Water quality of lakes, rivers and sea areas in Finland in 2000–2003

Finland is known as a land of numerous lakes and clean waters. There are about 56 000 lakes with a surface area of over one hectare and about 2600 lakes larger than one square kilometre.

Because of the relatively cold climate and prevalent pre-Cambrian bedrock, the rate of weathering is slow and, therefore, the concentrations of inorganic substances in Finnish surface waters are low. By contrast, the concentrations of dissolved organic substances, for example, humic acids, can be high locally, since bogs cover about 30% of the area of the country. The waters of Finnish lakes and rivers are mainly soft and often humic. The shallowness of lakes (average depth about 7 metres) and relatively low discharges of rivers, together with the long period of ice cover, make inland waters sensitive to pollution. Generally speaking, the water quality of Finnish inland waters improves from south to north and from west to east, being poorest in coastal areas in the south, southwest and west.

In many places, lakes and rivers form lake chains. Finland's rivers have a combined length of more than 21 000 kilometres, but mostly they are very short individually.

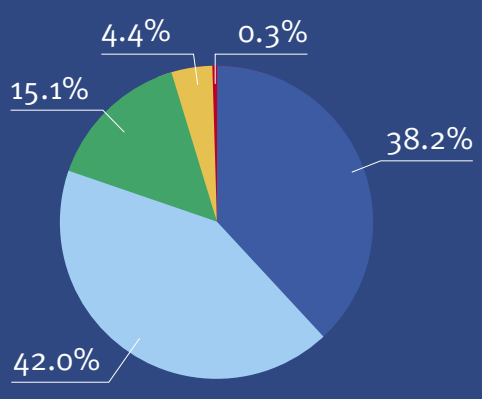
The Finnish coast is heavily embayed and fringed with 73 000 islands and islets.

The Baltic Sea is shallow with a mean depth of only 55 metres. The fact that the Baltic Sea forms a mostly closed, shallow and cold brackish basin means that coastal waters are also highly vulnerable to pollution. Harmful substances degrade slowly under the cold conditions and the winter ice cover prevents oxygen being transferred from the air to the surface water.

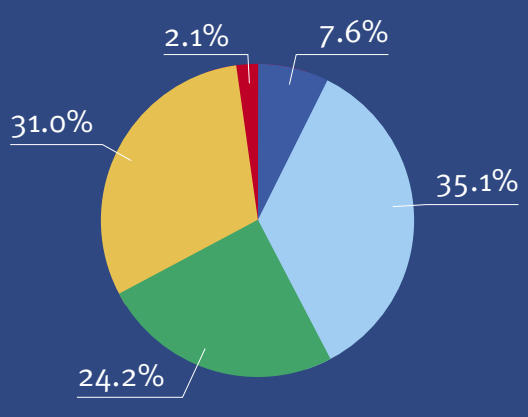
Finland has achieved good results in water protection by setting quantitative national water protection targets with specific time frames. The United Nations World Water Assessment Programme examined water quality indicator values in 122 countries. Finland was the highest ranked country in this assessment (the World Water Development Report in 2003). According to the water poverty index devised by the World Water Council and the British Centre for Ecology and Hydrology, Finland was also ranked number one in the world, among 147 countries included in the comparison. The criteria of this comparison included resources, access, capacity, use and the environment. However, there is still a lot of work to be done on water protection, for example, reducing eutrophication in lakes and the Baltic Sea.

Since the beginning of the 1970s, three national water protection programmes have been prepared, and the Government has adopted the two most recent ones. In these programmes quantitative targets for the most important pollution sources were defined. The third national water protection programme approved by the Government in 1998 sets targets for the year 2005. The long-term goal is that the state of the Baltic Sea and of inland surface waters is not degraded any further by human activities. The main aim of this programme is to reduce the eutrophication of the waters.

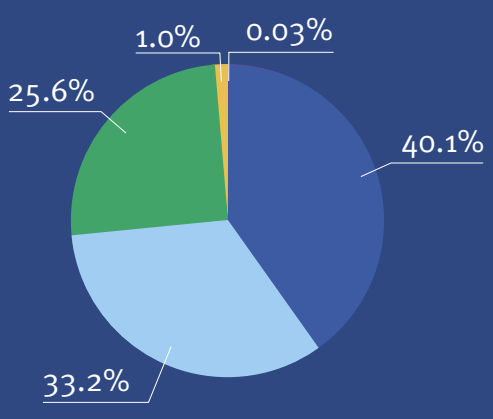
In April 2002, the Finnish Government adopted Finland's Programme for the Protection of the Baltic Sea. Steps will be taken to combat eutrophication, decrease the risks caused by hazardous substances, reduce the risks of maritime traffic, protect biodiversity, and increase environmental awareness and research.



Lakes



Rivers



Sea

Excellent

Good

Satisfactory

Passable

Poor

Tenojoki
Inari
Porttipahta Reservoir
Lokka Reservoir
Muonionjoki
Ounasjoki
Kemijärvi
Rovaniemi
Yli-Kitka
Tornionjoki
Kemijoki
Iijoki
Kiantajärvi
Oulu
Oulujärvi
Kajaani
Pyhäjoki
Kokkola
Vaasa
Lappajärvi
Pielinen
Kyrönjoki
Keitele
Kuopio
Kallavesi
Jyväskylä
Näsijärvi
Mikkeli
Saimaa
Pori
Tampere
Kokemäenjoki
Päijänne
Lappeenranta
Pyhäjärvi
Hämeenlinna
Kouvola
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The general usability classification

The general usability classification of water bodies gives an idea about the average suitability of the water bodies for water supply, fishing and recreation in Finland. The quality class is determined based on the natural quality of the water and human impacts. The water bodies have been classified into five classes: excellent, good, satisfactory, passable and poor.

Water quality mostly good in lakes and the open sea

The classification was based on data from the period 2000–2003 and covered 82% of the total area of lakes with size greater than one square kilometre, 16% of the total length of rivers with width more than two metres, and the sea area inside the Finnish territorial waters.

The quality of water was excellent or good in 80% of the classified lake area and in 73% of the sea area. In general, the water quality in rivers was worse than in lakes, because human activities, such as agriculture and development, are concentrated along rivers. Moreover, many rivers are sensitive to the effects of nutrient loading because of their low flow rates. Some 43% of rivers are classified as excellent or good quality. These rivers are mostly located in northern Finland.

More problems in rivers and in the Gulf of Finland

Eutrophication is a problem especially in the Gulf of Finland, in the Archipelago Sea and in the vicinity of some estuaries in the Gulf of Bothnia. Some 26% of sea areas were classified as satisfactory, passable or poor. In the Gulf of Finland, the area of the sea that was classified as passable had increased remarkably as compared with the earlier classification from the period 1994–1997.

In the Gulf of Finland, eutrophication is a consequence of excessive nutrient loads and the special physical conditions of the sea area. The nutrient load has actually decreased by nearly 40% since the late 1980s (nutrient load in 1987–2000, including point and diffuse source loading and natural background) for both nitrogen and phosphorus. However, eutrophication continues to be a problem, and is causing more abundant blue-green algae blooms in the summertime. The reason is that eutrophication is not only caused by nutrient loads from land areas, but also by the release of phosphorus from the sea bottom sediments. The release of phosphorus from the sediments has increased because of the lack of oxygen on the sea bottom.

Water quality affected by diffuse loading

In the vicinity of towns and industrial plants, water quality had improved considerably already at the beginning of the 1990s, because of long-term measures for water protection. These measures were further improved during the 1990s. However, a similar improvement in the state of water bodies has not been observed in areas with heavy diffuse loads.

Water quality is also affected by weather conditions and variations in runoff. During the years 2000–2003 there were periods where the water quality clearly deteriorated. In 2002 most of the country suffered from the worst drought in several decades, which caused water levels to drop in many water bodies. During the winter of 2002–2003, extremely poor oxygen conditions were observed in about 450 small and shallow lakes, especially in southern and western Finland, and mass die-offs of fish occurred in many of these lakes. The main reasons for the severe oxygen problems were an early ice cover and the low water levels. Low water levels also contributed to the degradation of rivers, especially in southwestern Finland.

Regular data collection

In Finland water quality has been classified since the 1970s. Using the same criteria, the environmental authorities have carried out the classification procedure four times for inland waters and twice for sea areas.

Water quality is monitored frequently in Finland in accordance with the national and regional programmes and under environmental permits. The national programme is based on monitoring networks of rivers, lakes and coastal waters. Several times annually, samples from about 550 sampling sites are analysed for some 20–40 water quality variables. In addition, there are thousands of sampling sites under regional and local monitoring programmes.

The results of the monitoring and control activities are stored in the national database maintained by the Finnish Environment Institute (SYKE). There are now more than 21 million records that have been entered into the database since the 1960s. In the classification done for 2000–2003, data from some 5370 lake sites, 3900 river sites and 1100 sea sites were used. In this period, some 2.6 million water quality records were entered into the database.

Comparison of the two latest classifications

	2000–2003		1994–1997	
Lakes	**km²**	**%**	**km²**	**%**
Excellent	10,110	38.2	9,730	37.8
Good	11,130	42.0	10,880	42.3
Satisfactory	4,010	15.1	3,990	15.5
Passable	1,160	4.4	1,070	4.1
Poor	79	0.3	67	0.3
Total	26,490	100	25,737	100
Rivers	**km**	**%**	**km**	**%**
Excellent	1,600	7.6	1,490	7.7
Good	7,430	35.1	6,030	31.2
Satisfactory	5,130	24.2	5,860	30.4
Passable	6,570	31.0	5,640	29.2
Poor	450	2.1	290	1.5
Total	21,180	100	19,310	100
Sea area	**km²**	**%**	**km²**	**%**
Excellent	21,090	40.1	22,370	42.5
Good	17,470	33.2	23,820	45.2
Satisfactory	13,490	25.6	5,890	11.2
Passable	540	1.1	590	1.1
Poor	16	0.03	17	0.03
Total	52,610	100	52,690	100

Classification will be based on ecological state of water bodies

By 2015 all surface and ground water bodies within the European Union should have reached a good state of water quality and the degradation of the state of waters should thus be prevented (Water Framework Directive from the year 2000). In order to reach this goal, river basin management plans are to be made for all river basin districts by 2009. In the plans, significant pressures and impacts of human activity will be identified, environmental objectives will be set and measures to achieve the environmental objectives will be identified.

The quality criteria for water bodies and the classification will be reformed in accordance with the directive; this work has already started in Finland. In the future, the classification will be based more on the ecological state of water bodies. This will be done by comparing such factors as fish fauna, benthic fauna and macrophytes with conditions in which the human impact is negligible.

Criteria for the general water quality classification in Finland

Excellent: The watercourse is in a natural state, usually oligotrophic, clear or with some humus. Water use is not restricted by any special occurrence of algae. Highly suitable for all modes of use.

Good: The watercourse is in a near-natural state, slightly eutrophic or clearly humic. Locally restricted algal blooms can occur occasionally. Water is still suitable for most modes of use.

Satisfactory: The watercourse is slightly affected by wastewaters, diffuse loading or other changing activity, or is appreciably eutrophic or humic due to natural causes. Algal blooms can occur repeatedly. Concentrations of harmful substances in water, sediment or biota can be slightly higher than in pristine conditions. The watercourse is usually satisfactory for most modes of use.

Passable: The watercourse is strongly affected by wastewaters, diffuse loading or some other changing activity. Algal blooms are common and may restrict water use for a long period. Concentrations of harmful substances in water, sediment or biota can be clearly higher than in pristine conditions. In catchments with Littorina Sea* clay deposits, the pH of water can be very low for short periods and die-offs of fish caused by the acidic conditions can sometimes occur. Water is suitable only for modes of use having few water quality requirements.

Poor: Wastewaters, diffuse loading or other changing activity extensively pollutes the watercourse. Algal blooms occur frequently and are often abundant, restricting water use for a long period. Oxygen concentrations are clearly affected by eutrophication. Concentrations of harmful substances in water, sediment or biota can be at levels that cause a clear risk to the use of water or biota. In catchments with Littorina Sea* clay deposits, the pH of water can be very low for long periods and die-offs of fish caused by the acidic conditions occur repeatedly. Poorly suited to any mode of use.

* The sulphate (SO_4^{2-}) in acid sulphate soils was formed during 7500–2500 B.P., in the warm Littorina period, when the soils were covered with sea water. Littorina Sea clay is found in coastal areas of Finland.

Criteria for the general water quality classification

Variable	Unit	I	II	III	IV	V
		Excellent	Good	Satisfactory	Passable	Poor
Chlorophyll-a (lakes, rivers)	µg l^{-1}	< 4	< 10	< 20	20–50	> 50
Chlorophyll-a (sea)	µg l^{-1}	< 2	2–4	4–12	12–30	> 30
Total phosphorus (lakes, rivers)	µg l^{-1}	< 12	< 30	< 50	50–100	> 100
Total phosphorus (sea)	µg l^{-1}	< 12	12–20	20–40	40–80	> 80
Transparency	m	> 2.5	1–2.5	< 1	-	-
Turbidity	FTU	< 1.5	> 1.5	-	-	-
Colour	mg l^{-1} Pt	< 50	50–100 (< 200) [1]	< 150	> 150	-
Oxygen in surface water	%	80–110	80–110	70–120	40–150	serious problems
Oxygen depletion in hypolimnion		no	no	occasionally	frequently	common
Faecal coliforms or streptococci	nr in 100 ml	< 10	< 50	< 100	< 1000	> 1000
Hg in carnivorous fish	mg kg^{-1}	-	-	-	-	> 1
As, Cr, Pb	µg l^{-1}	-	-	-	< 50	> 50
Hg	µg l^{-1}	-	-	-	< 2	> 2
Cd	µg l^{-1}	-	-	-	< 5	> 5
Total cyanide	µg l^{-1}	-	-	-	< 50	> 50
Algal blooms		no	occasionally	frequently	common	abundant
Off-flavours in fish		no	no	no	common	common

1) humic waters in a natural state

More information:

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