Summary of the Guidelines for Monitoring Surface water, European Water Framework Directive, for the water manager

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Introduction
This summary of the Guidelines for Monitoring Surface water (30 June 2005) was drawn up for water managers in the Netherlands, as an extra aid to compiling the actual WFD monitoring programmes. This summary deals with the formulation of the monitoring programmes without further explanations. With the aid of this summary, and their colleagues in the field, water managers will be able to put together their own WFD monitoring programme.

The objectives of the national WFD monitoring guideline are:
- An unequivocal interpretation of the WDF monitoring obligations;
- The harmonisation of WFD monitoring by water managers in the Netherlands for the purposes of an unequivocal assessment and reporting to Brussels;
- The adoption of an initial package for WFD monitoring necessary for reporting to Brussels.

Principles underlying the national guidelines
- These guidelines are the practical interpretation of the preconditions described in the MRE memorandum "Decision-making starting points";
- The guidelines focus solely on monitoring for WFD, appendix V;
- WFD monitoring dovetails as closely as possible with the current monitoring programmes;
- The monitoring network is designed at river basin level (note: not at sub-river basin level!);
- Not all water bodies need to be sampled, work with representative monitoring points;
- Rotating monitoring (distribution of locations over the years with a fixed frequency) is to be recommended; Harmonisation between the disciplines and the water managers is extremely important in this respect;
- The results must be comparable so as to send an unequivocal report to Brussels;
- Locations at country boundaries will be chosen in mutual consultation with neighbouring Member States;
- Monitoring reports sent to Brussels must be kept as brief as possible, at the lowest possible costs (efficient and effective);
- The guidelines describe the minimum requirements, supplemented by monitoring requirements from the assessment tools for natural waters; These minimum requirements do not always suffice for obtaining statistically reliable results;
- The water manager selects the existing and supplementary monitoring for his own management plan in addition to the compulsory WFD monitoring; He is advised to do this in accordance with these guidelines;
- The limit for using data is 6 years; Data from 2003 may be used until 2009, older data may then no longer be used;
- If different parameters can be chosen in the operational monitoring, the cheapest option should be selected.

Types of WFD monitoring
WFD distinguishes 3 types of monitoring, viz. surveillance monitoring, operational monitoring and investigative monitoring. It is recommended to design the programmes for all three types of monitoring in connection with each other, with the same sampling and analysis methods and, where possible, with corresponding monitoring locations. This will increase the efficiency and coherence of the programmes.

Surveillance Monitoring
The purpose of surveillance monitoring is to establish and assess long-term trends for human activities and for changes in natural conditions. The collected data must ultimately lead to an overall assessment of the waters within a river basin. The establishment of the precise surveillance monitoring programme is a task for the river basin.

Choice of location
Surveillance locations refer to water bodies. One or more water bodies may be selected as a representative location for a cluster of water bodies within a river basin. Aggregation is possible as long as water bodies are

comparable as regards geography, hydrology, geomorphology, trophic level, degree of human pressure, type and status. The quality elements within a water body should be monitored at one or more monitoring points.

Principles underlying the choice of a surveillance monitoring location are:

1) significant discharge flow within a river basin, including locations in large rivers with a river basin of more than 2500 km^2;
2) Significant volume of water;
3) Where significant water bodies cross the boundary of a Member State;
4) Designated in Decision 77/795/EEC;
5) Locations that are necessary to estimate the pollutant loads at Member States' boundaries and on the transitions to the marine environment.

The monitoring locations can be divided into locations that determine the ecological status and locations that determine the chemical status.

Choice of location for ecology per river basin

At locations where the ecological status is determined, the biological groups that are relevant to the water body are sampled, just as the general physico-chemical parameters, the substances for which no EU standards are available and the hydromorphological parameters.

Water bodies are eligible for ecological surveillance monitoring if one of the following questions can be answered with "yes":

a. Is it an important body of water within the river basin as regards size and function?
b. Is it a significant cross-boundary body of water?
c. Is it one of the dominant or important water types?

Median method

Within the group of selected water bodies of the same type and status, the median method will be subsequently applied. This means that a ranking of the water bodies takes place on ecological status[1] (from low to high) and on size (surface area). This ranking is first made on ecological status and secondly on size (in one sort); this means that in the case of an equal ecological status, the size will determine the ranking. The central water body (the median) is designated as a surveillance location; in the case of equal numbers (where there is no median) the water body with the better ecological status is selected, or if these are also equal, the biggest water body.

Testing selected locations

Finally, the selected surveillance locations must be tested as follows:

1. Are the surveillance locations well distributed over the river basin?
2. Do the locations give a good impression of the most important and most frequent water types in the Netherlands?
3. Have all the highly relevant water bodies been selected?

If necessary, add an extra water body.

Artificial waters

The number of artificial waters can be limited, because these are not logical locations for detecting autonomous changes, and they are also usually not so important in view of their volume.

Main waters versus regional waters.

Many main waters can be selected as a surveillance monitoring location on the basis of their volume, cross-boundary features and/or transition from freshwater to marine environment . Moreover, other frequently occurring smaller regional water types should also be included in a surveillance monitoring programme.

Choice of location for chemistry per river basin

At locations where the chemical status is to be determined, the substances that must be tested against the EU standards are determined in combination with the discharge flow (to calculate the load).

In principle, monitoring locations for chemistry are located in the downstream section of a hydrological discharge unit. The chemical surveillance monitoring network comprises the estuaries of the larger river basins, boundary-crossings and representative locations in the most important water systems and the larger

[1] The ecological status is based on the more formal risk assessment.

lakes. Surveillance locations that are located in the same cluster of water bodies as the 77/795/EEC locations, are considered representative of these locations.

Main waters versus regional waters.
Based on the starting points for the choice of locations for surveillance, it is reasonable to assume that well selected[2] locations in the main waters, with the addition of a number of regional waters, are representative of the most important water systems in the Netherlands. The regional locations are situated in water systems that comply as regards size with the starting points, and contribute significantly to discharge into the main waters.

Hydromorphology
Depending on the precise section, monitoring of one point (discharge flow, for example) in the water body or over the entire water body (morphology descriptions).

Choice of frequency
The WFD requires that surveillance monitoring checks all general physico-chemical parameters, priority and other polluting substances for one year during the validity of the river basin management plan (= 6 years) for each monitoring location. For priority and other polluting substances applies that if a good status was shown for a substance in the last surveillance monitoring and this substance is not discharged, surveillance monitoring is carried out once per three river basin management plans or once in 18 years.

Discipline	Quality element	Rivers	Lakes	Transitional waters	Coastal waters
Biology	Phytoplankton		2/monit.yr	6/monit.yr	6/monit.yr
	Phytobenthos	1/monit.yr	1/monit.yr		
	Macrophytes	1/monit.yr	1/monit.yr		
	Macroalgae			1/monit.yr	1/monit.yr
	Angiosperms			1/monit.yr	1/monit.yr
	Benthic invertebrates	1/monit.yr	1/monit.yr	12/monit.yr	1/monit.yr
	Fish	1/monit.yr	1/monit.yr	12/monit.yr	
Chemistry	Priority substances that are discharged	12/monit. yr	12/monit.yr	12/monit.yr	12/monit.yr
	Other polluting substances that are discharged	4/monit.yr	4/monit.yr	4/monit.yr	4/monit.yr
Supportive to biology	General physico-chemical parameters	4/monit.yr	4/monit.yr	4/monit.yr	4/monit.yr
Hydromorphology *Supportive to biology*	Hydrological regime /Tidal regime	Continuous	High frequency within the monit. yr	High frequency within the monit.yr	High frequency within the monit.yr
	River continuity	1/monit.yr			
	Morphology	1/monit.yr	1/monit.yr	1/monit.yr	1/monit.yr

Parameter choice for surveillance monitoring
Biology
In the case of surveillance monitoring, all the quality elements must be monitored that are available in the biological assessment tools. At this moment only the assessment tools for natural waters have been fully developed. When validating these assessment tools, the sub-assessment tools for a certain type of waters can be adjusted or eliminated. The sub-assessment tools can also be dropped when drawing up MEPs/GEPs for artificial and significantly changing waters.

[2] Considering that waters in the north and west of the Netherlands discharge water and waters in the south and east drain water.

Quality element	Minimum WFD frequency within monitoring year (1 monitoring year per 6 years (= planning period))	freq. (per monitoring year) as a result of assessment tools	What to monitor? *)
Lakes			
Phytoplankton	2 x between 1 April and 30 Sept.	6 x	S,A,B
Desmidian algae	1 x	1 x	S, A
Phytobenthos	1 x between 1 April and 1 June	1 x	S, A
Macrophytes (riparian plants included)	1 x between June and August	1 x	S, A
Benthic invertebrates	1 x in the spring	2 x (spring and autumn)	S, A
Fish	1 x	1 x	S,A,L,(B)
Rivers			
Phytoplankton			B
Phytobenthos	1 x in between 1 April and 1 June	1 x	S, A
Macrophytes (riparian plants included)	1 x between June and August	1 x	S, A
Benthic invertebrates	1 x in the spring	2 x	S, A
Fish	1 x	1 x	S,A,L
Transitional waters			
Phytoplankton	2 x	6 x	S,A,B
Benthic invertebrates	1 x in the spring	2 x	S, A
Angiosperms	1 x	1 x	S, A
Macroalgae	1 x	1 x	S, A
Fish	1 x	2 x	S,A,L
Coastal waters			
Phytoplankton	2 x	6 x	S,A,B
Benthic invertebrates	1 x in the spring	1 x	S, A
Angiosperms	1 x	1 x	S, A
Macroalgae	1 x	1 x	S, A

*)S = Species composition, A = Abundance, L = Age structure, B = Biomass

Chemistry

Priority substances (there are 18 with an EU standard) must be included in the surveillance monitoring network. These substances may only be excluded from monitoring if it can be established that they do not occur. In general, this will entail a screening. Other polluting substances that are discharged must also be monitored. These are substances that occur in the water body or river basin or sub-river basin in significant quantities.

In all cases one list ultimately remains of priority substances that must be monitored 12x per monitoring year, and one limited list of other substances that must be monitored 4x per monitoring year.

General physico-chemical parameters

Obligatory general physico-chemical parameters	Lakes	Rivers	Transitional waters	Coastal waters
Oxygen content and/or saturation	yes	yes	yes	yes
Temperature	yes	yes	yes	yes
Salinity	yes	yes	yes	yes
Concentration of total phosphorus	yes	yes	yes	yes
Concentration of total of nitrogen	yes	yes	yes	yes
Concentration of diluted inorganic phosphorus (DIP)	yes	yes	yes	yes
Concentration of diluted inorganic nitrogen(DIN)	yes	yes	yes	yes
Transparency	yes	no	yes	yes
pH value	yes	yes	no	no

Hydromorphology

The table below represents the parameters for surveillance monitoring hydromorphology in flowing waters, lakes, coastal and transitional waters respectively. This summary only includes the table for rivers.

Quality element	**Sub-elements**	**Parameter**

Continuity		1. number, location and possibility to cross barriers 2. accessibility/connectivity for fish
Hydrological regime	Quantity and dynamics of the water flow	3. water level 4. discharge, current velocity 5. degree of free run-off 6. degree of natural discharge pattern 7. tidal features: (tidal rivers) a. slack tide b. tidal amplitude c. ratio of horizontal tide
	Connection with groundwater bodies	8. groundwater level
Morphological conditions	Depth and width variation of the river	9. river course 10. cross section and degree of naturalness
	Structure and substrate of the river bed	11. presence of artificial river bed 12. degree of naturalness of substrate composition of the river bed 13. erosion/sedimentation structures
	Structure of the riparian zone	14. presence of embankment zone 15. land use of embankments 16. land use of flood plain/river valley 17. possibility for entirely natural inundation 18. possibility for entirely natural meandering

Table Quality elements and parameters surveillance monitoring of hydromorphology for streams, rivers and tidal freshwater rivers.

Sampling and analysis methods

Biology : The WFD requires representative samples of biotopes that occur on significant surfaces. The species composition and abundance is determined with the help of a representative random sample (described in more detail in the Guidelines. The aim is not to spell out the complete species diversity.

Chemistry : The quality of the applied analysis methods is guaranteed by monitoring performance features, (in particular, determination limit, monitoring defect, selectivity) of the applied methods. Monitoring is carried out in total water, not in suspended matter.

Operational monitoring

Operational monitoring has two objectives :

1. to observe the condition of the water bodies that are considered at risk (read: have a poor or moderate status and may therefore not achieve their 2015 objective);
2. to determine the effect (and not the extent!) of the measures taken to improve the status.

Operational monitoring only focuses on the parameters, which can best indicate any changes in a poor status. These can be chemical, hydromorphological or biological parameters. To assess a good ecological status/potential, at least one biological parameter must be included.

Operational monitoring is carried out in water bodies or in clusters of water bodies:

- of which it is known that they are in danger of not achieving the environmental objectives according to the significant antropogenous loads (risk assessment in 2004) and/or
- of which there are indications as a result of surveillance monitoring that they are in danger of not achieving the environmental objectives and/or
- in which substances included in the priorities list are being discharged.

Step-by-step plan

A check is carried out on the basis of a step-by-step plan to determine whether of not operational monitoring must be set up. The steps are explained briefly below.

Step 1 Yes or No operational monitoring

If a water body is at risk according to the formal risk assessment, operational monitoring will be necessary.

Step 2 Clustering of water bodies

Water bodies can be clustered for operational monitoring where there are similarities between the pressure, ecological and hydromorpholical functioning in the river basin. Only evident pressures limited by 'no regret' measures will be considered during the operational monitoring. This makes it possible to avoid a highly complex operational monitoring programme as the result of a mixture of different pressures. Water bodies smaller than 0.5 km2 (lakes) or rivers with a downstream area of less than 10 km2, are not included in the WFD monitoring, unless the insignificant water body in question is a protected area (see next step) or it is of major importance for the entire river basin.

Step 2a Protected areas

Water bodies that are situated in or near protected areas are included in the operational monitoring if the groundwater-related objectives of the protected area will not be achieved by 2015. If the objectives of protected areas are not going to be achieved for other reasons (air quality or alarm), this will not lead to any additional operational monitoring.

Step3 What is monitored?

Depending on the problems, either chemical , or hydromorphological or biological parameters will be monitored. Only the parameters related to the pressures, and then only those that are the most relevant (see second sentence step 2) need to be monitored. Because a biological quality element must always be included, a special pressure table has been drawn up for biology. This table shows which biological quality elements react best to which pressures. Subsequently, one or two biological quality elements (more in exceptional cases) must be selected for operational monitoring. For chemistry and hydromorphology the 'what' will be almost completely determined by exceedances of the standard and reversible impairment. This means that monitoring will focus on the substances that exceed the standard or on the hydromorphology that is affected.

Step 4 Why monitoring (choice of monitoring points within water body (cluster)

The same rules are followed as in surveillance monitoring.
In the case of a cluster of water bodies, the most representative water body will generally be selected if it concerns a cluster and the monitoring takes place exactly there. The representativeness also depends on the relevant quality element and that is the reason why monitoring might be carried out in more water bodies of the cluster.

Step 5 Frequency of monitoring

Monitoring frequency for operational monitoring.

Table with a minimum total number of monitorings per 6 year planning period for the different quality elements. The table represents the situation as prescribed by EU (white columns) and those that are necessary as a result of the Dutch assessment tools (grey columns).

Qual. Elem.	rivers WFD	rivers assessment tool	lakes WFD	lakes assessment tool	transl w. WFD	transl w. assessment tool	coastal w. WFD	coastal w. assessment tool
Ecological status								
Biology								
Phytoplankton	12	36	12	36	12	36	12	36
Phytobenthos	2	2	2	2				
Macrophytes/angiosperms/ macroalgae	2	2	2	2	2	2	2	2
Benthic invertebrates	2	4	2	4	2	4	2	2
Fish	2	2	2	2	2	4		
Chemistry								
General physico-chemical								
Thermal conditions	24	24	24	24	24	24	24	24
Oxygen supply	24	24	24	24	24	24	24	24
Salinity	24	24	24	24	24	24	24	24
Nutrients	24	24	24	24	24	24	24	24
Acidification status	24	24	24	24	24	24	24	24
Other polluting substances	24	24	24	24	24	24	24	24
Hydromorphology								
Continuity	1	1						
Hydrology	Continuous	continuous	72	72				
Morphology	1	1	1	1	1	1	1	1
Chemical status								
Priority substance	72	72	72	72	72	72	72	72

The frequencies for biology in particular (2 monitorings in 6 years) are probably too low to be able to detect trends within the planning period. This means that either the monitoring frequency must be intensified or the monitorings must cover more planning periods (and probably more locations) before it is possible to establish whether or not the status has improved.

Step 6 How to monitor?

The operational monitoring method does not deviate in any significant way from that of surveillance monitoring. The methods are described in the appendix to the unabridged document.

Monitoring for Further Study

This type of WFD monitoring must be employed if a water body is at risk as a result of exceedances or a too low ecological quality, but it is not clear what has caused that exceedance. This type of monitoring is tailored to local and specific conditions and demands a special approach. The guidelines do not therefore include the monitoring of further studies.

Summary of Guidelines for Monitoring by Tim Pelsma (RWS-RIZA) and Anke Zindler (RWS-NH).