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# Implementation of Water Framework Directive in Turkey

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**Abstract**

European Water Framework Directive (WFD) focuses on sustainable management of water resources. The main objective of WFD is to achieve "good water status". Surface, coastal and transitional waters must achieve "good ecological and chemical status" to protect human health, water supply, natural ecosystems and biodiversity. Physical and chemical pollutions in the water resources have great importance to achieve a good chemical status. The main concern in the chemical pollution is the priority pollutants and specific pollutants. Priority pollutants to be monitored have been determined by directive 2008/105/EC of the European Parliament and the Council. On the other hand, EU Member and candidate countries have to determine pollutants which are specific to their countries based on the point and non-point sources. Moreover, there is an urgent need in determination of Environmental Quality Standards (EQS) for the listed specific pollutants. This paper summarizes the methodology used by EU countries in determination of specific pollutants for implementation of WFD. Turkey as an EU candidate country has got an action plan for the implementation of WFD to natural water. The recent studies conducted in Turkey for the implementation of WFD regarding to specific pollutants were discussed.

**Keywords: Priority Pollutants, Specific Pollutants, Water Framework Directive, Water Resources**

## INTRODUCTION

### Water framework directive

Water Framework Directive of the European Union covers the principles of River Basin Management Plans and provides a program and timetable for EU member states to constitute management plans. WFD is an umbrella directive in the field of water. It aims to gather the legislation on water directives such as Bathing Water Directive (2006/7/EEC), Drinking Water Directive (98/83/EC), Fish Directive (2006/44/EC), Shellfish Waters Directive (2006/113/EC) and specific substances and pollution sources such as Dangerous Substances Directive (2006/11/EC), Ground Water Directive (80/68/EEC), Nitrate Directive 91/676/EEC) and Pesticide Directive (91/414/EEC) under one roof. The implementation of WFD is an issue for EU member states and candidate countries such as Turkey. The action plans must be prepared to obtain integrated management for the goal of the WFD at a certain timetable. The main objective of WFD is to achieve a good water status for all water bodies by the year 2015. In other words, WFD aims good ecological and chemical status for surface waters and good quantitative, chemical status for groundwater. To ensure this objective, economic and environmental aspects should be integrated to provide the sustainable management of water resources.

The WFD is not only implemented to the EU member states but also to the candidate countries. Therefore, implementation projects are often financed by EU member states. WFD is also defined as an important tool for creating own water management in the candidate countries [1]. The methodology used to implement WFD may differ depending on water basin and economics or environmental aspects of countries.

There are number of directives to protect the aquatic life, drinking water resources, special protection areas, etc. in WFD. Water quality is evaluated based on ecological, chemical and hydromorphological status for surface waters and chemical and quantitative status for groundwater. WFD declares quality elements for the classification of ecological status including hydro-morphological, chemical and physico-chemical elements. The ecological status comprises biological quality elements such as macro invertebrate fauna, aquatic flora, phytoplankton, phytobenthos and fish with physico-chemical quality elements (temperature, oxygenation, nutrient levels, etc.) and hydromorphological quality elements such as river continuity, flow regime, etc. [2].

Economic and social activities ,that produce chemicals impact adversely upon the water. The main concern for chemical status is the priority and specific pollutants. The point source and non-point pollution, including the group of priority substances, which come from urban and rural populations, industrial emissions and farming that discharged in river basins determinates chemical status of water. Surface, coastal and transitional waters must achieve "good ecological and chemical status" to protect human health, water supply, natural ecosystems and biodiversity. EU Member and candidate countries have to determine pollutants which are specific to their countries based on the industrial discharges. Priority pollutants to be monitored have been determined by directive 2008/105/EC of the European Parliament and of the Council. Therefore, monitoring networks must be planned such a way that the overall quality elements should be covered. Three types of monitoring namely surveillance, operational and investigative for surface waters are described in Annex V of the WFD.

### The methods for the selection of specific pollutants in European countries

The specific contaminants selection method is described in Water Framework Directive Guidance Document 3. Most important criteria is Environmental Quality Standarts for the selection of specific pollutants. Total specific pollutants in EU countries have been identified and have derived an EQS in one or more of the environmental compartment and water category combinations.

Environmental Quality Standards (EQSs) are tools used for assessing and classifying the chemical status of waterbodies. Therefore EQSs can affect the overall classification of a waterbody under the WFD (Figure 1). In addition, EQSs will be used to set discharge permits to waterbodies, so that chemical emissions do not lead to EQS exceedance within the receiving water. Chemical Status is determined from the specified EU-wide Environmental Quality Standards (EQSs) for the 45 substances in the Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy (Dangerous Substance Directive).

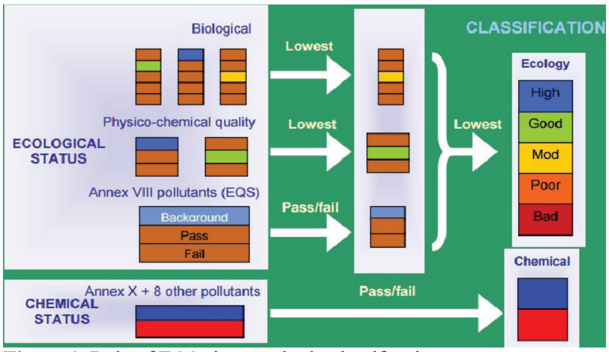


**Figure 1.** Role of EQSs in waterbody classification

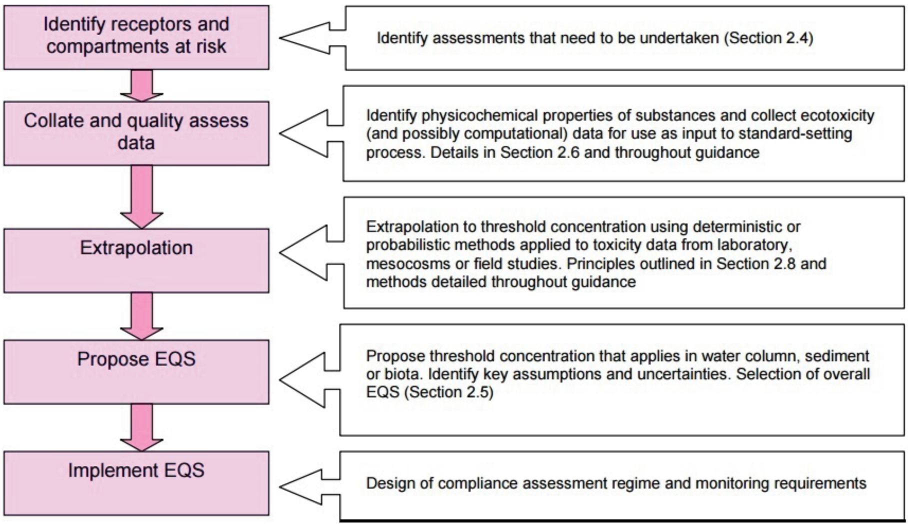


**Figure 2.** The key steps for EQS determination

The EQS values can be derived from river basin for different environmental compartments (i.e. water column, sediments and biota) and different water categories (i.e. rivers, lakes, transitional waters and coastal waters) in order to select specific pollutants in river basin.

Where possible, both acute and chronic data shall be obtained and EQS values were expressed as:

•Annual averages (AA); a long-term standard, expressed as an annuall average concentration (AA-EQS) and normally based on chronic toxicity data.

•Maximum Allowable Concentrations (MACs); a short-term standard, referred to as a maximum acceptable concentration EQS (MAC-EQS) which is based on acute toxicity data.

The vast majority of the EQS values have been derived for the water column of rivers, lakes, transitional waters and coastal waters. Only limited numbers of EQS values have been derived for sediments and biota.

Five different steps were evaluated in determination of specific pollutants. The key steps that are involved in deriving an EQS are presented in Figure 2 [3].

**Step 1. Identification of compartment**

Receptors and compartments at risk According to Article 3 of the EQS Directive, quality standards shall apply to contaminant concentrations in water, sediments and/or biota.

**Step 2. Data collection**

Data on physical and chemical properties, Ecotoxicological data, Mammalian toxicity data, Data on bioaccumulation Critical and supporting data, Data gaps-non testing methods, Using existing risk assessments are needed to calculate EQS.

**Step 3. Extrapolation**

Derivation of all EQSs requires some form of extrapolation from the available data to estimate a threshold. Two main approaches are possible namely, the deterministic and probabilistic methods. The deterministic approach takes the lowest credible toxicity data to extrapolate to a QS. Probabilistic methods adopt species sensitivity distribution (SSD) modelling in which all reliable toxicity (usually NOEC) data are ranked.

**Step 4. Propose of EQS**

Standards for water, sediment and biota are derived independently and they should all be made available for possible implementation. The lowest standard calculated from other steps will normally be adopted as the overall quality standard for that compartment.

**Step 5. Implemention of EQS**

After selection of EQS using different approaches, scientists advise the policymaker EQS of specific pollutants which are adverse effect on human health and nature. Then, the policymaker may decide the risks of specific pollutants on environment.

Briefly, EQS values may have derived using the Annex V 1.2.6 methodology as shown in Figure 2, these steps including:

•Derivation of quality standards for different receptors (e.g water column, sediment, biota).

•Use of different extrapolation techniques (i.e. deterministic or probabilistic) to derive quality standards for a particular receptors (e.g water column, sediment, biota).

•Use of different data sets resulting in different lowest toxicity values.

•Use of assessment (safety) factors of different magnitudes.

**Selection of specific pollutants in United Kingdom**

Specific Pollutants are defined as substances that can have a harmful effect on biological quality elements, and which may be identified by Member States as being discharged to water in "significant quantities" by UKTAG (The United Kingdom's Technical Advisory Group on the Water Framework Directive).

In other words, there are two main criteria for selection of pollutants.

1. Substances that affect aquatic life are used in member states of EU.

2. Pollutant discharged in large volumes into the water of EU.

The substances in the regulations, monitored substances in recent studies, potentially risky substances are considered for selection of specific pollutants by UKTAG. A specific substances list, including more than 300 chemicals, was created based on these criteria. A scale between 1 to 5 was used to determine the importance degrees for the pollutants in this list. The ranking category (1 and 2) was defined as high priorities pollutants in the category. Following this classification, it was decided that 33 of pollutants should be examined in the short term. The main features of these pollutants, large quantities of chemicals were discharged to UK waters and the common risk factors could be observed that it has harmful affects. In addition, these substances were checked with the list of Dangerous Substance Directive II. As a result, the number of specific pollutants were reduced by UKTAG to 18 of chemicals namely 2,4-D(ester and non-ester) 2,4-dichlorophenol, ammonia, arsenic, chlorine, copper, chromium, cyanide, cypermethrin, diazinon, dimethoate, iron, linuron, mecoprop, permetthrin, phenol, toluene and zinc. Standards were developed for only 9 of these chemicals which are 2,4-D(ester and non-ester) chromium, cypermethrin, diazinon, dimethoate, linuron, mecoprop, phenol, toluene. Long and short term effects of residual chemicals in the water were another important factor for selection of specific pollutants in UK and chronic toxicity for biological life was the primary concern. However, standards were developed based on the acute toxicity values for certain pollutants such as pesticides due to short-term release of these pollutants.

**Selection of specific pollutants in Netherlands**

The potential specific contaminants were reduced to 160 pollutants with preselecting based on the report named as specific pollutants and drinking water relevant substances in the context of the Water Framework Directive; Selection of potentially relevant substances for the Netherlands (2012). 70 of these chemicals in water samples was not observed or observed only once. Some pollutants were considered as negligible because of risk factors to human health or the ecosystem. As a result, these pollutants were removed from the list of specific pollutants and it was proposed to focus on significant risk factor for the quality of surface water. The pollutants selected were amidotrizoic acid, carbamazepine, metformin, metoprolol and disopropylether.

**Selection of specific pollutants in Finland**

The method used for selection of specific pollutants in Finland consists of three steps;

•Identifying a list of potential pollution: Studies began with 5400 of chemicals at the startup. Toxicity biodegradation, bioaccumulation data, etc. were obtained for 900 of these chemicals. After elimination of these chemicals based on related directives of WFD and the national database, 279 of chemicals were remained in the list.

• Studies on prioritizing of the pollutants: The emission factor "User Scores volumes and User Pattern" principle was used and the list was reduced to 50 pollutants that must be followed.

• The final list: Chemicals were eliminated according to the selection criteria. Chemicals that met the following requirements were selected.

EC/ LC 50 $\leq$ 10 mg/L and EC/ LC 50 $\leq$ 1 mg/L and BCF $\geq$ 500 or Kow $\geq$ 4

In the final list, heptane and octane were excluded and total number of chemicals to monitor were determined as 16.

The selection of pesticides and biocides were made using the Pesticide Risk Indicator Method developed by the Finnish Environment Ministry and a list of pollutants containing 30 pesticides and biocides was prepared. Moreover, 5 more pesticides were placed in the list of national pollutants based on calculated risk factors and the amount of pesticides used in Finland.

**Comparison of selection method for specific pollutants in EU**

The specific pollutant lists and observed issues on the formation of the these lists were compared for 27 European Union member countries in the final report of Comparative Study of Pressures and Measures in the Major River Basin Management Plans in the EU (2012). It was reported that there were significant differences for Ecological Quality Standard (EQS) and the type of pollutants which were declared by member states. The main reason for the differences is the method used in calculation of EQS and in the determination of specific pollutants.

Two different approaches were used for selecting river basin spesific pollutants (RBSPs) which should have involved a consideration of all the environmentally hazardous substances that could be present in aquatic systems in significant quantities.

"Two-tier approach" was the most commonly used method for this purpose. The starting point in this approach is to prepare a general pollutants list which was applied by 62 % of EU members. Then, the following steps can be used to finalize or to generate a list of candidate pollutants.

•The available data about amount of emissions, production and usage volume specific to the basin can be collected.

•The pollutants in the general list can be monitored in the basin

•Toxicity data of the pollutants can be gethared.

•A combined monitoring-based and modelling-based priority setting (COMMPS) or the use of existing procedures such as analysis of pressure and impact can be applied.

Adoption of this approach for selecting River Basin Specific Pollutants (RBSPs) should have involved a consideration of all the environmentally hazardous substances that could present in aquatic systems in significant quantities.

This would include the type of substances registered under Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), which is the current system to control chemicals in Europe, particularly those classified as R50/53.

Fifty percent of the EU member states used a different two tier approach method. The first step was evaluation of pressure caused by pollution and preparation of inventories of pollutants used or discharged. In the second step, the substances which are discharged at large quantities and also registered in REACH as R50/53 are selected as specific pollutants to be monitored in the basin. This approach may have included the type of substances registered under REACH.

About 4% of the member countries conducted monitoring activities to determine the concentration of the pollutants or applied analysis of pressure and impact of pollutants on water bodies. However, selected group of substances may not be registered in REACH or WFD, in this case.

Both the identified approaches were iterative, and included further adjustments to substance selections based on the results obtained and new monitoring and/or ecotoxicological data. A harmonised approach to the selection of River Basin Spesific Pollutants should be adopted by all Member States to identify specific pollutants. This approach would minimize the potential data gaps for RBSPs selected by MS.

## RECENT STUDIES on IMPLEMENTATION of WFD in TURKEY

The number of basin managed by National Basin Management Strategy in TURKEY is 25. River Basin Management Plans (RBMP) were prepared for each basin considering implementation of WFD. RBMP aims to identify the biological and chemical pollution. Determination of monitoring points of water bodies, point and non-point pollution sources and present situation of water bodies were taken into account to determine the current situation of the pollution in the river basin. The projects about river basin management and implementation of WFD conducted in Turkey are as follows;

•Basin Protection Action Plan Project,

•Water Quality Monitoring Capacity Building Project,

•Capacity Development Project for the Implementation of the Flood Directive in Turkey,

•Project on the Control of Hazardous Substances Pollution,

•Transforming the Basin Protection Action Plan of the River Basin Management Plan,

•Determination of Some Basin in Sensitive Areas and Quality Targets in Turkey Project,

•Basin Monitoring and Determination of the Reference Point Project,

•Determination and Classification of Water Quality Status of Marine and Coastal Project,

In order to identify specific pollutants following projects were carried out in accordance with the WFD by The Ministry of Forestry and Water Affairs in Turkey

•Project on the Control of Hazardous Substances Pollution

•Detection of Hazardous Substances on Coastal and Transitional Waters and Ecological Dynamics Project,

•Determination of Water Pollution Caused by the Use of Plant Protection Products and

•Determination of Environmental Quality Standards Project regarding to the Substances or Substance Groups

The project about the Control of Hazardous Substances Pollution aimed to determine the possible pollutants originated from point sources in the inland waters. It was conducted in Ergene, Susurluk and Konya basin. Industrial activities on these sites and the possible pollutants generated by the existing industries were evaluated together. The outcome of the project for the specific pollutants was possible existence of about 177 different specific pollutants in the basin. Further evaluations based on industrial activities and the pollutants in their discharges for all basin in Turkey, 39 substances have been identified and added to the list. Finally, capacity reports of substances that produced or imported up to 1 ton/year were considered. As a result of three stage evaluation, 3102 different pollutants were included in the total list of possible specific pollutants that may exist in the river basins of Turkey. The common methods used for selection of most dangerous or significant pollutants to monitor in the rivers basin are COMMPS and Total Hazard Scoring (THS). These two methods were applied to the total list of specific pollutants and the final list contained 147 substances.

The other project namely "Determination of Water Pollution Caused by the Use of Plant Protection Products and Determination of Environmental Quality Standards Project according to the Substances or Substance Group" aimed to determine non-point pollutants caused by the agricultural activities. The list of 430 substances was obtained after inventory study. The list was reduced to 293 substances after evaluations by COMMPS and THS methods.

Detection of Hazardous Substances on Coastal and Transitional Waters and Ecological Dynamics Project was carried out at Gulf of İzmit, Aliağa, İskenderun and Port of Samsun. The list contained 3300 potential substances but eliminated to 339 substances by applying risk code, expert assessment and bioaccumulation characteristics of substances. Further elimination to 45 substances was achieved by applying COMMPS. On the other hand, the candidate specific list was expanded with addition of PAH, PCB, heavy metals, diclofenac, 17-beta-estradiol,17-alpha-ethinyl estradiol. 29 substances were listed in project on Control of Hazardous Substances Pollution [5].

### Twinning project

Twinning Project called "Capacity Building Support to the Water Sector in Turkey" was financed to provide assistance for candidate countries on implementation of the European legislation for pre-accession program. The aim of the project was capacity building and training of the Turkish water authorities. A national monitoring plan was developed for Turkey and monitoring basin plans of Meric-Ergene, Susurluk, Akarcay, Sakarya, Buyuk Menderes and Konya were carried out by stakeholders from Turkey, Netherlands and other EU member states [6].

### Pilot study: Buyuk Menderes river basin

The project entitled "Determination of Environmental Quality and Goal for Surface, Coastal and Transitional Waters: Büyük Menderes Basin Pilot Study" aims to assist Turkey in the field of water quality monitoring in line with the EU Water Framework Directive (WFD) 2000/60/EC. The main objective of the project is to develop a methodology to achieve the good water status for all water bodies. The project contains biological, hydromorphological and chemical monitoring. The priority pollutants listed in

Directive 2000/60/EC and 2013/39/EU, most of the specific pollutants listed by Ministry and conventional physico-chemical pollution parameters are being monitored in 46 stations of Buyuk Menderes River.

The specific contaminants selection method is described in Water Framework Directive Guidance Document 3. There are 2 major steps to identify chemical substances. First step is evaluation of legislation for chemicals. Second step is selection of chemicals from candidate list. The procedure is divided into sub-categories.

The candidate specific list, obtained from aforementioned projects, were composed with industrial activities in Büyük Menderes Basin and the list of candidate substances for specific pollutants were prioritized for Büyük Menderes Basin. As a result, 102 specific substances were listed to monitor in the basin. Monitoring network and programs were planned in accordance with the Article 8, Annex 5 of WFD and Twinning Project. The water quality and types of water bodies were identified in Büyük Menderes Basin. Monitoring studies contain biological quality elements, hydromorphological quality, physico-chemical parameters, specific and priority pollutants.

## CONCLUSIONS

The studies on implementation of the WFD on national and regional levels are in progress. After classification of water bodies in Büyük Menderes River Basin according to WFD, the current status of water bodies will be determined by monitoring biological quality elements, hydromorphological quality elements, physico-chemical quality elements, as well as specific and priority pollutants. Environmental Quality Standarts of priority and spesififc pollutants will be used in determining industrial wastewater discharge standards by policymakers for the corresponding pollutants detected in Büyük Menderes River. For the water bodies classifed as bad, poor or moderate status, strategies will be developed to improve the recent status of the water body and also to prevent the further pollution in the River.

## REFERENCES

[1] Bruin EFLM, Jaspers FGW, Gupta J. 2005. The EU water framework directive: Challenges for institutional implementation. Environm Sci. 153-71.

[2] Buijs P. 2005. Surface Water Monitoring and Assessment under the EU Water Framework Directive. Proceedings of the 2nd International Yellow River Forum on Keeping Healthy Life of the River.6: 236-46.

[3] Lázaro C. Muñoz I.Meissner, K. 2014.Training on presentation of monitoring results and mapping of the ecological status and potential Technical Assistance for Capacity Building on Water Quality Monitoring

[4] Smit C.E, Wuijts S. 2012. Specifieke verontreinigende en drinkwater relevante stoffen onder de Kaderrichtlijn water Selectie van potentieel relevante stoffen voor Nederland RIVM Rapport 601714022/2012

[5] Şıltu E. 2015. Su Ortamında Bulunabilecek Tehlikeli Maddelerin Önceliklendirilmesi açısından Türkiye'de Uygulanabilecek Metodolojilerin Belirlenmesi, Orman ve Su işleri Bakanlığı, Uzmanlık Tezi

[6] Technical Assistance for Capacity Building on Water Quality Monitoring Inception Report. 2013. Final Version.

[7] Proposal for a Selection of National Priority Substances Fulfilling the Requirements Set by the Dangerous Substances Directive (76/464/EEC) and the Water Framework Directive (2000/60/EC).

[8] Comparative Study of Pressures and Measures in the Major River Basin Management Plans' - Task 2c (Comparison of Specific Pollutants and EQS): Final Report Contract No. 070311/2011/603663/ETU/D1.

[9] Proposals For Envıronmental Qualıty Standards For Annex VIII Substances (January 2008) UK Technical Advisory Group on the Water Framework Directive

[10] Ansari KF. Synthesis and evaluation of some new benzimidazole derivatives as potential antimicrobial agents. Eur J Med Chem. 2009; 44: 6-15.