EU4GREEN

# SURFACE WATER MONITORING DEVELOPMENT PLAN, MONTENEGRO

## EU 4 Green Recovery:
## Support the implementation of the Green Agenda for the Western Balkans

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**Responsible EU Member State Consortium project leader:**
Laura Hohoff, Project Leader

**Author:**
Daniel Trauner, Philipp Hohenblum; Umweltbundesamt (AT)

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# ABBREVIATIONS

| | |
|---|---|
| ADA | Austrian Development Agency |
| AIA | Administration for Inspection Affairs |
| ARB | Adriatic River Basin District |
| ASIG | State Authority for Geospatial Information |
| BQE | Biological Quality Element |
| CA | Competent Authority |
| CETI | Centre for Eco-Toxicological Research |
| CIS | Common Implementation Strategy |
| DCM | Decision of the Council of Ministers |
| DRB | Danube River Basin District |
| EC | European Commission |
| EEA | European Environment Agency |
| EIONET | European Environmental Information and Observation Network |
| EQR | Ecological Quality Ratio |
| EQS | Environmental Quality Standard |
| EU | European Union |
| EU ETS MRVA | EU Emissions Trading System Monitoring, Reporting, Verification and Accreditation |
| GAWB | Green Agenda for the Western Balkans |
| GC-MS | Gas Chromatography–Mass Spectrometry |
| IHMS | Institute of Hydrometeorology and Seismology |
| ICP-MS | Inductively Coupled Plasma Mass Spectrometry |
| IPH | Institute of Public Health |
| ISO | International Organization for Standardization |
| LIMS | Laboratory Information Management System |
| MAC | Macrophytes |
| MDP | Monitoring Development Plan |
| MZB | Macrozoobenthos |
| PAH | Polycyclic Aromatic Hydrocarbon |
| PFAS | Per- and Polyfluoroalkyl Substances |
| PHP | Phytoplankton |
| PHB | Phytobenthos |
| QA/QC | Quality Assurance / Quality Control |
| RBD | River Basin District |
| RBMP | River Basin Management Plan |
| RBSP | River Basin Specific Pollutant |
| SOP | Standard Operating Procedure |
| SWB | Surface Water Body |
| UBA | Umweltbundesamt (Environment Agency Austria) |
| VIS | Water Information System |
| WFD | Water Framework Directive |
| WISE | Water Information System for Europe |

# 1. EXECUTIVE SUMMARY

This **Surface Water Monitoring Development Plan (MDP)** provides a structured and practical roadmap for the development, implementation, and operation of a **Water Framework Directive (WFD)-compliant surface water monitoring system in Montenegro**. Developed within the framework of the EU4Green initiative, the plan supports Montenegro's transition towards **sustainable water management**, improved environmental governance, and alignment with EU acquis under Chapter 27.

The primary objective of the MDP is to establish a monitoring system capable of **reliably assessing the ecological and chemical status**, detecting trends and pressures, and evaluating the effectiveness of measures under River Basin Management Plans (RBMPs). Monitoring is recognised as a **core pillar of river basin management**, providing the data necessary for evidence-based decision-making and compliance with WFD requirements.

The document outlines the **technical and methodological foundations** for WFD-compliant monitoring, including the definition of biological quality elements (BQEs), supporting hydromorphological and physico-chemical parameters, and chemical substances such as Priority Substances and River Basin Specific Pollutants (RBSPs). It describes the three monitoring types required by Annex V—**surveillance, operational, and investigative monitoring**—each fulfilling distinct roles in status assessment, pressure analysis, and problem identification.

A central component of the MDP is the **phased implementation framework**, covering:

- baseline analysis and water body characterisation (Article 5),
- monitoring programme design (Article 8 and Annex V),
- operational implementation,
- data management and quality assurance,
- status assessment and reporting, and
- adaptive review and optimisation.

This phased approach is aligned with the **six-year WFD planning cycle**, ensuring a structured transition from planning to full system operation.

Montenegro has made significant progress in aligning its water management framework with the EU Water Framework Directive (WFD). The country is divided into two River Basin Districts (Danube and Adriatic), for which River Basin Management Plans (RBMPs) were adopted around 2020. These constitute the first generation of WFD-aligned planning instruments. Institutional responsibilities are clearly defined, with the Institute of Hydrometeorology and Seismology (IHMS) leading monitoring implementation, supported by the Water Administration, the Environmental Protection Agency (EPA), and laboratory institutions. Monitoring systems conceptually follow WFD requirements, and recent developments—such as the introduction of the Water Information System (VIS) in 2023 and the adoption of the 2024 national monitoring programme—represent important steps toward a more operational monitoring framework.

However, despite strong legal alignment, Montenegro's monitoring system is still in a **transition phase**, and substantial implementation gaps remain. Monitoring programmes are not yet fully operational across all water bodies, resulting in limited and inconsistent data coverage. Biological monitoring is particularly underdeveloped, with key Biological Quality Elements only partially implemented. Chemical monitoring also remains incomplete, especially for priority substances and biota. As a result, water status assessments often rely on limited datasets and expert judgement, leading to low confidence levels.

Additional challenges include insufficient laboratory capacity and quality assurance systems, fragmented data management (despite ongoing improvements through VIS), and weak integration between monitoring results and RBMP planning cycles. More broadly, institutional capacity constraints and gaps in supporting policy areas—such as pollution control and sludge management—further limit effective implementation.

To address these challenges, Montenegro requires a **structured transition to a fully operational WFD-compliant monitoring system**. The proposed roadmap outlines a phased approach for the period 2026–2030. Initial efforts focus on completing monitoring system design, strengthening legal and methodological frameworks, and clarifying institutional roles. This is followed by capacity building, including staff training, laboratory upgrades, and expansion of monitoring networks.

Subsequent phases aim at the full rollout of monitoring activities, ensuring consistent sampling, comprehensive parameter coverage (including biological and chemical elements), and improved spatial and temporal data consistency. This is complemented by the development of robust data management and assessment systems, including full operationalisation of the VIS, application of classification methods, and preparation of WISE-compatible datasets.

In the final phase, monitoring results are integrated into RBMP updates, enabling evidence-based water management and optimisation of monitoring systems. Key priorities throughout the roadmap include achieving full coverage of WFD monitoring requirements, establishing quality assurance systems, strengthening institutional capacity, and ensuring long-term sustainability.

In conclusion, Montenegro has laid the legal and institutional foundations for WFD-compliant monitoring, but decisive efforts are needed to move from planning to full implementation. Successfully implementing the proposed roadmap will be essential to achieve reliable water status assessments, effective river basin management, and compliance with EU environmental standards.

# 2. INTRODUCTION AND SCOPE

EU4Green is an important element of the continuous support by the European Union to empower and assist the Western Balkans' transition to modern, resource-efficient and competitive economies where growth is decoupled from emissions of greenhouse gases, resource use and waste generation and where climate resilience is pursued. It is the general objective of the project to support the Western Balkans in the implementation of the Green Agenda, thus in the development and transformation towards sustainability and reaching climate neutrality by 2050. Accordingly, EU4Green is a very broad initiative building on the combined expertise and cooperation within the thematic areas EU ETS MRVA, Circular Economy, Depollution Water, Depollution Air, Depollution Soil, Biodiversity, Sustainable Agriculture, Communication, Green Education, Stakeholder participation and Green Finance.

River basin management is based on monitoring of **surface water and groundwater resources** and plays a central role in any River Basin Management Plan (RBMP).
**Surface water monitoring** consists of ecological and chemical monitoring in accordance with the requirements of the Water Framework Directive (WFD). Ecological monitoring includes the assessment of biological quality elements (BQEs), supported by hydromorphological and physico-chemical elements, while chemical monitoring focuses on Priority Substances and other pollutants. These monitoring components are required to supplement and validate the characterization and risk assessment, to establish the status of surface water bodies (SWBs), and to evaluate the effectiveness of the measures implemented to achieve and maintain good ecological and chemical status.

In addition, surface water monitoring is needed to detect long-term trends in water quality, identify emerging pressures, and support the design and adjustment of programmes of measures under evolving environmental and climate conditions.

Sound monitoring is a fundamental instrument for good **surface water governance**. It provides all stakeholders with up-to-date and reliable information on the status and trends of surface waters within a river basin and enables informed decision-making for water management and the implementation of programmes of measures aimed at achieving the environmental objectives laid down by the Water Framework Directive (WFD).

This **Surface Water Monitoring Development Plan (MDP)** addresses the requirements for ecological and chemical monitoring of surface waters in line with the WFD. The comparison with the current situation provides the basis for identifying gaps, drawing conclusions, and formulating options for the progressive development and successful implementation of a WFD-compliant surface water monitoring system.

# 3. WFD COMPLIANT MONITORING

## 3.1. WFD monitoring principles

Article 8 of the Water Framework Directive (WFD) establishes the requirements for monitoring the status of surface waters, groundwater, and protected areas. Monitoring programmes are designed to provide a **coherent and comprehensive overview of water status** within each river basin district.

According to Annex V of the WFD, monitoring of surface waters is required to support the following objectives:

- Classification of ecological and chemical status;
- Supplementing and validating the risk assessment carried out under Annex II;
- Supporting the efficient and effective design of future monitoring programmes;
- Assessing long-term changes in natural conditions and those resulting from widespread anthropogenic activity;
- Estimating pollutant loads transferred across international boundaries or discharged into seas;
- Assessing changes in the status of water bodies identified as being at risk, particularly in response to implemented measures;
- Identifying the causes of failure to achieve environmental objectives where these are not yet known;
- Determining the magnitude and impacts of accidental pollution events;
- Supporting intercalibration exercises (comparison with neighbouring countries);
- Assessing compliance with the objectives and standards for protected areas; and
- Quantifying reference conditions for surface water bodies where these exist.

The results of monitoring programmes are reported within River Basin Management Plans (RBMPs) through **maps of monitoring networks, status assessments, and estimates of the confidence and precision** achieved by the monitoring systems.

Under the WFD, waters to be monitored are assigned to specific geographical and administrative units, in particular **river basins, river basin districts, and individual water bodies**, which form the fundamental units of assessment. Monitoring the status of these water bodies provides the basis for evaluating progress towards achieving the environmental objectives of the Directive.

Before monitoring programmes can be implemented, several preparatory steps must be completed:

- Delineation of surface water bodies;
- Identification of water body types (rivers, lakes, transitional and coastal waters);
- Definition of type-specific reference conditions for all biological quality elements.

Where such information is not yet fully available, particularly at national scale, **pressure analysis combined with expert judgement and/or modelling approaches (risk assessment)** can be used as an interim basis.

Annex V of the WFD distinguishes three main types of surface water monitoring: **surveillance monitoring, operational monitoring, and investigative monitoring**. These are complemented by additional monitoring requirements for protected areas identified under Article 6.

## 3.2. Recent update

Directive (EU) 2026/805 is a **recent update of the EU water policy framework** that amends the Water Framework Directive(2000/60/EC), the Groundwater Directive (2006/118/EC), and the Environmental Quality Standards Directive (2008/105/EC). It aims to strengthen protection of surface water and groundwater by updating the list of regulated pollutants, introducing stricter environmental quality standards, and enhancing monitoring and reporting requirements. The Directive places particular emphasis on emerging contaminants such as PFAS, pharmaceuticals, and microplastics, and promotes more advanced methods, including cumulative risk assessment and effect-based monitoring, in line with the EU's Zero Pollution ambition.

## 3.3. Precision and confidence

According to Annex V of the Water Framework Directive (WFD), monitoring results shall achieve appropriate levels of **precision and confidence**. What is considered "acceptable", "adequate", or "sufficient" will directly influence key design aspects of the monitoring programme, including:

- the number of water bodies included in the different types of monitoring;
- the number of monitoring stations required to assess the status of each water body; and
- the frequency at which parameters representing quality elements are measured.

The Directive does not prescribe fixed quantitative thresholds for precision and confidence. Nevertheless, it is clear that the levels achieved must be sufficient to enable **robust and meaningful assessments of water status**, both spatially and temporally.

In practice, many Member States begin by evaluating their **existing monitoring networks and datasets** to determine the level of precision and confidence that can be achieved with available resources. Monitoring system design is therefore typically an **iterative process**, involving ongoing adjustment and optimisation of networks, parameters, and sampling frequencies in order to reach levels that support reliable classification and decision-making.

In addition, **expert judgement** often plays an important role, particularly in assessing the risk of misclassification. For example, in cases where a water body may be incorrectly classified as being "at risk", responsible authorities will typically seek to reduce uncertainty through additional investigations before committing to costly measures. This approach helps ensure that management decisions are both **scientifically robust and proportionate**.

## 3.4. Biological quality elements for surface water

The basis of the classification of surface water bodies are the Biological Quality Elements (BQE) consisting of fish, macroinvertebrates, phytobenthos, phytoplankton, and macrophytes, while physico-chemistry and hydromorphology act as supporting elements.

- Biology
  - Macroinvertebrates (all rivers)
  - Phytobenthos (in small rivers only)
  - Phytoplankton (in very large rivers and lakes/reservoirs only)
  - Fish and macrophytes will be classified by expert judgment or by using local information (fishermen). If no information is available, these BQE will be included in a later phase. The same is true for macroinvertebrates and phytobenthos in lakes.
- Supporting elements
  - General physico-chemical parameters (all rivers and lakes)
  - Hydromorphology (based on a general classification of the river network)

"Supporting" means that the values of the physico-chemical and hydromorphological quality elements are such as to support a biological community of a certain ecological status, as this recognises the fact that biological communities are products of their physical and chemical environment. It is not intended that these supporting elements can be used as surrogates for the biological elements in surveillance and operational monitoring.

According the WFD, physico-chemical quality elements include 1) general physico-chemical parameters as listed in Annex V of the directive (temperature, $O_2$, nutrients, salinity, pH) and 2) specific pollutants to be expected in the respective water body. These River Basin Specific Pollutants (RBSP) have to be identified and selected beforehand.

## 3.5. Chemical quality elements for surface water

Chemical status assessment under the Water Framework Directive (WFD) is based on a defined set of quality elements, primarily focusing on the presence and concentration of chemical substances that may pose risks to aquatic ecosystems and human health. The core elements are the Priority Substances and Priority Hazardous Substances, which are regulated at EU level and subject to Environmental Quality Standards (EQS) in water, and in some cases also in biota and sediments. These substances include heavy metals (e.g. mercury, cadmium, lead), organic pollutants (e.g. pesticides, PAHs), and industrial chemicals. In addition, River Basin Specific Pollutants (RBSPs) are included at national or river basin level to address locally relevant pressures not fully covered by the EU list.

Assessment of chemical status requires monitoring across different matrices, primarily surface water, but increasingly also biota (e.g. fish tissue) and sediments, particularly for substances that accumulate in the food chain. The evaluation is based on compliance with EQS thresholds, with a strict “one out – all out” principle, meaning that exceedance of any single substance leads to failure of good chemical status. A key component of chemical monitoring is also the analysis of long-term trends, especially for substances that tend to accumulate or persist, in order to identify whether pollution is increasing or decreasing over time.

Together, these quality elements ensure a comprehensive assessment of chemical pressures on surface waters, enabling authorities to detect pollution, assess compliance with environmental objectives, and design targeted measures to reduce emissions and improve water quality.

## 3.6. Quality elements for groundwater and transitional and coastal waters

The Water Framework Directive (WFD) applies to all inland surface waters as well as groundwater and also defines quality elements for **transitional and coastal waters**. Coastal waters are defined as surface waters extending up to one nautical mile seaward from the baseline of the territorial waters. For **chemical status assessment**, the scope extends to territorial waters, which may reach up to 12 nautical miles.

For **groundwater**, EU legislation focuses on achieving **good quantitative status and good chemical status**. In addition, measures must be implemented to **prevent or limit the input of pollutants** and to **identify and reverse significant and sustained upward trends** in pollutant concentrations. (For further details on groundwater, reference is made to the document “Monitoring Development Plan – Groundwater, Montenegro”.)

Healthy **surface water ecosystems** are essential not only for ecological integrity but also for ensuring the availability of clean water for drinking, agriculture, and industrial use. The status of surface waters is influenced by a combination of **hydromorphological conditions and pollution pressures**. The WFD therefore requires that inland, transitional, and coastal waters achieve both **good ecological status (or potential)** and **good chemical status**.

Transitional waters are defined as bodies of surface water in the vicinity of river mouths that are partly saline due to their proximity to coastal waters, but still significantly influenced by freshwater flows. Coastal waters extend seaward from the baseline and include waters influenced by marine processes, as defined above.

Ecological status classification is based primarily on the condition of **biological quality elements**, supported by **hydromorphological** and **physico-chemical quality elements**, and compared against **type-specific reference conditions**. Appropriate classification systems and assessment tools must therefore be developed to evaluate deviations from these reference conditions.

For **transitional and coastal waters**, the following quality elements are defined under Annex V of the WFD:

**Biological quality elements**

- Composition, abundance, and biomass of phytoplankton (transitional and coastal waters)
- Composition and abundance of other aquatic flora (macrophytes and phytobenthos)
- Composition and abundance of benthic invertebrate fauna
- Composition and abundance of fish fauna (transitional waters only)

**Supporting hydromorphological elements**

**For transitional waters:**

- Morphological conditions:
  - Depth variation
  - Quantity, structure, and substrate of the bed
  - Structure of the intertidal zone
- Tidal regime:
  - Freshwater flow
  - Wave exposure

**For coastal waters:**

- Morphological conditions:
  - Depth variation
  - Structure and substrate of the coastal bed
  - Structure of the intertidal zone
- Tidal regime:
  - Direction of dominant currents
  - Wave exposure

**Supporting physico-chemical and chemical elements**

- General conditions:
  - Transparency
  - Thermal conditions
  - Salinity
  - Oxygenation conditions
  - Nutrient conditions
- Specific pollutants:
  - Pollution by Priority Substances and other relevant pollutants discharged into the water body
  - Pollution by other substances identified as being discharged in significant quantities

## 3.7. Surface Water Surveillance Monitoring

The Water Framework Directive (WFD) requires that a sufficient number of water bodies be included in the **surveillance monitoring programme** to provide a representative assessment of the overall surface water status within each catchment and sub-catchment of a river basin district. The design of the monitoring strategy should make use of all available information on **chemical pressures and impacts**, including knowledge of substance properties (as outlined in CIS Guidance Document No. 7), emission sources and data, identified pressures, and results from previous monitoring activities.

Surveillance monitoring must be undertaken for a **minimum period of one year within each six-year River Basin Management Plan (RBMP) cycle**. The Directive specifies that monitoring should be carried out at locations where water dynamics are most relevant at the scale of the river basin district, including:

- rivers with significant flow rates, particularly large rivers with catchment areas exceeding 2,500 $km^2$;
- large lakes and reservoirs where water volumes are significant;
- water bodies that cross Member State boundaries; and
- additional sites required to estimate pollutant loads transferred across boundaries and into the marine environment.

Within surveillance monitoring, parameters representing **all biological quality elements (BQEs), hydromorphological elements, and general as well as specific physico-chemical quality elements** must be monitored to ensure a comprehensive assessment of status.

**Proposal for monitoring frequency of surveillance sites:**

With regard to monitoring frequency, a harmonised and practical approach is recommended. For rivers, it is appropriate to sample chemical parameters monthly (12 times) over the course of one year, twice per RBMP cycle. For lakes, general physico-chemical parameters, River Basin Specific Pollutants (RBSPs), and Priority Substances (PS) may be sampled four times over one year, also twice per RBMP cycle (Table 1). Biological monitoring frequencies differ depending on the quality element and water category. In rivers, biological quality elements (BQEs) are typically monitored twice per RBMP cycle (Table 2). In lakes, phytoplankton is recommended to be sampled multiple times (e.g. four times) over a year, with sampling distributed across the vegetation period to capture seasonal variability.

**Table 1: Recommendations for chemical monitoring frequency at surveillance.**

| Monitoring | SWB | Quality Elements / Group of Parameters | Frequency within the selected year of the RBMP cycle | Intervals |
|---|---|---|---|---|
| Chemical Surveillance Monitoring | Rivers | General Physico-Chemical Parameters | 12x | at least every 3 years |
| | | River Basin-Specific Pollutants | | |
| | | Priority Substances | | |
| | Lakes | General Physico-Chemical Parameters | 4x | |
| | | River Basin-Specific Pollutants | | |
| | | Priority Substances | 12x | |
| | Transitional & Coastal Waters | General Physico-Chemical Parameters | 4x | |
| | | River Basin-Specific Pollutants | | |
| | | Priority Substances | 12x | |

**Table 2: Recommendations for biological monitoring frequency at surveillance sites.**

| Monitoring | SWB | Quality Elements / Group of Parameters | Frequency within the selected year of the RBMP cycle | Intervals |
|---|---|---|---|---|
| Biological Surveillance Monitoring | Rivers | Benthic Invertebrates | 1x | at least every 3 years |
| | | Phytobenthos | | |
| | | Fish | | |
| | | Macrophytes | | |
| | Lakes | Phytoplankton | 4x | |
| | | Fish | 1x | |
| | | Makrophytes | | |
| | Transitional & Coastal Waters | Benthic Invertebrates | 1x | |
| | | Phytoplankton | 4x | |
| | | Fish | 1x* | |
| | | Macrophytes | 1x | |

** Fish are not required in coastal waters.*

**Table 3: Recommendations for hydromorphological monitoring frequency at surveillance sites.**

| Monitoring | SWB | Quality Elements / Group of Parameters | Frequency / Intervals |
|---|---|---|---|
| Hydro-morphological Surveillance Monitoring | Rivers | Continuity | once in 6 years |
| | | Hydrology | continuously |
| | | Morphology | every 6 years |
| | Lakes | Continuity | - |
| | | Hydrology | Monthly |
| | | Morphology | once in 6 years |
| | Transitional & Coastal Waters | Continuity | - |
| | | Hydrology | - |
| | | Morphology | once in 6 years |

## 3.8. Surface Water Operational Monitoring

The objectives of **operational monitoring** are to:

- establish the status of water bodies identified as being at risk of failing to meet their environmental objectives; and
- assess changes in the status of these water bodies resulting from the implementation of programmes of measures.

Operational monitoring must be carried out for all water bodies identified as being at risk of failing the relevant environmental objectives. In addition, it is required for water bodies into which **priority substances** are discharged. However, it is not necessary to monitor every individual water body, as the Directive allows for **grouping of similar water bodies** and representative monitoring, provided that the approach ensures reliable status assessment.

Operational monitoring is **targeted and pressure-specific**, focusing on those parameters and quality elements that are most sensitive to the dominant pressures affecting a water body. For example, where organic pollution is a key pressure in a river, **benthic invertebrates** may serve as the most sensitive biological indicator for assessing ecological impacts.

**Proposal for monitoring frequency of operational sites:**

With regard to monitoring frequency, a practical and structured approach is recommended. General physico-chemical parameters should be sampled monthly (12 times per year) in rivers and four times per year in lakes, with monitoring carried out in two separate years within the six-year RBMP cycle (Table 4). For biological quality elements (BQEs), the most indicative quality elements in relation to the present pressures must be chosen to assess the water body at risk of failing the good ecological status. BQEs are typically monitored twice per RBMP cycle in rivers, while in lakes, phytoplankton is recommended to be sampled multiple times (e.g. four sampling events) within a single year, repeated twice within the

RBMP cycle. These sampling events in lakes should be distributed across the vegetation period to adequately capture seasonal dynamics (Table 5). However, if the BQE results do not allow for a clear status assessment due to the dynamics of natural systems and unpredictable events, the monitoring period should be extended by one additional year.

Where point source or diffuse pollution is identified, suspected Priority Substances and River Basin Specific Pollutants (RBSPs) should also be monitored, following comparable frequencies (e.g. 12 times per year in rivers and four times per year in lakes, repeated twice per RBMP cycle).

**Table 4: Recommendations for chemical monitoring frequency at operational sites.**

| **Monitoring** | **SWB** | **Quality Elements / Group of Parameters** | **Frequency within the selected year of the RBMP cycle** | **Intervals** |
|---|---|---|---|---|
| Chemical Operational Monitoring | Rivers | General Physico-Chemical Parameters | 12x | at least every 3 years |
| | | River Basin-Specific Pollutants | 12x* | |
| | | Priority Substances | 12x* | |
| | Lakes | General Physico-Chemical Parameters | 4x | |
| | | River Basin-Specific Pollutants | 4x* | |
| | | Priority Substances | 12x* | |
| | Transitional & Coastal Waters | General Physico-Chemical Parameters | 4x | |
| | | River Basin-Specific Pollutants | 4x* | |
| | | Priority Substances | 12x* | |

** If the risk assessment finds the SWB to be affected by point source or diffuse pollution, chemical analysis of the suspected substances should also be conducted. – Rivers: 12x; Lakes: 4x.*

**Table 5: Recommendations for biological monitoring frequency at operational sites.**

| **Monitoring** | **SWB** | **Quality Elements* / Group of Parameters** | **Frequency within the selected year of the RBMP cycle** | **Intervals** |
|---|---|---|---|---|
| Biological Operational Monitoring | Rivers | Benthic Invertebrates | 1x | at least every 3 years |
| | | Phytobenthos | | |
| | | Fish | | |
| | | Macrophytes | | |
| | Lakes | Phytoplankton | 4x | |
| | | Fish | 1x | |
| | | Makrophytes | | |

| | | | | |
|---|---|---|---|---|
| | Transitional & Coastal Waters | Benthic Invertebrates | 1x | |
| | | Phytoplankton | 4x | |
| | | Fish | 1x** | |
| | | Macrophytes | 1x | |

** Choose the most indicative quality element to the present pressures to assess the status of the water body at risk.*
*** Fish are not required in coastal waters.*

**Table 6: Recommendations for hydromorphological monitoring frequency at surveillance sites.**

| Monitoring | SWB | Quality Elements / Group of Parameters | Frequency / Intervals |
|---|---|---|---|
| Hydro-morphological Operational Monitoring | Rivers | Continuity | once in 6 years |
| | | Hydrology | continuously |
| | | Morphology | every 6 years |
| | Lakes | Continuity | - |
| | | Hydrology | Monthly |
| | | Morphology | once in 6 years |
| | Transitional & Coastal Waters | Continuity | - |
| | | Hydrology | - |
| | | Morphology | once in 6 years |

**Choosing operational monitoring sites:**

The following schemes A, B, and C (Figure 1, Figure 2, Figure 3) are adapted from a publication on implementing the Austrian Ordinance on the Monitoring of the Quality of Water Bodies (BMLFUW, 2008) illustrate the step-by-step approach on operational monitoring site selection:

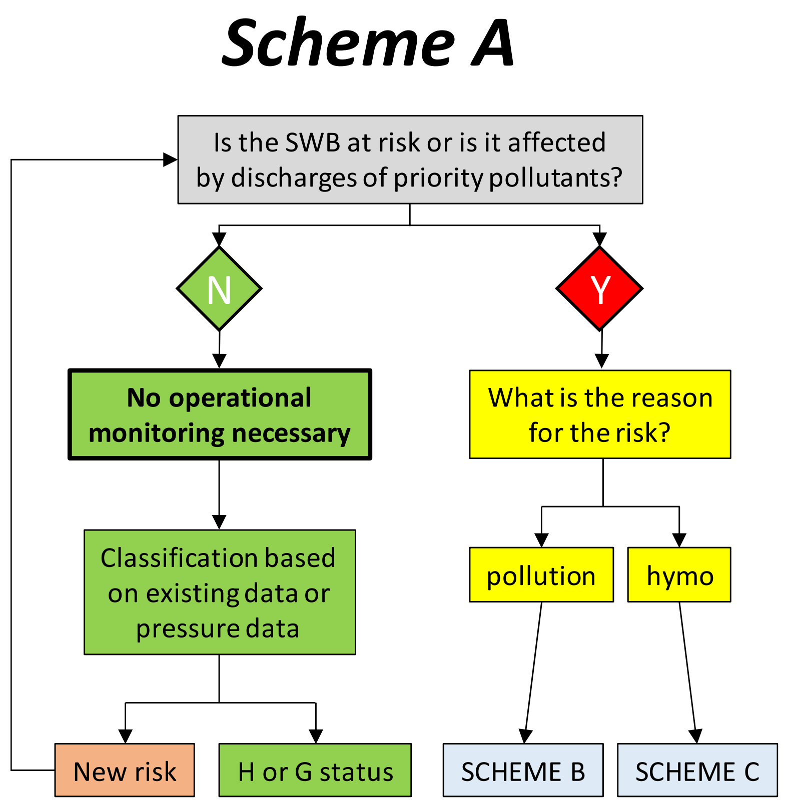


**Figure 1: Scheme A of decision tree for choosing operational monitoring sites.**

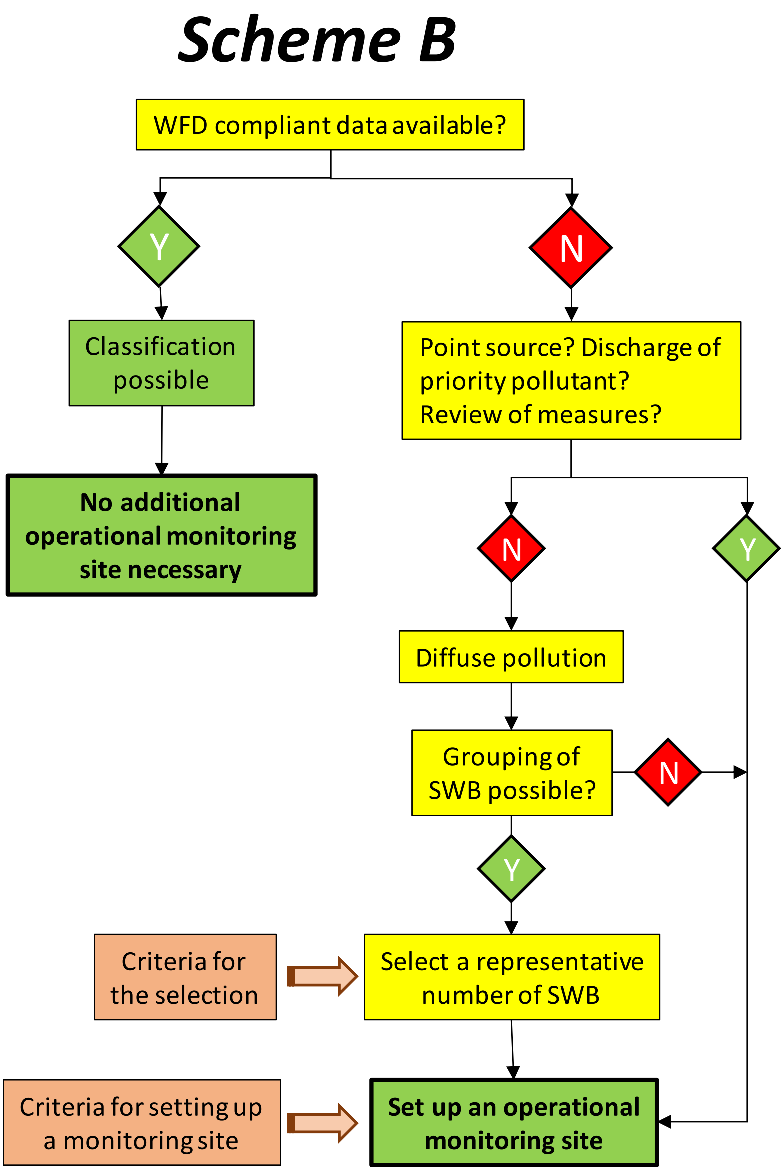


**Figure 2: Scheme B of decision tree for choosing operational monitoring sites.**

**Criteria for the selection of representative water bodies from the group:**

- Pollution from diffuse sources
- for successive SWB
    - diffuse load is uniform
    - monitoring site situated in the last SWB (most downstream)
    - Classification results can be applied to the SWB above (upstream)
- for SWB in different regions
    - diffuse load is uniform
    - SWB belong to the same type
    - SWB are comparable in terms of agricultural use

- Affected SWB of the group are affected by the same substance or combination of substances
- At least 25% of the SWB in a group are selected as representatives

**Criteria for the setting up a monitoring site in rivers**

- one site per SWB which is representative for the pollution
- Preferably at the lower end of the SWB
- Beware dilution effects of tributaries
- Distance to possible additional point sources should be at least 1 km or – if the river breadth is >100 m – at least the 10-fold of the river breadth

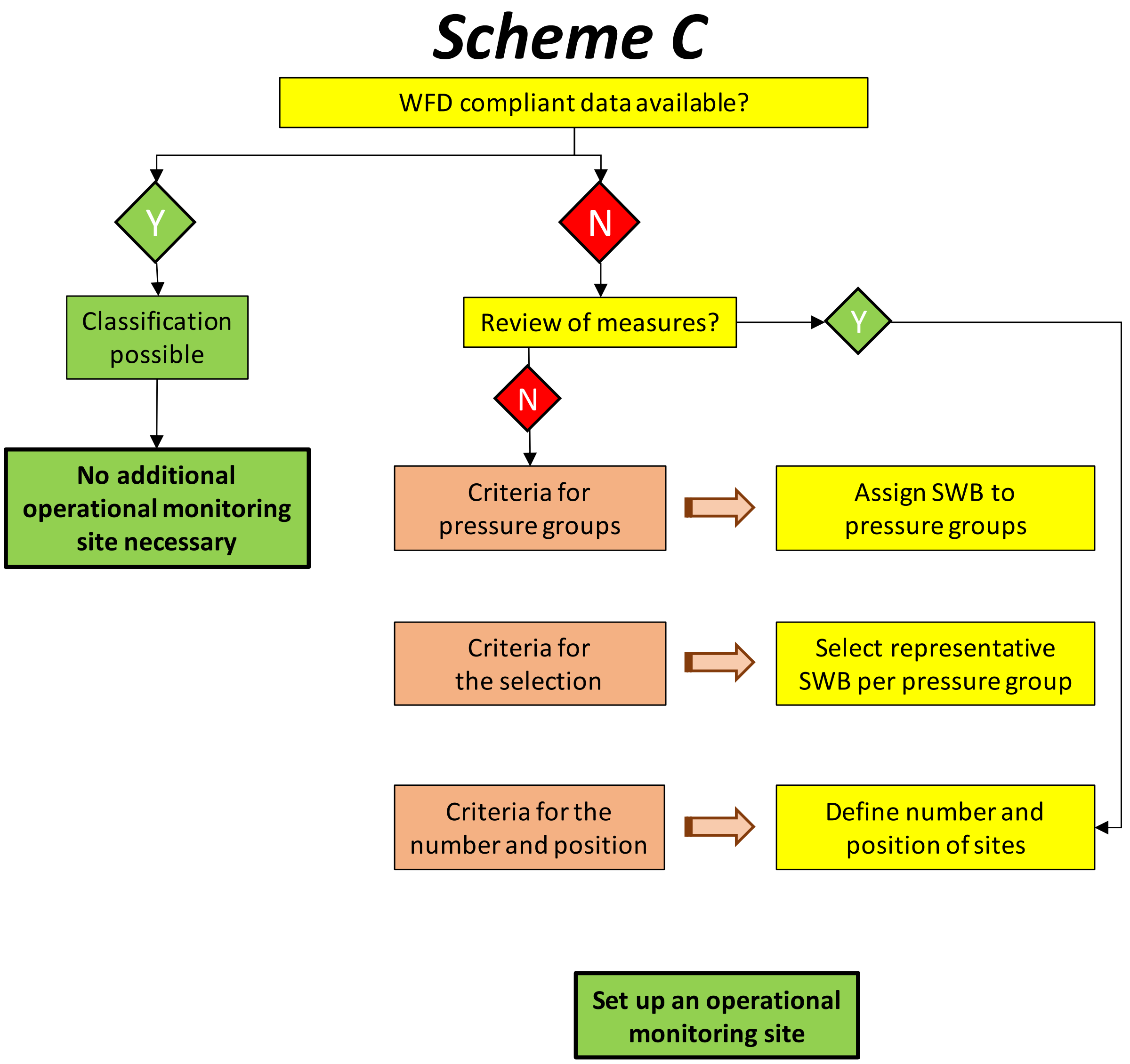


**Figure 3: Scheme C of decision tree for choosing operational monitoring sites.**

**Criteria for pressure groups in rivers**

A group of SWB

- with same river type,
- affected by the same pressure,
- which can be investigated and classified by the same indicative biological quality element

**Criteria for the selection within each pressure group**

- Ideally 1/3 of SWB within each pressure group
- Hydrological context: if possible, select sites within a hydrological subbasin
- No additional pressure (if possible)
- Easy to reach

**Criteria for the number and position**

- Morphology: one site in the longest uniform section
- Water abstraction: one site directly below the abstraction
- Continuum: one or two sites, above the weir or dam; if there is series of several weirs or dams, another one below the lowest one
- Impoundment: one site beginning (source) of the impoundment, optionally another site directly above the dam

## 3.9. Surface Water Investigative Monitoring

**Investigative monitoring** may be required in specific situations as defined in Annex V of the Water Framework Directive (WFD), including:

- where the reasons for exceedances of environmental objectives are unknown;
- where surveillance monitoring indicates that objectives are unlikely to be achieved and operational monitoring has not yet been established; or
- to determine the magnitude and impacts of accidental pollution events.

Investigative monitoring is therefore **problem-oriented and case-specific**, and its design must be tailored to the particular issue being addressed. In many cases, it involves **more intensive sampling strategies**, higher monitoring frequencies, and a focused selection of relevant water bodies, sub-areas, and quality elements.

In addition, investigative monitoring may include components of **alarm or early warning systems**, for example to protect drinking water abstractions from accidental pollution. Such systems may rely on **continuous or semi-continuous measurements** of selected parameters, including key physico-chemical indicators (e.g. dissolved oxygen) and, where appropriate, biological indicators.

Given its targeted and flexible nature, investigative monitoring is essentially an **"on-demand" approach**, triggered by specific problems or knowledge gaps. As a result, it is not possible to define standard monitoring sites, parameters, or frequencies in advance; instead, monitoring programmes must be **designed dynamically**, based on the specific objectives and pressures under investigation.

## 3.10. Sampling site selection in surveillance and operational monitoring

**Surveillance monitoring sites** should be strategically located to provide a representative and long-term overview of surface water status across the river basin district. These sites should remain **consistent across multiple RBMP cycles**, allowing for the assessment of trends and long-term changes in water quality and ecological conditions.

In contrast, **operational monitoring sites** should be applied in a more flexible manner and should not be considered part of a fixed, permanent monitoring network. Instead, their selection should directly reflect the need to assess **water bodies identified as being at risk** of failing environmental objectives.

Once the ecological status of a water body has been reliably determined through operational monitoring, it is advisable to **shift monitoring efforts to other at-risk water bodies in subsequent monitoring campaigns**. This approach allows for a more efficient use of resources and supports the progressive improvement of knowledge across the river basin district, ultimately contributing to a more comprehensive and targeted understanding of pressures and impacts.

## 3.11. Sampling and analysis

The representativeness of monitoring programmes begins with **careful and well-informed planning**, making full use of all available data and knowledge within the river basin. A crucial first step is to clearly define the **objectives of monitoring**—that is, the specific questions the monitoring programme is intended to answer.

An equally important aspect is the **planning and execution of sampling**. Errors introduced at the sampling stage—whether through inadequate design or improper field procedures—cannot be corrected by even the most advanced analytical methods. Therefore, it is essential to ensure the use of **appropriate equipment**, accurate selection of sampling locations, correct application of standardised methods, and the deployment of **properly trained personnel**. Effective communication with laboratories is also critical, particularly regarding sampling requirements, sample handling, preservation, and transport, in order to prevent any alteration or degradation of samples before analysis.

A number of international standards define the principles and requirements for ensuring high-quality monitoring and laboratory performance. In particular, **ISO/IEC 17025** provides a widely recognised framework for the competence of testing and calibration laboratories. This standard offers guidance on the key elements required to produce reliable and traceable results, including proper laboratory infrastructure, equipment management, and operational procedures. It emphasises the need for **safe handling, transport, storage, and maintenance of equipment**, as well as the management of consumables to prevent contamination or deterioration.

Quality assurance (QA) is therefore a fundamental component of monitoring systems, ensuring that results are **valid, reliable, and comparable**. It must be embedded as a continuous and evolving process within laboratory operations, supporting the ongoing improvement of analytical performance and the overall quality of monitoring data.

## 3.12. Data management, maintenance and reporting

Purpose of monitoring is to provide sound data on the current burden of pollution of water bodies, demonstrate long term changes (as result of measures or changes of pressures) as basis for fact-based decision making. Monitoring produces a high amount of data and requires, thus, a consolidated and uniform definition of requirements and format of data. This starts with the output of raw data and their plausibility, storage and maintenance. Full power of data can only be withdrawn, when a complete and consistent set of data is available in a well-maintained database. Pre-requisite is a solid and operational network including a powerful server, which connects all involved institutions.

Collaboration between institutions and entities is key to spreading relevant information and gaining added value from data. This regards checking raw data for plausibility and interpretation of data from different users' angles.

## 3.13. Sustainable Budget

Any form of monitoring requires sustainable budget to guarantee a meaningful set of data. The WFD provides a concept, which needs to be adapted to the needs of every economy to best suit its demands. This encompasses resources for already existing structures in the competent authorities, Ministries and entities to coordinate and administer the concept of the WFD, but also additional expenses for sampling, analysis and data maintenance. Thus, a high degree of awareness about the tasks and obligations at high level is needed to streamline the activities related to the implementation of the WFD.

- There is need for governmental understanding of the necessity, importance and benefits of water monitoring and for strong commitment of sufficient sustainable financing of water monitoring.
- Detailed cost estimations are needed, covering all aspects of monitoring. The estimate should distinguish between
  - sufficient <u>one-time budget</u> to cover the investment costs like infrastructure, equipment etc.;
  - sufficient and guaranteed permanent <u>long-term</u> budget to cover maintenance of infrastructure and equipment; and
  - <u>operational costs</u> for staff, training and consumables.
- It is necessary to demonstrate the political decision makers the benefits of monitoring. The costs of monitoring should be compared with the national economic

benefits gained from e.g. water industries and water related tourism. Such a comparison could strongly convince decision makers of the importance of comprehensive water monitoring.

# 4. WORKPLAN FOR IMPLEMENTATION

The following chapter gives an overview of prerequisites and steps that can be used as a checklist for establishing a WFD-compliant surface water monitoring system. It covers the governance structure and roles of responsible authorities, the design of the monitoring system based on river basin characterisation, and the development of monitoring programmes including selection of parameters, sites, and frequencies. The chapter further describe the implementation of field and laboratory activities, the establishment of data management and QA/QC systems, and the processes for status assessment, classification, and reporting.

## 4.1. Governance, Scope, and Responsibilities

### 4.1.1. Institutional Setup

- Designation of the **Competent Authority** (CA)
- Definition of roles:
  - Monitoring authority / agency
  - Laboratory services
  - Data management authority
  - Reporting authority
- Establish coordination mechanisms with:
  - River basin authorities
  - Nature conservation bodies
  - Stakeholders (where applicable)

### 4.1.2. Scope Definition

- River basin district(s)
- Surface water categories:
  - Rivers
  - Lakes
  - Transitional waters
  - Coastal waters
- Monitoring cycle aligned with the **6-year WFD planning cycle**

## 4.2. Phase 1 – Baseline Analysis and System Design

### 4.2.1. Characterisation of Surface Waters (Article 5)

- Delineation and typology of surface water bodies
- Review of existing data and monitoring programmes
- Identification of:
    - Significant pressures and impacts
    - Waters at risk of failing good status

**Deliverables**:

- Typology and water body register
- Pressure and impact assessment

### 4.2.2. Definition of Monitoring Objectives

Biological Elements:

- Establish a compliant sampling method
- Establish a compliant lab method
- Gather data on biology in a consolidated database
- Establish a pressure-response-relationship
- Define criteria for type-specific reference (benchmark) conditions (E)
- Set class boundaries (EQR)
- Compile all methods to a binding guidance document (as a basis for the monitoring)

Chemical Elements:

- Establish a pressure-response-relationship
- Which chemical pollutants and indicators are already monitored?
- Which chemical pollutants are missing?
- Establish a compliant lab method

Define objectives for each monitoring type:

- **Surveillance monitoring**
- **Operational monitoring**
- **Investigative monitoring**

Ensure consistency with:

- Ecological quality ratios (EQRs)
- Environmental Quality Standards (EQS)

**Deliverables**:

- Monitoring strategy document

- Type-specific EQRs
- National sampling and assessment guidances

## 4.3. Phase 2 – Monitoring Programme Development (Article 8 & Annex V)

### 4.3.1. Selection of Monitoring Types

| Monitoring type | Purpose |
|---|---|
| **Surveillance** | Long-term trends, baseline status |
| **Operational** | Status of water bodies at risk |
| **Investigative** | Causes of failure or incidents |

### 4.3.2. Parameter Selection

#### 4.3.2.1. Ecological elements:

- Biological quality elements (BQEs):
    - Phytoplankton
    - Macrophytes and phytobenthos
    - Benthic invertebrates
    - Fish fauna
- Supporting elements:
    - Hydromorphology
    - Physico-chemical parameters

#### 4.3.2.2. Chemical elements:

- Priority substances
- River Basin Specific Pollutants (RBSPs)

**Deliverables**:

- Parameter list by water category & monitoring type

### 4.3.3. Monitoring Network Design

- Selection of monitoring sites:
    - Representative sites
    - Risk-based site selection
- Spatial and temporal coverage
- Sampling frequency according to Annex V

**Deliverables**:

- Monitoring network maps
- Sampling schedules

## 4.4. Phase 3 – Operational Implementation

### 4.4.1. Field Sampling and Measurements

- Development of Standard Operating Procedures (SOPs)
- Training of field personnel
- Implementation of sampling campaigns

### 4.4.2. Laboratory Analysis

- Use of accredited laboratories
- Compliance with QA/QC requirements
- Intercalibration where applicable

**Deliverables**:

- SOPs
- Sampling and analysis reports

## 4.5. Phase 4 – Data Management and Quality Assurance

### 4.5.1. Data Management System

- Establishment or adaptation of a central database
- Metadata documentation
- Data validation and plausibility checks

### 4.5.2. Quality Assurance & Quality Control

- Internal QA/QC procedures
- Participation in interlaboratory comparisons
- Audit and review mechanisms

**Deliverables**:

- Validated monitoring datasets
- QA/QC reports

## 4.6. Phase 5 – Assessment, Classification, and Reporting

### 4.6.1. Status Assessment

- Calculation of ecological quality ratios (EQRs)
- Status classification (high → bad)
- Chemical status compliance check

### 4.6.2. Trend and Pressure Analysis

- Temporal trend analysis
- Linkage with pressures and measures

### 4.6.3. Reporting

- Input to RBMPs and Programmes of Measures
- Reporting to the European Commission (WISE)

**Deliverables**:

- Status classification results
- Assessment reports
- WFD reporting datasets

## 4.7. Phase 6 – Review and Adaptive Improvement

- Evaluation of monitoring effectiveness
- Review of site selection, parameters, and frequency
- Integration of new methods (e.g. continuous sensors, eDNA)
- Update monitoring programme for next cycle

**Deliverables**:

- Monitoring programme review
- Updated workplan for next WFD cycle

## 4.8. Indicative Timeline (6-Year Cycle)

**Table 7: Indicative timeline for WFD Monitoring**

| Year | Key activities |
|---|---|
| **1** | Characterisation, design, network setup |
| **2–5** | Monitoring implementation & QA |
| **4–5** | Status assessment & trend analysis |
| **6** | Reporting, review, and redesign |

## 4.9. Key Risks and Mitigation Measures

- **Data gaps** → risk-based prioritisation
- **Resource constraints** → phased implementation
- **Method changes** → harmonisation and documentation
- **Climate impacts** → adaptive monitoring strategies

# 5. CURRENT WATER MONITORING SITUATION IN MONTENEGRO

## 5.1. National Legal and Institutional Framework – Montenegro

### 5.1.1. River Basin Management Structure

Montenegro applies the **EU Water Framework Directive (WFD)** principle of managing water resources at the **river basin district (RBD)** level. Montenegro currently has two River Basin Management Plans (RBMPs) in force, corresponding to its two River Basin Districts:

- **Danube River Basin District (DRB)**
- **Adriatic River Basin District (ARB)**

These together cover **100% of Montenegro's territory** and form the basis for planning and management.

The Danube RBMP covers the Black Sea catchment, including major rivers such as the Tara, Lim, and Ćehotina, while the Adriatic RBMP covers the Adriatic basin, including the Morača River, Lake Skadar, and coastal and transitional waters. Both RBMPs were developed with support from EU-funded projects aimed at implementing the Water Framework Directive (WFD), and have been published and made available by national authorities. The Adriatic RBMP was finalised in March 2020, and both plans were completed and formally adopted around 2020.

These RBMPs represent the first generation of WFD-aligned planning documents in Montenegro and mark a major milestone in the country's alignment with EU water management requirements. However, they are still part of an early stage of WFD implementation. The plans are based on limited monitoring data and only partially developed status assessments, and therefore are not yet fully comparable to RBMPs implemented in EU Member States.

Under the WFD, RBMPs are required to be updated every six years. Accordingly, Montenegro should already have progressed to a second planning cycle (around 2021–2022), followed by subsequent updates. In practice, however, the development and reporting of second- and third-cycle RBMPs are still ongoing and not yet fully completed.

Furthermore, despite their formal adoption, the implementation of the RBMPs remains limited. Monitoring systems are not yet fully operational, and the data underpinning status assessments are still incomplete and associated with low confidence levels. As a result, while the RBMPs provide an important strategic framework, their effectiveness in guiding water management is constrained by the current limitations in monitoring and data availability.

### 5.1.2. Institutional Responsibilities

River basin management is implemented through a **multi-level governance system** involving national authorities, agencies, and local governments.

#### Strategic / Policy Level

- **Government of Montenegro**

  The **Government of Montenegro** operates at the strategic and policy level and is responsible for the adoption of key water management instruments, including River Basin Management Plans (RBMPs) and the national Water Management Strategy. It defines overarching environmental objectives, establishes monitoring frameworks, and determines water pricing and financing rules, thereby setting the overall direction for water governance in the country.

#### Central Coordination Authority

- **Ministry of Agriculture, Forestry and Water Management**

  The **Ministry of Agriculture, Forestry and Water Management** is the central coordination authority for water policy. It acts as the lead institution for water legislation and ensures alignment with the EU acquis. The Ministry is responsible for the preparation of RBMPs and for coordinating all water management activities across sectors and institutions.

#### Executive Body

- **Water Administration**

  The **Water Administration** serves as the core executive body for river basin management. It is responsible for implementing RBMPs, managing water use through permitting and concessions, and regulating pollution and water abstraction. The Administration also develops and maintains the national water information infrastructure, including the Water Information System (VIS), and manages water cadastres and registers. In addition, it plays an important role in facilitating public participation in water management processes.

#### Supporting Environmental Authorities

- **Ministry of Sustainable Development and Tourism**

The **Ministry of Sustainable Development and Tourism** is responsible for environmental policy and coordination, particularly in the context of EU accession under Chapter 27. Its responsibilities include wastewater management, the establishment of environmental standards, and ensuring alignment with EU environmental directives.

- **Environmental Protection Agency (EPA)**

  The **Environmental Protection Agency (EPA)** is responsible for environmental monitoring and reporting. It manages environmental data, supports the implementation of monitoring programmes, and ensures the dissemination of environmental information to national and international stakeholders.

### Monitoring and Scientific Bodies

- **Institute of Hydrometeorology and Seismology (IHMS)**

  The **Institute of Hydrometeorology and Seismology (IHMS)** is the main technical body responsible for hydrological and water monitoring. It conducts measurements related to water quantity and quality and is tasked with the implementation of national monitoring programmes in line with the requirements of the water legislation.

- **Centre for Eco-Toxicological Research (CETI)**

  The **Centre for Eco-Toxicological Research (CETI)** provides laboratory services and supports chemical monitoring. It plays a key role in the analysis of water samples and ensures the application of quality assurance and quality control (QA/QC) procedures in accordance with environmental standards.

- **Institute of Public Health (IPH)**

  The **Institute of Public Health (IPH)** is responsible for monitoring the quality of drinking water. Its role is focused on protecting human health by ensuring that water supplied for consumption meets established safety standards.

### Inspection and Enforcement

- **Administration for Inspection Affairs (AIA)**

  The **Administration for Inspection Affairs (AIA)** is responsible for the enforcement of water and environmental legislation. It conducts inspection activities through water and environmental inspectors, ensuring compliance with regulatory requirements. The capacity of this institution has recently been strengthened through the recruitment of additional inspectors.

### Local Level

- **Local Governments and Utilities**

At the local level, **municipalities and public utility companies** are responsible for water supply services and wastewater management. They operate and maintain infrastructure for water abstraction, distribution, collection, and treatment, thereby playing a key role in the implementation of water management measures on the ground.

### 5.1.3. Legal Framework

The legal framework governing water management and monitoring in Montenegro is primarily defined by the following key legislative acts:

- **Law on Water**
  *(Official Gazette of Montenegro, Nos. 27/07, 32/11, 48/15 and 84/18)*
  - Replaces the 1998 Law on Water Regime
  - Establishes the **fundamental principles of water management**
  - Defines **two River Basin Districts (RBDs)** as the basic units for water management, and requires RBMPs to be prepared
  - Serves as the **main legal instrument for transposing the Water Framework Directive (WFD)**
  - Regulates **Monitoring of surface waters, groundwater and protected areas** and defines responsibilities of competent institutions
  - Requires development of a **water information system** and establishment of **monitoring networks**

- **Decree on the Water Information System**
  *(Official Gazette of Montenegro, No. 33/08 of 27 May 2008)*
  - Regulates the **establishment, content, and management of the Water Information System (VIS)**
  - Specifies that the system shall include:
    - Data on **water quality status**
    - Classification of **surface water and groundwater bodies**
    - Water management documentation
    - Legislative, organisational, and strategic measures
  - Provides a framework for **integrated data management in water governance**

- **Law on Environment**
  *(Official Gazette of Montenegro, No. 52/16)*
  - Defines roles and responsibilities of:
    - **National authorities**
    - **Local self-government units**
  - Covers:
    - Planning
    - Implementation
    - Monitoring
    - Reporting of environmental measures
  - Establishes the framework for **environmental monitoring and financing**

    - Designates the **Environmental Protection Agency (EPA)** as the responsible authority for monitoring
    - Assigns EPA the following responsibilities:
        - Coordination of **environmental monitoring activities**
        - Engagement of **external institutions and experts** where necessary
        - Development of the **national list of environmental indicators**
        - Publication and dissemination of **environmental data and assessments**

**Secondary Legislation (Implementing By-laws)**

In addition, several rulebooks and decrees operationalize monitoring requirements. These by-laws are key for aligning Montenegro with **technical WFD monitoring requirements**, though their implementation is still ongoing.

- **Rulebook on Monitoring of Surface and Groundwater**
  Defines:
    - Monitoring parameters
    - Sampling methods
    - Frequency of monitoring

- **Rulebook on Status Assessment of Surface Waters (2019)**
  Establishes methodology for:
    - **Ecological status classification**
    - **Chemical status assessment**
    - Aligns national practice with WFD Annex V requirements

- **Rulebook on Bathing Water Quality**
  Supports monitoring of:
    - Recreational and bathing waters
    - Aligns with EU Bathing Water Directive

**EU Directives Supporting Chemical Monitoring**

In addition to the Water Framework Directive (WFD), Montenegro is progressively aligning its legal and technical framework with key EU directives related to chemical status assessment. In particular, the **Environmental Quality Standards Directive (EQSD – 2008/105/EC, as amended by 2013/39/EU)** establishes threshold values for priority substances and provides the foundation for the development of chemical monitoring programmes. The recently passed **Directive 2026/805** amends the WFD, the Groundwater Directive, and the EQS Directive. Among other things, this amendment expands and revises priority substances, adds certain emerging pollutants and introduces stricter threshold values. Furthermore, the **QA/QC Directive (2009/90/EC)** defines analytical performance criteria and sets requirements for laboratory quality standards to ensure reliability and comparability of monitoring results. While these directives serve as important reference frameworks for Montenegro, their full transposition and practical implementation are still ongoing.

### 5.1.4. Observations and Considerations

Recent developments indicate important progress in strengthening Montenegro's water management system, particularly in the areas of data management, monitoring, and enforcement. In December 2023, the Water Administration introduced a new Water Information System (VIS), designed as a centralized national database for both surface water and groundwater. This system provides a foundation for integrated data management, supports reporting under the Water Framework Directive (WFD), and enables the development of a cadastre of water polluters. In doing so, it directly addresses a key weakness identified in earlier RBMPs, namely the fragmentation and lack of digitalisation of water-related data.

In addition, the Government adopted the Programme for Monitoring of Surface and Groundwater in February 2024, marking a significant step toward the operational implementation of WFD-compliant monitoring. This programme responds to previous shortcomings, where monitoring frameworks existed but were not fully implemented in practice.

At the same time, institutional strengthening has been initiated, including the recruitment of four additional environmental inspectors, which enhances enforcement capacity and improves compliance monitoring.

However, typical areas requiring further strengthening (to be confirmed in detailed assessment) may include:

- Full operationalisation of monitoring programmes in line with Annex V of the WFD
- Consistent implementation across all RBDs
- Strengthening of quality assurance and laboratory capacity
- Further development of biological monitoring and RBSP assessment

## 5.2. Human Resources and Capacity Requirements – Biological Monitoring

### 5.2.1. General Principles

To ensure successful implementation of WFD-compliant biological monitoring, **trained and experienced experts are essential**. Monitoring teams must be capable of covering all Biological Quality Elements (BQEs) and supporting hydromorphological assessments in accordance with **Annex V requirements**.

The staffing levels presented below represent **minimum requirements per sampling campaign**. Field teams should consist of **at least two persons** to ensure safety, quality control, and validation of results. Efforts should be made to promote **gender balance** in staffing.

### 5.2.2. Minimum Staffing Requirements per Biological Quality Element

**Table 8: Minimum staffing requirements per BQE.**

| Biological Quality Element | Number of Staff | Prerequisites |
|---|---|---|
| **MZB (macrozoobenthos)** | 3 (min. two hydrobiologists + one chemist) | Coverage of all macroinvertebrate groups at required taxonomic resolution; strong coordination between field and laboratory; chemist responsible for physico-chemical measurements |
| **PHB / PHP (phytobenthos, phytoplankton)** | 1 | Experienced algae specialist (especially diatoms); laboratory capacity required for chlorophyll-a analysis |
| **MAC (macrophytes)** | 1 | Specialist in aquatic vegetation; diving skills may be required depending on site conditions |
| **FIS (fish)** | 4 (1 expert + 3 trained staff) | Expertise in river-type-specific sampling methods (e.g. electrofishing); high level of experience required, particularly in large rivers |
| **HYMO (hydromorphology)** | 2 | One expert in hydrology and one expert in morphology; understanding of river processes and habitat structure |

**Abbreviations**: MZB = macrozoobenthos (invertebrates); PHB = phytobenthos (diatoms); PHP = phytoplankton; MAC = macrophytes; FIS = fish; HYMO = hydromorphology

### 5.2.3. Competence and Qualification Requirements

- Staff must have **relevant academic backgrounds** (e.g. hydrobiology, ecology, environmental sciences, chemistry)
- Taxonomic expertise is critical, particularly for:
    - macroinvertebrates
    - diatoms
    - macrophytes
    - fish fauna
- Laboratories must be equipped and staffed for **specialised analyses**, including chlorophyll-a and biological sample processing
- Competence must be aligned with **intercalibration requirements** and WFD classification systems

### 5.2.4. Training and Capacity Development

- Continuous **professional development and training programmes** are essential to maintain and upgrade skills

- Institutions should establish **formal internal and external training plans**, with proper documentation
- Regular participation in:
  - interlaboratory comparisons
  - intercalibration exercises
- Training should specifically address **RBMP-identified gaps**, including:
  - limited biological datasets
  - insufficient taxonomic resolution
  - inconsistent application of methods

### 5.2.5. Organisational and Institutional Requirements

- Monitoring activities should be **centrally coordinated** to avoid fragmentation and ensure consistency
- Clear **roles, responsibilities, and job descriptions** are required
- Regular communication and exchange between field teams, laboratories, and data managers is essential
- Monitoring responsibilities should not be treated as secondary tasks but require **dedicated staff and structures**

### 5.2.6. Staff Retention and Workforce Planning

- Adequate remuneration is necessary to attract and retain qualified staff
- High levels of motivation should be supported through:
  - clear task definition
  - recognition of expertise
  - career development opportunities
- Forward-looking workforce planning is required to:
  - ensure balanced staffing
  - avoid loss of expertise
  - promote recruitment of young professionals

## 5.3. Human Resources and Capacity Requirements – Chemical Status Assessment

### 5.3.1. Required Functions and Roles

Chemical status assessment under the WFD requires a combination of **field sampling staff, laboratory analysts, QA/QC specialists, and data experts**. Minimum functional roles include:

- **Sampling teams (2–3 persons per campaign)**:
  - Trained technicians for water, sediment, and biota sampling

    - Knowledge of WFD-compliant sampling protocols and preservation requirements
- **Laboratory analysts**:
    - Chemists specialised in trace analysis of Priority Substances
    - Expertise in organic and inorganic pollutant analysis (e.g. metals, pesticides, PAHs)
- **Instrumentation specialists**:
    - Operation and maintenance of advanced analytical equipment (e.g. GC-MS, LC-MS/MS, ICP-MS)
- **QA/QC officers**:
    - Oversight of quality systems, calibration, validation, and interlaboratory comparisons
- **Data management and assessment experts**:
    - Processing of analytical results
    - Compliance checking against Environmental Quality Standards (EQS)
    - Preparation of WISE-compatible datasets

### 5.3.2. Competence and Laboratory Requirements

- Laboratories must achieve and maintain **accreditation (e.g. ISO/IEC 17025)**
- Analytical methods must meet **WFD performance criteria**, including:
    - limits of quantification below EQS values
    - validated and standardised methods
- alternatively, collaboration with regional and beyond regional laboratories should be considered to overcome national limitations
- Staff must be trained in:
    - trace-level chemical analysis
    - sampling and preservation techniques
    - uncertainty estimation and quality control

### 5.3.3. Equipment and Technical Capacity

- Adequate infrastructure is required, including:
    - advanced analytical instruments (GC-MS, LC-MS/MS, ICP-MS)
    - laboratory information management systems (LIMS)
- Capacity for **biota and sediment analysis** must be ensured, not only water samples
- Regular calibration and maintenance of equipment is essential

### 5.3.4. Training and Quality Assurance

- Continuous **training in analytical methods and QA/QC procedures** is required
- Mandatory participation in:

    - interlaboratory comparison exercises
    - proficiency testing schemes
- Training should target RBMP-identified weaknesses, including:
    - incomplete monitoring of Priority Substances
    - insufficient detection limits
    - inconsistent QA/QC application

### 5.3.5. Organisational Considerations

- Chemical monitoring should be **institutionalised and not project-based** and sustainably budgeted
- Strong coordination between:
    - sampling teams
    - laboratories
    - competent authorities
- Clear workflows are required from sampling to reporting to ensure **data traceability and compliance**

# 6. GAP ANALYSIS VS. EU REQUIREMENTS (WFD IMPLEMENTATION ROADMAP)

## 6.1. Purpose of the Gap Analysis

This section provides a structured comparison between the **target state defined by this MDP (Phases 1–6)** and the **current status of surface water monitoring in Montenegro**, based on River Basin Management Plans (RBMPs), EU screening findings (Chapter 27), and other national documents.

The analysis identifies key gaps and translates them into **priority actions**, forming a practical implementation roadmap toward WFD compliance.

## 6.2. Phase-by-Phase Gap Overview

**Table 9: General gap overview aligned with MDP phases.**

| MDP Phase | WFD Requirement | Current Status in Montenegro | Gap Level |
|---|---|---|---|
| **Phase 1 – Characterisation** | Full typology, pressures, risk assessment | Largely completed through RBMPs, but based on limited monitoring data | Moderate |
| **Phase 2 – Programme Design** | WFD-compliant monitoring (BQEs, chemicals, network) | Partially developed; strong focus on physico-chemical parameters, limited BQE and chemical coverage | High |
| **Phase 3 – Implementation** | Regular, systematic monitoring campaigns | Limited spatial coverage; inconsistent frequency; partly project-driven | High |
| **Phase 4 – QA/QC & Data** | Accredited labs, QA/QC systems, integrated databases | Fragmented systems; limited QA/QC implementation; weak interoperability | High |
| **Phase 5 – Assessment & Reporting** | Full classification (EQR, EQS) and WISE reporting | Partial assessments; incomplete datasets prevent full status classification | Very High |
| **Phase 6 – Adaptive Improvement** | Continuous optimisation of monitoring system | Improvements ongoing but largely driven by external projects | Medium–High |

## 6.3. Key Systemic Gaps Identified

The analysis of the current monitoring framework in Montenegro, based on RBMP findings and EU screening findings and subsequent Commission assessments (Screening report Montenegro: Chapter 27; Montenegro 2025 report) indicate that Montenegro has achieved a **relatively high level of legislative alignment** with the environmental acquis under Chapter 27, including in the water sector. However, **implementation capacity remains the main challenge**. The European Commission consistently highlights shortcomings in administrative capacity, monitoring systems, laboratory infrastructure, and data management. In particular, monitoring, reporting, and verification systems are not yet fully operational, and significant investment is required to establish WFD-compliant monitoring networks. Recent assessments confirm that while progress has been made in strengthening the legal and institutional framework, the transition from planning to full implementation is still ongoing, with monitoring systems representing a key area requiring further development.

A major limitation is the incomplete implementation of monitoring programmes. Although a national monitoring programme was adopted in 2024 (Government of Montenegro, 2024), monitoring activities are not yet fully operational across all water bodies and quality elements, resulting in limited spatial and temporal data coverage, particularly for biological parameters. **The 2024 programme constitutes an important step toward the operationalisation of WFD-compliant monitoring**, establishing a framework for both surface water and groundwater monitoring. It covers ecological and chemical status for surface waters, as well as chemical and quantitative status for groundwater, and includes key qualitative and quantitative parameters to support water status assessment, river basin management planning, and compliance with EU requirements. However, **implementation remains at an early stage**, and further development is needed to achieve full alignment with WFD standards, particularly regarding monitoring methodologies, frequency, and overall data coverage.

Another critical issue is the **insufficient development of biological monitoring**. Key Biological Quality Elements (BQEs), such as fish, macrophytes, and phytobenthos, are either partially implemented or missing, leading to significant constraints in conducting WFD-compliant ecological status classification.

The **chemical monitoring system** also remains incomplete. Monitoring of priority substances is not yet fully aligned with EU requirements, and there are gaps in the analysis of biota and sediments. In combination with the still-developing Environmental Quality Standards framework, this limits the reliability of chemical status assessment.

Despite recent progress, **data management remains an area requiring further strengthening**. The introduction of the Water Information System (VIS) represents a significant step forward; however, its full operationalisation, integration of monitoring datasets, and alignment with WISE reporting requirements are still ongoing.

Furthermore, the current system exhibits **limited confidence in status assessment results**, as many classifications are based on incomplete datasets and expert judgement rather than comprehensive monitoring data.

In addition, **institutional and technical capacity constraints** persist, particularly in relation to specialised expertise (e.g. taxonomy and advanced chemical analysis), laboratory capacity, and quality assurance systems.

## 6.4. Gap-to-Action Matrix (Priority Measures)

**Table 10: Gap-to-Action Matrix identifying key measures.**

| Gap Area | Identified Gap | Key Measures | Phase Link |
|---|---|---|---|
| **Monitoring Programme Implementation** | Monitoring programme not fully operational; inconsistent coverage and frequency | • Plan and implement 2024 monitoring programme nationwide<br>• Ensure full coverage of all water bodies and monitoring types (surveillance, operational, investigative) | **Phase 2 and 3** |
| **Biological Monitoring** | Incomplete or missing Biological Quality Elements | • Develop national methods for all BQEs (fish, macrophytes, phytobenthos) | **Phase 2 and 3** |

| | | | |
|---|---|---|---|
| | (BQEs); weak taxonomy capacity | • Train specialists and build taxonomy expertise<br>• Integrate BQEs into routine monitoring | |
| **Chemical Monitoring** | Limited monitoring of priority substances; missing biota and sediment data | • Expand monitoring to all priority substances and RBSPs<br>• Introduce biota and sediment monitoring<br>• Upgrade laboratories and ensure EQS-compliant detection limits | **Phase 2 and 3** |
| **Laboratory Capacity & QA/QC** | Insufficient lab capacity and QA/QC systems | • Achieve ISO 17025 accreditation<br>• Introduce national QA/QC framework<br>• Participate in interlaboratory comparisons | **Phase 3 and 4** |
| **Data Management & VIS** | Incomplete integration of monitoring data; VIS not fully operational | • Fully operationalise VIS<br>• Integrate all monitoring datasets<br>• Develop WISE-compatible reporting<br>• Establish polluter cadastre | **Phase 4 and 5** |
| **Status Assessment** | Low confidence in classification; reliance on expert judgement | • Develop national classification tools (EQR systems)<br>• Improve dataset completeness<br>• Standardise assessment procedures | **Phase 2, 3, and 5** |
| **Monitoring Network Design** | Limited representativeness and spatial coverage | • Optimise and expand monitoring network<br>• Include reference sites and pressure-based sites<br>• Ensure basin-wide coverage (Danube + Adriatic) | **Phase 1 and 2** |
| **Institutional Capacity & Coordination** | Fragmented responsibilities and limited technical capacity | • Strengthen coordination between WA, IHMS, EPA, Ministry<br>• Recruit and train staff<br>• Establish clear operational workflows | **All phases** |
| **Sustainability of Monitoring** | Monitoring partly project-based; unstable funding | • Secure long-term national financing<br>• Integrate monitoring into regular institutional budgets | **All phases** |

## 6.5. Conclusions

When comparing the status quo to the phases outlined in chapter 4, the following pattern becomes apparent:

- **Phases 1–2 (planning and design)** are largely in place but require refinement and completion
- **Phases 3–6 (implementation, QA/QC, assessment, and adaptation)** represent the main bottleneck

Bridging the identified gaps requires coordinated investments in **infrastructure, human resources, institutional capacity, and data systems**. The phased approach outlined in this MDP provides a structured pathway to achieve **full WFD-compliant monitoring and reporting in Montenegro**. The MDP therefore serves as a **practical implementation roadmap** to:

- close compliance gaps with the Water Framework Directive
- support evidence-based RBMP implementation
- facilitate **progress in EU accession negotiations**

To achieve WFD compliance, Montenegro should prioritise:

1. Transition from pilot- and project-based monitoring to a fully operational, nationwide monitoring system
2. Strengthening institutional, human resource, and laboratory capacities
3. Achieving full monitoring coverage of biological, chemical, and hydromorphological quality elements in line with WFD Annex V
4. Establishing robust QA/QC procedures and integrated data management systems (including full operationalisation of VIS)
5. Ensuring systematic integration of monitoring results into RBMP assessment, classification, and reporting cycles

# 7. ROADMAP 2026–2030 (IMPLEMENTATION PLAN)

The following roadmap translates the identified gaps into a **time-bound implementation plan (2026–2030)** aligned with the WFD planning cycle and the progressive preparation of the next RBMP update cycle.

| Task | Timeframe | Strategic Focus | Key Actions | Expected Outputs |
|---|---|---|---|---|
| **Task A – System Completion** | 2026 | Finalisation of monitoring design and legal framework | Complete monitoring programme design (all BQEs + chemicals) | • Adopt/update secondary legislation and technical guidelines<br>• Define national QA/QC framework<br>• Fully defined WFD-compliant monitoring programme<br>• National standards and SOPs approved |
| **Task B – Capacity & Infrastructure Build-up** | 2026–2027 | Strengthening operational capacity | Recruit and train biological and chemical experts | • Upgrade laboratory infrastructure (equipment + accreditation)<br>• Expand monitoring network (sites, reference conditions)<br>• Operational monitoring teams in all RBDs<br>• Accredited laboratories (or roadmap to accreditation)<br>• Expanded monitoring network |
| **Task C – Full Monitoring Implementation** | 2027–2028 | Regular and systematic monitoring | Implement surveillance and operational monitoring campaigns | • Expand monitoring of Priority Substances in water, sediment, and biota<br>• Ensure consistent sampling frequencies<br>• Complete datasets for ecological and |

| | | | | |
|---|---|---|---|---|
| | | | | chemical parameters<br>• Improved spatial and temporal data coverage |
| **Task D – Data Integration & Assessment** | 2028–2029 | Data validation, classification, and reporting | Establish centralised database VIS (Water Information System) and validation workflows | • Apply EQR-based ecological classification tools<br>• Perform EQS compliance assessment<br>• Prepare WISE-compatible datasets<br>• First fully WFD-compliant status assessment<br>• Integrated national monitoring database<br>• Improved RBMP evidence base |
| **Task E – RBMP Update & Optimisation** | 2029–2030 | Integration into planning cycle and optimisation | Use monitoring results to update RBMPs (next cycle) | • Refine monitoring network and parameters based on results<br>• Integrate advanced methods (eDNA, sensors where feasible)<br>• Updated RBMPs based on robust monitoring data<br>• Optimised monitoring system<br>• Increased cost-efficiency and effectiveness<br>• Secure stable long-term financing |

## 7.1. Link to WFD Planning Cycles

The phased roadmap is aligned with the **WFD 6-year planning cycle**:

- **2026–2027**: Transition phase from planning to full implementation
- **2027–2029**: Data generation for status assessment
- **2029–2030**: Input to next RBMP cycle and reporting obligations

By following the outlined steps by the next RBMP update, Montenegro could reach:

- **robust biological and chemical datasets**
- **fully operational monitoring programmes**
- **WFD-compliant status classification and reporting**

## 7.2. Strategic Priorities

To ensure successful implementation of the roadmap, the following priorities must be addressed:

1. **Institutionalisation of monitoring systems** (move beyond project-based approaches)
2. **Investment in human resources and laboratories**
3. **Completion of monitoring coverage** (BQEs and chemicals)
4. **Development of integrated data management systems**
5. **Strong coordination between implementing institutions**

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