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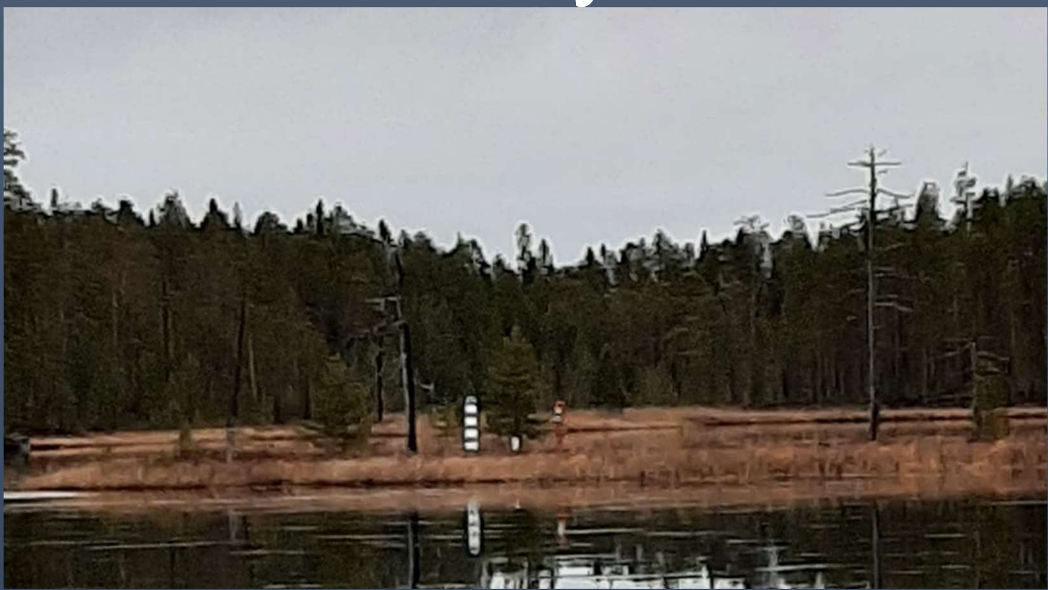
Finnish and Russian water legislation in the research projects of transboundary water



PÄTYNEN JUUSO, BERDINO ALEXANDER, GUSTAFSSON JAAKKO, PIRHONEN ILKKA

FINNISH ENVIRONMENT INSTITUTE, FINLAND AND KARELVODOKANAL, RUSSIA AND ANO ENERGY EFFICIENCY CENTER, RUSSIA
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1 Introduction

Good ecological status of the water bodies is an essential factor in successful environmental policy of a country. Several factors can deteriorate or endanger the ecological status of a water body. Threats can originate from the natural processes, but mostly their origin is in human activities, especially in the most severe cases.

Various human activities are intensive and large-scaled, and despite of their undeniable benefits for society, these activities could cause different harms and environmental problems. The disbenefits could be imminent because of their severity (pollution) or magnitude if potential negative effects spread to wide areas afar from their origin. Considering water basins, problems could escalate quickly because of the natural water flow and the contamination capacity of it.

Because of these realities, there is an inevitable need to take care of the good status of water basins and other water bodies like groundwater. The natural circulation of water is exceedingly pervasive, and many water basins spread to large geographical areas. As an example, quite common situation is, that a water basin stretches to the area of two or more countries, and therefore activities in one country could change the ecological or physical status of water basin in other countries also. Consequently, should something harmful occur, the negative consequences could spread to the area of another country. Especially so-called downstream countries are vulnerable. Therefore, it is not surprising that other countries are interested in potential emissions or other forms of distraction from the upstream countries.

Because harmful effects can be supranational, the actions that can prevent these kinds of problems should be implemented multilaterally as well. Considering the actual legislation, the main principle is, that the validity of each country´s own legislation will reach to its borderline. If there are immanent needs to co-operate between neighbour countries, that must make an agreement separately between two or more countries. In some cases, like between EU-countries, there are also other forms to create coordination, like directives that set some basic principles that must be implemented to each country´s legislation, which may help the cross-border coordination. The situation might be a bit more problematic, when there are not any or only a small number of ready-made arrangements between two or more countries considering actual issues.

Finland is a member of the European Union and obligated to follow the instructions of the Water Framework Directive and other EU law, whereas Russian Federation is outside of these arrangements. However, Finland and Russian Federation have made an agreement considering border water issues. The Finnish-Russian Agreement on the utilization of transboundary watercourses was concluded as early as in 1964. It sets out the principles for the use of transboundary rivers and lakes shared by the two states. The agreement is comprehensive, comprising the use, management, and protection of waters. The Agreement itself creates common frame of reference to the cooperation between Finland and Russian Federation, but there are still many differences considering the actual water legislation and its standards between these countries. In this report the focus is on legislative emission limits set for industry and environmental quality standards used in chemical and ecological classification of inland freshwater systems. In Finland, the review is focused on two EU directives, Water framework Directive (2000/60/EC) and Priority Substance Directive 2013/39/EC, and The Finnish Government Decree on Substances that are Hazardous and Harmful to the Aquatic Environment (1022/2006).

In Russia, the focus is on the environmental quality standards concerning water bodies that are identified as: 1) The highest class, first class or secondary class fishery areas. 2) Sources of usage and drinking water for settlements and food enterprises. 3) Water bodies used for recreational and cultural purposes. Also, the Russian approach to ecological classification of water bodies is reviewed. The Russian reference documents are: 1) "Requirements for the quality of water in reservoirs for drinking, cultural and household, recreational and fishery purposes”, 2) State Standard GOST R 58556-2019 “Assessment of water quality of water bodies from ecological viewpoints 3) "On approval of water quality standards for water bodies of fishery significance, including standards for maximum permissible concentrations of harmful substances in the waters of water bodies of fishery significance.”

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2 Ecological classification of water bodies

2.1 Finland: Five ecological status classes

Overall description

The water bodies are divided in five classes based on how strongly they have been changed by human activities chemically, morphologically, or biologically from the time the waterbody was in natural state. The lesser the impact caused by human activities has been, the better ecological status the waterbody is given.

The descriptions of the ecological classes are given in Water framework Directive Annex V (2000/60/EC) and they are from the best to the worst:

1) High status
2) Good status
3) Moderate status
4) Poor status
5) Bad status

The general definitions for statuses of rivers, lakes, transitional waters, and coastal waters as given in Annex V are:

High status

There are no, or only very minor, anthropogenic alterations to the values of the physico-chemical and hydromorphological quality elements for the surface water body type from those normally associated with that type under undisturbed conditions. The values of the biological quality elements for the surface water body reflect those normally associated with that type under undisturbed conditions, and show no, or only very minor, evidence of distortion. These are the type-specific conditions and communities.

Good status

The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.

Moderate status

The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.

Poor status

Waters showing evidence of major alterations to the values of the biological quality elements for the surface water body type and in which the relevant biological communities deviate substantially from those normally associated with the surface water body type under undisturbed conditions, shall be classified as poor.

Bad status

Waters showing evidence of severe alterations to the values of the biological quality elements for the surface water body type and in which large portions of the relevant biological communities normally associated with the surface water body type under undisturbed conditions are absent, shall be classified as bad.

Water Framework Directive Annex V also states more detailed definitions of statuses based on biological, hydromorphical, physico-chemical and general quality elements. However, because there are only rivers and lakes in the program region of Karelia CBC, this document will focus on class status definitions of rivers and lakes. For those type of waterbodies, the following quality element groups are used for definition of ecological statuses "high", "good" and "moderate":

- Biological quality elements: phytoplankton, macrophytes and phytobenthos, benthic invertebrate fauna and fish fauna.
- Hydromorphological quality elements: hydrological regime and morphological conditions. For rivers also river continuity.
- Physico-chemical quality elements: general conditions, specific synthetic pollutants, and specific non-synthetic pollutants.

Generally, the ecological status of the waterbody is determined by the lowest ranking quality element category. For example, if the waterbody otherwise fulfils the requirements to be classified as "good" ecological status; but observed levels of one or more nationally defined priority substances exceed their environmental quality standards, the best ecological status the waterbody can be classified as "moderate".

Table 1 Guidelines for 12 parameters that are used for defining water quality in water bodies in Finland (Vedenlaatuluokituksen raja-arvot ja lähteet).

Alkalinity	> 0.2 mmol/l good 0.1 – 0.2 mmol/l average 0.05 – 0.1 mmol/l mediocre 0.01 – 0.05 mmol/l poor < 0.01 mmol/l expired	Total Iron (Fe)	< 200 µg/l usage water 500-1000 µg/l inland waters 1000 -2000 µg/l swampy watersheds
Conductivity	<5 mS/m low conductivity 5 - 10 mS/m inland waters 50 - 100 mS/m wastewaters	Total phosphorus	< 15 µg/l poor 15-25 µg/l mildly eutrophicated 25-100 µg/l eutrophicated >100 µg/l highly eutrophicated
Colour	<15 mgPt / l: Colourless 20 to 40 mgPt / l: Slightly humus-rich 40 - 100 mgPt / l humus content > 100 mgPt / l highly humus-rich	Total nitrogen	< 400 µg/l poor 400-600 µg/l mildly eutrophicated 600-1500 µg/l eutrophicated >1500 µg/l highly eutrophicated
Chemical Oxygen Demand CODMn	< 4 mg/l Clear 4 -10 mg/l Colourless 10-20 mg/l Humus waters < 4 mg/l Humus levels scarce 4 -10 mg/l Humus levels low 10 -20 mg/l Humus levels medium > 20 mg/l Humus levels high	Acidity (pH)	> 7: Basic 7: Neutral <7 Acid 6.5 to 6.8: Slightly acidic, *typical value in Finnish waters.* 6.0-8.0: aquatic life adapted to life at this level. <5.5: The reproduction of roach and salmonids is disturbed
Suspended solids	< 1 mg/l clear 1 - 3 mg/l not having ice cover < 25 mg/l no risks for the fish	Oxygen saturation	85-110 % Excellent 80-110 % Good 70-80 and 110-120 % Satisfactory 40-70 and 120-150 % Adequate 0 and> 150 % Poor
Turbidity (Formazin Turbidity Unit - **FTU**).	< 1 FTU clear 1 - 5 FTU mildly turbid > 5 FTU clearly turbid	Chlorophyll-a	< 3 µg/l poor 3-7 µg/l mildly eutrophicated 7-40 µg/l eutrophicated >40 µg/l highly eutrophicated

2.2 Russian Federation: Five ecological status classes

This chapter presents a standard list of legal and scientific methods and instruments for assessing the ecological well-being of water bodies in Russian Federation based on State Standard **GOST R 58556-2019 "Assessment of water quality of water bodies from ecological viewpoints".**

Assessment of the water quality of water bodies from an ecological point of view is an obligatory stage of expert work related to the use of the resources of streams and reservoirs in economic activities when justifying the conditions for water use, the need for rehabilitation work, the expediency of water protection measures, et cetera.

The purpose of this standard is to develop, from an environmental standpoint, a system for assessing the quality (quality class) of surface waters and studying the dynamics of their state for streams and reservoirs. This standard is used whenever an expert opinion is associated with the assessment of the harmful effects of economic activities on a water body, and the assessment is carried out by assessing the quality of surface waters from an ecological perspective. It establishes terms, basic indicators, and an algorithm for determining the class of quality, depletion of water, degradation of aquatic ecosystems from an ecological point of view.

The standard is intended for:

- state executive bodies, local self-government bodies, whose responsibilities include monitoring, control, expertise, protection, preservation, rehabilitation of water bodies from the negative impact of waste, storm or rain waters, polluted groundwater discharges.
- legal entities and individual entrepreneurs, whose activities are related to the generation of industrial wastewater, subject to state accounting and regulation and discharged into water bodies.
- scientific, building and civil engineering design, and other organisations providing services in the field of conservation and rehabilitation of surface water bodies.

Some general basic terms connected to water quality parameters (indicators) are used in this State Standard:

- **water quality class** (from I to V)**:** The level of water quality established in the range of numerical values of the properties and composition of water, characterizing its suitability for a specific type of water use.
- **water quality:** A characteristic of the composition and properties of water that determines its suitability for specific types of water use.
- **analytic marker:** A marker (parameter) that provides a characteristic of a certain type of negative impact on the components of the natural environment in the form of a quantitative analysis result.
- **basic (estimated) indicators of water quality:** A group of analytic markers, which in the aggregate, provide unambiguous conclusions about the class of water quality of a surface water body from an ecological point of view.
- **basic indicator of anthropogenic load (**IAL_b or $ПАН_б$ in Russian): The indicator shows, in fact, how much water we should add to the concrete sample of dirty water (in m^3) in order to make this sample comply with the standard value (normative) for a specific analyte marker (for example, total phosphorus or others). Because of that the measurement unit of the IAL_b is m^3/m^3.

Table 2 shows how the natural **water quality classes** depend on the IAL basic indicator mentioned above (the same 5 classes of quality like in Finland).

Table 2 Classification of the natural waters' basic indicator of anthropogenic load (IALb)

Comprehensive assessment indicator	Water quality class of water bodies from an ecological point of view				
	I	II	III	IV	V
	very clean	clean	moderately polluted	contaminated	dirty
Ecosystem criticality state	The state of reversible changes		Threshold vulnerable state	The state of reversible and irreversible changes	
IAL_b ($ПАН_б$), cond. m^3/m^3 (GOST R 57075)	< 4.2	4.2 – 10.8	10.9 – 24	24.1 – 70	70.1 – 135

The IAL_b is an integral indicator of anthropogenic water load according to the established basic types of impacts and it is determined by summing of several IAL_i (indicator for each marker):

$$ПАН^б = \sum_{i=1}^{n} ПАН_i$$

It means that firstly each IALi should be calculated for each type of impact on water quality according to concrete methodology presented in the **GOST R 58556-2019,** Appendix B (compulsory) - **"Method for assessing water quality / negative impact on water quality based on the basic indicator of anthropogenic load".**

Eight basic factors of anthropogenic load are taken in consideration in this method of assessment:

1. Increase in total mineralization (Dry residue)
2. Acidification or alkalization (pH)
3. Reduced transparency (Inert suspended solids, suspended substances of anthropogenic origin)
4. Reduction of dissolved oxygen content (chemical oxygen demand COD)
5. Eutrophication (Total phosphorus / incl. phosphorus phosphates, Total nitrogen, Ammonium nitrogen, Nitrogen nitrate, Nitrite nitrogen)
6. Biogenic replenishment inside water bodies (Total Iron)
7. Secondary pollution from bottom sediments (Total Manganese)
8. Increased toxicity (toxicity is determined by calculation COD / BOD_5, if COD is > 50 mg/dm^3.

Note: The above list of basic analytic-markers includes: ***pH, dry residue, suspended solids, ammonium nitrogen, nitrite nitrogen, nitrate nitrogen, total phosphorus or phosphate phosphorus, total iron, total manganese, chemical oxygen demand (COD)*** *- totally* ***10 hydro-chemical markers (parameters)****.*
Biological oxygen demand (BOD) is not taken into account in the calculation of IAL_b, but taken into account in the preliminary operational assessment of the estimated calculated toxicity for waters of III-V quality class. In case ***COD> 30 mgO_2 /l the calculated toxicity (Tc)*** *should be included in the water monitoring and control programme at the assessment sites. It is calculated according to the formula:* ***Tc=COD/BOD_5,***

Therefore, it is necessary to measure only 14 basic indicators of anthropogenic load (IALi) for surface waters which are presented in *Table 3*.

Table 3 Quality standards of surface waters from an ecological viewpoint

Indicators (IALi)	Water quality class ([1])				
	I	II	III	IV	V
PH value, units pH	6.5-8.0	6.5-8.5	6.5-8.5	6.0-8.5	6.0-9.0
Mineralization (dry residue[2]), mg/dm^3 (sum of the concentrations of inorganic cations and anions)	<300	500	800	1000	1200
Suspended substances of natural origin[3], mg/dm^3 (organic and inorganic particles contained in water in suspension)	<20	20-30	31-50	51-100	101-200
Iron total, mg/dm^3	<0.5	0.5-1	0.5-1	0.5-5	5.1-10
Manganese total, mg/dm^3	<0.05	0.05-0.1	0.2-0.3	0.4-0.8	0.9-1.5
Ammonium (N), mg/dm^3	<0.1	0.1-0.2	0.3-0.5	0.6-2.0	3.0-5.0
Nitrite (N), mg/dm^3 ([4])	<0.002	0.002-0.005	0.006-0.02	0.03-0.05	0.05-0.1
Nitrates (N), mg/dm^3 ([2])	<1	1-3	4-5	6-10	11-20
Phosphates (PO_4) mg/dm^3 ([2])	<0.025	0.025-0.2	0.3-0.5	0.6-1.0	1.1-2.0
Total phosphorus (PO_4),mg/dm ([2])	<0.05	0.05-0.4	0.5-1.0	1.1-2.0	2.1-3.0
Chemical oxygen demand (COD), mg/dm^3	<15	15-25	26-50	51-70	71-100
Biochemical oxygen demand (BOD_5), mg/dm^3	<2	2-4	5-8	9-15	16-25
Organic carbon, mg/dm^3 ([2])	<3	3-5	6-8	9-12	13-20
Total nitrogen, mg/dm^3 ([2])	<1.5	1.5-4.0	4.1-7.5	7.6-17	17.1-35

2.3 Russian Federation: Water usage type approach

There is more applicable and widely used approach in Russian environmental and healthcare legislation, when “water quality" of surface waters is defined as - a characteristic of the composition and properties of water, which determines its suitability for specific **types of water use.** That is why in Russian legislation all water bodies are divided into three categories (types) of water use purposes:

1. The first type of water use includes the use of water bodies or their sections as a source **of drinking and household** water use, as well as for water supply for food industry enterprises.
2. The second type of water use is **recreational water use** *(for swimming, tourist and sport activities).* The water quality requirements established for this category of water use also apply to all sections of water bodies located within the boundaries of populated areas.
3. The third type of water use is the use of water bodies **for fishery** *(the highest category, first category and second category).*

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[1] If the parameter value is higher than the value specified for the V quality class, the water quality is characterized as "worse than the V quality class”

[2] The sum of the concentrations of inorganic cations and anions, dissolved in the water

[3] Organic and inorganic particles contained in water in suspension, not dissolved

[4] In well-equipped testing laboratories, it is recommended to additionally monitor the quality of water in water bodies in terms of total nitrogen along with a group of indicators: ammonium (N), nitrites (N), nitrates (N), organic nitrogen; total phosphorus, total and organic carbon

2.3.1 Water bodies used for drinking, household, and recreation

The main purpose of standardizing water quality in water bodies of 1 and 2 categories is to ensure the prevention and elimination of surface water pollution, which can lead to disruption of public health, the development of massive infectious, parasitic, and non-infectious diseases, as well as to a deterioration in the conditions for water use by the population and the ecological state of water bodies. That's why water bodies of 1 and 2 types are regulated by the **Federal Service for Supervision of Consumer Rights Protection and Human Welfare (Rospotrebnadzor)**. The main rules and norms are described in **SanPiN 1.2.3685-21 "Hygienic standards and requirements for ensuring the safety and (or) harmlessness to humans of environmental factors" (dated January 28, 2021, N 2)** where the list of standardized substances and their MAC values are presented.

These Hygienic Requirements (Sanitary Rules) establish hygienic requirements:

- To the quality of water of water bodies at points of drinking, household and recreational water use;
- To the conditions of wastewater discharge into water bodies;
- To the placement, design, construction, reconstruction and operation of economic and other facilities that can affect the state of surface waters, as well as requirements for the organization of water quality control of water bodies.

These requirements apply to **all surface water bodies** on the territory of the Russian Federation used, or planned **to use, for the needs of the population**.

Table 4 General requirements for the composition and properties of water in water bodies in control sections and places for drinking, household, and recreational water use

Indicators of composition and water properties	**Water use categories**	
	For drinking and household water supply, as well as for water supply to food enterprises	For recreational water use, as well as within the boundaries of populated areas
Suspended solids *	When discharging wastewater, performing work on a water body and in the coastal zone, the content of suspended solids in the control section (point) should not increase in comparison with natural conditions by more than:	
	0.25 mg/l	0.75 mg/l
	For water bodies containing more than 30 mg / l of natural suspended solids during low-water periods, an increase in their content in water within 5 % is allowed. Suspensions with a fallout rate of more than 0.4 mm / s for flowing water bodies and more than 0.2 mm / s for reservoirs are prohibited for descent	
Floating impurities (substances)	On the surface of the reservoir there should not be detectable floating films, spots, mineral oils and the accumulation of other impurities.	
Smell	Water should not acquire unusual odours with an intensity of more than one point, detectable:	
	directly or with subsequent chlorination or other ways processing	directly
Colour	Should not be found in the column	
	20 cm	10 cm
Temperature	Summer water temperature as a result of descent wastewater should not rise more than by 3 °C in comparison with the average monthly temperature of the hottest month of the year for last 10 years	
Acidity (pH)	Should not go beyond 6.5 - 8.5	
Mineral composition	Should not exceed 1000 dry matter mg / l, including chlorides 350 mg / l, sulphates 500 mg / l	
Dissolved oxygen	Should not be less than 4 mg / l at any time years, in a sample taken before 12 noon	

BOD full (same as BOD_{20})	Should not exceed at 20 °C:	
	3.0 mg O^2 /l	6.0 mg O^2 /l
COD	Should not exceed:	
	15.0 mg O2/l	30.0 mg O2/l
Disease causative agents	Water must be free of pathogens diseases	
Lactose-positive Escherichia coli (ЛКП)	Not more than 10000/l **	Not more than 5000/l
Coliphages (in plaque-forming units)	Not more than 100/l **	Not more than 100/l
Viable eggs helminths (ascaris, whipworm, toxocar, fasciolus), oncosphereteniids and viable cysts of pathogenic intestinal the simplest	Should not be contained in 1/litre	
Chemical substances	Should not be contained in concentrations exceeding MPC or TAC	

* Content of suspended anthropogenic substances in water (flakes of metal hydroxides formed during wastewater treatment, particles of asbestos, fiberglass, basalt, nylon, lavsan, etc.) is regulated in accordance with clause 2.4 and clause 4.4.

** Does not apply to sources of decentralized drinking water supply.

MPC: Maximum Permissible Concentration. Maximum concentrations at which substances do not have a direct or indirect effect on the state of health of the population (when exposed to the body throughout life) and do not worsen hygienic conditions of water use.

TAC: Approximate permissible levels of substances in water, developed on the basis of calculated and express experimental methods for predicting toxicity and applicable only at the stage of preventive sanitary supervision of projected or under construction enterprises, treatment facilities.

2.3.2 Water bodies used for fishery

In 2016 Ministry of Agriculture of the Russian Federation, and its subordinate Federal Agency for Fisheries (Rosrybolovstvo) issued the main legal document Order N 552 of December 13, 2016, **“On approval of water quality standards for water bodies of fishery significance, including standards for maximum permissible concentrations of harmful substances in the waters of water bodies of fishery significance”.** This document defines three categories of water bodies of fishery significance:

The highest category includes the locations of spawning grounds, mass feeding and wintering pits of especially valuable and valuable fish species and other commercial aquatic organisms, as well as protection zones of farms of any type for artificial breeding and rearing of fish, other aquatic animals, and plants.

The first category includes objects used for the preservation and reproduction of valuable fish species (like salmonids) that are highly sensitive to oxygen content.

The second category includes water bodies used for other fishery purposes.

The highest and first-class fishery waterbodies have stricter environmental quality standards than second-class fishery waterbodies.

Table 1 of the Order N552 includes nine general physico-chemical guidelines for fishery water bodies (presented below in the

Table *5*).

Table 2 of the Order “Standards for maximum permissible concentrations of harmful substances in the waters of water bodies of fishery significance” including MACs for hundreds of substances (some of them with CAS numbers) that are considered harmful (divided into five classes of danger) for fishery water bodies.

Table 5 Water quality standards for fishery water bodies

Indicators of water quality	**The fishery water body category**	
	the highest and first class	second class
Suspended solids	When wastewater is discharged by a specific water user to a water body and in the coastal zone, the content of suspended solids in the control section point should not increase in comparison to natural conditions more than:	
	the first class: 0.25 mg/l	the second class: 0.75 mg/l
	In fishery water bodies that naturally have suspended solids more than 30 mg/l in water, an 5 % increase is allowed. Wastewaters containing suspended solids with higher sedimentation rate than 0.4 mm/s shall not be discharged into watercourses. If sedimentation rate is at maximum 0.2 mm/s, wastewaters can be released into water bodies	
Floating impurities and substances	Films of oil products, oils, fats, and other accumulations of impurities should not be found on the water surface in the zone of anthropogenic impact.	
Temperature	The economic activity (including wastewater discharge) should not increase the water temperature more than 5 °C in comparison with the natural temperature of the water body. In habitats of the fish that require cold water (salmon and whitefish), the temperature should not exceed 20 °C in summer and 5 °C in winter. In other water bodies, temperature should not exceed 28 ° C in summer, and 8 ° C in winter. In spawning grounds of burbot, it is prohibited to increase the water temperature more than 2 °C in winter.	
Acidity (pH)	Should be same than the natural background value of the water body.	
Dissolved oxygen	The content of dissolved oxygen should not fall below 6.0 mg/l under the influence of economic activities (including wastewater discharge) During the frozen period, the content of dissolved oxygen should not fall below: **First class: 6.0 mg/l** **Second class: 4.0 mg/l** During the unfrozen period all water bodies should have oxygen at least 6 mg/l	
Biological oxygen demand (BOD) with a 5- day incubation time,	Under the influence of economic activity (including wastewater discharge) in 20 °C, BOD_5 should not exceed	
	First class: 2.1 mg/l	Second class:2.1 mg/l
Biological oxygen demand (BOD) with a 20- day incubation time,	Under the influence of economic activity (including wastewater discharge) in 20 °C, BOD_{20} should not exceed	
	First class: 3.0 mg/l	Second class: 3.0 mg/l
	In winter if the content of dissolved oxygen decreases to 6.0 mg/l in a first- class water body and to 4 mg/l in a second- class water body, then only wastewaters that do not change the BOD, can be discharged into water body	
Water toxicity	The water in the places of wastewater discharge should not have acute nor chronic toxic effects on the test objects.	
Anionic synthetic surfactants (ASPAS)	The total mass concentration of ASPAS in fishery water bodies should not exceed 0.1 mg/l.	

2.4 Comparison of the Finnish and Russian approaches on ecological status of waterbodies.

Both Finnish and Russian approaches use five ecological classes in their ecological classification of water bodies.

In the Finnish approach the ecological quality class of a water body can be determined by three different methods:
1) A water body is compared to water body of similar type with lower impact from human activities.
2) The original state of the water body is estimated by computer models.
3) Combination of the two first methods.

In practice, all three methods are used in Finland, modelling being the least used method despite it is generally the most accurate method (SUOMEN YMPÄRISTÖKESKUKSEN RAPORTTEJA 37/2019). As simplified, the Finnish approach on ecological status of water bodies is trying to determine how heavily human activities have changed the biological, morphological, and chemical properties of a water body from the time it was in its natural state.

In Russian Federation, there are two approaches on classification of water bodies. In the **ecological approach** the ecological water quality class is determined by **the indicator of anthropogenic load** (IALb) that is described in **State Standard GOST R 58556-2019 "Assessment of water quality of water bodies from ecological viewpoints"**. The standard sets quality standards for 14 indicators that are used in calculation of the water quality class for a surface water mass (1 – 5, from the best to the worst). Based on the available information, Russian ecological classification is more based on mathematical algorithms than the Finnish one.

The second approach is based on the **usage type of the water body**, which focuses more on preserving the quality of ecosystem services (like fishing and drinking water) that are available to the local population. Briefly, the Russian water usage approach defines what are the levels of "acceptable changes from natural state" caused by human activities in a water body intended for human use; and which indicators must not be found from the water body. This approach may be more pragmatic than the ecological ones (especially the Finnish approach), since it can be a challenging task to determine what kind of properties the water body had in its natural state, before the large-scale anthropogenic impact began. Compared to this, it is relatively easy and straightforward to determine how well the population can utilize the ecosystem services offered by the water body, as is performed in the Russian water usage approach.

3 Chemical classification of water bodies

3.1 Finland

There are two categories of hazardous substances whose concentrations can alter classification of water bodies:

The first category are **EU priority substances** that are determined to be hazardous in aquatic environment by the Water framework Directive (2000/60/EC). These substances are recited by The Finnish Government Decree on Substances that are Hazardous and Harmful to the Aquatic Environment in Annex 1 C2. The list includes 45 hazardous or harmful substances and is based on Directive 2013/39/EU. The EU priority substances are chosen by their toxicity, bioaccumulation to food webs and persistence (slow degradation) in environment. The list is updated every four years at minimum. These 45 substances are used in classification of **chemical status** of water bodies. If environmental quality standards are exceeded even on one substance from the list, the water body is classified to be "worse than good" by its chemical status.

If all substance levels are below their environmental quality standard, the water body is qualified to be in "good" chemical status. As a remark, chemical classification has only two classes, when compared to five in ecological classification of water bodies.

The second category are **national priority substances** that are stated in The Finnish Government Decree on Substances that are Hazardous and Harmful to the Aquatic Environment in Annex 1 D. The annex includes 15 nationally recognized hazardous or harmful substances that can deteriorate ecological status of water bodies. If even one national substance exceeds its environmental quality standard, the best **ecological status** a water body can be given is "moderate".

Generally, the EU and national priority substances are given two environmental quality standards (EQS): Annual Average concentration (AA-EQS) and Maximum Allowable Concentration (MAC-EQS). Annual Average concentration (AA-EQS) can be exceeded in individual sampling times as long as the annual average concentration of the substance stays within the EQS. If MAC-EQS is not applicable, AA-EQS values are considered to provide protection against short-term pollution peaks in continuous emissions, because they are significantly lower than the levels considered to cause acute toxicity. AA-EQS applies to the total concentration of all isomers of a substance unless it is enacted otherwise. Maximum Allowable Concentration (MAC-EQS) states what is the highest acceptable concentration for the substance, which must not be exceeded. If the concentrations exceed MAC-EQS, it is generally investigated what is the source of pollution.

3.2 Russian Federation

3.2.1 Fishery water bodies

The chemical quality standards are approved by Ministry of agriculture of the Russian Federation **"Requirements for the quality of water in reservoirs for drinking, cultural and household, recreational and fishery purposes**" (Order on December 13, 2016, N 552). In the Table #2 of the document called *"Standards for maximum permissible concentrations of harmful substances in water bodies of fishery significance"* lists hundreds of chemicals by their chemical name (exact number is unavailable since the substances are not numbered and they are far too many to be calculated individually in reasonable time frame), CAS number, hazard class and maximum allowable concentrations mg/l (MAC-EQS) in aquatic environment.

Hazard classes are defined as:

Class I - extremely dangerous
Class II - highly hazardous
III class - dangerous
IV class - moderately dangerous

From the total content of Table #2, **there are about 33 chemicals that are same as in the Finnish national and EU priority substances** and for which the environmental quality standards (EQS) are somehow comparable. However, for many of these 33 substances the case is that the Finnish EQS is based on annual average (AA-EQS) concentrations while the Russian counterparts are based on maximum allowable concentration (MAC-EQS).

The estimation of 33 shared priority substances is based on CAS (**Chemical Abstract Service**) number matches in the document **"***Standards for maximum permissible concentrations of harmful substances in water bodies of fishery significance***". I**t might be possible there are more shared substances, if the CAS number search did not register them for some reason. Taking into account the large number of chemicals in Table #2, the effort-benefit-ratio was assessed to be too low to try identifying potential additional shared chemicals by other means than CAS numbers. CAS is an international standard, which made it the fastest, the most accurate and the easiest way to identify shared harmful substances.

3.2.2 Water bodies used as source of drinking water

Chemical water quality guidelines are given in the Table 1 "*The maximum permissible concentration of harmful substances in water bodies of household, drinking and cultural and household water use"* of the document **SanPiN 1.2.3685-21 "Hygienic standards and requirements for ensuring the safety and (or) harmlessness to humans of environmental factors"** by Ministry of Health of the Russian Federation.

Table 1 declares 1345 chemicals that are given maximum allowable concentration (MAC.EQS, unit mg/l) standards for usage water. The document also states general guidelines for protection of surface water quality and prevention of pollution in surface waters. Table 2 "*Index of technical and trade names to the list of maximum permissible concentrations of harmful substances in water bodies for household and drinking and cultural and household water use*" of the document lists the technical and trade names of the priority chemicals for usage water bodies.

3.3 Comparison of the Finnish and Russian approaches on chemical status of waterbodies

In Finland there are two status classes for chemical quality of water bodies: "good" and "worse than good". A water body is qualified to be in "worse than good" status, if at minimum one of the 45 EU priority substances, that are deemed to be hazardous or harmful in aquatic environment, exceeds its environmental quality standard.

From the Finnish point of view, the Russian definition of chemical status of water bodies is more complex and maybe confusing because of two reasons: 1) There are several classifications of water bodies by their intended use with their own physico-chemical and chemical guidelines. 2) The number of listed hazardous or harmful substances is enormous, roughly estimated 1600- 2000 substances in total.

Fishery water bodies are divided in three categories: **the highest class**, **first class and second class** fishery waters. Likewise **drinking and usage water bodies** are divided in two categories: 1) Water bodies used as usage water sources for centralized or decentralized households and food enterprises; 2) Water bodies used for recreation of the population. Second class includes also reservoirs located in inhabited regions.

The highest and first class fishery water bodies have stricter physico-chemical guidelines than **second class** fishery waters but the maximum allowable concentrations (MAC-EQS) for hazardous substances are similar in both classes of fishery water bodies. The number of chemicals listed for monitoring is hundreds of substances (*On approval of water quality standards for water bodies of fishery significance, including standards for maximum permissible concentrations of harmful substances in the waters of water bodies of fishery significance*).

Water bodies that are used as **drinking and usage water** sources for households and food industry have stricter guidelines for physico-chemical parameters than water bodies used for **recreational purposes**. The maximum allowable concentrations for hazardous substances are similar for both usage water classes.
There are about 1350 different chemicals with corresponding **MACs** are listed in the comprehensive regulatory document **SanPiN 1.2.3685-21** for the water of drinking systems of centralized and non-centralized water

supply, water of underground and surface water bodies of domestic drinking and cultural and domestic water use, water of swimming pools, water parks.

3.3.1 Environmental quality standards for hazardous substances in Russia and Finland

Based on CAS number searches, Finland and Russian Federation share in total 33 priority substances that are considered harmful or hazardous in aquatic environments. The main difference in their environmental quality standards is, that in Russian Federation they use only **maximum allowable concentrations (MAC-EQS)**; whereas in Finland **annual average** concentrations (AA-EQS) are also used.

Some of the guidelines are quite close to each other, like MACs for diuron and endosulfan. However, there are also large differences like in case of naphthalene: Finnish MAC is 130 µg/l and Russian MAC is 4 µg/l. There are also some substances, like naphthalene, Hexachloro- cyclohexane and para-para- DDT, whose Finnish AA-EQS and Russian MAC-EQS are close or at same level.

In general the Russian MAC-EQSs used for drinking water cannot be properly compared because of absence of CAS numbers in **SanPiN 1.2.3685-21**. Thus, an error risk, caused by the language differences, was assessed to be too high; and searching the Finnish priority substances from a document listing 1350 different substances and written in Russian language, would have taken too much time.

3.3.2 Example of comparable research carried out by the project KA10010

Based on the goals of the project it was decided by the project team that underlying parameters (see Table 6) were used in the monitoring of Tohmajoki and Koitajoki. As well in Russia as in Finland these parameters were in use and it was possible to analyse these from water samples by the same methods. In Finland moss collectors were used to analyse heavy metals and solids contents. In Russia this method was not possible to use and for this reason in both countries were same parameters analysed from water samples in both countries and moss collectors were used only in Finland.

Table 6 Available Finnish and Russian MAC-EQS -values for metals, that are analysed from River Tohmajoki by project TohmaKoita KA10010

Parameters	CAS	**Finnish AA-EQS Inland surface waters**	Finnish MAC-EQS Inland surface waters	Russian MAC-EQS for inland waters	Unit
Cadmium and its compounds (depending on water hardness classes)	7440-43-9	**≤ 0.08 (Class 1) 0.08 (Class 2) 0.09 (Class 3) 0.15 (Class 4) 0.25 (Class 5)**	≤ 0.45 (Class 1) 0.45 (Class 2) 0.6 (Class 3) 0.9 (Class 4) 1.5 (Class 5)	5	µg/l
Lead and its compounds	7439-92-1	**1.2**	14	6	µg/l
Mercury and its compounds	7439-97-6	**x**	0.07	0.01	µg/l
Nickel and its compounds	7440-02-0	**4**	34	10	µg/l

Table 7 EU priority substances *(italic*) and some other substances shared with Russian Federation.

	Parameters	CAS number	AA-EQS Inland surface waters	MAC-EQS Inland surface waters	Russian MAC-EQS for inland waters	Unit
1	*1,2-Dichloroethane*	107-06-2	10	not applicable	100	µg/l
2	*Benzene*	71-43-2	10	50	500	µg/l
3	*Atrazine*	1912-24-9	0,6	2	5	µg/l
4	*Cadmium and its compounds (depending on Finnish water hardness classes)*	7440-43-9	≤ 0.08 (Class 1) 0.08 (Class 2) 0.09 (Class 3) 0.15 (Class 4) 0.25 (Class 5)	≤ 0.45 (Class 1) 0.45 (Class 2) 0.6 (Class 3) 0.9 (Class 4) 1.5 (Class 5)	5	µg/l
5	Carbon-tetrachloride	56-23-5	12	not applicable	1	µg/l
6	*Chlorpyrifos (Chlorpyrifos- ethyl)*	2921-88-2	0.03	0.1	0.01	µg/l
7	Cyclodiene pesticides: Aldrin,Dieldrin,Endrin,Isodrin	309-00-2, 60-57-1, 72-20-8, 465-73-6	Σ = 0.01	not applicable	0.01	µg/l
8	*Cypermethrin*	52315-07-8	8 × 10 –5	6 × 10 –4	0.0054	µg/l
9	*Dichloromethane*	75-09-2	20	not applicable	9400	µg/l
10	*Dichlorvos*	62-73-7	6 × 10 –4	7 × 10 –4	0.01	µg/l
11	*Dicofol*	115-32-2	1.3 × 10 –3	not applicable	0.01	µg/l
12	*Diuron*	330-54-1	0.2	1.8	2	µg/l
13	*Endosulfan*	115-29-7	0.005	0.01	0.02	µg/l
14	*Hexachloro- cyclohexane*	608-73-1	0.02	0.04	0.01	µg/l
15	*Lead and its compounds*	7439-92-1	1.2	14	6	µg/l
16	*Mercury and its compounds*	7439-97-6		0.07	0.01	µg/l
17	*Naphthalene*	91-20-3	2	130	4	µg/l
18	*Nickel and its compounds*	7440-02-0	4	34	10	µg/l
19	para-para- DDT	50-29-3	0.01	not applicable	0.01	µg/l
20	*Simazine*	122-34-9	1	4	2	µg/l
21	Tetrachloro- ethylene	127-18-4	10	not applicable	160	µg/l
22	*trichlorethylene*	79-01-6	10	not applicable	10	µg/l
23	Trichloro- benzenes	12002-48-1	0.4	not applicable	1	µg/l
24	*Trichloro- methane(clorophorm)*	67-66-3	2.5	not applicable	5	µg/l
25	*Trifluralin*	1582-09-8	0.03	not applicable	0.3	µg/l

Table 8 Finnish national priority substances shared with Russian Federation.

	Name	CAS	Finnish AA-EQS inland waters, µg/l	Russian MAC-EQS for inland waters µg/l
1	bronopol (2-bromo-2-nitropropane-1,3-diol)	52-51-7	4	5
2	chlorobenzene	108-90-7	9.3	1
3	dibutyl phthalate (DBP)	84-74-2	10	1
4	dimethoate	60-51-5	0.7	1
5	MCPA (4-chloro-2-methylphenoxyacetic acid)	94-74-6	1.6	20
6	Metamitron (4-amino-3-methyl-6-phenyl-1,2,4-triazin-5-one)	41394-05-2	32	5
7	prochloraz (N-propyl-N- [2- (2,4,6-trichlorophenoxy) ethyl] -1H-imidazole-1-carboxamide)	67747-09-5	1	4
8	tribenuron-methyl (methyl 2- (3- (4-methoxy-6-methyl-1,3,5-triazin-2-yl) -3-methylureidosulfonyl) benzoate)	101200-48-0	0.1	200

4 Best practices

During the comparison of Russian and Finnish water legislation was found, that the given task was much wider and complicated than expected. Thus, the separate best practice assessment was truncated to a few lines in this report. The most important finding based on our study is the emphasis on the importance of good project planning. Because of different legislation and norms of two countries it is important to carefully plan already in the application stage of project, which is possible to do in both countries. Which methods are possible to use in both countries in collecting samples or analysing samples, and which parameters are valid according to the legislation of both countries. This facilitates practical implementation and budgeting.

Differences in the variables used can be challenging if the differences in the variables used, as defined by law, are not sufficiently considered in advance. For example, In Finland biological oxygen demand is generally performed with a seven-day-test (BOD7), while a five-day-test (BOD5) seems to be common in Russian Federation. In some cases, even BOD20 is used in Russia – so called full BOD. Finnish laboratory with a standard for BOD5 can be found, but this may not be possible in all cases. Another example is water quality monitoring variable “viable helminth eggs”. Helminth eggs are the infective agents for the types of worm diseases known globally as helminthiases. In Russian Federation, there are laboratories that analyse this variable, but currently not in Finland.

Every project has its goal, and it is crucial, to think about, in which country is the project’s main goal, and then built activities so, that they directly fit to the legislation of this country. If we must justify things to Russian authorities, but the project’s laboratory work is fulfilled according to Finnish legislation and norms, the argument will not be very effective.

Practical project work is facilitated if both parties are even superficially acquainted with the partner's legislation and practices. For example, water samples: whether only a surface sample of 1 meter from the surface is taken from the lakes, or a surface sample and a bottom sample of 1 meter from the bottom. Likewise, the terms are worth going through to know that the same thing is being investigated. Preferably agree on the use of internationally defined terms. For example, CAS numbering in naming chemicals. Similarly, the clarity of the operation will be enhanced if it is agreed that the names of chemical compounds will be used in conjunction with their chemical formulas. For example, ammonia (NH_3).

And finally related to cross-border-cooperation project, not connected the to water legislation, but connected to border crossing and its legislation. It is better to do first inter calibration of laboratories, and after it to analyse samples in it country, where they are sampled. Namely boarder formalities and traffic jams in the border area increase the risk of aging and contamination of the samples.

5 Conclusions

Both Finnish and Russian ecological approaches for surface water mass classification use five water quality classes. In Finland the used classification is: high status, good status, moderate status, poor status and bad status. In Russian Federation the best ecological class is “I” and the worst “V”. The main difference between Finland and Russian Federation seems to be, that the Russian ecological approach is more based on mathematics: Each of the 14 basic indicators have quality standards for each water quality class (I to V), which are used in calculations of the **indicator of anthropogenic load (IALb).** Meanwhile the Finnish ecological approach is a combination of comparing a water body to similar type water mass with lower impact from human activities and utilization of computer models (mathematics). Although computer models are not yet generally used in Finland in 2021.

Besides the ecological classification, water bodies are also categorized by their water usage type in Russia:

1) The water body used as a source of drinking water includes the use of water bodies or their sections as a source of drinking and household water use, as well as for water supply to food industry enterprises.
2) The water bodies used for recreational and cultural purposes. This includes also other water bodies located within the boundaries of populated areas.
3) Fishery waterbodies that are classified in three subgroups: **the highest category, first category and second category.**

The highest category and first category fishery water bodies have stricter water quality standards than second category fishery water bodies. The water bodies used as drinking and usage water sources by households and food enterprises have stricter water quality standards than water bodies used for recreational purposes. From a Finnish perspective, the Russian water usage type guidelines seem to focus more on setting limits for “allowable changes” in water bodies caused by human activities; and defining which indicators must not be found from the water body.

Chemical classification of water bodies seems to be simpler in Finland than in Russia: In Finland there are only two classes for chemical state of a water body: good and worse than good. The total number of monitored substances is also relatively small in Finland: 45 EU priority substances and 15 national priority substances. The Finnish environmental standards are declared for inland surface waters (lakes and rivers), surface waters used as usage water sources and other surface waters (mostly Baltic Sea basin). Whereas in Russian Federation, the number of substances is 1345 just in **drinking and usage water source water bodies**, besides the chemical substances listed for **fishery water bodies**.

There are some interesting differences in parameters that are used for monitoring of water body statuses. In Finland, biological oxygen demand is generally measured by a seven-day incubation standard (BOD_7), whereas in Russia the general standard is a five-day incubation standard (BOD_5). Once BOD_5 was used as general standard in Finland also but it was then replaced by BOD_7 standard, because BOD_7 reduced or removed need for weekend work in laboratories. Some Finnish laboratories still have a standard for BOD_5, but it must be specifically requested, and it sets certain time conditions for planning and execution of sampling. In Russia there is also a 20- day- incubation standard (BOD_{20}), which is used either extremely rarely or at all in Finland.

From Finnish perspective an interesting Russian parameter for water quality is viable eggs of worm-like parasites, generally referred as helminths. Based on inquiries made by Finnish Environment Institute in summer 2019, there are not known Finnish laboratories that analyse viable eggs of helminths from water samples. Some Finnish laboratories actually asked if there are Russian laboratories that could teach analysis methods for them. Based on this there might be need for a cooperation project on the subject in the future.

There might be differences in chemical oxygen demand (COD) analysis standards between Finland and Russia. In Finland, generally used standard is CODMn (mg O_2/l). In Russian documents that are referred in this report, there is not specified if the used COD standard is CODMn or some other standard.

Common feature between Russian Federation and Finland is that some chemical substances have different environmental quality standards depending on a water body category. A big difference is that in Russia they use only environmental quality standards for maximum allowable concentrations (MAC-EQS), whereas in

Finland annual average concentrations (AA-EQS) are also used. This may complicate comparison of the environmental quality standards between the countries if Finland uses only AA-EQS for the substance. **A small but potentially confusing difference is that Finnish environmental quality standards are stated in unit µg/l, whereas in Russian Federation the used unit is mg/l,** or **mg/dm^3**, as it is generally prescribed in Russian Federation.

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