

GUIDANCE ON LABORATORY WORK FOR THE ANALYSIS OF ORGANIC AND INORGANIC CONTAMINANTS

WP 1-13: Harmonized Laboratory Facilities and Capacities

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ABBREVIATIONS

AAS	Atomic absorption spectroscopy
AOX	Adsorbable organic halides
BIH	Bosnia and Herzegovina
CETI	Center for Ecotoxicology, Podgorica
CV-AAS	Cold Vapor Atomic Absorption Spectroscopy
EAA	Environment Agency Austria
EPA	Environmental Protection Agency
FTIR	Fourier-transform infrared spectroscopy
GC-ECD	Gas chromatography – electron capture detector
GC-MS	Gas chromatography coupled to mass spectrometry
HPLC-MS/MS	High performance liquid chromatography - tandem mass spectrometry
ICP-MS	Inductively coupled plasma mass spectrometry
ITRC	Interstate Technology & Regulatory Council
OCP	Organochlorine pesticides
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PCDD/F	Polychlorinated dibenzo-p-dioxines and dibenzofuranes
PFAS	Per- and polyfluoroalkyl substances
PSE	Pressurized Solvent Extraction
QA/QC	quality assurance, quality control
QuEChERS	Quick, Easy, Cheap, Effective, Rugged, Safe (dSPE)
dSPE	(dispersive) Solid Phase Extraction
TED GC/MS	Thermal Extraction Desorption-Gas Chromatography/Mass Spectrometry

WB	Western Balkans
WB6	Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, Serbia
WP1-11	Workpackage "Soil Monitoring"
WP1-12	Workpackage "Contaminated Sites"
WP1-13	Workpackage "Laboratories in WB6"

1. EXECUTIVE SUMMARY

This guidance provides practical, technical and legal support for laboratories analysing organic and inorganic contaminants in soil, water, air and waste, with a focus on strengthening capacities in the Western Balkans under the EU4GREEN project. It consolidates best practices for sampling, sample preparation, instrumental analysis and quality assurance, and aligns laboratory workflows with relevant EU regulatory frameworks and standardisation efforts.

The EU Soil Monitoring Law (SML) for example outlines core contaminant groups: heavy metals (As, Sb, Cd, Co, Cr (total concentration), Cu, Hg, Pb, Ni, Tl, V, Zn), legacy and current organic pollutants (list has to be established by Member States), and emerging contaminants such as PFAS, pesticides and their metabolites. For each group it summarizes environmental behaviour, health risks, matrix-specific sampling recommendations and typical analytical approaches: ICP-MS/AAS and complete digestion for metals; GC-MS/MS and LC-MS/MS for volatile, semi-volatile and polar organics; QuEChERS, PSE and SPE extraction techniques; and specialised workflows for PFAS.

Quality assurance is emphasised throughout: laboratories must define data quality objectives, implement field and laboratory QC (blanks, spikes, isotopically labelled standards), validate methods per matrix, use certified reference materials and participate in proficiency tests to ensure comparability. Practical guidance addresses contamination control, chain of custody, preservation and matrix effects.

This guidance maps analytical needs to EU legal drivers — notably the EU Soil Monitoring Law, Water Framework Directive, ambient air rules and sectoral regulations — and highlights required indicators and contaminant lists included in annexes for soil, water and air. Capacity building activities, trainings and accreditation support delivered under the project are referenced.

Key recommendations call for harmonised, validated methods; investment in instrumental and human capacity; robust QA/QC and interlaboratory cooperation; and phased implementation of national monitoring networks with interoperable reporting to support evidence-based remediation and policy decisions.

At the regional level, training courses on specific methods and topics are recommended to improve harmonization and analytical capabilities. Based on the experience gained from the training courses in 2024 (organic pollutants in Podgorica, heavy metals in Durres) and 2025 (pesticides in Skopje), a laboratory network should be established to organize further training courses and meetings.

2. INTRODUCTION

This guidance gives an insight into technical and chemical basics as well as insights into the EU legal framework for environmental analyses of SOIL, WATER, (WASTE) and AIR. Experience gained within the project EU4GREEN has been considered. Information on selected methods (e.g. heavy metals, pesticides, polycyclic aromatic hydrocarbon) and equipment (e.g. gas chromatography (GC), liquid chromatography (LC)) as well as input for quality assurance and quality control for implementation are provided.

Within EU4Green an overview of the status and the capacities of environmental laboratories in the Western Balkans (WB) was given in the “Report on status of pollution detection in environmental laboratories in WB6” based on a workshop in November 2023. Common trainings were held in the years 2024 on analyses of organic (at CETI in Podgorica) and inorganic (at TENUIS in Durres) contaminants, and 2025 on selected pesticides (at SsCyril University in Skopje). Through additional support selected laboratories in BiH were accompanied in the process of accreditation and reaccreditation. Recommendations elaborated within this work are considered.

3. INORGANIC CONTAMINANTS

Heavy metals such as arsenic, cadmium, copper, chromium, lead, mercury, nickel, and zinc come from natural sources (rock weathering, volcanic activity) and human activities (mining, metal processing, fossil fuel combustion, agriculture, waste disposal). In soil they tend to accumulate and bind to particles; in water they occur dissolved or attached to suspended matter; in air they travel as particulates from industrial emissions and traffic. Urban and industrial areas usually show higher levels than rural or remote sites.

These metals can cause acute poisoning and chronic health effects. Lead and mercury harm the nervous system, especially in children. Cadmium affects kidneys and bones. Arsenic is linked to skin lesions and cancer. Chromium VI is carcinogenic. Nickel, copper, and zinc are essential at low levels, but toxic at high concentrations, causing respiratory, gastrointestinal, or neurological problems.

Sampling must match the matrix and purpose. For soil, use composite surface and depth samples with stainless steel tools. Soil samples are typically collected on a rectangular pattern. Usually the soil samples are taken from 0-10 cm (grassland) or 0-20 cm (arable land) depth. For water, collect grab or composite samples, filter when needed, and acidify to preserve dissolved metals. For air, use high-volume samplers or passive collectors for metals. Include field blanks, duplicates, and chain-of-custody records. Avoiding contamination is critical because metals are ubiquitous. Low detection limits and matrix interferences require careful sample preparation, complete digestion for solids, and appropriate preservation for waters.

Microwave-assisted digestion for soil samples is recommended to improve digestion efficiency and analytical precision. Although matrix-matched calibration should be applied, therefore calibration standards with similar acid concentration and residual matrix to the samples should be prepared. When significant matrix variation exists, use the standard addition method (spiking aliquots of samples with incremental analyst concentrations) for robust matrix correction. Routinely certified reference materials (CRMs) or reliable internal/external reference materials should be used to monitor and control analytical performance.

Speciation matters: different chemical forms have different toxicity (e.g., methylmercury vs inorganic mercury, Cr III vs Cr VI), but speciation analysis is more complex.

Instruments such as ICP-MS, AAS, and CV-AAS for mercury need rigorous calibration, certified reference materials, and quality controls to ensure reliable results.

ICP-MS is one of the most suitable techniques for the determination of the majority of chemical elements at very low concentrations in various types of environmental matrices. The characteristics of this instrument make it suitable for various applications in the chemical, pharmaceutical, food, clinical, geological and forensic sectors. Furthermore, it is possible to determine multiple elements simultaneously in a single run allowing the execution of analyses, characterized by a high degree of precision and accuracy.

4. ORGANIC CONTAMINANTS

Organic contaminants include pesticides, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), per- and polyfluoroalkyl substances (PFAS), pharmaceuticals, personal care products, and solvents. They originate from agriculture, industry, fossil fuel combustion, wastewater discharges, landfill leachate, and consumer use.

In soil persistent and hydrophobic organics bind to organic matter and can remain for years. In water polar and mobile compounds travel with groundwater and surface water; hydrophobic compounds partition to sediments. In air volatile organics and particle-bound compounds can disperse regionally and deposit to land or water.

Health risks range from acute toxicity to long-term effects such as endocrine disruption, reproductive harm, neurotoxicity, and cancer. Persistent, bioaccumulative compounds (PCBs, some PFAS, certain PAHs) concentrate in food chains, exposing people through fish, meat and dairy products. Cereals, fruits, and vegetables are the main route of entry for pesticides and their metabolites into the food chain. Pharmaceuticals and personal care products may affect microbial communities and have subtle chronic effects at low doses. Mixtures and transformation products complicate risk assessment because combined and metabolite effects are often unknown.

Sampling strategies depend on the analytes to be investigated, the matrix to be examined and the required quality of the results. In the case of soils and sediments, homogenised composite samples are usually taken from a predefined area or grid (e.g. 10 m x 10 m square, composite sample from 13 individual samples), unless small-scale variations are of interest. When selecting the tools, the analytes to be examined must be taken into account (plastic tools or stainless steel for heavy metals, metal tools for organic parameters). During transport and storage, care must be taken to ensure that no losses occur due to evaporation or decomposition. For most analytes, this can be avoided by transporting and storing them in a cool place and in the dark (no direct sunlight).

For water, random samples or time-proportional composite samples should be taken. The samples should be stabilised by cooling and, if necessary, by adding chemical preservatives. The choice of container material can have a major influence on the result. For example, plastic sampling devices must not be used for hydrophobic analytes that can adsorb to plastic surfaces. Passive samplers can be used over a longer period of time for semi-volatile or hydrophobic compounds.

In the case of hydrophobic compounds that tend to be adsorbed onto particles, care must be taken to ensure that the particles are also sampled representatively during passive collection.

For air, depending on the required quality of the results, active sampling devices with filters and sorption cartridges or passive air sampling devices can be used to collect gases and particles. Here, too, care must be taken to ensure that the particles are also sampled representatively during passive collection or that this is taken into account when interpreting the results.

For quality assurance purposes, it may be useful to use field blank samples, transport blank samples and spiked samples to monitor contamination and recovery.

Organic contaminants are often present in very low concentrations (ng/l to µg/l) in complex matrices, which require sensitive and selective methods.

The choice of extraction and purification methods is crucial for the quality of the analytic results.

Many methods are available for extraction, ranging from classic manual Soxhlet extraction, which is almost always applicable, to automatic extraction methods for specific issues. The most common techniques include Soxhlet extraction, ultrasonic-assisted extraction, microwave-assisted extraction, accelerated solvent extraction (PSE) and QuEChERS for solids, as well as liquid-liquid extraction and solid-phase extraction (SPE) for liquids.

Column chromatographic methods are usually used for sample clean-up, separating the analytes from the interfering matrix based on differences in polarity, molecular size or solubility. Here, too, the methods range from simple manual methods to fully automated purification methods for special analytical procedures.

In instrumental analysis, GC-MS/MS for volatile and semi-volatile compounds and LC-MS/MS for polar and thermally labile substances are state of the art. Both methods offer high sensitivity, which can only be utilised after the interfering matrix has been separated by intensive sample clean-up. In order to detect and, if necessary, correct any losses of the analyte of interest, the use of isotope-labelled internal standards (isotope dilution method) is also state of the art. Only in this way is it possible to achieve very low detection limits with acceptable measurement uncertainty.

It should be noted that transformation products and metabolites may not be detected by routine methods, leading to an underestimation of the total exposure. As described above, sorption and losses during sampling and storage (on container walls, filters or sampling materials) are common problems.

Emerging contaminants such as novel PFAS or new pharmaceuticals require continuous updating of methods. As certified reference materials are often lacking for these new substances, the comparability of results between laboratories is limited by different methods and target lists. Participation in proficiency tests and the application of internal laboratory quality assurance measures are essential to obtain reliable, comparable data.

As methods are rapidly evolving and new contaminants are constantly being identified, it remains difficult to compare studies. Laboratories must update and validate their methods, participate in laboratory proficiency tests and, where available, use certified reference materials

5. EMERGING CONTAMINANTS

5.1. Microplastics

Microplastics can appear in almost all places. They are found in drinking water, surface water, seawater, wastewater, and landfill leachate. They also occur in sediments, soil, sewage sludge, and compost. Microplastics are present in consumer products and food such as cosmetics, salt, beverages, and supplements, and they have been detected in fish, mussels, animal organs, and human tissues. The Environment Agency Austria has analysed microplastics since 2015 and has developed sampling and laboratory procedures and is contributing to the process of standardization.

Sampling is challenging because particles behave differently from dissolved chemicals. Representative sampling needs a concept for suitable locations, it must deal with different particle sizes and densities and must avoid contamination from equipment and containers.

Sample preparation aims to remove non-plastic material and to concentrate plastics while keeping particles intact for optical and spectroscopic analysis. Main steps include liquid–solid separation, sieving and filtration, chemical and enzymatic digestion to remove organic matter, fats, and cellulose, density separation, and careful handling on inorganic filters. Preparation can be time consuming, may fragment particles, and carries a high contamination risk.

The analytical methods include optical techniques such as FTIR microscopy and Raman spectroscopy, and thermoanalytical techniques such as pyrolysis GC-MS and TED GC-MS. Microscopy provides particle count, particle size and shape, while spectroscopy identifies polymer types. Thermoanalytical methods identify the polymer type and determine its mass. Clean rooms and filtered reagents are used to avoid blank values. For quality assurance, the analysis of blank samples, duplicate determinations and spiked samples are essential.

Currently, there are very few standards available for calibrating the analysis methods, so laboratories are forced to produce them themselves. Due to the novelty of the methods, there are no certified reference standards. Although the laboratories work to the best of their knowledge and belief, studies in this field are difficult to compare.

The following list provides ISO and EU standardisation work:

- ISO 24187:2023 Principles for the analysis of microplastics present in the environment
- ISO/TS 20593:2017 Ambient air - Determination of the mass concentration of tire and road wear particles (TRWP) Pyrolysis-GC-MS method
- ISO 5667-27:2025 Water quality — Sampling Part 27: Guidance on sampling for microplastics in water
- ISO 16094-2:2025 Water quality — Analysis of microplastic in water; Part 2: Vibrational spectroscopy methods for waters with low content of suspended solids including drinking water

- ISO 5667-4:2026 Water quality — SamplingPart 4: Guidance on sampling from lakes, natural and man-made
- COMMISSION DELEGATED DECISION of 11.3.2024 supplementing Directive (EU) 2020/2184 of the European Parliament and of the Council by laying down a methodology to measure microplastics in water intended for human consumption

5.2. PFAS

Per- and polyfluoroalkyl substances (PFAS) are a large group of synthetic, highly fluorinated chemicals used since the mid-20th century in firefighting foams, nonstick coatings, dirt- and water-repellent textiles, food packaging, and many industrial processes. Their strong carbon–fluorine bonds make them persistent in the environment and resistant to degradation. The term PFAS covers several thousand chemicals whose only common feature is the presence of carbon-fluorine bonds. The best-known groups are perfluorocarboxylic acids, perfluorosulfonic acids, fluorotelomer sulfonic acids, perfluorooctane sulfonamide and fluorotelomer alcohols. Within these groups, the substances differ in carbon chain length and thus in volatility and polarity. Their behaviour in the environment, solubility in water, volatility and accumulation in soil and sediment vary accordingly. PFAS are therefore found in all environmental compartments and can move between these compartments under certain conditions.

PFAS toxicity varies by compound, but many PFAS are associated with adverse human health effects at low doses, including developmental and immune effects, liver toxicity, endocrine disruption, and increased risk of certain cancers. Long-chain PFAS (e.g. PFOA, PFOS) bioaccumulate and have been most studied. Although substitutes with shorter chainlength may be less bioaccumulative, they are still persistent and are causing increasing concern, as larger quantities have been used, mainly due to less functionality (e.g. pronounced water-repellent properties).

Sampling requires extreme care to avoid contamination and loss. Since PFAS are ubiquitous, all vessels and tools must be cleaned and checked for blank values before use. All chemicals must also be checked for blank values as soon as a new batch is used. Particular attention must be paid to avoiding Teflon and similar materials. The residual monomers present in these plastics can lead to massive, often characteristic blank values. Incidentally, the general considerations for sampling organic compounds in Chapter 4 also apply.

Field blank values and, if necessary, transport blank values are necessary to control the overall process.

While standards are already available for the determination of water, European standards for the determination of PFAS in air and deposition are currently being developed.

The analytical challenges include the large number of PFAS compounds and isomers, some of which behave differently chemically and may require different analytical methods. The very low concentrations in the environment (in the ng/l range) make the analyses susceptible to

matrix interference. There is also the possibility that precursor compounds may convert into monitored PFAS.

Typical workflows include solid-phase extraction for water and solvent extraction for solids, sample purification if necessary, followed by LC-MS/MS for targeted quantification using isotope-labelled internal standards added prior to extraction. Non-target analyses and total fluorine approaches complement the target methods. Quality assurance/quality control measures with method validation, procedural blind samples, isotope dilution procedures, participation in interlaboratory tests and control via certified reference materials are mandatory.

Examples of available methods and guidance include ITRC sampling guidance, US EPA analytical methods (e.g. method 533/537 series for drinking and environmental waters), and a growing set of national and commercial laboratory protocols. International standardization (ISO/CEN) and EU regulatory work are evolving and being published progressively. Relevant examples are listed here:

- ISO 21675:2019; Water quality — Determination of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in water — Method using solid phase extraction and liquid chromatography-tandem mass spectrometry (LC-MS/MS)
- DIN 38407-42; Determination of selected polyfluorinated compounds (PFC) in water-Method using high-performance liquid chromatography and mass spectrometric detection (HPLC/MS-MS) after solid-liquid extraction

6. QUALITY ASSURANCE

Quality assurance (QA) and quality control (QC) ensure analytical results are reliable and fit for purpose. A QA system defines data quality objectives, documentation, staff training, instrument maintenance, and audit trails. QC implements routine checks during sampling and analysis to verify performance. Clear planning links the monitoring goal to required detection limits, target analytes, and acceptable uncertainty.

Field QA/QC focuses on preventing contamination and preserving sample integrity. Common measures are use of clean, contaminant-free sampling tools and containers, field blanks, trip blanks, and duplicate or replicate samples to assess variability. Proper sample handling includes immediate cooling, appropriate preservatives (e.g., acidification for metals), chain-of-custody records, and timely transport to the laboratory.

Laboratory QC covers sample preparation, instrument performance, and data checks. Typical elements are method blanks, laboratory control samples (LCS), matrix spikes and spike duplicates to assess recovery and matrix effects, calibration checks, and use of isotopically labeled internal standards for organics. Regular instrument tuning, maintenance logs, and daily performance checks reduce drift and false results.

Method validation and comparability require documented validation of accuracy, precision, linearity, detection limits, and robustness for each matrix and analyte. Use of certified reference materials, participation in interlaboratory comparisons or proficiency tests, and routine analysis of quality control charts (e.g. control limits) support long-term data quality. Non-target and high-resolution methods need additional QA steps such as surrogate standards, blank subtraction strategies, and reporting of identification confidence.

Finally, transparent reporting of QA/QC results with each dataset blank levels, recoveries, detection limits, and any corrective actions - allows users to judge data fitness for use. Continuous review and updates of QA procedures keep methods aligned with evolving contaminants and analytical technologies.

7. EU LEGAL DOCUMENTS

The most important laws for environmental analysis in WATER, SOIL and AIR samples in EU are the Soil Monitoring Law, the Water Framework Directive, and the Directive on ambient Air quality and cleaner air for Europe.

Below is a list of the most important European laws and regulations that drive environmental analysis (monitoring, sampling, laboratory methods, reporting) for organic and inorganic contaminants. These acts set quality standards, monitoring obligations, and technical/QA requirements across water, air, soil, waste and chemicals.

Key EU laws and directives are:

- Soil Monitoring Law (EU 2025/2360)

The new EU Soil Monitoring Law establishes a harmonised, EU-wide framework requiring Member States to monitor soil health and to analyse both organic and inorganic contaminants using comparable methods.

- Water Framework Directive 2000/60/EC

Establishes the overall river-basin approach, the objective of achieving good ecological and chemical status for surface and ground waters, and the monitoring programmes that determine which contaminants must be analysed.

- Directive (EU) 2024/2881 on ambient air quality and cleaner air for Europe

The Directive (EU) 2024/2881 raises analytical and monitoring standards across the EU, driving investment in laboratory capacity, harmonised methods, and data systems so that organic and inorganic air contaminants are measured more accurately, comparably and transparently to support policy action and protect public health.

- Regulation on Classification Labelling and Packaging CLP 1272/2008

Sets harmonised rules for hazard classification and labelling of chemical substances and mixtures, which underpin reporting, safety data sheets and analytical identification requirements.

- Nitrates Directive 91/676/EEC

Requires monitoring of nitrate pollution from agriculture in surface and groundwater and drives routine inorganic (nitrate/nitrite) analysis and reporting in vulnerable zones.

- REACH Regulation 1907/2006

Requires registration, testing and submission of analytical and toxicological data for chemicals placed on the EU market; analytical methods and validated data are central to compliance dossiers.

- Groundwater Directive 2006/118/EC

Complements the Water Framework Directive by defining criteria for assessing and protecting groundwater chemical status and for reversing upward trends of pollutants.

- Sewage Sludge Directive 86/278/EEC

Controls the use of sewage sludge in agriculture by setting contaminant limits (heavy metals, organic pollutants) and monitoring obligations for soils and sludge.

- Drinking Water Directive (EU) 2020/2184

Recast of EU drinking-water rules that updates parametric values, expands monitoring (including emerging contaminants), and tightens QA/reporting requirements for public water supplies.

- Industrial Emissions Directive 2010/75/EU

Sets permitting, monitoring and emission limit obligations for industrial installations (BREFs and BAT conclusions), requiring continuous and periodic analysis of organic and inorganic emissions to air, water and soil.

- Commission Directive 2009/90/EC

Lays down technical specifications for chemical analysis and monitoring of water status under the Water Framework Directive, including method performance and comparability requirements for laboratories.

- Marine Strategy Framework Directive 2008/56/EC

Requires Member States to monitor marine waters and achieve Good Environmental Status; it defines descriptors that drive analysis of contaminants in water, sediments and biota.

- Regulation on Persistent Organic Pollutants 2019/1021

Implements POPs controls (Stockholm Convention obligations) and mandates monitoring and reporting for listed persistent organic contaminants across media.

- Directive 2013/39/EU on Priority Substances

Amends WFD-related rules to set Environmental Quality Standards for priority substances and expands the list of pollutants that Member States must monitor in surface waters.

Practical note: For laboratory compliance and comparability, Member States and competent authorities rely on the WFD/2009/90 technical specifications, national implementing laws, BREF documents under the IED, and harmonised EU parametric values in the Drinking Water and EQS Directives; certified reference materials and ISO/CEN methods are commonly required.

7.1. Soil Monitoring Law (SML)

The new Soil Monitoring Law (EU 2025/2360), implements the EU Soil Strategy for 2030 and addresses major threats like erosion, compaction, loss of organic carbon, and contamination. The overall, non-binding objective is to achieve a state of healthy soils across the entire EU by 2050.

The new EU Soil Monitoring Law establishes a harmonised, EU-wide framework requiring Member States to monitor soil health and to analyse both organic and inorganic contaminants using comparable methods, with mandatory reporting to a central EU database to support policy and remediation actions.

The Soil Monitoring Law creates a common monitoring architecture across the EU that obliges Member States to set up national monitoring networks and regular sampling programmes for soil quality, including specific lists of organic pollutants (e.g., persistent organic pollutants, pesticides) and inorganic contaminants (e.g., heavy metals, nitrates) to be analysed and reported.

The directive emphasises method comparability and data quality: laboratories must apply validated analytical methods, quality assurance procedures and interoperable data formats so results are comparable across borders and over time. The Commission and reference laboratories will provide technical guidance and support for harmonised sampling and laboratory protocols.

A core aim is to link monitoring results to resilience and restoration targets: Member States must assess trends, identify hotspots, and feed data into EU-level indicators that guide remediation priorities, land-use planning and agri-environmental measures. The law also strengthens surveillance of emerging contaminants and requires periodic review of the contaminant lists to reflect scientific and technological advances.

What to monitor: soil health indicators (organic carbon, pH, texture, biodiversity proxies) plus heavy metals (arsenic, antimony, cadmium, cobalt, chromium (total), , copper, mercury, lead, nickel, thallium, vanadium, zinc) and current organic pollutants (list has to be established by Member States), and emerging contaminants such as PFAS, pesticides and their metabolites. The EU Soil Monitoring Law establishes a harmonized monitoring framework and lists core indicators and contaminant categories for Member States to track soil health and contamination.

The whole list of descriptors is given in ANNEX 1.

7.2. Water framework directive (WFD)

The aim of the water framework directive is to achieve a good status for all waters.

It sets quality objectives and provides methods for achieving them and maintaining good water quality. The focus is on a river basin-based approach, which requires, based on a current status analysis, the development of planning provisions to achieve environmental objectives within set deadlines.

- Directive 2008/105/EC of the European Parliament and of the Council on environmental quality standards in the field of water policy (OJ EC No. L 348 p. 84) is based on Article 16 of the Water Framework Directive (WFD) on strategies against water pollution.

This Directive establishes harmonized environmental quality standards for 33 priority substances in order to achieve a high level of protection for the environment and health. These environmental quality standards constitute the decisive benchmark for the good chemical status of surface waters required by the Water Framework Directive. The input of "priority substances" into water bodies must be gradually reduced.

- In the list of priority substances, the "priority hazardous substances" that are toxic, bio-accumulative or give comparable cause for concern were particularly emphasized. Discharges and emissions of these substances are to be completely phased out within a certain period of time so that they no longer occur in water bodies in the long term.
- The whole list of substances is given in the ANNEX 2.

7.3. Directive on ambient air quality and cleaner air for Europe

The Directive is a recast of the EU air quality framework that updates and replaces earlier acts (2008/50/EG and 2004/107/EG) and aligns EU policy with recent scientific guidance on health impacts. Key inorganic pollutants covered include particulate matter (PM), nitrogen dioxide (NO₂), sulfur dioxide (SO₂) and selected heavy metals, while organic contaminants explicitly addressed include benzene, polycyclic aromatic hydrocarbons (e.g., benzo[a]pyrene) and other volatile organic compounds that affect air quality and human health. Limit values and target dates are tightened, increasing the need for sensitive, comparable analytical methods across Member States.

A central feature is the requirement for harmonised, high-quality monitoring: Member States must establish national networks with supersites for detailed source apportionment and chemical speciation, adopt standardised sampling and laboratory protocols, and ensure data comparability through QA/QC and reference laboratories. Analytical expectations include use of validated instrumental techniques (e.g., reference gravimetric and automated PM methods, chemiluminescence for NO₂, GC-MS/LC-MS and speciated analysis for organics) and interoperable data formats for EU reporting and public access.

Implementation imposes clear timelines and national transposition duties, with Member States required to adapt monitoring plans, upgrade networks, and report progress. National authorities will integrate results into air-quality management, permitting and public-health measures. The Directive also strengthens surveillance of emerging contaminants and mandates periodic review of pollutant lists to reflect scientific advances and monitoring capabilities.

Overall, Directive (EU) 2024/2881 raises analytical and monitoring standards across the EU, driving investment in laboratory capacity, harmonised methods, and data systems so that organic and inorganic air contaminants are measured more accurately, comparably and transparently to support policy action and protect public health.

What to monitor: PM_{2.5} and PM₁₀, NO₂, SO₂, O₃, CO, benzene, benzo[a]pyrene (BaP), and heavy-metal fractions associated with particulates (As, Cd, Ni, Pb); Member States also track exposure indicators and, increasingly, ultrafine particles, black carbon and ammonia as precursors. The revised Ambient Air Quality rules tighten limits and expand monitoring to align with WHO guidance.

- The whole list of parameters is given in the ANNEX 3.

8. ANNEX

8.1. Annex 1: SOIL

Directive (EU) 2025/2360 of the European Parliament and of the Council of 12 November 2025 on soil monitoring and resilience (Soil Monitoring Law). These legal requirements must be implemented into national law of member states (MS) within a certain timeframe (3 years).

In Annex I, Part B, soil descriptors with criteria for healthy soil condition must be established at Member State level for the following parameters.

- Arsenic
 - Antimony
 - Cadmium
 - Cobalt
 - Chromium (total)
 - Copper
 - Mercury
 - Lead
 - Nickel
 - Thallium
 - Vanadium
 - Zinc
-
- concentration of a selection of **organic contaminants** established by Member States and taking into account existing concentration limits in Union law, e.g. for water quality and air emissions

In Annex I, Part C soil descriptors without criteria are listed.

- Concentrations of PFAS-21 (6:2 FTS, PFBA, PFBS, PFDA, PFDODA, PFDoDS, PFDS, PFHpA, PFHpS, PFHxA, PFHxS, PFNA, PFNS, PFOA, PFOS, PFPeA, PFPeS, PFTTrDA, PFTTrDS, PFUnDA, PFUnDS or other 21 PFAS, as available in the laboratories) or concentrations of
- PFAS-43 (PFOS, PFOA, PFHxS, PFNA, PFBS, PFPeS, PFHpS, PFNS, PFDS, PFUnDS, PFDODA, PFTTrDS, PFBA, PFPeA, PFHxA, PFHpA, PFDA, PFUnDA, PFDODA, PFTTrDA, PFTTeDA, PFOSA, N-EtFOSA, N-MeFOSA, FOSAA, N-EtFOSAA, N-MeFOSAA, FHxSA, N-EtFHxSA, N-MeFHxSA, FHxSAA, N-EtFHxSAA, N-MeFHxSAA, FBSA, N-EtFBSA, N-MeFBSA, FBSAA, N-EtFBSAA, N-MeFBSAA, 6:2 FTS, 8:2 FTS, 5:3 FTCA, 7:3 FTCA or other 43 PFAS, as available in the laboratories.) or
- selected PFAS set by Member States in accordance with Article 7(4)

- Concentrations of selected active substances in pesticides and their metabolites set by Member States in accordance with Article 7(4)
- Optional: concentrations or presence of a selection of other emerging soil contaminants set by Member States in accordance with Article 7(4)

If organochlorine pesticides (OCP) are in the focus of specific projects, the following procedure can be suggested:

- ISO 23646:2022; Soil quality - Determination of organochlorine pesticides by gas chromatography with mass selective detection (GC-MS) and gas chromatography with electron-capture detection (GC-ECD)

8.2. Annex 2: WATER

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, or unofficially the European Water Framework Directive (EU WFD), is a European directive that aims to harmonize the legal framework for the European Union's (EU) water policy and intends to steer its corresponding policy more towards sustainable and environmentally compatible water use.

13 priority hazardous substances

- Anthracene
- Brominated diphenyl ethers (p-BDE)
- Cadmium and cadmium compounds
- C10-13 chloroalkanes
- Endosulfan
- Hexachlorobenzene
- Hexachlorobutadiene
- Hexachlorocyclohexane
- Mercury and mercury compounds
- Nonylphenols
- Pentachlorobenzene
- Polyaromatic hydrocarbons (without fluoranthene)
- Tributyltin compounds

20 priority substances

- Alachlor
- Atrazine
- Benzene
- Chlorfenvinphos
- Chlorpyrifos
- 1,2-Dichloroethane
- Dichloromethane
- DI (2-ethylhexyl) phthalate (DEHP)
- Diuron
- Fluoranthene
- Isoproturon
- Lead and lead compounds
- Naphthalene
- Nickel and nickel compounds
- Octylphenol
- Pentachlorophenol
- Simazine
- Trichlorobenzenes
- Trichloromethane (chloroform)
- Trifluralin

The environmental quality standards regulated at EU level for these 41 substances define the good chemical status. Directive No 2008/105/EC has been transposed into national law by adapting the existing Chemicals Surface Water Quality Objectives Ordinance.

Directive No 76/464/EEC - insofar as it was still in force at that time - expired on 23 December 2013.

Revision of the Directive

With the entry into force of **Directive No 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 on 13 September 2013, the first revision of the list of priority substances was published. The most important changes are summarised below.

- Inclusion of **12 new substances or groups of substances** in the list of priority substances (Annex X of Directive No 2000/60/EC), 6 of the new substances were classified as priority hazardous substances; this means that a total of 45 substances or groups of substances are now regulated by the Directive;
- Changes to the environmental quality standards for certain substances or groups of substances on the **existing list of priority substances**; two substances were categorised as priority hazardous substances;
- With the amendment, **more biota EQS** were defined for a total of 11 substances or substance groups;
- Extension of the list of substances for which **trend monitoring** is required;
- Introduction of a so-called **watch list** for substances that pose a significant risk to or via the aquatic environment and for which no monitoring data are available; diclofenac, 17 α -ethinyl oestradiol and 17 β -oestradiol will be included in the first watch list;
- Commitment of the European Commission to develop a strategic approach to combat the pollution of water by **pharmaceutical substances** and, if necessary, to submit a proposal for measures to reduce the potential environmental impacts of pharmaceutical substances by 14 September 2017

The list of priority substances must be revised no later than 4 years after this Directive comes into force (2017) and every 6 years thereafter.

8.3. Annex 3: AIR

Directive (EU) 2024/2881 of the European Parliament and of the Council of 23 October 2024 on ambient air quality and cleaner air for Europe shows the following parameters to be measured in the Member States. The methods to be applied are given in the Directive.

Mandatory:

- PM₁₀, PM_{2,5}, UFP (ultra fine particles), BC (black carbon) - (fixed measurements)
- NO₂, O₃ - (fixed measurements)
- SO₂, CO
- Size distribution of UFP
- Benzo(a)pyren, other polycyclic aromatic hydrocarbons (PAH) as relevant
- Total deposition (2) of benzo(a)pyrene, and other polycyclic aromatic hydrocarbons (PAH) as relevant
- Arsenic, cadmium, lead und nickel
- Total deposition of arsenic, cadmium, lead, nickel and mercury
- Benzene
- Chemical composition of PM_{2,5} in accordance with Section 2

Recommended

- Size distribution of UFP
- Particulate matter oxidative potential
- Ammonia
- Levoglucosan to be measured as part of the chemical composition of PM_{2,5}
- Total gaseous mercury
- Particulate and gaseous divalent mercury
- Nitric acid

If pesticides are in the focus of a specific project, the following procedure can be suggested:

- EPA 10A (1999): Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using Low Volume Polyurethane Foam (PUF) Sampling Followed by Gas Chromatographic/Multi-Detector Detection (GC/MD)

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Date / Signature: 12.02.2026