes of surface water bodies and the procedure for determining status classes*. The main problems are high content of total nitrogen and total phosphorus in river water [7]. River water mostly belongs to moderate ecological status class.

The assessments given under this project are presented in Figure 22, Figure 23 and Table 24.

Rivers in a poor chemical status or **polluted rivers** must definitely be regarded as **non-conforming**: Selja River, Pühajõgi River, Ilmatsalu River, Purtse River together with Kohtla and Erra Rivers, Soolikaoja Stream, Orajõgi River downstream of Põlva, lower course of Kaave River); among small rivers – Toolse, Rausvere and Kavilda Rivers and Kose, Sanniku and Koreli Streams.

Lakes. Among the small lakes assessed, 9% are in a high, 48% in a good, 39% in a moderate and 4% in a poor ecological status class. High status lakes are Lake Saadjärv (Vooremaa Landscape Conservation Area), Lake Leegu (Emajõe-Suursoo Mire Reserve/Landscape Conservation Area), Lake Viisjaagu (Natura temporary restriction area), Lake Kooraste Kõverjärv (Natura temporary restriction area), Lake Räätsma (Kurtna Landscape Conservation Area) and Lake Rõuge Suurjärv (Haanja Nature Park, Haanja limited management zone).

Poor-status (non-conforming) lakes are Lake Arbi; Lake Tilsi Kõrbjärv; Lake Tilsi Pikkjärv and Lake Väimela Alajärv.

In summary. Conformity with the requirements established by legislation requires great efforts. In some respects the requirements are impracticable and irrelevant.

5 ENVIRONMENTAL OBJECTIVES

Peipsi sub-district will be seen as a many-sided area where populated area and well managed arable- and grassland varies with forests and protected wetlands. Essential point sources are under control, hazardous wastes are liquidated, habitation and reproduction places of aquatic life are under sufficient protection. The best possible methods and technology is used in agriculture. The status of water bodies and groundwater has not deteriorated.
Viru sub-district will be seen as an industrial area with large nature landscape areas. Industrial waste is under control and does not expand any more into surface and groundwater, habitation and reproduction places of aquatic life are under sufficient protection. Artificial waterbodies which result from mining activities develop into attractive water bodies with a good ecological potential, within a longer period groundwater with a natural quality will restore in mining areas. The waterbodies in poor status improve slightly due to the taken measures.

5.1 Treatment of Environmental Objectives in the Context of Water Framework Directive (2000/60/EU)

The general objective of the Directive is to achieve a good status of water by the year 2015. It is considered an expression of political willpower that is not accomplished within such a short period of time. Therefore the Member States have to set feasible objectives and deadlines in their water management plan. The Directive gives a possibility to set flexible objectives. The necessity of applying a combined approach is emphasized in the Directive. Setting quality assurance (following environmental standards in surface and groundwater) and maximum waste limits (in larger perspective requirements for environmentally hazardous sites) should be combined. The following points in the preamble of the Directive are:
40) With regard to pollution prevention and control, Community water policy should be based on a combined approach using control of pollution at source through the setting of emission limit values and of environmental quality standards;
41) For water quantity, overall principles should be laid down for control on abstraction and impoundment in order to ensure the environmental sustainability of the affected water systems;
42) Common environmental quality standards and emission limit values for certain groups or families of pollutants should be laid down as minimum requirements in Community legislation. Provisions for the adoption of such standards at Community level should be ensured;

A lot is still to be done to apply this principle of water policy in Estonia.
Currently established environmental legislation does not enable to fix more rigorous environmental requirements concerning environmental quality objectives for the companies (e.g. stricter maximum discharge limit values or limiting wastewater discharging in a polluted river basin).
The following general principles of exceptions are brought out in the preamble:
29) In aiming to achieve the objectives set out in this Directive, and in establishing a programme of measures to that end, Member States may phase implementation of the programme of measures in order to spread the costs of implementation;
30) In order to ensure a full and consistent implementation of this Directive any extensions of timescale should be made on the basis of appropriate, evident and transparent criteria and be justified by the Member States in the River Basin Management Plans;
31) In cases where a body of water is so affected by human activity or its natural condition is such that it may be infeasible or unreasonably expensive to achieve good status, less stringent environmental objectives may be set on the basis of appropriate, evident and transparent criteria,

and all practicable steps should be taken to prevent any further deterioration of the status of waters;
32) There may be grounds for exemptions from the requirement to prevent further deterioration or to achieve good status under specific conditions, if the failure is the result of unforeseen or exceptional circumstances, in particular floods and droughts, or, for reasons of overriding public interest, of new modifications to the physical characteristics of a surface water body or alterations to the level of bodies of groundwater, provided that all practicable steps are taken to mitigate the adverse impact on the status of the body of water.

Environmental objectives concerning programme of measures set by water management plan are the following (according to Article 4 Paragraph 1):

a) Surface water

i) Member States shall implement the necessary measures to prevent deterioration of the status of all bodies of surface water, subject to the application of paragraphs 6 and 7 and without prejudice to paragraph 8;
ii) Member States shall protect, enhance and restore all bodies of surface water, subject to the application of subparagraph (iii) for artificial and heavily modified bodies of water, with the aim of achieving good surface water status at the latest 15 years after the date of entry into force of this Directive, in accordance with the provisions laid down in Annex V, subject to the application of extensions determined in accordance with paragraph 4 and to the application of paragraphs 5, 6 and 7 without prejudice to paragraph 8;
iii) Member States shall protect and enhance all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status at the latest 15 years from the date of entry into force of this Directive, in accordance with the provisions laid down in Annex V, subject to the application of extensions determined in accordance with paragraph 4 and to the application of paragraphs 5, 6 and 7 without prejudice to paragraph 8;

iv) Member States shall implement the necessary measures in accordance with Article 16(1) and 16(8), with the aim of progressively reducing pollution from priority substances and ceasing or phasing out emissions, discharges and losses of priority hazardous substances;

b) Groundwater

i) Member States shall implement the necessary measures to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater, subject to the application of paragraphs 6 and 7 and without prejudice to paragraph 8 of this Article and subject to the application of Article 11(3)(j);
ii) Member States shall protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater, with the aim of achieving good groundwater status at the latest 15 years after the date of entry into force of this Directive, in accordance with the provisions laid down in Annex V, subject to the application of extensions determined in accordance with paragraph 4 and to the application of paragraphs 5, 6 and 7 without prejudice to paragraph 8 of this Article and subject to the application of Article 11(3)(j);
iii) Member States shall implement the necessary measures to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order progressively to reduce pollution of groundwater;

c) Protected areas

Member States shall achieve compliance with any standards and objectives at the latest 15 years after the date of entry into force of this Directive, unless otherwise specified in the Community legislation under which the individual Protected Areas have been established.

Where more than one of the objectives under paragraph 1 relates to a given body of water, the most stringent shall apply.

It has been added in Article 4 Paragraph 4 that deadlines established under paragraph 1 may be extended for the purposes of phased achievement of the objectives for bodies of water, provided that no further deterioration occurs in the status of the affected body of water when all of the following conditions are met:
a) member States determine that all necessary improvements in the status of bodies of water cannot reasonably be achieved within the timescales set out in that paragraph for at least one of the following reasons:

i) the scale of improvements required can only be achieved in phases exceeding the timescale, for reasons of technical feasibility;

ii) completing the improvements within the timescale would be disproportionately xpensive;

iii) natural conditions do not allow timely improvement in the status of the body of water.

b) extension of the deadline, and the reasons for it, are specifically set out and explained in the River Basin Management Plan required under Article 13;

Article 4 paragraph 5: Member States may aim to achieve less stringent environmental objectives than those required under paragraph 1 for specific bodies of water when they are so affected by human activity, as determined in accordance with Article 5(1), or their natural condition is such that the achievement of these objectives would be infeasible or disproportionately expensive, and all the following conditions are met:
a) the environmental and socio-economic needs served by such human activity cannot be achieved by other means, which are a significantly better environmental option not entailing disproportionate costs;
b) Member States ensure,

- for surface water, the highest ecological and chemical status possible is achieved, given impacts that could not reasonably have been avoided due to the nature of the human activity or pollution;
- for groundwater, the least possible changes to good groundwater status, given impacts that could not reasonably have been avoided due to the nature of the human activity or pollution;

c) no further deterioration occurs in the status of the affected body of water;
d) the establishment of less stringent environmental objectives, and the reasons for it, are specifically mentioned in the River Basin Management Plan required under Article 13 and those objectives are reviewed every 6 years.

According to Article 4 Paragraph 3 Member States can consider surface waters as artificial or heavily modified, when:
a) the changes to the hydromorphological characteristics of that body which would be necessary for achieving good ecological status would have significant adverse effects on:

i) the wider environment;

ii) navigation, including port facilities, or recreation;

iii) activities for the purposes of which water is stored, such as drinking water supply, power generation or irrigation;

iv) water regulation, flood protection, land drainage; or

v) other equally important sustainable human development activities.

b) the beneficial objectives served by the artificial or modified characteristics of the water body cannot, for reasons of technical feasibility or disproportionate costs, reasonably be achieved by other means, which are a significantly better environmental option.

Designation of water bodies and its reasons should be brought out in water management plan and renewed after every six years.

The Estonian guidance on water management plans requires in the first water management plans of subdistricts treatment of at least following main environmental objectives:

- Supplying the whole population with drinking water safe for the health, in coordination with the economic potential of the region;
- Sustainable use of groundwater, guaranteeing the protection of the most valuable springs, getting the hazardously polluted groundwater areas under control to improve the situation;
- Achieving or maintaining a good status of surface waters depending on the type and use of the water body; expanding the recreation possibilities and guaranteeing sustainable land use in agriculture and forestry;
- Preservation of aquatic biodiversity;
- The possibilities and limits of use of water bodies are clearly determined and support sustainable development.

5.2 The Objectives of Drinking Water Supply

The whole population should be supplied with drinking water safe for the health. Drinking water should be attainable and should not contain bacteria or overnormative chemical toxical compounds.

The first priority (by the year 2007)lies in water supply of larger settlements (over 2000 people).

Urgent problems should be solved first, i.e.water of the centralised water supplies using drinking water containing hazardous components to the health (more widespread is fluorine, in some intakes also boron) should correspond to the requirements of drinking water.

All inhabitants of the densely populated areas should have the possibility to join centralised water supply .

In farer perspective (by the year 2013) water of centralised water supply (used by more than 50 people) should correspond to all the quality requirements: being visibly clear and with a good taste; corresponding to requirements concerning indicative indices, and technical standards.

In villages and sparsely settled areas water supply should be improved at least to the satisfied level by the year 2014: drinking water supply with drinking water safe for the health should be guaranteed also in areas polluted with hazardous pollutants and households with periodically dry wells.

5.3 Prevention and Control of Pollution

The top priority is to make the essential sources of pollution correspond to the current environmental standards. It is not excluded that in the future environmental requirements could be made stricter in the polluted areas or areas which need specific protection.

The appropriate self-monitoring financed by pollutes shall be guaranteed, which in case of bigger polluters expands also on monitoring of impavted aquatic environment (recipient monitoring, groundwater monitoring in the affected area).

Collection and treatment of wastewater in accordance with requirements
Wastewater systems and purification equipment should be repaired and maintained in larger settlements (more than 2000 people) by the year 2010.
By the year 2014 the following should be done:

- All inhabitantsin densely populated areas should be given a possibility to join the centralized water supply and sewerage system;
- Water and sewerage systems (pipelines, pumping stations, purification systems) which are in the worst status should be taken in accordance with the requirements;
- Wastewater discharged into water bodies and soil shall be treated according to the requirements.

In the areas where the above-mentioned measures are not enough to achieve a good status of water the following should be done:

- Wastewater treatment efficiency in sparsely populated areas shall depend on the status of the environment;
- Additional phosphorus removal from the wastewater (compared to minimal environmental requirements);
- Purification of old sewage lagoons and areas polluted by sludge rich in phosphorus.

Upkeeping livestock farms in accordance with the requirements
To prevent water pollution water protection requirements should be followed in livestock farms:

- Providing manure storages in accordance with the requirements in all livestock farming constructions where more than 10 animal units are kept;
- Spreading all the manure in due time and in accordance with the environmental requirements;
- Preventing silage effluent discharges into water bodies and groundwater;
- Following the requirements concerning wastewater treatment in livestock farms.

Localisation and improvement of safety of past pollution in order to prevent the emissions of hazardous substances into the water

By the year 2007 the danger of leakage of liquid hazardous waste into the environment from the state past pollution sites shall be liquidated.
By the year 2009 the emissions of hazardous substances into the environment from the state past pollution sites should be limited (localisation of pollution).
By the year 2011 remediation of industrial areas and waste heaps in Kohtla-Järve and Kiviõli .
By the year 2011 environmental damages of ash fields of oil shale power plants stations should be reduced.
Remediation of local past pollution sites according of local governments applications.

Limitation of non-point pollution
Non-point pollution should be kept on the level it would not endanger the good status of water or favourable conditions of aquatic life.
A good status of upper groundwater layers, small watercourses and small lakes should be provided in agricultural areas. The use of fertilizers and pesticides should be optimised following the objectives of plant cultivation and water protection.
The increase of polluted groundwater and surface water areas should be prevented in industrial area of NorthEast Estonia.

5.4 Environmental Objectives of Groundwater Protection

The general objective is to preserve a good status of groundwater bodies and the sustainable use of groundwater, including:

- The expansion of groundwater pollution influenced by non-point pollution and point pollution sources shall be prevented;
- The sustainable use of groundwater supplies proceeding from approved groundwater resource shall be ensured;
- The protection of groundwater in groundwater formation area of Pandivere uplands shall be ensured;
- By 2008 the nitrate pollution reduction programme of in nitrate sensitive areas shall be implmented;
- Guarantee the necessary water protection regime in groundwater intakes and formation areas;
- Wastewater directly discharged into groundwater shall be treated according to the requirements.

5.5 Environmental Objectives for Watercourses

Current water management plan proceeds from three main objectives concerning rivers:

- Firstly, despite the prognoses of quick economic growth, including the development of agriculture in the next decade, the deterioration of the status of rivers should be prevented. The most important is preservation of water quality of large rivers whcih are important bathing waters and recreation areas (Narva River, Emajõgi, Põltsmaa and Võhandu rivers), drinking water sources (Narva River) or protected rivers (including Natura rivers). It is important to preserve a good status of valuable reaches of rivers.
- Secondly, to restore a good chemical and ecological status of natural rivers where it is possible by the year 2015. The top priority is placed on bathing rivers again (Võhandu River above Räpina) and protected rivers (including Natura rivers). In the following subchapter these rivers, where a good status will evidently not be achieved in time, are treated separately and therefore derogations should be made.
- Thirdly, to achieve or maintain a good chemical status and ecological potential of artificial or heavily modified water bodies by the year 2015.

The other objectives are:

- To improve the water quality of the Narva River used as a drinking water source;
- To provide a good status of bathing waters;
- To provide a good status of lakes and coastal sea being as recipients of watercourses;
- Flood protection.

5.5.1 Water Bodies that might not achieve a good status

Risk assessment of 299 rive water bodies of Viru-Peipsi region was made and the following was found out:

- Water bodies which will not or probably will not achieve a good status by the year 2015;
- The reasons and indicators why a good status cannot be achieved;
- Water bodies that need additional investigation to give a more exact risk assessment.

The results of the analysis show that from 299 examined natural river water bodies 31 will evidently not achieve a good status by the year 2015.

Concerning the lakes, Lake Pihkva and Lake Peipsi might not achieve a good status (if the requirements for good status will not be mitigated), Also small lakes in poor status and some

lakes in moderate status might not improve (if the environmental requirements are not mitigated). Environmental objectives for water bodies in poor status shall be specified on the basis of detailed research. Specification of environmental objectives is needed in Purtse river, basin which is polluted by hazardous substances (including severely polluted Erra and Kohtla rivers).
Environmental objectives of severely polluted small lakes (like Raadi and Plaki) are undefined.

5.6 Lakes

The first objective is to maintain the status of small lakes, which are already in a good status.
Secondly the status of lakes, which are in bad or medium status should be improved.
It is important to preserve the good status of attractive lake areas: Kurtna, Vooremaa, Rõuge and Kooraste lakes.

5.6.1 Peipsi lake

Due to a big inner inertia it is difficult to achieve the improvement of its status even when reducing the external load. The different future scenarios analyzed by POLFLOW and SHALMOD models do not give hope for a quick improvement of the status of Lake Peipsi. There is a danger that even in case of efficient protection measures and favourable scenario a good ecological status of the lake will not be achieved by the year 2015.
The aim is to reduce the phosphorus load of the lakes. The shortterm objective is to renovate Pihkva wastewater treatment plant with phosphorus removal and consequent reduction of the phosphorus load. The longterm perspective is to control the agricultural load.
It is expected to work out unified environmental objectives in cooperation with Russia by the end of the year 2005.

5.7 Artificial and Heavily Modified Water Bodies

The aim is to achieve the status as possible as close to natural (good ecological potential), especially concerning the very large (Narva), large (Põltsmaa, Võhandu) and medium (Kunda, Purtse) rivers. Whether restoration is possible and practical should be found out by additional examination of the river and a designation test. After that the more exact environmental objectives can be defined.
The objective for artificial water bodies is creation of close to natural conditions. This concerns irst of all water bodies, which specified use is finished (e.g. water bodies in exhausted open casts, polder canals). Artificial water bodies still in economic use should be utilized so that it would not deteriorate the status of other surface and groundwater bodies.
In mining work should be planned so that the formed water bodies will be safe after finishing work, with a good ecological potential and with a natural look.

5.8 Coastal Sea

The aim is to achieve a general good status that depends a lot on application of the Baltic Sea protection objectives within the framework of international cooperation. It is also important to ensure that ports, beaches and wastewater effluents on the coast will meet environmental requirements and environmental accidents in ports will be prevented.

6 ECONOMIC ANALYSIS OF WATER USE

6.1 Economic analysis in the context of the Water Framework Directive

According to Article 9 of the directive member states must adhere to the cost recovery principle for water services:

> 1. Member States shall take into account of the cost recovery principle of water services, including environmental and resource costs, having regard to the economic analysis conducted according to Annex III, and in accordance in particular with the polluter pays principle.
>
> Member States shall ensure by 2010:
>
> - that water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive,
>
> - an adequate contribution of the different water uses, disaggregated into at least industry, households and agriculture, to the recovery of the costs of water services, based on the economic analysis conducted according to Annex III and taking account of the polluter pays principle.

Member States may in so doing have regard to the social, environmental and economic effects of the recovery as well as the geographic and climatic conditions of the region or regions affected.

2. Member States shall report in the river basin management plans on the planned steps towards implementing paragraph 1 which will contribute to achieving the environmental objectives of this Directive and on the contribution made by the various water uses to the recovery of the costs of water services.

3. Nothing in this Article shall prevent the funding of particular preventive or remedial measures in order to achieve the objectives of this Directive.

4. Member States shall not be in breach of this Directive if they decide in accordance with established practices not to apply the provisions of paragraph 1, second sentence, and for that purpose the relevant provisions of paragraph 2, for a given water-use activity, where this does not compromise the purposes and the achievement of the objectives of this Directive. Member States shall report the reasons for not fully applying paragraph 1, second sentence, in the river basin management plans.

Annex III specifies the content of the economic analysis:

The economic analysis shall contain enough information in sufficient detail (taking account of the costs associated with collection of the relevant data) in order to:

(a) make the relevant calculations necessary for taking into account under Article 9 the principle of recovery of the costs of water services, taking account of long term forecasts of supply and demand for water in the river basin district and, where necessary:

- estimates of the volume, prices and costs associated with water services, and

- estimates of relevant investment including forecasts of such investments;
- (b) make judgements about the most cost-effective combination of measures in respect of water uses to be included in the programme of measures under Article 11 based on estimates of the potential costs of such measures.

6.2 Results of the completed economic analysis

The economic analysis of the Viru-Peipsi region was conducted by Estonian Water Consultancy within the framework of the LIFE project. In the following part the main conclusions of this work [15] are presented. The economic analysis primarily considers water supply and sewerage as water services.

Data from five principal sources has been used to conduct the economic analysis of water use:

- Reports from the Statistical Office of Estonia;
- Water permit reporting database of the Estonian Environment Information Centre of the Ministry of the Environment;
- Data from the Population Register of Estonia;
- Data from the Commercial Register of the Ministry of Justice;
- Questionnaires sent to local governments and companies.

6.2.1 Assessment of the economic importance of water use

Water and water-related branches of the economy are important in the Viru-Peipsi water management division from the point of view of turnover (24 % of the turnover of the region's business) and the creation of added value. 31 % of employees of the region's businesses are involved in sectors of the economy related to substantial water use.

The turnover of the companies of the Viru region accounts for 54% of the turnover of the businesses of the Viru-Peipsi region. 57% of the employees of the Viru-Peipsi region work in the Viru sub-district. The turnover of the companies with substantial water use of the Viru sub-district amounts to 32 % of the total turnover and is two times bigger than the turnover of the Peipsi sub-district. The reason for this is the location of oil shale mines and oil shale power plants in Ida-Virumaa.

The turnover of the businesses of the Peipsi sub-district accounts for 46 % of the business turnover of the Viru-Peipsi water management division. Here and henceforth the 2004 data from the Commercial Register is used.

Table 34 Business turnover and turnover of sectors with substantial water use [15]

Sub-district	Total business		Sectors with substantial water use	
	Turnover (mln EEK)	Relevancy in turnover of total business (%)	Turnover (mln EEK)	Relevancy in turnover of total business (%)
Viru	26 649	54	8 484	32
Peipsi	23 053	46	3 442	15
TOTAL	**49 702**	**100**	**11 926**	**24**

The turnover of companies with substantial water use in the Peipsi sub-district forms amounts to 15 % of the turnover of the sub-district and is mainly associated with food industry. 43 % of the employees of the Viru-Peipsi region work in the Peipsi sub-district.

Table 35 Employment and employment in sectors with substantial water use by sub-district [15]

Sub-district	Total business		Sectors with substantial water use	
	Number of employees	Relevancy (%)	Number of employees	Relevancy of the total number of employees (%)
Viru	37 500	57	14 300	38
Peipsi	28 800	43	6 000	21
TOTAL	**66 300**	**100**	**20 300**	**31**

The biggest contribution to the turnover of the economic sectors associated with water use in the Viru-Peipsi region comes from the production/distribution of electric energy (7,0% of the business turnover of the whole region), followed by the food industry (6,1%) and mines (4,3%).

Table 36 Relevancy of turnover of sectors with substantial water use in business turnover (%) [15]

NACE-codes	01	05	10 14	15	17	21	26	40	90	
Sub-district	Agri-culture	Fish far-ming	Mines	Food indust-ry	Textile indust-ry	Cellu-lose and paper indust-ry	Production of other non-mineral products	Pro-duction/distri-bution of electric energy	Effluent and waste pro-cessing	**TOTAL** (sectors with substantial water use)
Viru	0,60	0,02	7,69	3,72	5,01	0,23	2,30	11,92	0,35	31,83
Peipsi	1,70	0,02	0,38	8,89	0,12	0,09	2,03	1,39	0,33	14,93
TOTAL	1,11	0,02	4,30	6,12	2,74	0,17	2,17	7,03	0,34	24,00

The Viru sub-district has a strategically substantial role in water use (the turnover of sectors with substantial water use accounts for 32% of the total business turnover). The production/distribution of electric energy and mines have great relative importance in the Viru sub-district. The food industry has greater proportion in the Peipsi sub-district.

The share of employees corresponds to the size of the turnovers of the sectors. The textile industry is an exception in the Viru sub-district, as the number of employees there is considerably larger than in other sectors. In the Peipsi sub-district the proportion of employees is the biggest in the food industry and in agriculture.

The biggest water users in Estonia (oil shale mines and power stations, and also the biggest textile industry) are located in the Viru sub-district, and are the biggest employers in the region. There is enough water in the sub-district for production. The price increase of quality drinking water may cause problems in the future, as part of the Cambrian-Vendian natural resource does not adhere to the set drinking water standard in terms of chloride ions and radionuclides. The increase in the use of the Vasavere ground water deposit quaternary period is unclear at the moment due to conflicting interests (the preservation of Natura lakes and bathing bodies of water, the mining of mineral resources) in the region. Socio-economic problems and the price of quality drinking water may also be increased by the opening of new oil shale mines in Ida- and Lääne-Virumaa.

The food industry and agriculture are economically important in the Peipsi sub-district. Agricultural water demand is mostly associated with animal husbandry and the water demands of the residents in scattered settlement areas; the latter is considered as water intended for human consumption. There is enough surface and ground water in the sub-district for both agriculture and animal husbandry. The intensive development of agriculture (animal husbandry and cereal growing) may cause socio-economic problems, and in the event of a breach of environmental requirements would endanger the water quality water bodies and upper groundwater layers.

Table 37 The ratio of the number of employees in the sectors with substantial water use to the total number of employees (%) [15]

NACE-codes	01	05	10 14	15	17	21	26	40	90	

Sub-district	Agri-culture	Fish far-ming	Mines	Food in-dustry	Textile ind-ustry	Cellu-lose and paper ind-ustry	Produc-tion of other non-mineral products	Pro-duction /distri-bution of electric energy	Effluent and waste pro-cessing	**TOTAL** (sectors with substantial water use)
Viru	1,70	0,10	5,91	6,42	14,01	0,21	2,31	6,60	0,97	38,23
Peipsi	5,00	0,10	1,26	9,61	0,58	0,26	1,98	1,15	0,80	20,74
TOTAL	3,13	0,10	3,89	7,80	8,18	0,23	2,17	4,24	0,90	30,63

6.2.2 Calculation methodology of the cost recovery for water and sewerage services

The analysis of the cost recovery is based on the methodology indicated in the Water Framework Directive guidance document [35].

In calculating the cost recovery for water supply a model was used, according to which the level of the water service cost recovery was estimated. Total costs include operational, maintenance, administrative, capital and tax expenditures (tax expenditure consists of value added tax and environmental taxes –special use of water charge and pollution charge). As a result of the calculation a distribution of the cost recovery by different fields and by who covers the costs was achieved. The indicators of cost recovery are presented as a monetary value and as a proportion. The monetary value of the cost recovery indicates the absolute value of the recovered costs of water use of a given field that are recovered by the water company (or in case of the absence of public water supply and sewage system by a generalised water user) and the amount of costs recovered by the state. The proportion of the cost recovery characterises a fixed agent who recovers the costs, indicating the relevancy of the fixed agent in recovering the total expenditure of water management.

In calculating the cost recovery it has been presumed that the size of the costs recovered by the state corresponds to the total sum of their water service costs that are not recovered by a company providing water services or a water user. Among these, the costs recovered by the state are all costs associated with the detriment of the environment that are not compensated by the water user. The calculation of the cost recovery is based on formula that are adapted to the databases of water use and water service costs involving the river basins of Estonia.

Assessment of cost recovery of private households. The results of an individual case study have been used to calculate the costs related to the water usage of private households. In the course of each individual case study total cost calculations of water company and household were made. To calculate the cost recovery from settlements not covered by the database but with more than 100 residents, the unit costs of the individual case study, the number of the residents of the settlement, data from the database, and the proportion of cost recovery calculated at the level of the same county have been used. In settlements with less than 100 residents the absence of public water supply and sewage system has been presumed. Thus the bases of the cost recovery are the unit costs from the results of suitable individual case studies, the number of residents and the proportion of the cost recovery, calculated at 100%, as in private households with their own water supply and sewage system recovery is presumed at 100%. In extrapolation the database has taken into account the costs of residents in the settlements who do not use the public water supply and sewage system.

Industrial water use and water service costs. Data on the industrial water use covers the water usage of industries which are clients of water companies, and the water usage of businesses which hold a permit for the special use of water. The water usage of businesses holding permits accounts for 99% of industrial water use.

Agricultural water use and water service costs. Agricultural water use costs and the cost recovery are determined by capital expenditure made to cut pollution from point sources of pollution (animal husbandry farms) and by operating expenditure to provide water services for agricultural water users. In assessing the capital costs, the number of essential cattle (porcine and bovine animals) by region and the presumed investment necessary in manure storage facilities – 8000 EEK per animal - have been taken into account. The building or conversion of the facilities into ones that correspond to the requirements of manure storage facilities is one of the required measures for achieving good status of water bodies. Costs associated with manure storage facilities have been fully determined as water protection costs, proceeding from proper work in the field.

Other environmental costs (the influence of fertiliser losses and plant protection products on the environment, leakage of nutrients from fields, runoff from drainage networks etc.) related to agriculture have not been included in the analysis of the cost recovery. So far, agricultural producers do not pay a pollution charge (there is no methodology for determining the exact amount of pollution for taxation) and the environmental costs related to agriculture are covered by nature (the natural water service in the broader sense).

6.2.3 The level of the recovery of water use costs

Proceeding from the economic indicators of 2004, for consumption and price level, the level of Viru-Peipsi water service costs can be estimated at 2 064 mln EEK a year.

The biggest category of costs for the water service is the population, the costs of services provided to them are estimated at 1 341 mln EEK or 65 % of all water service costs. Given that, according to the Statistical Office of Estonia, the population of the Viru-Peipsi region is 494 000 (2004), the average cost per resident for the water service is estimated at 2700 EEK a year. At the moment about 80% of the residents in the Viru-Peipsi region use the public water supply and sewage system.

Industrial water service costs are estimated at 566 mln EEK a year, which makes about 27 % of the total costs of water service (table 9.5); industrial users pay 582 mln EEK a year for water use, i.e. water service costs are covered with an extra 15 mln EEK a year.

Agricultural water service costs are estimated at 155 mln EEK a year, comprising 8% of the total water service costs.

Table 38 Water service costs structure [15]

Consumer	**Costs – mln EEK**	**Relevance of total costs**
Households	1 341	65%
Industry	566	27%
Agriculture	155	8%
Total	2 064	100%

The water service cost recovery varies according to the consumer groups (households, industry and agriculture).

Table 39 Water service cost recovery level [15]

Water use area	**Cost recovery water enterprise mln EEK / %**	**Cost recovery taxpayer mln EEK / %**
Viru-Peipsi water management division		
Households	857 / 64%	484 / 36%
Industry	582 / 103%	-15 / -3%
Agriculture	0 / 0%	155 / 100%
Total	1 440 / 70%	624 / 30%

According to the data from 2004 approximately 1 440 mln EEK (70%) of the water service costs will be recovered from the sale of the water services and other services and approximately 624 mln EEK (30%) will come from the taxpayer. Thus the income from the tariffs covers more than two thirds of the costs of providing the whole service.

At the moment the taxpayer predominantly invests in the provision of the water service through the recovery of the capital expenditure. The funds used for the investment in water service are received by the state through two channels:

- transfers from charges paid for environmental authorisations (permit for the special use of water, pollution charge); other taxes implied in the area of water service;
- investments directly financed by the state, both the State Investment Programme and institutions dealing with regional investments (Enterprise Estonia). Investments from the European Union Structural Fund are also considered as state investments.

The Environmental Investment Centre predominantly deals with investments received from transfers. In 2003 it invested a total of 130 mln EEK (KIK, 2003) in water protection programmes. The importance of transfers has grown rapidly over the past few years, mostly due to pollution charges (the charges for releasing BHT_7, total nitrogen and total phosphorus into the environment set in the Pollution Charge Act have increased by an average 200% in the period January 1, 2001- January 1, 2005). The cost for the permit for the special use of water also increased by 150% between July 1, 2001 and January 1, 2005.

6.3 Conclusion and future recommendations

The existing statistical data and experience only allow an assessment of the economic aspects of water and sewerage services. The following conclusions can be made:

- The level of the cost recovery of water and sewerage services in the Viru-Peipsi region is 70 %;
- No improvement in the cost recovery for residents can be foreseen in the coming years because an increase in the water service price is only possible in densely populated areas;
- Local governments in rural areas are not able to build the required public water supply and sewage systems using only their own funds and loans;
- The increase in the cost recovery may be foreseen mostly in the industrial sector, where charges for the natural environmental service in its broader sense can be established;
- Because of the large increase of the load it would be necessary to impose the *polluter pays principle* in agriculture too, but in socio-economic terms it is very difficult;
- In oil shale energy nature has to deal with a large portion of the water-bodies, ground water and landscapes ruined by environmental damage, as pollution and resource charges received from oil shale energy are directed elsewhere ;
- The assessment of the environmental costs of blocking watercourses takes place in the course of a heavily modified water bodies designation tests;
- The intentional application of preventive measures is most cost-effective.

In continuing the economic analysis, in 2006 the identification of heavily modified water-bodies and a socio-economic assessment of them have to be carried out in order to specify the objectives of heavily modified water bodies, whether it is possible to improve their status, the socio-economic practicality and the necessary measures.

The assessment for the recovery of all water service costs by 2015 must be started, taking into account the socio-economic prognosis of the state. This assessment must consider all the measures included in the programme of measures of water management plans in order to secure the implementation of the directive by 2015.

Ways of cutting the water service costs covered by nature in mining and agriculture must be analysed. Studies and analyses on the influence of oil shale energy on the water environment carried out so far do not cover the financial aspect. The strain on the water environment created by agriculture also has great influence, but there are also no economic analyses in this area.

From the socio-economic aspect the balance in the application of efforts in the field of water protection is very important. In addition to the samll wastewater treatmnt palnts onstruction, more attention has to be paid to stopping manure and silage facilities lagging behind. The irrational usage of water energy may nullify other efforts in bringing a river into good status. An economic analysis of the damage caused by both industry and agriculture must be completed. The results achieved will help and support in the future the decisions made for the protection of and the rational use of the water environment.

The usage of nature's water service by the industrial, agricultural and consumer sectors must be analysed. For the development of the water environment concept in the near future, plans containing specific environmental and economic analysis of the management of water-bodies in poor status or otherwise in a problematic state must be completed. For example, this plan should provide an solution for how oil shale miners, oil producers, hydro-energy producers, mill owners, fishermen, farmers, local residents and vacationers could together use the Purtse and Piusa Rivers or Kurtna lakes most effectively. On the basis of such specific analysis it is possible to clarify the water management plans of the river basin.

It is necessary to analyse the influence of environmental and pollution charges on the status of water and link the environmental charges more clearly with the volume of nature's water service and with the negative influence of the strain on the environment of the status of water.

The collecting of environmental charges, resource charges and pollution charges and the system of allocating subsidies through the Environmental Investment Centre must be organised in such a manner that the use of the collected means takes place according to the sub-districts. This would apply to the requirements of the Water Framework Directive and guarantee the transparency of the tax system, and allow economic accounting; the planning of measures for subsidising the water and sewage service, and for eliminating the environmental damage caused by mines; and the carrying out of economic analysis within the river basin. Most of the pollution damage compensation from mines and power stations is not at the moment directed to the elimination of environmental damage but to the building of water and sewage systems.

7 The Programme of Measures

The programme of measures includes the main measures (fulfilment of the relevant environmental requirements set by the European Union and Estonian legislation) and supplementary measures where compliance with minimal environmental requirements is not sufficient to achieve good water status and to ensure a safe environment for the whole population and favourable status of biota. The main measures include the elimination of obvious and essential non-conformity.

Legislation does not specify (for instance) the supply of drinking water for households, or all aspects of the recovery of past pollution and renovation of the existing impoundment structures of water bodies.

Measures for achieving the requirements for regulating sources of pollution are similar for groundwater and surface water and they do not mutually duplicate each other. It must be observed when implementing the programme of measures that objects which impact or endanger areas with unprotected groundwater, lakes in a very good status, small lakes and small valuable rivers are cleaned up first. Safe drinking water for the whole population must also be ensured as soon as possible.

Bringing wastewater treatment facilities and the manure and silage storages of livestock farms into compliance with requirements regarding point pollution sources is essential. As for diffuse pollution primary attention must be paid to the observation of environmental requirements concerning the use of toxic chemical agents, manure and fertilisers.

Environmental requirements are also to be met for other point source pollution (waste disposal sites, fuel storage facilities, transformer substations, chemicals storage facilities) which are not separately specified within this project. Modest resources have been allocated for them in the budget under supplementary measures or repair of local sites. If such sites appear dangerous to water intakes and water bodies, such expenditures will be given a higher priority.

Companies (including water companies) are obliged to comply with minimum environmental requirements. Given a high volume of such expenses, implementation of the first water management plan requires support from both the government and the EU.

This water management plan focusses mainly on fixing sources of pollution, on supplying drinking water and on preventing the deterioration of water status. The application of the principles of environmental management in water sector (administrative and surveillance measures) is essential. The current stage of improving the status of water bodies focusses mainly on measures with clear results in the identification of management solutions for essential water bodies and polluted water bodies (those in moderate or poor status).

The need to improve water bodies in moderate status, environmental objectives, assessments of status and action programmes must be carefully considered in the future. If we were guided by assessments on the status of water bodies (regarded as natural) carried out by researchers from Estonia or the European Union, large costs would be created because the proportion of water bodies which do not meet the standards for good status is very high. The environmental objectives of heavily modified water bodies and artificial water bodies have not been clearly specified either (i.e. what is good ecological potential).

Consequently, the high theoretical costs for bringing all water bodies into a good status have not been assessed. It is desirable to follow the recommendation of WRD to implement expenditures step by step starting with the clearer objectives.

On the basis of the water management and of a socio-economic evaluation of experience gained through the implementation of any necessary additional surveys and of the current pre-planned measures the programme of measures is to be specified by the year 2009 in accordance with the requirements of the Water Framework Directive.

The costs of the programme of measures shall be covered from the resources of the population, business, local governments, the national government and EU financial assistance. Due to the horizontal nature of the water management plan it gives an indication of the expenses essential for water protection (a total of 230 million kroons) of other action plans (*National Waste Management Plan; Rural Development Plan*). Expenditures on the surveillance and monitoring required to achieve the objectives of the water management plan outside the administrative area of the Ministry of the Environment have not been estimated. Expenditures after the year 2014 have not been estimated either.

The total cost of the programme of measures is 8 billion kroons.

7.1 The Drinking Water Programme

Main measures. Bringing drinking water into compliance with the directive 80/778/EEC (amended 98/83 EEC) and the Estonian legislation in the Viru and Peipsi region will cost, according to current estimates, 1 billion and 0.8 billion kroons respectively; a total of 1.8 billion kroons in the Viru-Peipsi catchment area (Table 40). About 80% of the expenditures will go to reconstruction and construction water supply pipelines.

The desirability of the further use of water which does not meet the requirements of radiological indicators and the deadlines for ensuring the suitability of drinking water have not been decided as yet. This programme of measures does not include the cost of bringing a new water source into service or of purifying water from radium [20]. An assessment of the health hazards from the use of water which does not conform to the effective dosage and a feasibility study for bring a new source of water into use have to be carried out in the next few years. This is especially required in the water intake of Kunda and also in the Cambrium-Vendian water intake at Rakvere.

Additional measures, water supply in scattered settlement areas. Investment planning still does not take into account the “actual rural population” – people who are sparsely distributed and live in small villages, those who remain under the threshold of 50 people per settlement as set by the Drinking Water Directive but suffer from a shortage of water or have to use polluted water. On the basis of the principle of equality of treatment the programme of measures includes: the replacement of dry wells; the supply of safe drinking water to people who live in the vicinity of past pollution sources, or of groundwater polluted with dangerous substances; the replacement of low polluted wells of isolated consumers in areas with intensive agriculture or construction of a water supply. An assessment of the costs takes into consideration that about 15% of the population of the water management area live beyond the reach of the public water supply. Costs in the Viru-Peipsi water management area would reach 0.25 billion kroons (Table 40).

7.2 The Programme for Point Source Pollution

7.2.1 Sewage and the Treatment of Waste-Water

The main measures include measures for fulfilling the Urban Waste-Water Treatment Directive (91/271/EEC) and the Sewage Sludge Directive (86/278/EEC) along with the relevant Estonian legal acts.

The programme of measures focusses on renovating the sewage structures of settlements of more than 500 inhabitants. In some cases smaller settlements are included, for instance investment requirements in Jõgeva county take into account settlements in Kasepää rural community on the shore of Lake Peipsi, Raja, Kükita, Tiheda and Kasepää, as they form a larger community with more than 1000 inhabitants.

The solvency of most local governments is low and the volume of state or EU assistance is limited, therefore construction works must be carried out step by step [20].

The programme of measures have two stages:

- work which will be carried out in 2006-2008 (inclusive) before the water management plans are finalization;
- tasks of the long-term programme in 2009-2014.

Work which has already received funding from the EU together with co-financing from Estonia has been planned for the next 3-4 years (e.g. reconstruction of the regional wastewater treatment system at Kohtla-Järve) as has that where the financing resolution is expected to be granted in the near future (the Emajõe-Võhandu project; Narva regional environmental project: Narva 3). The transition period of the Urban Wastewater Directive will end in 2010.

Reconstruction of pipelines is a continuous and time-consuming process, which, in the long run, should be regarded as maintenance of the pipeline rather than an investment. The investment plan only includes the extension of those pipelines which improve the living standards of people who have not had this service over a long period [20].

The estimated cost of the main measures [20] in the Viru sub-district is 2 billion kroons and the Peipsi sub-district 1 billion (Table 40).

The communications and utility networks of the new real estate developments under construction will be built with financial resources from affiliation fees. Maintenance, running repairs and re-acquisition of pipelines and other systems are financed from an income from water tariffs which must include depreciation of facilities and systems.

The above principles also apply to drinking water supply.

Supplementary measures. Some wastewater treatment plants require additional treatment of sewage, especially phosphorus removal, as compared to current requirements. Small water bodies serve as artificial recipients for many wastewater treatment plants, where post-treatment has to be applied in order to maintain the status of the water body. Assistance is provided to sewage facilities of smaller settlements and scattered settlement areas. The estimated volume of supplementary measures is currently 0.3 billion kroons.

7.2.2 Renovation of livestock farms

Main measures. The storage and use of manure and silage in livestock farms must be brought into line with the Nitrates Directive (91/676/EEC) and relevant Estonian legal acts. Sewage treatment also requires more attention.

The estimation of the costs for bringing the use of manure into compliance with the requirements (Annex 13.5) is based on earlier surveys of a nitrate-sensitive area [21]. The cost of setting the wastewater treatment of silage storages and farms in order has not been investigated, and the figures are purely indicative.

The cost of the main measures [20] in the Viru sub-district is 0.25 billion kroons and the Peipsi sub-district 0.8 billion (Table 40).

The implementation of supplementary measures (for instance the construction of larger liquid manure storages or additional restrictions concerning spreading manure) is first and foremost required in areas where the groundwater is not protected, in the recharge areas of groundwater intakes, the catchment areas of surface water intakes and the catchment areas of small water bodies. The volume of supplementary measures has not been assessed in this programme. The actual volume of such measures will become apparent after the implementation of the main measures; thereafter the necessity of supplementary measures must be assessed.

7.2.3 Restriction of Pollution from Hazardous Substances

7.2.3.1 Restriction of Discharge of Phenols

The main measures have been determined by the resolution of the Government of 27 April 2004 “The National Programme for 2004-2014 on the reduction of emissions of phenolic compounds discharged into water”. Actions of the programme overlap with the main measures for recovery of past pollution and sewage facilities. It also lists surveys, monitoring and surveillance, and training costs. These costs are presented among the administrative costs of the water management plan.

7.2.3.2 Recovery of Past Pollution

Main measures. Recovery of past pollution sources is necessary for the fulfilment of the directive on discharges of certain substances in the aquatic environment (76/464/EEC; 86/280/EEC; 80/68/EEC.

35 past pollution sites of national importance (significant environmental impact) are located in the Viru-Peipsi water management area, most of them in Ida-Virumaa county. The estimated total cost of measures in the Viru sub-district is 0.5 billion kroons, and in the Peipsi sub-district 50 million kroons. The primary tasks are the closure of industrial landfill sites with oil production residues (semi-coke hills) and improvement in the technology of ash depositing from power stations, and recovery of ash-disposal areas.

Supplementary measures include the elimination of small-scale sites of past pollution. Cleaning ponds (Raadi, Plaki) which are soiled with dangerous substances will evidently be necessary. The amount of work is not clear at present. 3 million kroons has been allocated for cleaning the Raadi pond within the groundwater programme of measures. Work at Plaki Lake requires up to 10 million kroons according ta Kobras Ltd estimation.

Past pollution cleanup need more resources then in use today.

7.2.4 Renovation of Other Environmentally Hazardous sites

The elimination of old landfill sites and the improvement of landfill sites for dangerous waste must be completed on the basis of the *National Waste Management Plan*. The relevant inspections as regards the closure of landfill sites must be carried out whine the water management plan is being implemented.

This programme of measures does not deal separately with IPPC companies, or with the impact of farms of fur-bearing animals, or of aquaculture. These and other potentially environmentally dangerous sites must be monitored through water use licences and appropriate supervision. Water protection expenses should be covered by the companies. Most IPPC companies have joined the programme of measures within programmes of measures for point source pollution (treatment facilities, farms and sources of past pollution).

7.3 The Plan for the Restriction of Diffuse Pollution

Main measures. The Nitrates Directive provides measures of a primarily preventive and administrative nature (mostly to limit diffuse pollution). A separate action plan is being implemented in the nitrate-sensitive area, its estimated cost in the Viru-Peipsi water management area is 28 million kroons up to the year 2014.

Supplementary measures. Measures are planned for the reduction of diffuse pollution in order to decrease diffuse pollution from plant production (Annex 14.7), oil shale mines and quarries, peat production and forestry.

Some actions which are here considered as supplementary measures, can be made compulsory in the future under the Water Act where they are necessary to achieve good status of water bodies and groundwater.

Supplementary research is planned on the Võhandu River to determine the source of phosphorus pollution.

An indication of planned additional resources for the supplementary measures for small lakes and rivers has been given.

The estimated total cost of measures for the reduction of diffuse pollution in the Viru sub-district is 120 million kroons, and 190 million kroons in the Peipsi sub-district. Supplementary measures are thematically described below.

7.3.1 Plant Production

This programme of measures attempts to link the actions of the Rural Development Plan (RDP) with the water management plan and to present the number of measures and their costs by catchment area (Annex 14.7). Funding from the RDP is implemented on the basis of applications, therefore the following is a forecast rather than a planning measure for a particular catchment area.

7.3.2 Oil Shale Mining

Measures to reduce the negative impact of diffuse pollution caused by oil shale mining are targeted towards restricting the spread of dangerous substances from mined areas.

In order to stop the extension of groundwater bodies spoiled by mining, areas of mining cavities with polluted groundwater near past pollution sources must be isolated. All pollution sources must be carefully eliminated or cleaned. To restrict diffuse pollution the natural situation must be restored as much as possible, and “underground lakes and rivers” which have developed in mining cavities should be broken into smaller bodies so as to provide statuss for the creation of water of better quality. Simultaneously, the safe water level in mines and quarries must be secured, whicg meetes the requirements of land use and of protected areas (restorationof the physical status of groundwater).

A feasibility study has to be conducted to find suitable solutions in order to promote the restoration of the groundwater body of the mined areas, or to achieve the best possible ecological potential of the bodies of surface water which have been heavily modified or of artificial water bodies after mining works have been terminated.

7.3.3 Peat Mining Areas

The main aim of water protection regarding peat mining is to control pollution from suspended solids. The essential attributes for the reduction of suspension are sedimentation basins where suspended matter contained in run-off water is deposited on the bottom of ponds; sedimentation depressions in drains can be used as well as piped dams to suppress flow rates on collector drains [18].

7.3.4 Reduction of the Impact of Clear Cut Areas

The following measures can be used to reduce nutrient leaching: planning clear cutting over the period when forest turf is harmed least; using forestry machinery which cause the least harm to plantation and turf when clear cutting.

When clearing the cutting areas, it is advisable to remove logging waste or spread logging waste evenly on the ground. It is undesirable to heap logging waste in piles or banks and leave it to decompose.

It is advisable to construct sedimentation pools and small wetlands as part of forest drainage systems [17].

7.4 The Groundwater Programme

The main measures involve a programme for fixing direct wastewater discharges and the main measures for dealing with the above sources of point pollution and the main measures for fighting diffuse pollution.

Supplementary measures. The groundwater programme of measures lists the specific measures required for the maintenance of groundwater bodies in good status. The expansion of groundwater bodies in poor status in the Ida-Viru industrial area must be limited, and this tendency should be brought to a halt by measures for eliminating past pollution and by a better system of closure of oil shale mines (measures against diffuse pollution).

These measures are described in Annex 13.6 by groundwater body. The estimated total cost of the groundwater programme of measures is 80 million and 50 million kroons for the Viru sub-district and the Peipsi sub-district respectively (Table 40).

7.5 The Surface Water Programme

In addition to the above mentioned poluution reduction measures, the surface water programme of measures focusses on preserving the status of water bodies which are in a good or very good status and on improving the status of water bodies in poor status. In the case of water bodies in moderate status, the point pollution sources will be fixed and the physical status of the water bodies will be improved through the implementation of projects. When we have the results of the above work, the programme of measures for the water bodies in moderate status will be specified.

The cost of the surface water programme is 0.5 billion kroons which is divided almost equally between the two sub-districts (Table 40).

7.5.1 The Main Measures for Surface Water

In addition to the above main measures against pollution the costs of the main measures of the surface water programme are 65 million kroons in the Viru sub-district, and 50 million kroons in the Peipsi sub-district. A more detailed description of the main surface water measures follows below.

7.5.1.1 Preventive Measures for Lakes in High Status

Only six lakes have been preserved in high status. To maintain the high status of these lakes (which all belong to the Natura 2000 areas) a risk assessment and a management plan have to be compiled on the basis of surveys of each lake and its catchment. It will be difficult to avoid undesirable developments without such a plan, as an analysis of projects carried out near all the lakes would be costly and would not allow assessment of the accumulating impact of isolated developments. The estimated cost of preventive measures is 9 million kroons.

Extra costs cannot be ruled out, such as the need to purchase land or to pay compensations, or the cost for supporting extensive land use.

7.5.1.2 Preventive Measures for Sections of Rivers in Good Status

Valuable sections of rivers should be identified and plans are to be prepared regarding their preservation. Initial planned expenditure for the valuable sections of rivers covers: the Nõmme River; the Preedi River; the Piusa River headwaters; the Võhandu River headwaters; cleaning of the Põltsamaa River between the town of Põltsamaa and Kamari; and improvements to the state of spawning areas in the Loobu River, including downstream sections of Undla and Kadrina dams. Studies on the feasibility of dams on upper courses of Ahja, Piusa and Võhandu rivers and on the possibility of constructing fish passes have been planned. Estimated costs come to 17 million kroons.

Surveys of fish populations and assessment of the environmental impact on the whole river must precede the construction of any new dams. The same applies to polluted rivers (e.g. the Purtse and Selja rivers), although they should not be polluted forever. Those expenses are included in the administrative costs of the water management plan. Payment of compensation to owners of land and dams (in ruins) cannot be excluded as a cost.

7.5.1.3 Recovery of Rivers in Poor Chemical Status

Detailed surveys of pollution sources and impoundment facilities, and management plans which consider all water users of the catchment area, must be prepared for the rivers in poor status. When plans are ready and negotiations with the users of water services have been completed, cleaning of the polluted rivers can be started, and opportunities for the specification of the special use of water permits or for the issuing of new permits can be identified. The present programme of measures allocates 30 million kroons up to the year 2014 for the surveys of and pilot work on the rivers in poor status.

For instance, the Selja River which is in poor status, is the only salmon river in Estonia where most of potential fish spawns are accessible to highly migratory species of Salmonidae. The first dam is located in Päide at a distance of 36 km from the river mouth. The natural salmon habitat disappeared in the 1970s due to heavy pollution (wastewater from the town of Rakvere). The salmon population is currently being restored.

Cleaning work on the Purtse, Erra and Kohtla rivers has obviously been postponed until past pollution sources have been removed and the Kohtla-Järve regional treatment facility has been repaired, and will evidently begin after 2014. A management plan for the Purtse River must be drawn up immediately to prevent the river's status being recklessly worsened by the erection of a cascade of dams on the river.

7.5.1.4 Measures for Recovery of Lakes in Poor Status

Four lakes are in poor status (Arbi, Tilsi Kõrbjärv; Tilsi Pikkjärv and Väimela Alajärv) covering a total area of 51 ha. Lakes Tilsi Kõrbjärv and Tilsi Pikkjärv must be researched to find the reason for their status. Measures can be considered for Arbi Lake and Väimela Alajärv Lake when the level of pollution is under control. The present programme of measures allocates 25 million kroons up to the year 2014 for the surveys of and pilot work in the lakes in poor status. Another 25-75 million kroons may be required to complete the planned work.

7.5.1.5 The programme for the Reduction of Flood Risks

Currently, 8 reservoirs are at risk of flooding and require prompt repairs, 45 million kroons are required to fix the regulators and remove sediment [8].

Flooding of the Emajõgi River periodically disturbs life in the town of Tartu as do floods from Tamula Lake in the town of Võru. Large-scale hydro-technical work against floods has not been included in the programme. An applicable preventive measure is to avoid building up flooded areas.

7.5.1.6 Tidying up Bathing Areas and Bathing Waters

The estimated total cost of maintenance work at bathing areas and in bathing waters is 11 million kroons (Table 40).

7.5.1.7 Improvement of the Status of Heavily Modified and Artificial Water Bodies

A supplementary assessment of the costs related to heavily modified water bodies will be carried out along with the inventory-taking and assessment of artificial water bodies.

The programme of measures for heavily modified water bodies will be specified after an designation test and surveys of water bodies in poor status have been carried out, and management plans drawn up (e.g. Purtse).

The programme of measures related to the mitigation of the impact of dams on some rivers (e.g. Kunda and Piusa Rivers) will be specified in the process of implementation of the project of technical assistance of the Cohesion Fund.

30 million kroons have been planned for the restoration of the dry river bed of the Narva River to give an indication, but costs may increase considerably.

The aim of Technical Aid is to restore the rivers' natural status as much as possible. That should be the main objective for very large rivers (the Narva River), large rivers (Põltsamaa, Võhandu rivers) and medium rivers (Kunda, Purtse rivers). Each river which has been designated as a heavily modified water body is to be further researched and an assessment test carried out to resolve where restoration of its natural status is possible and practical. Thereafter more detailed environmental objectives can be determined for those water bodies.

Artificial water bodies must be listed first and then their restoration planned according to the purpose of their use.

Both costs and socio-economic impacts will be taken into account, along with opportunities to heavily modified water bodies and artificial water bodies to reach a good state.

7.5.2 Supplementary Measures for Surface Water

7.5.2.1 Improvement of the Status of Watercourses

The Cohesion Fund's Technical Aid project for improving the ecological status of watercourses includes the following within the Viru-Peipsi water management area:

- on the Emajõgi River: oxbows between Lake Võrtsjärv and the town of Tartu;
- on the Põltsamaa River: Kamari dams;
- on the Piusa River: Majase, Vasekoja, Makke, Savioja Halla mill, Härmä mill, Keldre mill, Saarõ mill, Tamme dam, Tillo mill, Korela mill, Tsüdsinä mill and Oro mill. Külmoja dam on the Kivioja River is part of the Piusa basin;
- on the Mustaoja River: Vihula (I) sawmill;
- on the Pedja River: the dam of Puurmanni Reservoir;
- on the Loobu River: the Joaveski dam and the dam of Loobu Reservoir;
- on the Kunda River: the dams of Kunda I, Kunda II and Kunda III (Linnuse).

The amount of work being prepared within the Cohesion Fund's Technical Aid project for the improvement of the ecological status of watercourses will be determined by the end of 2006. The cost of that work in the Viru-Peipsi region is estimated at 100 million kroons.

7.5.2.2 Improvement of the Status of Regulated Watercourses

Hydro-technical work for putting worn-out regulators in order at 12 sites costs 6.2 million kroons in total [8].

Rehabilitation of reservoirs (removal of sediment and vegetation) at 18 sites costs 57 million kroons in total [8].

With help from experts 23 watercourses that need cleaning up were selected in 2005 within this project. The total length of watercourses sections that are maintained by the state is 329 km [16].

The implementation of environmental measures for the clean-up of a water body (clean-up of controlled water conduits) costs about 10 million kroons. Cost calculations are based on the cost of clean-up projects on the rivers Amme [19], Leisi and Taebla.

The above plans do not include 56 dams where a dam should be removed, or a fish ladder is needed, or where other measures need to be implemented in order to restore spawning grounds. The volume of the above work has not been estimated in the programme of measures. The volume is to be specified by application of the experience gained in surveys, design and application of measures within the Technical Aid project of the Cohesion Fund.

For instance, in order for the Põltsamaa River to achieve the good ecological status, it would be necessary to remove the Ao dams which currently have no clear function and restore the natural rapids which were destroyed when the river was impounded. The Rutikvere dam would need a fish pass if the dam cannot be removed. As a result, the Põltsamaa River would form a unitary section of 97 km from its sources to the Põltsamaa dam which evidently cannot be removed due to its importance in the town milieu.

In the case of the Võhandu River elimination of the Räpina dam or the Leevaku hydropower plant is not planned, but the removal of unnecessary dams or the construction of fish passes should be considered.

7.5.2.3 Preservation and Restoration of the Status of Lakes

The clean-up of lakes (various tasks, cleaning a lake of vegetation and mud, preparing swimming areas) is a project-based work. While such measures are expensive and their practicality obscure, they can only be implemented provided there is local initiative and considerable self-financing available. Such measures can mostly be implemented for lakes in towns or near towns where an improvement in the situation is in the interest of the general public.

As for dystrophic soft water lakes in moderate status, the possibilities for the improvement of their status are not known and thus no measures are planned either. Such lakes are: Holvandi Kivijärv, Lauga Lake, Listaku Soojärv, Partsi Saarjärv, Ihamaru Palojärv, Pikamäe Lake.

An action plan for Vooremaa lake area. A programme of measures will be drawn up for the preservation and, if possible, improvement of the status of the lakes in Vooremaa. The programme is prepared and implemented in cooperation with Vooremaa Landscape Protection Area. Agricultural producers and developers of recreation facilities must find a middle ground while preparing the action plan. The estimated cost of the action plan is 21 million kroons.

An action plan for Kurtna lakes. An action plan will be prepared for the preservation of the status of Kurtna lakes within the Kurtna Landscape Protection Area. This action plan must seek a compromise between the plan for the use of natural resources and groundwater and the development of recreational facilities. The estimated cost of the action plan is 16 million kroons.

7.5.2.4 Ensuring the Ecological Potential of Artificial Water Bodies

100 million kroons are planned to ensure the ecological potential of artificial water bodies related to oil shale energetics. 16 million kroons will be allocated for other artificial water bodies. The amount of work will be defined after a survey has been carried out.

7.5.3 A Coastal Water Sub-Programme

The above programmes of measures describe the control of pollution which impacts coastal water from the mainland. The elimination of the Sillamäe waste disposal site is almost finished, as with a change in technologies the amount of nitrogen from the Sillamäe earth metals plant decreased rapidly.

As regards the coastal water, no large-scale specific measures are scheduled. 15 million kroons are provisionally designated for the prevention of accidents in harbours and for the improvement of waste treatment in small ports.

Manifestations of satisfactory status are closely related to the general situation in the Gulf of Finland, therefore international cooperation needs special attention.

7.6 Sustainable Use of Water Resources and Administration of the Water Management Plan

The implementation of the water management plan presumes the inclusion of the general public on a permanent basis and cooperation with various institutions and companies. Monitoring and research are required to ensure these activities, including inspection of the results of the measures implemented, improvement of the action plan and an increase in the efficiency of measures for preserving the good status of water.

Attaining the objectives of the water management plan is only possible through close cooperation by all parties involved. Tasks of the Ministry of the Environment, the Ministry of

Social Affairs and local governments and the interests of the business community and residents are intertwined where suitable provision of water supply is concerned.

Differentiation of costs for the implementation of the water management plan from the rest of the administrative tasks of the government agencies is somewhat conditional. This assessment should reflect costs accompanying the implementation and application of the water management plan.

The programme of cross-border cooperation is prepared separately and appended to this water management plan.

7.7 The programme of Measures for the Viru and Peipsi sub-districts for 2006-2014

Table 40 Programme of measures

Measures	Implementation period	Area and activities	PEIPSI million EEK	VIRU million EEK	TOTAL million EEK
I Supplying suitable drinking water to population					
Preparation of projects	-2007	All local governments	8,00	7	15
Improving water supply, constructing new pipelines – for settlements > 500 residents					
	-2008	Ida-Virumaa	2,375	211,29	214
			10,375	514,53	525
	-2008	Lääne-Virumaa	10,0875	31,48	42
			39,125	237,33	276
	-2008	Tartumaa	233,22	-	233
			75,50	-	76
	-2008	Jõgevamaa	20,29	-	20
			182,18	-	182
	-2008	Põlvamaa	33,59	-	34
			47,61	-	48
	-2008	Võrumaa	33,87	-	34
			44,24	-	44
		Järvamaa	3,00	-	3
			4,50	-	5
	-2008	Valgamaa	1,25	-	1
			3,85	-	4
	-2014	Settlements with 50-500 residents, incl. construction of lower water intakes (F, Fe)	50	10	60
Assessment of health risks for water containing Ra, a survey of opportunities for using a new source of water	-2007	Kunda		3	3
	-2008	Rakvere		2	2
Drinking Water Directive 80/78/EU 98/83/EU compliance in full			**803**	**1017**	**1820**
Supplementary measures in scattered settlement areas					
		Improvement of water supply in small settlements	80	100	180
	-2014	Boring wells in areas with intensive agricultural production	20	5	25

Measures	Implementation period	Area and activities	PEIPSI million EEK	VIRU million EEK	TOTAL million EEK
		Ensuring safe drinking water in areas of scattered settlement in areas with OA polluted ground water		10	10
		Support given to replace dry dug wells	20	20	40
Total of supplementary measures in scattered settlement areas			**120**	**135**	**255**
I Total			**923**	**1152**	**2075**
II Improvement of point pollution sources					
Reconstruction of wastewater treatment plants and sewarage					
	-2008	Ida-Virumaa	2,25	790	792
			34,88	827,05	862
	-2008	Lääne-Virumaa	6,99	79,5	86
			53,38	284,39	338
	-2008	Tartumaa	216,882	-	217
			88,177	-	88
	-2008	Jõgevamaa	61,75	-	62
			255,038	-	255
	-2008	Põlvamaa	67,451	-	67
			56,385	-	56
	-2008	Võrumaa	28,23	-	28
			72,2	-	72
	2008	Järvamaa	2,55	-	3
			9,95	-	10
	-2008	Valgamaa	3,7	-	4
			22	-	22
Main measures for municipal wastewater in total			**982**	**1981**	**2963**
Supplementary measures	-2014				
	-2014	Supplementary measures of point pollution sources near lakes (15)	17		17
		Aid to sewarage in scattered settlement areas	80	20	100
		Improvement of P removal in treatment facilities and after-treatment	120	30	150
	-2014	Clean-up of areas of past pollution from phosphorus (polluted meadows, full biological ponds, muddy river beds)	10	5	15
Supplementary measures in total			**227**	**55**	**282**
Main measures for renewal of livestock farms					
	2014	Repair of manure storage	553,2	167,3	721
	2014	Manure spreading equipment	120	40	160

Measures	Implementation period	Area and activities	PEIPSI million EEK	VIRU million EEK	TOTAL million EEK
		Silage storage 0.2	100	30	130
		Wastewater treatment 0.1	50	20	70
Main measures for renewal of livestock farms in total			**823**	**257**	**1080**
Main measures for past pollution					
Localisation and elimination of past pollution (35 sites)	-2007	Localisation of past pollution – elimination of liquid dangerous waste	20,33	7,85	28
	-2009	Localisation of past pollution – pollution study and elimination of pollution	23,94	15,92	40
Tidying up industrial territories	-2011	Elimination of a pitch lake (fuses, pitch waste) at Kohtla-Järve		19	19
	-2011	Closure of semi-coke deposits at Kohtla-Järve and Kiviõli		200	200
	-2011	Renovation of the Kohtla-Järve industrial territory and the polluted rain water system of the semi-coke deposit (+ prevention of floods)		30	30
Elimination of the Vaivara temporary storage for dangerous substances	*2006*	*From the funds of the Waste Programme*		*30*	*30*
Water protection measures for oil shale power stations	2009	Renovation of transportation of ash and tidying up of ash landfills		200	200
Total of main measures for past pollution			**44**	**503**	**547**
Elimination of local past pollution sources	2006-2014	According to applications from local governments	25	10	35
		Recovery of Lake Plaki	3		3
Follow-up inspection and tidying closed landfills up	*-2014*	*From the funds of the Waste Programme*	*24*	*6*	*30*
Past pollution in total			**96**	**519**	**615**
III Restriction of diffuse pollution, main measures					
Action plan for nitrate sensitive areas	2006-2008	The Government order for years 2004-2008 V-P part 2/3	4,14	4,14	8
	2009-2014	Action plan for nitrate sensitive areas 2009-2014	10	10	20
Restriction of diffuse pollution, supplementary measures					
		Surveys of the phosphorus cycle on the Võhandu River	1		1
Aid awards from the Rural Development Plan	*-2014*	*Agriculture (crop farming)*	*118*	*47*	*165*
		Mined areas (oil shale)		50	50
		Supplementary measures for valuable small rive basins	10	2	12
	-2014	Supplementary measures for diffuse pollution near lakes	10		10
		Peat production	15	5,5	21
		Forestry	20	5	25

Measures	Imple menta tion period	Area and activities	PEIPSI million EEK	VIRU million EEK	TOTAL million EEK
Supplementary measures against diffuse pollution in total			**188**	**124**	**312**
IV Preservation of the quality of groundwater and its resources					
Surveys and inspection of groundwater resources, protective measures					
Main measure: Recovery of direct discharges of wastewater	-2007	Programme for renovation of direct discharges of waste-water	1	1	2
Supplementary measures					
Q	2006-2014	Vasavere - Kurtna		13,3	13
Q	2006-2008	Lakes Meltsiveski and Raadi	5		5
Q	2007-2014	combined body of Q	1,6		2
Upper-Devonian	2006-14		0,9		1
Middle-Devonian	2006-14		3,6		4
Middle-Lower-Devonian	2006-14		2,7		3
O	2006-14	Ida-Viru body		4,5	5
		polluted body of the oil shale basin		5,1	5
S_O under Devonian	2006-14		2,7		3
S-O	2006-14		5,8	2,6	8
Measures of Pandivere groundwater sub-district, 500 million kroons as of 2004 (10%)	2014	More stringent specific measures for the protection of groundwater in Pandivere, not specified in the Viru-Peipsi plans	25	25	50
O-Cm	2006-14			4,5	5
Cm-V	2006-14	Voronka water-bearing horizon/aquifer		4,5	5
		Gdov water-bearing horizon		3,6	4
Protection of water intakes against pollution, creation of sanitary protection zones	2007	Ensuring implementation of restrictions within sanitary protection zones of groundwater intakes	1,5	0,5	2
IV Measures of groundwater in total			**50**	**65**	**115**
V Ensuring near-natural status of surface water bodies, water quality and resources					
Main measures					
Preventive measures for water bodies in good status	-2007	Tidying up and maintaining valuable river sections in good status	5	1	6

Measures	Implementation period	Area and activities	PEIPSI million EEK	VIRU million EEK	TOTAL million EEK
	-2014	Tidying up and maintaining valuable river sections in good status	8	2	10
	-2007	Surveys of headwaters of the Ahja, Piusa and Võhandu rivers	1		1
	-2007	Conservation programme for lakes in very good status	1,5		2
	-2014	Preventive measures for lakes in very good status	7		7
Recovery of rivers in poor chemical status					
Surveys and programmes of rivers in poor status	-2006	Purtse		2,5	3
	-2007	Selja, Pühajõgi, Ilmatsalu, Soolikaoja	3	0,5	4
	-2007	Toolse, Rausvere, Kavilda, Sanniku, Koreli	1,5	1	3
	-2014	Pilot work	10	10	20
Pilot works for renovation of lakes in a poor status	-2014	Surveys and pilot works of renovation of lakes	25		25
Prevention of flooding risk		Renovation of regulators of reservoirs at high risk of flooding and removal of sediment	31,1	14	45,1
		Alleviation of floods in the town of Võru	1		1
		Alleviation of floods in the town of Tartu	0,5		0,5
Tidying up bathing areas and bathing waters	-2014	Lake Peipsi and small lakes	2	4	6
	2006-2014	Beaches on the sea		3	3
		Rivers	1	1	2
Supplementary assessment of heavily modified water bodies	2006		1,4	0,7	2
Inventory-taking and assessment of artificial water bodies	2006		0,5	0,5	1
Main measures for surface water in total			**100**	**40**	**140**
Supplementary measures for surface water					
The Cohesion Fund project on improving the ecological status of flowing bodies of water			60	40	100
Improvement of the status of regulated water conduits					
		Hydro-technical work to ensure sanitary flow rates, renewal or reconstruction of regulators	5,5	0,7	6,2
		Removal of sediment and vegetation from reservoirs	50,8	6,3	57,1
		Sanitation of regulated watercourses	8	2	10
Regulation of beaver populations, removal of dams on rivers			5	1	6
	-2021	Measures for 56 dams			

Measures	Implementation period	Area and activities	PEIPSI million EEK	VIRU million EEK	TOTAL million EEK
Preservation and renovation of the status of lakes					
	-2006	An action plan and a draft project for Kurtna lakes		1	1
	-2014	Implementation of the action plan for Kurtna lakes		15	15
	-2006	Vooremaa action plan	1		1
	-2014	Implementation of the action plan for Voremaa lake district	20		20
Ensuring receipt of waste and bilge water		*Waste management plan*	*5*		*5*
Ensuring the ecological potential of artificial water bodies					
	2007-2014+	Ensuring the ecological potential of the artificial water bodies of oil shale energetics		100	100
	2014	Improvement of the status of artificial water bodies	6	10	16
Restoration of the dry river bed of the Narva River	-2014			30	30
Clean-up of the Purtse, Erra and Kohtla rivers	-2021				
Supplementary measures for Lake Peipsi	-2021				
V Surface water measures in total			**261**	**246**	**507**
VI Coastal waters					
Accident prevention in harbours	2006-2014			10	10
Ensuring receipt of waste and bilge water in small ports		*Waste management plan*		*5*	*5*
VI Coastal waters in total				**15**	**15**
VII Management and administration of the water management plan	2006-2014				
Assurance of horizontal cooperation between institutions	2006-2014		0,9	0,5	1,4
Lake Peipsi cooperation	2006-2014		3	0,5	3,5
Inspection of the situation of environmentally dangerous sites and observation of production requirements	2006-2014	In addition to current activities concerning KI	4	3,5	7,5
Inspection and monitoring of areas of past pollution	2006-2014		1	4	5
Monitoring programmes of surface and groundwater, incl. OA	2006-2014		12	6	18
Restriction of discharge of phenolic compounds – control, training, monitoring	-2014		0,3	1,5	1,8
Inspection of bathing water	2006-2014				

Measures	Implementation period	Area and activities	PEIPSI million EEK	VIRU million EEK	TOTAL million EEK
Inspection of the water quality of public water supply and drinking water of scattered settlement areas	2006-2014				
Preparation of management plans for land improvement systems	-2009				
Completion of inventory-taking and permit-issuing for dams and reservoirs	2008		2	1	3
Management of the water management plan, guidelines, inclusion of the parties and general public, training courses	2006-2014	9 years of coordination	9	9	18
Cross-border cooperation with Russia	2006-2014		18	9	27
Linking the water management plan horizontally with other programmes (Estonian National Development Plan, Rural Development Plan, RES, etc)	2006-14		1,5	0,5	2
Specific identification of the public interests in the use of water bodies	-2007		0,5	0,2	0,7
Establishment of water conservation areas, combining water conservation and present LKA	2005-2008		2	2	4
Development of recreational holidays near water bodies	-2014		4	4	8
Economic surveys of water use and a model (with calculations of indirect expenses and impact compensation)	-2009			3	3
Bringing monitoring programmes into conformity with the objectives of the water management plan, incl. starting self-monitoring	-2006		0,3	0,3	0,6
Organisation of assessment of environmental impact by sets of water bodies			2	1	3
Economic assessment of the use of natural water services and measures	2006		1	2	3
Conclusion of major problems with water	2007		0,2	0,5	0,7
Specification of environmental objectives on the basis of socio-economic and environmental assessment	-2008		1	2	3
Adjusted water management plan for each sub-district	-2009		1	2	3
VII Administration in total			**64**	**52**	**116**
Sub-districts in total			**3614**	**4466**	
Water management area in total					**8079**

8 INCLUSION OF AND PROVISION OF INFORMATION TO THE GENERAL PUBLIC

Publication of the water management plan should bear in mind the real interests of the parties involved and the general public – contradictory interests of stakeholders has to be identified and a compromise must be reached with the help of the public. For instance, the following issues deserve attention:

- Relations between economic development and the status of the environment, environmental requirements for production stemming from the objective of achieving good status of water.
- Potential competition for use of water resources (e.g. in areas where groundwater resources are limited; the use of surface water as recipient, for aquaculture, or for recreational purposes).
- Quality objectives, environmental requirements, water supply and sewerage costs.
- The impact of oil shale mining, energetics and the oil shale chemical industry on the status of water, securing quality drinking water to people in the Viru sub-district.
- Contradiction between groundwater (drinking water) quality and agricultural development in nitrate sensitive area.
- Contradiction between the interests of dam users and the preservation of fish habitats and fish migratory routes.
- The preservation of fish stock in Lake Peipsi and development of coastal villages.
- The impact of livestock farming on lakes and small watercourses.
- The recreational use of water bodies (ensuring access, safe-guarding the interests of land owners, and nature conservation).

When the water management plan is published, focus must primarily be laid on regional problems (above the local government level).

8.1 Publicity events in 2002-2005

2002

Presentation of the project for preparing the Viru-Peipsi water management plan

19 November, Tartu (local governments of the Tartu, Viljandi and Jõgeva counties)

20 November, Räpina (local governments of the Põlva, Võru and Valga counties)

26 November, Rakvere (local governments of the Harju and Lääne-Virumaa counties)

27 November, Jõhvi (local governments of the Ida-Virumaa County).

The project implementation unit organised four seminars in November 2002 together with the local environmental authorities to present the project for compiling the Viru-Peipsi water management plan. Invitations to seminars were sent to environmental authorities and those local governments which are located within Viru-Peipsi catchment area. (107 in total), county governments, health protection offices and county land improvement bureaux. About 100 representatives of local governments and the environmental authorities participated in seminars.

The Viru-Peipsi project manager Ain Lääne and the project manager assistant Peeter Marksoo dedicated the first part of the seminars to presentation of the principles of the Water Framework Directive and preparation of the water management plans, and the objectives, time-schemes, planned tasks and outputs of the project. Other issues covered were the role of environmental authorities and local governments in implementing the project; cooperation with the project implementation unit; and publication of the course and results of the project (articles in the press, materials for presenting the project, the project website).

The second part of the seminars was dedicated to water management issues of the counties. Presentations were made by Hilja Kikas and Kristiina Kütt from Tartumaa Environmental Authority, Enn Selgis from Jõgevamaa Environmental Authority, Marina Hiiob, Ly Kaasik and Merle Laas from Võrumaa Environmental Authority, Meelis Järvemägi from Põlvamaa Environmental Authority, Virve Kask from Lääne-Virumaa Environmental Authority and Tiiu Sizova from Ida-Virumaa Environmental Authority.

2003

The meeting of transboundary water bodies

26-29 May 2003, Tartu

Participants: representatives of the Viru-Peipsi and TACIS projects. The meeting discussed an assessment of the status of Lake Peipsi, prepared by a TACIS project representative Mr Mikko Jokinen, and its submission to the Estonian-Russian commission on transboundary water bodies. The joint commission approved the report on the status of Lake Peipsi which will serve as the basis for the application of measures for the protection of Lake Peipsi.

The seminar on water management plans for specialists of environmental authorities

4-5 December, Vihula, Lääne-Virumaa

Participants: representatives of the Viru-Peipsi project, specialists from the Ministry of the Environment and specialists from all environmental authorities.

They discussed the status of rivers, lakes and groundwater in the Viru-Peipsi water management area and designation of water bodies.

The meeting of the Estonian and Russian experts on Lake Peipsi

15 December, Tartu

Participants: representatives of the Viru-Peipsi project, specialists from the Ministry of the Environment and environmental specialists from Russia.

The meeting discussed the following:

1) Guideline documents on the status of the status water bodies

2) Joint expeditions to Lake Peipsi in 2004

3) Opportunities for rendering a joint opinion on the status of Lake Peipsi

2004

The seminar on restoration and reconstruction of reservoirs

18-19 March, Rõuge, Vooremaa

Participants: experts from Maa ja Vesi AS, Maves AS, the Institute of Zoology and Botany of the Estonian Agricultural University, and representatives of the Viru-Peipsi project.

Water problems related to the reservoirs were discussed.

Joint seminars of the projects LIFE Viru-Peipsi CAMP, UNDP/GEF and of officials of the Jõgeva, Tartu, Põlva, Võru and Ida-Virumaa local governments on the issues of water management

1-2 April, 2004, Voore, Jõgeva County (20 participants)

15-16 April 2004, Waide Motel, Tartu County (17 participants)

19-20 May, 2004, Karaski, Põlva County (25 participants)

8 June, 2004 Remniku, Ida-Viru County (15 participants)

Participants in the seminars: officials of the LIFE Project, the Peipsi Cooperation Centre and the Jõgeva, Tartu, Põlva, Võru and Ida-Viru counties, specialists from the environmental authorities of these counties; Indrek Tamberg, Head of the Water Department of the Ministry of the

Environment; Marko Err from Eesti Veevärk Konsultatsioon AS; Leena Albreht, Head of the Planning and Monitoring Department of Health Protection Inspectorate; Indrek Tamm, the project manager of Maves AS; Vahur Värk, the project manager of Entec AS.

The seminars aimed to discuss issues concerning the public water supply and sewage development plans with officials of the Jõgeva, Tartu, Põlva, Võru and Ida-Viru counties, and relations between these plans and the Viru-Peipsi water management plan, and to describe the status of the aquatic environment in the Jõgeva, Tartu, Põlva, Võru and Ida-Viru counties.

The international BERNET CATCH seminar

13-14 June, Toila

Peeter Marksoo presented the status of the aquatic environment in the Viru-Peipsi region.

The joint seminar on groundwater modelling in Russia

15-18 June, St Petersburg

Ain Lääne and Rein Perens participated from the Geological Survey of Estonia. Ain Lääne presented the Viru-Peipsi water management plan project and Rein Perens spoke about groundwater modelling in the Viru-Peipsi area.

2005

Public meetings in six counties for the presentation of the programmes of measures compiled in the course of the project of the Viru-Peipsi water management plans

1 June, Jõgeva (local governments of the Jõgeva, Järva and Harju counties)

2 June, Tartu (local governments of the Tartu county)

8 June, Jõhvi (local governments of the Ida-Viru county)

9 June, Rakvere (local governments of the Lääne-Viru county)

15 June, Võru (local governments of the Võru and Valga counties)

16 June, Põlva (local governments of the Põlva county)

Invitations to the seminars were sent to representatives of those local governments which are located within Viru-Peipsi region (rural municipalities and towns, 107 in total), county governments, health protection offices, county land improvement bureaux and businesses. Ain Lääne (the project manager of the Viru-Peipsi project), and experts from Maves AS and Eesti Veevärk Konsultatsioon AS presented the project results.

The status of the water bodies within the project area was presented along with measures for achieving good status, fulfilling of the Urban Wastewater and the Drinking Water Directives, reducing agricultural pollution, and protecting groundwater. These issues were actively discussed.

Results of the publicity events

The effectiveness of such public events is obvious. The water management specialists of the local governments were active participants in the events. Later on, the local governments have provided detailed information on the status of surface water bodies and groundwater in their territories. The prepared project materials will enable the local governments to implement the measures of the water management plans in the future. They are also interested in linking local development plans for public water supply and sewage and the water management plans of the basins. It is in their interest that the basin's water management plan take local priorities into consideration.

Local residents remained inactive in the project meetings, evidently because environmental issues are not of a high priority to people, and individual water-related problems cannot be related to the water management plan.

These results were achieved:

- Attention was drawn to the need to identify reasons why a heavily modified water bodies are considered to have been substantially modified, and to submit initial proposals for the improvement of the status of water bodies (rivers) either by constructing fish ladders or removing dams. The project chapter on dams should look at other aspects as well beyond the aspect of fisheries management. It was concluded that the information on impoundment structures collected in the course of the project is insufficient and such work should be continued. Supplementary information has to be recorded in the database of dams at the Environment Information Centre. Local governments should participate more actively in the assessment and resolution of problems related to reservoirs and impoundment structures. ERDF funding will probably be partly used.
- The problem of fluorine with expected solutions should also be included in the water management plans.
- It was also decided that proposals concerning a problem with radium in Kunda must be included in the management plan. Options include finding a new groundwater supply from elsewhere, and using surface water as a source of drinking water.
- The inclusion of planned mines and other large-scale industries in the water management plan is not possible as a rule. The primary aim of the water management plan is to prepare a set of measures to bring a water body into good status. The preservation of the good status of water bodies must be ensured as well, which requires the observation of procedures in compliance with the Water Act and the taking into consideration of restrictions established in the water management plans covering the issuance of new water use permits and new construction. Attention should be drawn to the impact of potential plans concerning the preservation in good status of the water resources of the region on the basis of the material collected within the Viru-Peipsi project.
- The water management plans cannot possibly establish additional restrictions on existing livestock farms or those under planning. The problem should find its logical solution when the IPPC Directive is implemented in 2007.
- Participants agreed that the inclusion of settlements of less than 500 inhabitants and of scattered settlement areas in the measure programme of the management plan will not be feasible unless local governments include such areas in the public water supply and sewage development plans. It was considered necessary that the assessment of financial expenses forms a financial and economic part of the programme of measures.
- The water management plans and management plans for land improvement systems should be linked. This should be carried out in close cooperation with land improvement bureaux in the next few years.
- The participants learned that the water management plan within the Viru-Peipsi CAMP project will be completed by late August 2005 and will then be made accessible on the project's website for three months. The project has no funds for developing the water management plan further.

9 COMPETENT AUTHORITIES AND CONTACT INFORMATION

The Water Framework Directive 2000/60/EU of the European Parliament and the European Commission provides for the organisation of water management on the basis of river basins. For this purpose all Member States identify river basin districts in their territories and determine competent authorities. A river basin district serves as the primary unit of administration of river basins. A competent authority coordinates the preparation of a water management plan of a river basin district.

The Water Act is mainly used to regulate administration of the use and protection of water. Pursuant to the Water Act the Minister of the Environment coordinates the preparation of the water management plans and consequent application of the Water Framework Directive.

River basin districts which form the primary management units of the river basins are determined on the basis of the government order of 3 June 2004 No 210 "Determination of River Basin Districts and Sub-districts" which lists three river basin districtss in Estonia: West Estonia, East Estonia and Koiva. Both the East Estonia and Koiva districts are international as water bodies which form part of those basins cross the national borders of Estonia.

The Minister of the Environment oversees the preparation of the water management plans and the application of the requirements of the said Directive in the river basins. Relevant international agreements provide for the coordination of activities in the case of international river basin districts. The cooperation agreement on protection and sustainable use of transboundary water bodies between the Government of Estonia and the Government of the Russian Federation shall apply in the case of the East Estonian river basin district. As regards the Koiva river basin district, the Ministry of the Environment of Estonia and the Ministry of the Environment of Latvia have concluded an agreement on cooperation.

The process of implementation of the Water Framework Directive began in 2000 with the adoption of the Directive. To achieve the environmental objectives established on the basis of the Directive, a programme of measures is drawn up for each river basin, with implementation of the programmes to begin in 2009 within the framework of the water management plan of the relevant river basin district. The first deadline for achieving the environmental objectives set on the basis of the Directive is 2015 [36].

The river basin districts in Estonia are internally divided into sub-districts.

The geographical area included in the river basin districts and sub-districts is presented in Chapter 1. The boundaries of the river basins and sub-districts are presented in Figure 1.

Legal form of a competent authority The competent authority is the Ministry of the Environment. The Ministry of the Environment is a government authority which operates pursuant to its statutes. The statutes of the ministry were enacted by the Government regulation No 437 of 30 December 1999.

The area of government of the Ministry of the Environment covers the following:

- the management of national environmental and nature protection;
- the performance of tasks relating to land and to databases containing spatial data;
- the management of the use, protection, recycling and registration of natural resources;
- radiation protection;
- environmental supervision; the management of meteorological observation, nature and marine research,
- the management of geological, cartographic and geodetic operations;

- the maintenance of the land cadastre and water cadastre;
- international environmental aid and the preparation of relevant draft legislation.

The Minister of the Environment runs the ministry. The Chancellor runs the operations of structural units of the ministry. The Water Department organises the preparation and implementation of the water management plans.

The Ida-Virumaa Environmental Authority coordinates the preparation and implementation of the Viru sub-district plan. The Tartumaa Environmental Authority coordinates the preparation and implementation of the Peipsi sub-district plan.

Names and addresses of the competent authorities

East Estonia river basin:

The Ministry of the Environment
Narva mnt 7a Tallinn 15172
Phone (+372) 6262 802
Fax (+372) 6262 801
E-mail: min@ekm.envir.ee

Peipsi sub-district:

Tartumaa keskkonnateenistus
Aleksandri 14 Tartu 51004
Phone 7302242
Fax 7302241
E-mail: E-mail: tkt@tartu.envir.ee

Viru sub-district:

Ida-Virumaa keskkonnateenistus
Pargi 15, 41537 Jõhvi
Phone 33 24 401
Fax 33 24 403
E-mail: keskkond@ida-viru.envir.ee

Area of responsibility

The Ministry of the Environment as a competent authority is responsible for the administration of all issues arising from the implementation of the Water Framework Directive.

The competent authority is responsible for the following:

- identification of river basins
- identification of bodies of water
- identification of heavily modified and artificial water bodies
- identification of areas which require protection
- preparation and maintenance of the registry of areas requiring protection
- description and classification of water bodies
- determination of reference conditions
- preparation of a review of impact of the human activities
- economic analysis of water use
- determination of deviations

- monitoring of surface water bodies
- monitoring of groundwater
- monitoring of protected areas
- calculation of the principle of cost recovery of water services
- setting of emission limit values
- application of control measures concerning emissions
- preparation of programmes of measures
- application of programmes of measures
- issuance of emission permits
- abstraction regulation
- administration of prohibition of discharge of pollutants into groundwater
- application of measures for the reduction of accidental pollution
- public information
- inclusion of the general public
- implementation of control of priority hazardous substances

On the basis of its statutes:

For the administration of the use of national natural resources and environment and management of nature conservation, the ministry carries out the following activities within its area of competence. It:

1) manages the preparation and implementation of common policies for environment and nature conservation, forestry and fisheries;

2) manages the inclusion of natural objects under protection and their conservation, and manages those under conservation;

3) administers the management of state forests;

4) regulates the introduction of genetically modified organisms into the environment;

5) manages the observation of the state of the natural environment and forecasts the state of the environment;

6) organises the preparation of environmental norms;

7) coordinates and administers the assessment of environmental impacts and risks; coordinates the introduction of environmental auditing and environment management systems;

8) manages the creation of the system of treatment for hazardous waste;

9) manages radiation safety activities;

10) organises the issuance of pollution permits and the control of the volumes of pollutants;

11) manages the collection and mediation of meteorological information;

12) manages the survey, accounting and use of national mineral resources;

13) issues permits and licences pursuant to legislation.

In the area of surveillance of the natural environment the ministry carries out the following. It:

1) organises supervision of the environment, the use of natural resources and environment and nature conservation in Estonia, and also the exclusive economic zone inasmuch as exercise thereof does not contradict international agreements;

2) organises radiation monitoring.

The ministry maintains national registers as follows. It:

1) manages the maintenance of the state land cadastre and development of the land register;

2) organises the maintenance and development of the registers on the environment, the use of natural resources, pollution of nature, and natural sites, and ensures the public availability of such data.

The ministry prepares draft legislation. It:

1) prepares draft legislative acts which regulate the area of government of the ministry and bears responsibility for their compatibility with the constitution and their applicability; participates in drafting other legal acts related to environmental protection;

2) issues opinions on and coordinates draft legislation prepared by other ministries which has been submitted for coordination;

3) manages the preparation of accession to the international agreements and conventions within the area of government of the ministry.

Other issues. The ministry:

1) disseminates public information on the environment;

2) prepares development plans and programmes within the ministry's area of government, analyses and assesses the efficiency of their application;

3) assists and cooperates with other government departments concerning issues within the area of government of the ministry;

4) represents the state at an international level within the area of government of the ministry pursuant to procedures set in the Foreign Relations Act (RT I 1993, 72/73, 1020; 1996, 49, 953; 1997, 73, 1200);

5) coordinates international cooperation and the fulfilment of international agreements in the area of government of the ministry;

6) prepares the draft budget of the ministry on the basis of the area of government and tasks, and prepares a budget report;

7) administers state assets in the ministry's area of government pursuant to the State Assets Act and legal acts adopted on the basis of that act;

8) inspects the activities of the government departments in its area of government;

9) fulfils other tasks prescribed by law, resolutions of the Parliament, decrees of the President of the Republic and regulations and orders of the Government of the Republic.

Membership

The Ministry of the Environment as a competent authority is not a coordinating authority between other competent authorities.

International relations

The basin districts of Lake Peipsi and the Narva River are transboundary and the basins are shared by several states.

Pursuant to *The Convention on the Protection and Use of Transboundary Watercourses and International Lakes* of the UN Economic Commission for Europe, the Government of Estonia and the Government of the Russian Federation concluded an agreement for the protection and sustainable use of common transboundary water bodies. The agreement's objective is to arrange cooperation for the protection and sustainable use of transboundary water bodies and their ecosystems. The parties of the agreement have agreed:

1) to cooperate on the preparation of water quality norms, assessment methods and classification;

2) to apply the necessary measures to avoid discharge of pollutants in water sites or to reduce to it an agreed minimum level;

3) to ensure the sustainable use of water resources through the application of modern technologies, efficient waste treatment facilities and the use of water-efficient technologies;

4) to ensure maintenance of hydro-technical and water protection facilities on transboundary water bodies in the required technical status;

5) to avoid act or omission which may cause worsening of hydrological and hydro-chemical regimes of the transboundary water bodies or their ecosystems;

6) to conduct joint research on the ecosystems of Lake Peipsi and Lake Pskov;

7) to perform coordinated environmental surveillance.

An Estonian-Russian joint commission for transboundary water bodies has been set up to coordinate the activities arising from the agreement.

10 UPDATING THE WATER MANAGEMENT PLAN

The water management plans of river basins are updated every six years. The time-scheme for the implementation of the Water Framework Directive and the preparation of the water management plans is as follows:

- 2003 Compliance with the Directive's requirements and obligations, and with the legal systems of the Member States
- 2004 Completion of the review of the impact of human activities and the economic analysis of the use of water
- 2006 Review of the monitoring programmes, identification of major problems, setting of priorities in the river basin distrit
- 2008 Presentation of the water management plan of the river basin district to the public
- 2009 Finalisation of the first water management plan
- 2010 Implementation of the water management plan
- 2015 Achievement of environmental objectives (good water status); water management plan No 2

The water management plans of the Viru and Peipsi sub-districts together with that of the Võrtsjärve sub-district form part of the East Estonia water management plan. The need to update the water management plans may arise when unexpected changes in the status of the water occur and prompt amendments to the programme of measures are required. The need to review the water management plan of the river basin may be caused by a large-scale project planned in the sub-district. The environmental impact of such projects must be carefully assessed and, where necessary, the specifications of the water management plan or rejection of the project must be considered, if there is a shortage of water resources for the implementation of the project, or if water status may considerably deteriorate. Motions to amend the plan have to be made in writing and made public.