ECONOMIC COMMISSION FOR EUROPE

Guidelines for Developing National Strategies to Use Air and Water Quality Monitoring as Environmental Policy Tools

Eastern Europe, the Caucasus, Central Asia and South-Eastern Europe

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NOTE

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The present publication is the result of a series of meetings organized by the United Nations Economic Commission for Europe (ECE) Working Group on Environmental Monitoring and Assessment.

Vladislav Bizek, consultant to the ECE secretariat prepared the first drafts of two sets of guidelines contained in this publication. National experts from Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Finland, Georgia, Italy, Hungary, Kazakhstan, Kyrgyzstan, Montenegro, Norway, Poland, Republic of Moldova, the Russian Federation, Serbia, Switzerland, Tajikistan, the former Yugoslav Republic of Macedonia, Turkey, Ukraine and Uzbekistan participated in the preparation of these guidelines, together with experts from the European Environment Agency, the United Nations Environment Programme (UNEP), the United Nations Statistics Division, the World Health Organization (WHO) European Centre for Environment and Health (ECEH), and the Interstate Statistical Commission of the Commonwealth of Independent States, as well as representatives of environmental civil society associations and the scientific community.

Mikhail Kokine, from the ECE secretariat, served both as content editor and overall project manager.

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Preface

Since 1991, the “Environment for Europe” process has provided the framework for the countries of the United Nations Economic Commission for Europe (ECE) to work together in achieving their commitment towards improving environmental protection and the promotion of sustainable development throughout the ECE region.

At the Sixth “Environment for Europe” Ministerial Conference (Belgrade, 2007) ministers invited ECE to continue its efforts to make monitoring an effective instrument in environmental policymaking, particularly in the countries of Eastern Europe, the Caucasus, Central Asia and South-Eastern Europe. In doing so, ECE was invited to work in close cooperation with the European Environment Agency and other relevant partners.

As a follow-up, the ECE Committee on Environmental Policy, through its Working Group on Environmental Monitoring and Assessment, undertook the preparation of guidelines for developing national strategies to use air and water quality monitoring as environmental policy tools. The Extended Bureau of the Committee on Environmental Policy approved the Guidelines for Developing National Strategies to Use Air Quality Monitoring as an Environmental Policy Tool for the countries of Eastern Europe, the Caucasus, Central Asia and South-Eastern Europe in March 2010. The Committee on Environmental Policy approved the Guidelines for Developing National Strategies to Use Water Quality Monitoring as an Environmental Policy Tool for the Countries of Eastern Europe, the Caucasus and Central Asia, as well as interested South-Eastern European countries in May 2010.

The present publication contains the texts of both sets of guidelines. It is addressed to governmental officials and experts working for governmental bodies responsible for environmental policy, environmental monitoring and compliance monitoring. In a broader sense, the guidelines can also benefit those working in the private sector, the scientific community and civil society associations active in the environmental and health fields. I truly hope the guidelines will become a useful instrument for them.

Sven Alkalaj
Executive Secretary
Economic Commission for Europe

GUIDELINES FOR DEVELOPING NATIONAL STRATEGIES TO USE AIR AND WATER QUALITY MONITORING AS ENVIRONMENTAL POLICY TOOLS FOR THE COUNTRIES OF EASTERN EUROPE, THE CAUCASUS, CENTRAL ASIA AND SOUTH-EASTERN EUROPE

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I. GENERAL INTRODUCTION

The present Guidelines were prepared in response to the invitation of the Sixth "Environment for Europe" Ministerial Conference (Belgrade, October 2007) to the United Nations Economic Commission for Europe (ECE) "to continue its efforts, in cooperation with EEA[1] and other partners, to make monitoring an effective instrument in environmental policymaking in countries of Eastern Europe, Caucasus and Central Asia and South-Eastern Europe" (ECE/BELGRADE.CONF/2007/8, para. 7). They were also a response to the subsequent decision by the ECE Committee on Environmental Policy that its Working Group on Environmental Monitoring and Assessment should complete guidelines to help interested countries in developing national strategies for the use of air and water quality monitoring as an environmental policy tool.

The aim of these Guidelines is to provide guidance to countries of Eastern Europe, the Caucasus, Central Asia and South-Eastern Europe (hereinafter "the target countries") with respect to revising their air and water quality monitoring programmes to make monitoring a practical tool for environmental policy, especially for target setting, for the development of pollution abatement strategies and for assessing progress in achieving policy targets and the effectiveness of abatement measures.

While the present Guidelines focus on target countries as a group, they take into account country specifics such as geographic conditions, the diversity of national economies and established practices for setting monitoring networks, practices and procedures.

1 The European Environment Agency.

II. AIR QUALITY MONITORING GUIDELINES

INTRODUCTION

The following Guidelines are based on the assessment of the situation with air quality monitoring in the target countries made by the Working Group and the evaluations contained in the country environmental performance reviews (EPRs) prepared under the ECE EPR Programme. The document reflects relevant experiences gained in the European Union (EU) and the United States of America, where coherent systems of air quality assessment and management have been developed and implemented. They also take into account relevant international activities, requirements, guidance documents and recommendations, especially those developed under the Convention on Long-range Transboundary Air Pollution (CLRTAP), the Global Atmospheric Watch Programme of the World Meteorological Organization (WMO-GAW), the World Health Organization (WHO), the International Standardization Organization (ISO) and the Global Atmospheric Pollution Forum (GAP Forum).

Minimization of health and environmental effects of air pollution are recognized as main policy objectives (see box 1 for air pollution effects).

Box 1: Health and environmental impacts of air pollution

Concerning health impacts, currently in the EU there is a loss in statistical life expectancy of over eight months due to particulate matter (PM) in the air, equivalent to 3.6 million life-years lost annually.

<u>Source:</u> *Communication from the Commission to the Council and the European Parliament: Thematic Strategy on air pollution, COM (2005) 446final.*

There are serious risks to health from exposure to PM and ground-level ozone (O_3) in many cities of developed and developing countries. It is possible to derive a quantitative relationship between the pollution levels and specific health outcomes (increased mortality or morbidity). This allows invaluable insights into the health improvements that could be expected if air pollution were reduced. Even relatively low concentrations of air pollutants have been related to a range of adverse health effects. Poor indoor air quality may pose a risk to the health of over half of the world's population. In homes where biomass fuels and coal are used for cooking and heating, PM levels may be 10–50 times higher than the guideline values.

<u>Source:</u> *World Health Organization (WHO) 2005 Air Quality Guidelines.*

Current exposure to PM from anthropogenic sources leads to an average loss of 8.6 months of life expectancy in Europe. The total number of premature deaths amounts to about 348,000 in 25 EU member States (EU-25). In addition, some 100,000 hospital admissions per year can be attributed to exposure.

<u>Source:</u> *Health Risks of Particulate Matter from Trans-boundary Air Pollution, WHO Regional Office for Europe (WHO-Europe), 2006.*

It is estimated that some 21,000 premature deaths per year are associated with ozone exceeding 70 $\mu g/m^3$ measured as a maximum daily eight-hour average in the EU-25. Ozone is also associated with 14,000 respiratory hospital admissions annually in the EU-25.

<u>Source:</u> *Health Risks of Ozone from Long-range Trans-boundary Air Pollution, WHO-Europe 2008.*

A. LINKING AIR QUALITY MONITORING TO ENVIRONMENTAL POLICY DEVELOPMENT

To minimize the negative health and environmental effects of air pollution, those target countries that have not yet done so should develop strategies to establish comprehensive air quality assessment and management systems (see box 2) with a focus on priority pollutants, particularly PM_{10} (and $PM_{2.5}$), ground-level ozone, sulphur dioxide (SO_2) and nitrogen oxides (NO_x).[2] Within it, a realistic approach to enhancing monitoring (focusing on both ambient air quality monitoring and emissions monitoring) should be developed.

The air quality assessment and management system should include a clearly defined institutional setting, including one central competent authority responsible for the coordination of all activities within this system (see box 2). Institutions responsible for permitting and especially for enforcement are recommended to be independent from the central competent authority (i.e. should be coordinated but not managed directly).

The main message of this document is that air quality monitoring systems should become an integral part of national air quality assessment and management systems and should therefore be designed, developed and interpreted in a broader policy and scientific context (see box 2).

As a part of the air quality assessment and management system, a well-developed air quality monitoring system is a basic precondition for priority and target setting, for the preparation of instruments and measures as well as for the assessment of their effectiveness. In addition, air quality monitoring can also be used as an "early warning" and scientific instrument to better understand complex environmental systems and their developments before starting regulation.

1. Integrating air quality monitoring data with emission inventories

An effective air quality assessment and management system, as a part of environmental policy formulation and implementation, should fit the DPSIR (driving force-pressure-state-impact-response) framework. Especially the relation between emissions (pressure) and ambient air quality (state) is of the utmost importance (bearing in mind that in the case of ground-level ozone and secondary particles, the relation between ambient air concentrations and the emissions of precursors is very complex).

[2] It should be taken into account that two of priority pollutants are either fully (ground-level ozone) or partially (secondary particles — inorganic or organic aerosols) created via precursors (nitrogen oxides, volatile organic compounds (VOCs), sulphur dioxide and ammonia (NH_3)), which makes assessment of the relations between emissions and air quality difficult in comparison to other pollutants that are being emitted directly into the air.

Box 2: Basic elements of air quality assessment and management system

Institutional framework

(a) Central competent authority responsible for air quality issues (generally, the ministry of the environment), which coordinates activities of all relevant authorities (including the ministry of health) and institutions;

(b) Relevant public administration institutions at the national, regional and local levels;

(c) Supporting institutions (mainly a hydrometeorological service).

Policy-level document setting:

(a) Objectives;

(b) Priorities;

(c) Targets.

Regulatory and other instruments

(a) Standards (ambient air limit values, emission limit values, emission ceilings, fuel standards, product standards) and, where appropriate, compliance deadlines;

(b) Technical requirements (operation of emission sources, measurement of emissions by operators, monitoring protocols, etc.);

(c) Economic and market-based instruments (pollution charges, product charges, taxation, emission trading, incentives, etc.);

(d) Financial instruments (e.g., environmental funds);

(e) Voluntary instruments (ISO 14 000, eco-labelling, codes of conduct, voluntary agreements etc.);

(f) Information instruments (public information and awareness raising, environmental education).

Monitoring and information management

(a) Operation of a core air quality monitoring system (including its coordination with local and specialized monitoring networks and supporting activities);

(b) Development of emission inventories and projections;

(c) Air quality modelling;

(d) Scenario analysis;

(e) Assessment of effects on human health and the environment;

(f) Operation of air quality information system (including public information);

(g) Reporting.

Operational level setting

(a) Permitting including environmental impact assessment (EIA)/environmental expertise, hygienic-epidemiologic expertise, strategic environmental assessment (SEA) and life-cycle assessment (LCA);

(b) Regional approach (zoning, planning);

(c) Application of instruments/implementation of measures;

(d) Enforcement (inspection);

(e) Feedback mechanisms (mechanisms to update policy and technical levels).

Source: ECE.

Target countries that have not yet done so should:

(a) Update the mechanisms to create and operate national emission inventories on a regular basis; these inventories should cover the most important priority pollutants which are being regulated;

(b) Include the assessment of emissions from mobile sources (mainly road transport, but also non-road mobile machinery) and small stationary sources (mainly decentralized local heating and small businesses) into emission inventories;

(c) Apply the *EMEP/EEA*[3] *Air Pollutant Emission Inventory Guidebook* as the methodological tool;[4]

(d) Use, in addition, the GAP Forum's *Air Pollutant Emission Inventory Preparation Manual,* together with its associated software (an Excel-based workbook) as a practical tool for preparing emission inventories;[5]

(e) Arrange for the preparation of emission projections for selected pollutants on a regular basis (these projections should at least cover those priority pollutants which are being regulated);

(f) Coordinate preparation of emission inventories and projections for "classic" air pollutants (mainly PM, SO_2, NO_X, VOCs and NH_3) with the preparation of emission inventories and projections for greenhouse gases (GHGs).

2. Integrating air quality monitoring data with modelling activities

It is recommended that target countries that have not yet done so develop or implement existing modelling tools extrapolating the monitoring data to cover all territories where the compliance with the standards is required and correlating the air quality monitoring data with the emissions from specific sources.

As a first step, past and actual situations should be assessed by appropriate models (e.g., processing of time series of monitoring data) to define background for setting targets. Suitable policies and measures should be proposed to achieve them. As a second step, modelling should be carried out to predict future developments in air quality and to check both whether the proposed targets are technically and economically achievable and whether the policies and measures are likely to achieve them.

It is recommended to use dispersion and/or chemical transport models (e.g., EMEP,[6] TM5[7] or CAMx[8]) and complex "scenario analysis" models developed by IIASA[9] (e.g., RAINS[10] or GAINS[11]) which attempt to cover the whole DPSIR cycle and are a very important policymaking tool.

Those target countries that are covered by the IIASA GAINS Europe model are still recommended to work with this tool actively, as it enables not only the calculation of emission inventories and emission projections but also the assessment of impacts of air

[3] Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)/European Environment Agency (EEA).
[4] The last version (June 2009) available at: www.eea.europa.eu/publications/emep-eea-emission-inventory-quidebook-2009.
[5] Version 2.2 (October 2008) available for free download at: www.sei.se/gapforum/tools.php.
[6] Available from http://www.emep.int/OpenSource/index.html.
[7] Global Chemistry Transport Model (TM5). Available from www.phys.uu.nl/~tm5.
[8] Comprehensive Air Quality Model with extensions (CAMx). Available from www.camx.com.
[9] International Institute for Applied System Analysis.
[10] Regional Air Pollution Information and Simulation (RAINS) model. Available from www.iiasa.ac.at/Research/TAP/rains_europe/intro.html.
[11] Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model. Available from http://gains.iiasa.ac.at.

pollution on human health and ecosystems for various policy scenarios, including the cost assessment. Other target countries are recommended to contact IIASA to check the possibility of being included among the "GAINS countries" (either under GAINS Europe or GAINS Asia).

3. Integrating air quality monitoring data with the assessment of health and environmental effects

The Guidelines for Reporting on the Monitoring and Modelling of Air Pollution Effects[12] offer guidance for estimating and reporting monitoring and modelling data on effects of air pollution to human health and the environment (e.g., forests, waters, vegetation, ecosystems and materials), including quantification of those effects. Their application will help to establish a scientific basis for dose-effect relationships and, where possible, to evaluate economically the benefits for the environment and human health resulting from emission reductions. The Guidelines address effects of acidifying pollutants, nutrient nitrogen, ozone, heavy metals and persistent organic pollutants (POPs). Technical details for monitoring are specified in the technical manuals of the International Cooperative Programmes (ICPs) of the Working Group on Effects.

4. Integrating air quality monitoring data with the results of remote sensing

Data obtained from remote sensing may play very important role in air quality assessment, especially in the case of large space scales, as they provide complementary data to that obtained via ground-level monitoring. It can be applied in conjunction with dispersion modelling for the tracking of very dynamic phenomena, such as, transported air pollution. The WMO-GAW is developing integrated systems to couple data from ground based station with those from satellites.[13]

Experiences could also be taken into account with the development by the European Space Agency (ESA) and the EEA of the "Integrated Air Quality Platform for Europe" service, part of the ESA GMES (Global Monitoring for the Environment and Security) PROMOTE (Protocol Monitoring for the GMES Service Element) project. Its aim is to provide end-users information about air quality. It is currently providing forecasts for up to 72 hours at a resolution of 50 km. The service includes data on O_3, NO_2 and PM (the sum of all particles suspended in air, including dust, smoke, pollen, etc.).[14]

5. Integrating air quality monitoring with other monitoring networks

It is recommended that the target countries consider preparing and implementing integrated monitoring strategies which would create a framework for coordination of specialized monitoring networks (e.g., air, water, soil, forests, biodiversity, noise and waste).

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[12] Developed by the Working Group on Effects of the CLRTAP Executive Body (ECE/EB.AIR/WG.1/2008/16/Rev.1). Available from www.unece.org/env/lrtap/ExecutiveBody/welcome.26.html.
[13] See http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html. .
[14] Details are available from http://www.esa.int/esaCP/index.html.

6. Revising air quality standards and harmonizing them with international standards and guidelines

Current air quality standards should be updated or discontinued and new ones set by the central-level competent authority responsible for the coordination of national air quality assessment and management systems. Where a ministry of health is responsible for setting national air quality standards, the same central-level competent authority should participate actively in the process of air quality standards updating and setting.

The WHO Air Quality Guidelines values may be taken into consideration when revising and setting new air quality standards. Nevertheless, as certain WHO values (especially annual mean values for PM_{10} and $PM_{2.5}$) are hardly achievable for many countries, it is recommended that the target countries consider the approach that has been developed and implemented either in the EU or in the United States of America. The differences between the EU and the United States approaches are described in detail in box 3. A comparison between the air quality limits in the EU and the United States of America is made in the recent ECE study.[15] Due to practical reasons, a step-wise approach is recommended, in any case with a sufficient transition period.

In the first phase, the assessment of an existing set of national air quality standards should be carried out to decide which ones should remain in place (taking into account their role in permitting procedures like environmental expertise and setting emission limits) and which ones should be updated and or replaced. It is recommended to divide air pollutants among three categories: priority pollutants, important pollutants and other pollutants.

In the second phase, selected air quality standards should be introduced or updated for priority pollutants: mainly PM (PM_{10} in any case), ground-level ozone, SO_2 and NO_2. New or revised standards for other pollutants — CO, lead and benzene — could be added if found appropriate. It is also recommended that alert thresholds for sulphur dioxide, nitrogen dioxide and ground-level ozone and information threshold for ozone be introduced.

In the third phase, new or revised standards for important pollutants — $PM_{2.5}$ (if not introduced earlier), heavy metals (As, Cd and Ni) and PAHs (benzo(a)pyrene) — could be added depending on their impact on air quality in particular target country and limit values for the protection of vegetation (secondary standards) could be introduced as well, if not in place. Existing standards (MACs) for other pollutants could be either cancelled or retained, if considered necessary by a particular country, with respect to permitting procedures.

[15] *Adaptation of Monitoring Networks in Eastern Europe, Caucasus and Central Asia: Air Quality Mo*nitoring (2006) (ECE/CEP/AC.10/2006/3). Available from www.unece.org/env/europe/monitoring.

Box 3: Major differences between the European Union and the United States air quality standards

These differences are as follows:

(a) The United States basic set of standards (criteria pollutants)[16] does not include benzene, arsenic (As), nickel (Ni), cadmium (Cd) and benzo(a)pyrene;
(b) The EU limit values are more stringent (in absolute values) than the US ones, with the exception of $PM_{2.5}$;
(c) The United States compliance criteria are often more stringent than the EU ones (in the case of short-term limit values);
(d) The United States compliance timing is more flexible than that in the EU (where the same flat deadlines are set for all Member States);
(e) Averaging periods are different in certain cases;
(f) The United States secondary standards (limit values for the protection of vegetation, ecosystems) cover more pollutants than the EU standards[17] (and take into account visibility and protection of man-made materials);
(g) The EU approach distinguishes between limit values[18] and target values[19] and more complicated standards are applied in the case of ground-level ozone (target value and long-term objectives) and $PM_{2.5}$ (average exposure indicator, national exposure reduction target, exposure reduction obligation, target value and limit value).
(h) In the EU, ambient air quality standards for certain pollutants (PM_{10}, sulphur dioxide, nitrogen dioxide and nitrogen oxides, lead, benzene and carbon monoxide) are legally binding and are to be (or were to be) complied with by given deadlines (2005 or 2010) throughout the whole territory of all Member States. In the case of ground-level ozone, heavy metals (As, Cd and Ni) and polycyclic aromatic hydrocarbons (PAHs) expressed as benzo(a)pyrene, the target values set should be complied with by a given deadline (2013) in the case that all necessary measures not entailing excessive costs are taken. In the case of $PM_{2.5}$, the targets have been introduced in a more complex way: exposure reduction target (to be met by 2020), exposure concentration obligation (to be met by 2015), target value (to be met by 1 January 2010) and limit values (to be met by 1 January 2015 and 1 January 2020).
(i) In the United States of America, the country is divided into three categories (attainment areas, non-attainment areas and unclassifiable areas). For the non-attainment areas, the compliance deadlines for criteria pollutants (sulphur dioxide, nitrogen oxides, ozone, lead, carbon monoxide, PM_{10} and $PM_{2.5}$) are differentiated in accordance with the pollution levels (marginal, moderate, serious or severe).

Source: *Comparison of EU Air Quality Pollution Policies and Legislation with Other Countries. Study 1. Review of the Implications for the Competitiveness of European Industry. January 2004. AEA Technology Environment and Metroeconomica for the European Commission.*

The step-wise EU-like approach (e.g., average exposure indicator, national exposure reduction target, exposure reduction obligation, target value and limit value) is recommended to be followed in the case of $PM_{2.5}$ (the United States standard of 15 $\mu g/m^3$ for annual average concentration seems to be too stringent even for the EU Member States).

In updating their current air quality standards and developing new ones, the target countries may use relevant background information (e.g., health impact studies, cost-benefit analyses)

[16] Sulphur dioxide, nitrogen dioxide, carbon monoxide, lead, ozone, PM_{10} and $PM_{2.5}$.
[17] Fixed level to be attained within a given period and not to be exceeded once attained.
[18] Fixed level to be attained where possible over a given period.
[19] Critical levels for the protection of vegetations for sulphur dioxide and nitrogen oxides, target value and long-term objective for protection of vegetation for ground-level ozone.

available at the international level (e.g., EMEP,[20] WHO,[21] EEA[22] and the United States Environmental Protection Agency[23]).

The target countries should also decide on compliance deadlines for their updated or newly introduced ambient air quality standards for priority and important pollutants (following, for instance, the EU more flat approach or the US more flexible approach). Without compliance deadlines, these standards would remain at the level of statements without any real power. In addition, differentiated compliance criteria are recommended: limit values[24] for priority pollutants and target values[25] for important pollutants. In the case of other pollutants, for which decision is taken to continue with existing standards (MACs), status of guiding value for permitting purposes is recommended.

7. Target setting

Detailed analysis of available air quality monitoring data (supported by modelling as far as possible) and of available emission data is a necessary precondition for sound target setting (setting the baseline).

In general, targets should be constructed under the SMART (Specific, Measurable, Achievable, Realistic, Timely) concept and structured as main targets (e.g., air quality targets and emission reduction targets) and complementary technical targets (e.g., development of air quality monitoring networks, institutional settings, mechanisms for preparation of emission inventories and development of emission projections etc).

Main targets in the field of air quality should always include the priority pollutants: PM_{10} (and $PM_{2.5}$), ground-level ozone, sulphur dioxide and nitrogen dioxide. If necessary, certain important or other pollutants could be added taking into account specific conditions in particular country.

Main targets in the field of air quality and emission reduction should be mutually coordinated and focused on minimization of health effects (PM and ground-level ozone) and environmental effects (acidification, eutrophication, ground-level ozone). As a result, the following priority air pollutants “on the emission side” are recommended to any target country:

(a) Dust[26] (primary emissions);

(b) Sulphur dioxide (precursor of secondary particles, acidifying agent);

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[20] http://www.emep.int.
[21] http://www.who.int/topics/air_pollution.
[22] http://www.eea.europa.eu/themes/air.
[23] http://www.epa.gov/epahome/learn.htm#air.
[24] See the definition in footnote 18.
[25] See the definition in footnote 19.
[26] Emissions of heavy metals and of polycyclic aromatic hydrocarbons are related with the emissions of primary particles (dust).

(c) Nitrogen oxides (precursors of ground-level ozone and of secondary particles, acidifying and eutrophication agent);

(d) Volatile organic compounds (precursors of ground-level ozone and secondary particles);

(e) Ammonium (precursor of secondary particles, eutrophication and acidification agent).

A particular target country may add other main targets based on its specific conditions.

It is recommended that coordination of air quality targets and emission reduction targets be carried out using relevant modelling techniques (e.g., the GAINS model).

Complementary technical targets should be coordinated with the main targets (especially as for timing) to create conditions both for setting the main targets and for the assessment of compliance.

Setting the targets, both country-specific issues (e.g., geographic conditions, state-of-the-environment, environmental commitments at the international level and general policy trends) and economic assessment of achievability should be taken into account.

Reasonable timing of targets is recommended strongly following a prioritization of problems based on detailed analysis. A step-wise and flexible approach to the timing of compliance with targets is recommended as well.

For the assessment of compliance with the targets, the role of air quality monitoring is crucial.

8. Integration of air quality monitoring, assessment and management with climate change

It has been found[27] that certain air pollutants (e.g., PM, ground-level ozone) have considerable effects on the climate and there are many complex interactions between air pollutants and GHGs. Bearing in mind that the major part of both air pollutants and GHGs is generated by the same anthropogenic activities (e.g., energy, transport), the co-benefits of an integrated approach to the air quality assessment and management and climate change mitigation (reduction of GHG emissions) are evident.

The target countries are recommended to coordinate the development of their air quality assessment and management strategies with the development of climate change mitigation strategies to make use of the application of the co-benefit ("one measure — two effects") approach.

[27] Main conclusions of the conference Air Pollution and Climate Change: Developing a framework for integrated co-benefits strategies, Stockholm, 17–19 September 2008 (http://www.sei-international.org/rapidc/gapforum/html/conf/papers.php).

9. Better use of air quality monitoring data

(a) Permitting

All target countries have introduced permitting procedures for activities which may have an impact on air quality. In this respect, results of air quality monitoring, preferably in combination with modelling (or at least expert assessment), are necessary to decide on the location of a new potentially polluting activity or in the case of a substantial change of existing activity which may cause an increase in emissions. Results of air quality monitoring are used during the process of EIA or environmental expertise as a baseline for an air dispersion study which should estimate the incremental concentration of pollutants caused by the implementation of the project assessed.

The target countries are recommended to extend the use of air quality monitoring data in combination with modelling tools in permitting processes.

(b) Compliance with ambient air quality standards

Once ambient air quality standards are adopted, reliable air quality monitoring data are the most relevant way how to monitor compliance.[28] Nevertheless, due to the costs it is not possible to monitor all pollutants for which some kind of regulation (e.g., emission limit values) is in place. In any case, priority pollutants should be monitored in ambient air for which air quality standards have been set or updated. The national legislation should clearly impose responsibilities on the actors responsible for monitoring of specific sets of standards together with technical requirements for monitoring networks.

(c) Reporting

It is recommended to the target countries to include air quality data in their national state-of-the-environment reports. As national environmental reports are produced for policymakers as well as for the public, the data on air quality should be accompanied by detailed interpretation of that data. Such interpretation should cover at least the following issues:

(a) Population living in areas with increased concentrations of pollutants;

(b) Areas of environmental importance (e.g., national parks or other protected areas) with increased pollution levels;

(c) Potential risks for human health and for the environment;

(d) Origin of air pollution (both sectoral and territorial distribution of emission sources);

(e) Impact of meteorological conditions;

[28] In the case of lower concentrations, the results of monitoring may be supplemented or even replaced by modelling or expert assessment.

(f) Trends in air pollution;

(g) Policies applied and measures taken.

This information cannot be made available in full without monitoring, modelling and emission inventory results.

When preparing state-of-the-environment reports, the application of indicators[29] is recommended strongly to the target countries.

Besides the state-of-the-environment reports, those target countries that do not do it yet are recommended to regularly prepare and publish easily accessible specialized reports on air quality. These should include not only the air quality monitoring data together with their detailed interpretation, but also relevant emission data. International developments in air quality reporting[30] are recommended to be taken into account.

(e) Public information and warning: urgent actions

In the case of certain pollutants (mainly PM, ground-level ozone, SO_2 and NO_X), increased concentrations may lead to immediate health risk for sensitive groups or even for population as a whole. If so, public should be duly informed or warned. The role of reliable air quality monitoring system is clear and very important in such a case. Air quality monitoring systems should be able not only to detect such situations immediately, but also to predict them (on the basis of meteorological predictions). In addition, short-term plans, prepared and adopted by the respective competent authority, should be implemented in such cases. These may include restrictions on traffic or specific stationary sources of pollution.

It is recommended that target countries introduce (if not introduced earlier) alert thresholds for sulphur dioxide, nitrogen dioxide and ground-level ozone and information threshold for ozone. In addition, it is recommended that they consider the introduction of alert threshold for PM_{10}.

(f) International targets

At present, there is no explicit international quantitative target for the target countries in terms of compliance with binding ambient air quality standards. On the “emission side”, the quantitative targets are in place for those target countries that have ratified respective CLRTAP protocols.

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[29] *Environmental Indicators and Indicator-based Assessment Reports — Eastern Europe, Caucasus and Central Asia*. Geneva and New York, 2007. Sales No. E 07.II.E.9. The English version of this publication is available online from http://www.unece.org/fileadmin/DAM/env/documents/2007/ece/ece.belgrade.conf.2007.inf.6.e.pdf, and the Russian version at http://www.unece.org/fileadmin/DAM/env/documents/2007/ece/ece.belgrade.conf.2007.inf.6.r.pdf.

[30] See, for instance, *City annual air quality reports. A proposal for a reporting format*. DCMR/AIRPARIF. November 2006 (http://citeair.rec.org/downloads/Products/CityAnnualAirQualityReports.pdf).

B. MODERNIZING AND UPGRADING NATIONAL AIR QUALITY MONITORING NETWORKS AND INFORMATION SYSTEMS

Within the framework of the development of national air quality assessment and management systems, the target countries are recommended to prepare and implement their national programmes for modernization and upgrading of their air quality monitoring networks and air quality data management and information systems. The main objective of these programmes is to create modern systems that respond to the information and policymaking needs of the target countries and operate on the basis of best available techniques, methodologies and good practices available in the ECE region.

Development of a complete national core air quality monitoring network as a part of air quality assessment and management system (see box 2) should be the main specific target of these programmes. The following issues should be covered by these programmes:

(a) Sampling points, their location and densities;

(b) Parameters measured;

(c) Technical capacities, particularly automated measurements;

(d) Reliability of measurements and analyses;

(e) Data management;

(f) Publication of data including for the general public;

(g) Mobilization of funds from various domestic and external sources.

(h) A step-wise approach is recommended taking into account financial and technical possibilities of particular target countries.

1. Sampling points, their location and densities

It is recommended that the target countries observe the following guidance related to the siting and equipment of sampling points:

(a) Sampling points should be sited in such a way as to provide data on the concentrations of pollutants both in highly populated areas (impact on human health) and in rural areas that are not highly influenced by anthropogenic pollution (impact on vegetation and ecosystems);

(b) Siting of sampling points is given by the type of station (e.g., traffic, industrial or background), the type of area (e.g., urban, suburban or rural) and the characterization of area (e.g., residential, commercial, industrial, agricultural or natural);

(c) In general, sampling points should be sited in such a way to avoid measuring very small micro-environments and to be representative for air quality monitoring in their reasonable vicinity, which is different for different types of stations and areas (from hundreds of square metres in the case of traffic or industrial sites to thousands of square kilometres in the case of stations targeted at obtaining the information related to the protection of vegetation);

(d) Sampling points targeted at obtaining the information related to the protection of vegetation should be located more than 20 km from agglomerations (250,000 or more inhabitants) or more than 5 km from other built-up areas, industrial installations or major motorways (with more than 50,000 vehicles per day);

(e) From the micro-scale point of view, sampling points should be located in such a way as to ensure unrestricted flow of air around the inlet, obviously in the height between 1.5 m and 4 m;

(f) In general, minimum number of sampling points in populated areas should be set depending on — besides the number of population — typical concentrations of relevant pollutants (in the case of lower concentrations, this number could be reduced);

(g) In the case of stations targeted at obtaining the information related to protection of vegetation, at least one sampling point per 20,000–40,000 km^2 is recommended for smaller countries depending on typical concentrations of pollutants;

(h) Additional sampling points should be established to measure pollution related to the important point sources of emissions.

In the case of PM (PM_{10} and $PM_{2.5}$ sampling points), the minimum number of sampling points should be higher than that for other pollutants. In the case of ground-level ozone, minimum numbers of sampling points can be slightly lower than those for other pollutants, but 50 per cent of ozone sampling points should measure nitrogen dioxide and at least one sampling point per country for measuring ozone precursors (VOCs) should be in place. In the case of heavy metals (As, Cd and Ni) and benzo(a)pyrene, one background sampling point should be installed every 100,000 km^2 in the case of smaller countries.

In the case of large target countries with a low density of population, the numbers of sampling points sited outside highly populated areas could be lower than that proposed under this section B.1.

2. Parameters measured

It is recommended that target countries monitor, generally, a core set of priority pollutants for which standards have been or will be set or updated (namely PM_{10}, ground-level ozone, sulphur dioxide and nitrogen dioxide as well as carbon monoxide, benzene, lead, where appropriate), at least in the biggest cities and highly populated agglomerations. In addition, it is recommended that the target countries, where it has not yet been done, start monitoring, at least at selected monitoring stations, $PM_{2.5}$, heavy metals (As, Cd, Ni) and PAHs (benzo(a)pyrene).

In target countries where it has not been done yet, besides the concentration of pollutants, meteorological parameters should be measured at least at selected stations, representative with respect to monitoring data assessment, as the relation between emissions and air quality cannot be interpreted without having relevant meteorological data. Data on wind velocity and direction, temperature 10 m and 2 m above terrain, relative air humidity, atmospheric pressure, precipitation amount and global radiation is necessary for the interpretation of ambient air quality measurements. At selected representative stations, precipitation quality (chemical composition) and atmospheric deposition should be monitored as well.

3. Technical capacities, particularly automated measurements

For the establishment of a national core air quality monitoring network, the stepwise introduction of automated monitoring stations is recommended (starting with the biggest cities and highly populated agglomerations and continuing "top down"). A national core air quality monitoring network based on automated stations could be supplemented by manual monitoring stations and by "passive monitoring devices" (diffusion tubes). In addition, mobile monitoring stations could be applied to provide supplementary data in a flexible way.

4. Reliability of measurements and analyses

Application of internationally recognized reference sampling and measurement methods is recommended to the target countries. ISO is standardizing tools for air quality characterization of ambient air, in particular measurement methods for air pollutants[31] and for meteorological parameters, measurement planning, procedures for quality assurance/quality control (QA/QC) and methods for the evaluation of results, including the determination of uncertainty. ISO also outlines the general principles to be taken into account when assessing the accuracy of measurement methods and results.[32] EU relevant standards could be another option.[33] Data quality objectives are recommended to be defined by three variables: uncertainty, minimum data capture and minimum time coverage.[34]

The technical recommendations presented in the second paragraph of section B.1 (sampling points, their location and densitites), subparagraphs (b) and (c), and the first paragraph of this section are based, among others, on the current practice in the EU and are mainly related to the establishment of national core air quality monitoring networks. The *EMEP Manual for*

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[31] Twenty-one ambient atmospheres standards/projects of TC 146/SC 3 and 11 general standards and/or guides of TC 146/SC 4 (http://www.iso.org/iso/home.html).

[32] *1993 Guide to the Expression of Uncertainty of Measurements* and guidance for the accuracy of the measurement and for testing laboratories (ISO 5725-1-8:1994-1998 and ISO 17025:2005) (http://www.iso.org/iso/home.html).

[33] See the Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe.

[34] In the EU legislation, for instance, different values of some of these variables are set for particular pollutants: Uncertainty of fixed measurement is 15 per cent for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, carbon monoxide and ozone while 25 per cent for benzene and particulate matter. Minimum data coverage is 90 per cent. Minimum time coverage is 90 per cent for industrial sites and 35 per cent for background sites.

Sampling and Chemical Analyses[35] could be another source of information for the target countries but it should be taken into account that the EMEP network of stations is intended to supplement national air quality monitoring networks.

5. Data management

It is recommended that a national air quality information system, as a subsystem of the national air quality assessment and management system, should be established/updated to implement the following main tasks:

(a) Collection of data on air quality (e.g., core network, specialized networks and mobile stations);

(b) Processing of the data (quality control);

(c) Modelling of concentration fields of pollutants;

(d) Assessment and modelling of trends in air quality;

(e) Assessment of health and environmental effects;

(f) Reporting (both national and international);

(g) Providing information to the public.

(h) The air quality information system should be closely linked operationally with:

(i) Compliance assessment (exceedance of limit values or other relevant standards);

(j) Collection of data on emissions (emission cadastre/inventory);

(k) Preparation of emission projections.

National air quality information systems are recommended to be established preferably within those authorized institutions that operate the national core air quality monitoring network (mostly hydrometeorological services). In the case that such institutions are not related to the competent authority responsible for air quality assessment and management, other arrangement should be applied (e.g., environmental agency or the competent authority itself). Such arrangement should include data exchange based on an inter-agency agreement.

[35] Available from www.nilu.no/projects/ccc/qa/index.htm.

6. Cost estimates

The recommended step-wise top-down approach to the upgrade of air quality monitoring system (starting with the most populated areas) may allow to the target countries to optimize the needs of air quality assessment and management with economic conditions.

The (investment) cost of one fully equipped automated monitoring station (for meteorological data, PM_{10}, $PM_{2.5}$, sulphur dioxide, nitrogen dioxide and nitrogen oxides, carbon monoxide and ozone) could be estimated between $140,000 and $190,000. Annual operational cost of such a station could be between $20,000 and $50,000. In the case of specialized stations or stations without meteorological data measurement could be less expensive (less than $120,000).

Additional costs (analytical laboratories and staff) must be expected for monitoring data management and the operation of the whole air quality information system.

Detailed cost estimates for the monitoring of PM (PM_{10} and or $PM_{2.5}$) in countries of Eastern Europe, Caucasus and Central Asia were published by WHO Regional Office for Europe.[36]

7. Mobilization of funds from various domestic and external sources

The expenditures related to modernizing and upgrading national air quality monitoring systems (core systems) as well as to national air quality information systems are to be funded from the State budget.

Additional sources could be found in public (regional and municipal) budgets to support supplementary monitoring activities (regional or municipal networks).

Optionally, private companies could bear a part of the costs related to the modernizing of and upgrading air quality monitoring system, either voluntarily (promoting their corporate social responsibility) or through legal requirements (mandatory self-monitoring stations included in the State monitoring system).

It is also recommended to the target countries to participate in certain international activities to be qualified for financial support from external sources (e.g., trust funds under CLRTAP).

C. IMPROVING COORDINATION OF NATIONAL AIR QUALITY MONITORING PROGRAMMES

Air quality monitoring networks and/or individual monitoring stations (groups of stations) may be operated by different institutions, e.g., hydrometeorological services, environmental inspectorates, sanitary/health inspections, territorial authorities, municipal authorities, enterprises or specialized companies. Due to different reasons (e.g., location of monitoring

[36] *Framework Plan for the Development of Monitoring of Particulate Matter in EECCA*, WHO-Europe 2006 (http://www.euro.who.int/__data/assets/pdf_file/0019/130762/E88565.pdf)).

stations, monitoring frequencies), the results often differ in scope of pollutants monitored, in parameters of measurements, in the timing of measurements, in data treatments as well as in the quality of data and information obtained.

It is recommended that the authorized institution (preferably the one which operates the national core air quality monitoring network) have the power to coordinate all air quality monitoring activities in the country. This power should be accompanied by certain responsibilities with regard to data management (e.g., data flow, data validation and comparison) and support services, including the operation of reference laboratories, the organization of inter-calibration exercises, the publication of manuals and the organization of expert training.

In the case that such an authorized institution does not report to the Ministry of Environment, the coordination power should be given to the Ministry of Environment.

III. WATER QUALITY MONITORING GUIDELINES

INTRODUCTION

The following guidelines deal not only with the quality of water in the natural environment — surface water and groundwater — but also with the quantity of water. Wherever necessary, monitoring of drinking water quality is taken into account as well. Minimization of health and environmental risks of water pollution is a main objective.

The guidelines are based on the assessment and evaluation of the situation with regard to water quality monitoring in the target countries contained in those countries' EPRs prepared under the ECE EPR Programme, as well as in the report, "Europe's Environment: The fourth assessment".[37] The document reflects relevant experiences gained in the EU and other countries where coherent systems of water quality assessment and management have been developed and implemented. They also take into account relevant international activities, requirements, guidance documents and recommendations, especially those developed under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) and its Protocol on Water and Health, under the World Health Organization (WHO), the World Meteorological Organization (WMO) and the International Organization for Standardization (ISO).

A. LINKING WATER QUALITY MONITORING TO ENVIRONMENTAL POLICY DEVELOPMENT

To minimize the negative health and environmental effects of water pollution, those target countries that have not yet done so are recommended to develop strategies to establish comprehensive water management systems (see box 4) including appropriate policy setting (objectives, priorities and targets). Within it, a realistic step-by-step approach to enhancing water quality monitoring (focusing on both surface water and groundwater quality monitoring and emission/discharge monitoring) is recommended to be developed, taking into account technical and economic conditions in a particular target country. Where such systems exist, their revision and step-by-step update is recommended with respect to the present state of the art.

It is recommended that water management systems include a clearly defined institutional setting, including one central competent authority responsible for the coordination of all activities within that system. Institutions responsible for permitting and for enforcement should be independent from each other.

The main message of the present guidelines is that water quality monitoring systems should become an integral part of national water management systems and should therefore be designed, developed and interpreted in a broader policy, economic, technical and scientific context (see box 4). When developing or upgrading national water management systems, the river-basin approach is strongly recommended, especially with regard to the institutional setting. In addition, the concept of integrated water resources management (IWRM) should be taken into account. Finally, water quality monitoring systems should provide data on transboundary rivers and other international water bodies and should therefore be coordinated with relevant international programmes.

[37] Published by the European Environment Agency, Copenhagen, 2007. The report is available from http://www.eea.europa.eu/publications/state_of_environment_report_2007_1.

1. Integrating water quality monitoring with water quantity monitoring

As water quantity and availability is an important issue for all countries, water quality monitoring has to be linked with monitoring of both groundwater and surface water quantity. In addition to water quality, national water management systems should deal with the protection of water resources in terms of quantity and availability (water quantity assessment and management), including protection against floods and other emergency situations (flood management; drought management, climate change adaptation).

In this respect, the balance between groundwater consumption and intake should be monitored, as well as fluctuations in river flows due to hydropower plants and other water-related infrastructure.

2. Integrating water quality and quantity monitoring with climate change mitigation and adaptation policies

Water quality and quantity monitoring should also be coordinated with national climate policies, especially in linking hydrological scenarios with climate scenarios and in the field of adaptation to the impacts of climate change.

Box 4: Basic elements of water management systems

Institutional framework

(a) Central competent state/public administration authority which coordinates activities of all relevant authorities and institutions with regard to water quality and quantity issues;

(b) Relevant public administration institutions at the national, regional and local levels (e.g., river basin authorities, water agencies, sanitary and hygienic services, environmental inspectorates);

(c) Supporting institutions (mainly hydrometeorological services, research institutes, etc.).

Policy-level document setting

(a) Objectives;

(b) Priorities;

(c) Targets.

Regulatory and other instruments

(a) Standards (water quality limit values, emission/discharge limit values, product standards, best available techniques, good agricultural practices) and, where appropriate, compliance deadlines;

(b) Technical requirements (operation of water related infrastructure, operation of emission/discharge sources, measurement of emissions by operators, monitoring protocols, etc.);

(c) Economic and market-based instruments (water abstraction charges, water pollution charges, product charges, taxation, incentives, etc.);

(d) Financial instruments (e.g., environmental funds);

(e) Voluntary instruments (ISO 14 000, eco-labelling, codes of conduct, voluntary agreements, etc.);

(f) Information instruments (public information and awareness-raising, environmental education).

Monitoring and information management

(a) Operation of a core national water (quality and quantity) monitoring system (including its coordination with local and specialized monitoring networks and supporting activities);

(b) Development of emission/discharge inventories and projections;

(c) Water quality and quantity modelling;

(d) Scenario analysis;

(e) Assessment of effects on human health and the environment;

(f) Operation of water information system (including public information);

(g) Reporting.

Operational level setting

(a) Permitting, including environmental impact assessment (EIA)/environmental expertise, hygienic-epidemiologic expertise, strategic environmental assessment (SEA) and life-cycle assessment (LCA);

(b) Regional approach (river basins, planning);

(c) Application of instruments/implementation of measures;

(d) Enforcement (inspection);

(e) Feedback mechanisms (mechanisms to update policy and technical levels).

3. Integrating surface water and groundwater quality monitoring with drinking water quality monitoring

Groundwater and surface water quality monitoring systems are recommended to be integrated with monitoring of drinking water quality, taking into account the structure of drinking water sources (direct use of groundwater, treated groundwater or treated surface water).

Integration of monitoring systems should take into account not only the localization and capacity of particular bodies of water intended for use for production of drinking water, but also the drinking water quality standards and standards set for water sources intended for drinking water production.

4. Integrating water quality monitoring data with emission/ discharge inventories

Monitoring activities should take into account the relationship model known as DPSIR (driving force-pressure-state-impact-response), which represents the conceptual model for development and implementation of water management systems. The relation between emissions/discharges from both point and diffuse sources (pressure) and surface and groundwater quality (state) is of utmost importance. Emission/discharge monitoring helps to find important sources of emissions/discharges and, when combined with water quality monitoring, it allows proposing effective and feasible measures to improve water quality. In order to integrate surface water quality monitoring with discharges monitoring, it is recommended to coordinate sampling of discharged waters with sampling of water in recipients downstream of points of discharges.

Target countries that have not yet done so are recommended to:

(a) Prepare a preliminary assessment of available data on emissions/discharges (including data quality assessment);

(b) Update the mechanisms to create and operate national emission/discharge inventories[38] on a regular basis; it is recommended that these inventories cover those priority pollutants (see below section A.9, paragraph 5, on target setting) which are being regulated by national legislation (using emission/discharge limit values) or reported under the Pollutant Release and Transfer Register (PRTR) framework;

(c) Include the assessment of emissions/discharges from small stationary sources (mainly households and small businesses not connected to public sewers) and from diffuse sources (mainly agriculture or contaminated land) into emission/discharge inventories;

(d) Arrange for the preparation of emission/discharge projections for selected pollutants on a regular basis (these projections should at least cover those priority pollutants which are being regulated using emission/discharge limit values).

5. Integrating water quality monitoring data with modelling activities

It is recommended that target countries that have not yet done so develop and verify or implement, in a step-by-step way, existing modelling tools extrapolating the monitoring data to cover all water bodies where compliance with standards is required and correlating water quality monitoring data with emissions/discharges from specific sources.

As a first step, past and actual situations should be assessed by appropriate models (e.g., processing of time series of monitoring data) to define the background for setting targets. Suitable policies and measures should be proposed to achieve them. As a second step, modelling should be carried out to predict future developments in water quality (and quantity) and to check both whether the proposed targets are technically and economically achievable, and whether the existing policies and measures are likely to achieve them.

This model-based approach is useful in the case of flow (quantity) and of diffuse pollution assessment, where the effect of prescribed measures is long term and not easy to measure or calculate in a simple way. Nevertheless, emission/discharge and water quality data and their correlation should also be taken into account in the case of routine point sources permit issuing where such a decision can be made on the basis of ordinary calculation.

[38] Emission/discharge inventories should include not only the amounts of pollutants discharged, but also the volumes of polluted water discharged into recipients.

6. Integrating water quality monitoring data with the assessment of health and environmental effects

Poor quality of both surface water and groundwater may have serious impacts on human health and/or on the environment. Direct use of polluted surface or groundwater as drinking water or use of insufficiently treated surface water is the most serious direct health effect, while the consumption of fish and shellfish from polluted surface waters represents one of serious indirect impacts on human health. In addition, bathing in polluted water may lead to negative health effects. Pollution of surface waters causes direct deterioration of aquatic ecosystems (acidification, eutrophication).

Water quality monitoring data, together with information on pollution sources and various types of adverse impacts (disasters, technical accidents, secondary pollution), is the only way to assess the risk of the negative effects of polluted water on human health and the environment. Water quality monitoring systems should therefore be designed to provide sufficient information on potential risks. Special attention should be given to those water bodies which are being used for drinking water production (taking into account the number of people served) and/or represent important aquatic ecosystems.

7. Integrating water quality monitoring with other monitoring networks, including international networks

It is recommended that the target countries consider preparing and implementing integrated environmental monitoring strategies which would create a framework for coordination of specialized monitoring networks (e.g., water, air, soil, forests, biodiversity, noise and waste). The experience of those target countries that have prepared and are implementing such integrated environmental monitoring strategies should be made available to other target countries.

It is also important to give particular attention in integrated environmental monitoring strategies to monitoring water quality and quantity in transboundary watercourses and international lakes. Where such international networks do not exist, the relevant target countries are recommended to consider their establishment.

8. Revising water quality standards and harmonizing them with international standards and guidelines

A specific problem for the assessment of waters in countries of Eastern Europe, the Caucasus and Central Asia arises from the widely used “maximum allowable concentrations of pollutants for a specific water use” (MACs)[39] formula, which seem to be more stringent than water quality criteria and objectives often used in other parts of the ECE region. It is frequently impossible to comply with MACs, partly due to the lack of appropriate measuring devices and partly because financial and human resources or feasible technical solutions are lacking.

[39] MACs had been introduced based on hygiene standards for many hundreds of pollutants. MACs represent a background for issuing permits for discharges from particular pollution sources (using calculations).

Current surface water and groundwater quality standards are recommended to be reviewed and, thereafter, revised, discontinued or set anew, where necessary. Where the ministry of health is responsible for setting national water quality standards, the central-level competent environmental authority should participate actively in the process of water quality standards updating and setting. When developing water quality standards for hazardous substances, the form in which these substances are present in water should be taken into account. For instance, as heavy metals and pesticides are present in water in the organo-mineral form and as suspensions, standards and targets should be developed also for a total content of these substances.

While revising groundwater and surface water quality standards, it is recommended to take into account relevant internationally agreed guiding documents. For instance, WHO has developed the Guidelines for Drinking-water Quality and the Guidelines for Safe Recreational Water Environments.[40]

The EU has developed and implemented a comprehensive system of water quality assessment and management with the Water Framework Directive[41] (WFD) as its background. Annex VIII of the WFD established a first indicative list of main pollutants (dangerous substances). The hazardous substances are the substances already indicated in the list I and II of the Directive 76/464/EEC (codified by 2006/11/EC)[42] and are included as substances and classes of substances in Annex VIII of the WFD. The priority substances are all those which present a significant risk both directly or via an aquatic environment, including risks to waters used for the abstraction of drinking water. Among them, hazardous substances are identified in order to set up interventions to eliminate their emission and loss in the aquatic environment. The first step of this EU strategy is a list of priority substances and hazardous priority substances, adopted by Decision 2455/2001/EC, which identifies 33 substances of priority concern.[43] It is evident that with the WFD and Decision 2455/2001/EEC the number of substances to be controlled grows remarkably, because the criteria for toxicity, persistence and potential bioaccumulation are combined with the criterion of risk for the aquatic environment.

Besides the requirements for the quality of groundwater[44] and surface water, EU legislation includes special provisions for the quality of drinking water,[45] bathing water,[46] water for fish[47] and water for shellfish.[48] In addition, the requirements related to the reduction of

[40] Available, respectively, from www.who.int/water_sanitation_health/dwq/gdwq3rev/en/ and http://www.who.int/water_sanitation_health/bathing/en/.
[41] Directive 2000/60/EC of the European Parliament and of the Council of 23 October establishing a framework for Community actions in the field of water policy (as amended).
[42] Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community.
[43] Decision No. 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC.
[44] Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration.
[45] Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption.
[46] Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality.
[47] Directive 2006/44/EC of the European Parliament and of the Council on the quality of fresh waters needing protection or improvement in order to support fish life.
[48] Directive 2006/113/EC of the European Parliament and of the Council of 12 December 2006 on the quality required of shellfish waters.

emissions/discharges should be taken into account (e.g., directives concerning urban waste water treatment,[49] water pollution from agricultural sources[50] and integrated pollution prevention and control[51]). In addition, certain "specialized directives" establish requirements for groundwater monitoring.[52]

In the United States of America, the water quality assessment and management system is based on the 1972 Clean Water Act[53] (last update 2002). According to this act, the U.S Environment Protection Agency (EPA) is responsible for the development of criteria for water quality. The current EPA's compilation of national recommended water quality criteria contains water quality criteria for the protection of aquatic life and human health in surface water for approximately 150 pollutants.[54] These criteria provide guidance for states to use in adopting water quality standards.

The target countries are recommended to apply a step-by-step approach in harmonizing their water quality standards with the international ones. The assessment of an existing set of national groundwater and surface water quality standards should be carried out to decide which ones should remain in place (taking into account their role in permitting procedures like environmental expertise and setting emission/discharge limits) and which ones should be updated and or replaced. It is recommended that water pollutants be divided among, at least, two categories: priority pollutants (see the following paragraph) and important pollutants (those which are not listed as priority ones but are considered to have an impact on water quality in the country or in part of its territory).

It is recommended that surface water quality standards be updated or introduced for the following priority pollutants: substances having unfavourable effects on oxygen balance (measured as Biochemical Oxygen Demand (BOD) or Chemical Oxygen Demand (COD); soluble substances; insoluble substances; total nitrogen; ammonia, nitrates; total phosphorus; phosphates; cadmium; mercury; lead; nickel; aromatic/polyaromatic hydrocarbons; and halogenated hydrocarbons). Nevertheless, the target countries can be flexible in developing their lists of priority pollutants, taking into account country-specific situations.

In the case of groundwater, quality standards should be introduced and/or updated for the following priority pollutants — arsenic, cadmium, lead, mercury, ammonium, chloride, sulphate, trichloroethylene and tetrachlorethylene — as well as for conductivity. However, the target countries can be flexible in developing their lists of priority pollutants, taking into account country-specific situations.

Revised standards or new standards for important pollutants could be set and existing standards for other pollutants could either be abolished or retained if considered necessary for permitting procedures.

In updating their current groundwater and surface water quality standards and developing new ones, the target countries may use relevant background information (e.g., health impact

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[49] European Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment.
[50] European Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources.
[51] European Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (IPPC).
[52] E.g., European Council Directive 99/31/EC of 26 April 1999 on the landfill of waste.
[53] http://epw.senate.gov/water.pdf.
[54] http://water.epa.gov/scitech/swguidance/waterquality/standards/current/index.cfm.

studies and cost-benefit analyses) available at the international level (e.g., developed by ECE,[55] the European Commission,[56] WHO,[57] EEA[58] or the U.S. EPA[59]).

It is recommended that target countries consider the introduction of special water quality standards at the subnational level (e.g., for particular rivers, lakes or river basins) wherever reasonable.

The target countries are also recommended to decide on compliance deadlines for their updated or newly introduced groundwater and surface water quality standards for priority and important pollutants. Without compliance deadlines, these new or updated standards would remain at the level of statements without any real power.

9. Target setting

Detailed analysis of available water quality monitoring data (supported by modelling as far as possible) and of available emission/discharge data is a necessary precondition for sound target setting (setting the baseline).

Targets are recommended to be structured as main targets (e.g., water-quality objectives and discharge reduction targets) and complementary technical targets (e.g., development of water quality and quantity monitoring networks, institutional settings, mechanisms for preparation of emission/discharge inventories, development of emission/discharge projections, etc.). The application of the Specific, Measurable, Achievable, Realistic, Timely (SMART) concept will be useful for the purpose.

Water-quality objectives are generally considered to be numerical values or descriptive statements that must be met within a specified period of time to protect human health and to protect or restore a set of environmental values (e.g. aquatic ecosystem protection, recreation and aquaculture). Water-quality objectives established should be considered as the ultimate goal, that is, as a target value which indicates a negligible risk of adverse effects on water uses and the ecological functions of waters.

Water-quality objectives should be set, taking into account specific physico-chemical, biological and other characteristics of water bodies and their catchment area. In setting water-quality objectives, the application of the Guidelines for developing water quality objectives and criteria is recommended, as presented in Annex 3 to the Water Convention (see Box 5). Water-quality objectives should always include the priority pollutants (see above, sect. B.8, paras. 8 and 9). Important pollutants should be added taking into account specific conditions in a particular country.

55 See, e.g. http://www.unece.org/env/water/publications/pub74.htm.
56 See http://ec.europa.eu/environment/water/index_en.htm.
57 See http://www.who.int/topics/water.
58 See http://www.eea.europa.eu/themes/water.
59 See http://www.epa.gov/epahome/learn.htm#water.

Box 5: Guidelines for developing water quality objectives and criteria

Water quality objectives and criteria shall:

(a) Take into account the aim of maintaining and, where necessary, improving the existing water quality;

(b) Aim at the reduction of average pollution loads (in particular hazardous substances) to a certain degree within a certain period of time;

(c) Take into account specific water quality requirements (raw water for drinking-water purposes, irrigation, etc.);

(d) Take into account specific requirements regarding sensitive and specially protected waters and their environment, e.g., lakes and groundwater resources;

(e) Be based on the application of ecological classification methods and chemical indices for the medium- and long-term review of water quality maintenance and improvement;

(f) Take into account the degree to which objectives are reached and the additional protective measures, based on emission limits, which may be required in individual cases.

Source: *Annex 3 to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes*.

When setting emission/discharge targets the following priority water pollutants are recommended to be covered (taking into account different sources of emissions/discharges — wastewater treatment plants, households, industrial installations and diffused sources like agriculture or contaminated sites):

(a) Substances having an unfavourable effect on oxygen balance (measured as BOD or COD);

(b) Total Phosphorus;

(c) Phosphates;

(d) Total Nitrogen;

(e) Ammonium-N (NH4-N);

(f) Nitrates;

(g) Soluble inorganic substances;

(h) Insoluble substances;

(i) Microbiological pollution;

(j) Hazardous substances (e.g., mercury, cadmium, nickel, lead, aromatic/ polyaromatic hydrocarbons, halogenated hydrocarbons).

A particular target country may add other pollutants based on its specific conditions (e.g. specific hazardous substances), both countrywide and local ones. Particular attention should be given to water bodies used for the withdrawal of water for the purposes of drinking water production.

Water quality objectives and emission/discharge reduction targets should be mutually coordinated and focused on minimization of adverse health and environmental effects. It is recommended that coordination of water-quality objectives and emission/discharge reduction targets be carried out using relevant modelling techniques.

Complementary technical targets should be coordinated with the main targets (especially as regards timing) to create conditions both for setting the main targets and for the assessment of compliance.

In setting the targets, both country-specific issues (e.g., geographic conditions, the state of the environment, environmental commitments at the international level and general policy trends) and technical and economic assessment of achievability should be taken into account.

Reasonable timing of targets is strongly recommended following a prioritization of problems based on a detailed analysis. A stepwise and flexible approach to the timing of compliance with targets is recommended as well.

For the assessment of compliance with the targets, the role of water quality and quantity monitoring and control is crucial.

10. Better use of water quality monitoring data

(a) Permitting

All target countries have introduced permitting procedures for activities which may have an impact on surface water and groundwater quality and quantity. In this respect, results of water quality and quantity monitoring, preferably in combination with modelling (or at least expert assessment), are necessary to decide on the location of a new potentially polluting activity or in the case of a substantial change in existing activity which may cause an increase in emissions/discharges. Results of water quality and quantity monitoring are used during the process of environmental impact assessment (EIA) or environmental expertise as a baseline against which the estimate of the incremental concentration of pollutants caused by the implementation of the project is assessed.

An integrated permitting approach, as applied in the IPPC Directive,[60] is recommended to be applied to prevent and control pollution in all recipients (air, water, soil). This directive uses

[60] The 96/61/EC Directive on Integrated Pollution Prevention and Control (consolidated text in Directive 2008/1/EC) has the objective of preventing, reducing and as long as possible eliminating pollution produced into production sectors. The goal will be reached with an "integrated approach" both with regard to the coordination of competent authorities and with regard to the control of emissions, in undertaking the analysis of any environmental effects and the assessment of techniques adopted in the production processes. It is worthwhile to remark that techniques mean not only the process technologies but also their design, construction, maintenance, implementation, management and closure. Among others, the best available techniques (BATs) for optimizing efficiency and minimizing environmental impacts should be used, provided they are economically and technically viable.

the combined approach to any pollution source (wastes, emissions, discharges, energy and material use), which means that the discharge permit in any environment recipient can only be authorized if the limits of emissions for all other recipients are respected.

The target countries are recommended to extend the use of water quality and quantity monitoring data in combination with modelling tools in permitting processes. In the case that modelling is not available, simple calculation of consequent concentration in stream could be used.

(b) Compliance with water quality standards

Once groundwater and surface water quality standards are adopted, reliable water quality monitoring data are the most relevant way to monitor compliance.[61] In any case, priority pollutants should be monitored in surface and ground waters for which water quality standards have been set or updated, taking into account the technical and economic conditions in the particular target countries. National legislation should clearly impose responsibilities on the actors responsible for monitoring specific standards, as well as set out the technical requirements for monitoring networks.

(c) Reporting

Target countries which do not yet include water quality and quantity data in their national state-of-the-environment reports are recommended to do so. As national environmental reports are produced for policymakers as well as for the public, the data on water quality should be accompanied by detailed interpretation of that data. Such interpretation should cover at least the following issues:

(a) Populations living in areas with increased concentrations of pollutants in surface water and groundwater;

(b) Areas of environmental importance with increased water-pollution levels;

(c) Potential risks for human health and for the environment;

(d) The origin of water pollution (both sectoral and territorial distribution of point and diffuse sources of pollution);

(e) The impact of hydrological and meteorological conditions;

(f) Trends in water quantity;

(g) Trends in water pollution;

(h) Policies applied and measures taken or proposed.

This information cannot be made available in full without monitoring, modelling and emission/discharge inventory results.

[61] In the case of lower concentrations, the results of monitoring may be supplemented or even replaced by modelling or expert assessment.

When preparing state-of-the-environment reports, the application of indicators[62] is strongly recommended for the target countries.

Besides state-of-the-environment reports, those target countries that do not do so as yet are recommended to regularly prepare and publish easily accessible specialized reports on water quality and quantity. These reports should include not only water quality monitoring data together with their detailed interpretation, but also data on water quantity and relevant emission/discharge data. International developments in water quality and quantity reporting are recommended to be taken into account.

(d) International targets

Target countries are recommended to cooperate with other riparian countries in the case of specific transboundary waters and to work towards agreeing upon explicit quantitative targets for water quality. In the framework of bilateral or multilateral agreements on transboundary water protection and use, target countries should also establish joint monitoring networks and agree on conditions of their operation, including water quality and quantity standards.

B. Modernizing and upgrading national water quality and quantity monitoring and information systems

Within the framework of the development of national water management systems, the target countries are recommended to prepare and implement their national programmes for modernization and upgrading of their water quality and quantity monitoring systems (including monitoring networks, data quality management and information systems). The main objective of these programmes is to create modern systems that respond to the information and policymaking needs of the target countries and operate on the basis of best available techniques, methodologies and good practices available in the ECE region.

Development of a complete national core water monitoring network as a part of water management systems should be the main specific target of these programmes. National core water monitoring networks could become a part of international networks/systems.

Water (quality and quantity) monitoring networks (as well as the whole water monitoring system) should be evaluated on a regular basis.

Surface water quality and quantity monitoring network should also be designed for particular river basins and should cover both its ecological and chemical status, namely:

(a) Quantitative issues;

(b) Parameters indicative of all biological and microbiological quality elements;

(c) Parameters indicative of all hydromorphological quality elements;

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[62] Environmental Indicators and Indicator-based Assessment Reports — Eastern Europe, Caucasus and Central Asia (United Nations publication, Sales No. E 07.II.E.9). The English version is available online from http://www.unece.org/fileadmin/DAM/env/documents/2007/ece/ece.belgrade.conf.2007.inf.6.e.pdf and the Russian version from http://www.unece.org/fileadmin/DAM/env/documents/2007/ece/ece.belgrade.conf.2007.inf.6.r.pdf.

(d) Parameters indicative of all physico-chemical elements;

(e) Priority and important pollutants discharged into the river basin;

(f) Other pollutants discharged into the river basin in significant amounts.

Groundwater quality and quantity monitoring networks should be designed for particular groundwater bodies to cover:

(a) Quantitative issues (groundwater level, drawing-off and recharge);

(b) Parameters indicative of all physico-chemical and biological (and microbiological) elements;

(c) Possible sources of pollution (mostly diffuse).

The following issues should be covered by the programmes provided for in the first and second paragraphs of this section:

(a) Objectives and targets;

(b) Monitoring points, their location and densities;

(c) Frequency of monitoring;

(d) Parameters measured (for surface water, groundwater and sediments);

(e) Sampling and analytical methods;

(f) Technical capacities, particularly automated measurements;

(g) Reliability of measurements and analyses (quality assurance (QA)/quality control (QC) including control of laboratory performance);

(h) Data management, validation and presentation;

(i) Cost estimates;

(j) Mobilization of funds from various domestic and external sources.

A stepwise approach is recommended for the development of networks as set out in the preceding paragraphs, taking into account the financial and technical resources of particular target countries.

1. Monitoring points, their location and densities

In the case of surface water, monitoring is recommended to be carried out at points, where:

(a) the volume of water flow is significant within the river basin district as a whole, including points of large rivers where the catchment area is great (depending on the country's area — e.g., in smaller countries, greater than 2,500 km^2);

(b) the volume of water present is significant within the river basin district, including large lakes and reservoirs;

(c) there is a risk of significant pressure from point sources;

(d) there is a risk of significant pressure from diffuse sources;

(e) there is a risk of significant hydromorphological pressure;

as well as at the upstream confluences (of two rivers or a river and a lake or sea) and the upstream drinking water abstraction points. Monitoring points should be located with respect not only to water abstraction points, but also to protected areas, areas used for bathing, areas with important fish populations as well as in the areas with considerable discharges of pollutants.

In the case of groundwater, the monitoring points are recommended to be established in order to:

(a) Provide a reliable assessment of quantitative status of all groundwater bodies, including the assessment of available groundwater resources (taking into account abstraction and recharge of groundwater);

(b) Provide a coherent and comprehensive overview of the chemical, biological and microbiological status of each groundwater body;

(c) Detect the presence of long-term anthropogenically induced upward trends in pollutants.

Monitoring points should be located with respect to vulnerability of groundwater bodies (e.g., karst aquifers).

2. Frequency of monitoring

In the case of surface waters, the frequency of monitoring should distinguish among types of water bodies (rivers, lakes, transitional bodies or coastal zones) and types of parameters measured (biological, hydromorphological and physico-chemical). Frequency of physic-chemical monitoring should be coordinated with hydrological and vegetation cycles. The values applied by WFD are recommended as a basic guidance, presented in the table below. Nevertheless, target countries may decide on different frequencies, taking into account their natural, technical and economic possibilities.

Additional monitoring of surface water is recommended to be carried out in drinking water abstraction points (4 times to 12 times per year depending on the number of persons served) and in habitat and species protection areas.

In the case of groundwater, monitoring should be carried with a frequency sufficient to assess the impact of abstractions and discharges on the groundwater level and to detect the impact of relevant pressures on chemical status, but at a minimum of once per year.

Frequency of monitoring

Quality Element	*Rivers*	*Lakes*	*Transitional*	*Coastal*
		Biological		
Phytoplankton	6 months	6 months	6 months	6 months
Other aquatic flora	3 years	3 years	3 years	3 years
Macro invertebrates	3 years	3 years	3 years	3 years
Fish	3 years	3 years	3 years	
		Hydromorphological		
Continuity	6 years			
Hydrology	continuous	1 month		
Morphology	6 years	6 years	6 years	6 years
		Physico-chemical		
Thermal conditions	3 months	3 months	3 months	3 months
Oxygenation	3 months	3 months	3 months	3 months
Salinity	3 months	3 months	3 months	
Nutrient status	3 months	3 months	3 months	3 months
Acidification status	3 months	3 months		
Other pollutants	3 months	3 months	3 months	3 months
Priority substances	1 months	1 months	1 months	1 months

Source: Water Framework Directive (2000/60/EC), Annex V (see http://eur-lex.europa.eu/en/legis/20100101/chap15102020.htm)

3. Parameters measured

In the case of surface water, the following parameters are recommended to be monitored:

(a) Biological and microbiological parameters (bacteria, zooplankton, phytoplankton, other aquatic flora, macroinvertebrates, fish);

(b) Hydromorphological parameters (continuity, hydrology, morphology);

(c) Physico-chemical parameters (thermal conditions, oxygenation, salinity, nutrient status, acidification status, priority pollutants, important pollutants).

In the case of groundwater, the following parameters should be monitored:

(a) Groundwater level;

(b) Conductivity;

(c) pH;

(d) Concentration of nitrates;

(e) Concentration of ammonium;

(f) Concentrations of other pollutants including microbiological/organic parameters.

4. Technical capacities, particularly automated measurements

Step-by-step introduction of advanced monitoring techniques is recommended, starting with the most important water bodies which are being used for drinking water production (taking into account the amount of the population served) and including important aquatic ecosystems.

Automatic gauging stations are recommended rather than automatic stations for water quality measurement, as the latter stations can measure only a restricted choice of parameters and the results are not reliable. Therefore, in the case of water quality monitoring manual sampling and chemical analysis are recommended. Regular assessment of the laboratories control is mandatory. Automatic chemical status measurement can be useful in the case of accidental pollution for a quick rough estimate of the pollution level.

5. Reliability of measurements and analyses

The target countries are recommended to apply internationally recognized reference sampling and measurement methods (CEN/ISO standards). All methods of analysis, including laboratory, field and online methods used for the purposes of chemical monitoring, are recommended to be validated on a regular basis (including laboratory performance assessment) and documented in accordance with the EN ISO/IEC-17025 standard (General requirements for the competence of testing and calibration laboratories).[63]

6. Data management

It is recommended that a national water information system, as a subsystem of the national water management system (see box 4), should be updated or established to implement the following main tasks:

(a) Collection of data on water quality and quantity (e.g., core network, and specialized networks);

(b) Processing of the data (quality control);

(c) Modelling of concentration fields of pollutants and of hydrological conditions;

(d) Assessment and modelling of trends in water quality and quantity;

(e) Assessment of health and environmental effects;

(f) Emergency and warning in case of accidental pollution, possible health threat and in case of extraordinary weather events accompanied by floods or droughts;

(g) Reporting (both national and international);

(h) Providing information to the public.

Relevant international guidelines like those developed under the WMO World Hydrological Cycle Observing System (WHYCOS) should be used for the purpose.[64]

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[63] http://www.iso.org/iso/catalogue_detail.htm?csnumber=39883.

[64] Available online from http://www.whycos.org/IMG/pdf/WHYCOSGuidelines_E.pdf.

The water information system should be closely linked operationally with:

(a) Compliance assessment (exceedances of limit values or other relevant standards);

(b) Collection of data on emissions/discharges (cadastre/inventory);

(c) Preparation of emission/discharge projections.

National water information systems are recommended to be established preferably within those authorized institutions that operate the national core water quality and quantity monitoring network (often hydrometeorological services). If other arrangements are made they should promote data exchange based on an inter-agency agreement.

7. Cost estimates

The recommended stepwise top-down approach to upgrading water quality and quantity monitoring systems (starting with the most vulnerable areas) will allow for the target countries to optimize the needs of water quality assessment and management in accordance with their various economic conditions.

Additional costs (analytical laboratories and staff) must be expected for monitoring data management and the operation of the whole water information system (see box 6).

Box 6: Costs of water- monitoring system

(a) Network administration, including design and revision;

(b) Capital costs of monitoring and sampling equipment, automatic measuring stations and data transmission systems, construction of observation boreholes or surface water sampling sites and gauging stations, transport equipment, data processing hardware and software;

(c) Labour and other operating costs of sampling, field analysis of water quality determinants and field measurements of water levels and discharge characteristics;

(d) Operating costs of online data transmission systems (e.g., water levels, accidental water pollution);

(e) Labour and other operating costs of laboratory analyses;

(f) Labour and associated operating costs of data storage and processing;

(g) Assessment and reporting (including joint work for transboundary waters);

(h) Production of outputs, including geographic information systems (GIS) or presentation software and report printing costs.

Source: *Strategies on Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters* (United Nations, Sales Publication No. E.06.II.E.15).

8. Mobilization of funds from various domestic and external sources

The expenditures related to modernizing and upgrading national water quality and quantity monitoring systems (core systems) as well as for national water information systems should be funded from the State budget.

Additional sources could be found in public (regional and municipal) budgets to support supplementary monitoring activities (regional or municipal networks).

Optionally, private companies could bear a part of the costs related to the modernizing and upgrading of water quality monitoring systems, either voluntarily (promoting their corporate social responsibility) or through legal requirements (mandatory self-monitoring stations according to monitoring legislation).

It is also recommended that the target countries actively participate in certain international activities in order to qualify for financial support from external sources (e.g., resources from trust funds under the ECE Water Convention).

C. Improving coordination of national water quality monitoring programmes

Water quality and quantity monitoring networks and/or individual monitoring stations (groups of stations) may be operated by different institutions, e.g., hydrometeorological services, environmental inspectorates, sanitary/health inspection services, river basin authorities, water agencies, territorial authorities, municipal authorities, enterprises or specialized companies. Owing to different reasons (e.g., location of monitoring stations and monitoring frequencies), the results often differ in the scope of pollutants monitored, in the parameters of measurements, in the timing of measurements and in data treatments, as well as in the quality of the data and information obtained.

It is recommended that the authorized institution (preferably the one which operates the national core water quality and quantity monitoring network) have the power to coordinate all water quality and quantity monitoring and data collection activities in the country. This power should be accompanied by certain rights and responsibilities with regard to data management (e.g., data flow, data validation and comparison) and support services, including the operation of reference laboratories, the organization of inter-calibration exercises, training of staff, the publication of manuals and the organization of expert training.

Where such an authorized institution does not report to the central competent authority, the coordination power should be given to that central competent authority.