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# MEASUREMENT PLANNIG OF NATURAL PURIFICATION IN ARTIFICIAL WATER RESERVOIRS



**Наведено і описано схему планування вимірювань процесів природного очищення води в штучних водоймах. Схему можна використати для вимірювання якості води в інших водоймах, таких як річки, озера і підземні води, однак об'єкт вимірювань у цій статті чітко визначений. Також розглянуто конкретні чинники впливу на якість води та засоби вимірювань. Описану схему контролю якості води можна використати для інших об'єктів.**

**Ключові слова: планування вимірювання, природне очищення, штучні водойми, показники води.**

**The measurement planning process of natural purification in artificial water reservoirs was presented and discussed in the paper. The general scheme of the measurement in reservoirs is similar to water quality assessment in another water bodies like rivers, lakes and groundwater, however in this work the objective of measurements is clearly define. In the paper the specific factors and needs for objective realization were presented. The paper describes measurements planning process and it can be use as the source for measurements preparation.**

**Key words: measurement planning, natural purification, artificial water reservoirs, water indicators.**

## Introduction

The pollutant migration from non-point agriculture sources can be partly stopped and accumulated in artificial water reservoirs0. The well conducted measurements of the natural water purification in artificial reservoirs can furnish us in information about the efficiency of that process and assist in the future reservoirs design.

Measurements of the natural water purification process have to be thought out, well-prepared, frequently and methodically coherent. The measurements need a time, results should be well discussed and clearly presented, however the well preparation to measurements enable to save time and resources.

## The main problem

The general schema for the measurement process in water bodies is presented in

Fig. ***1***.

According to the schema presented in

Fig. ***1*** in the first step the general objectives which we want to find out have to be formulated. In our case the interesting object is a pollutant load which migrate from non-point agriculture sources with water and the lead which can be reduced by the artificial water reservoir.

Secondly, the water variability have to be chosen. Any variable is a function of space and time: $c = f(x, y, z, t)$. Not all of these four parameters have equal influence in the different types of water bodies 0. The artificial water reservoirs can be well describe by the function of longitudinal dimension (x), vertical dimension (z) and time (t): $c = f(x, z, t)$. The frequency of measurement should be adequate to the reservoir overturn. As well the hydrological information should be taken into consideration before the start of measurements:

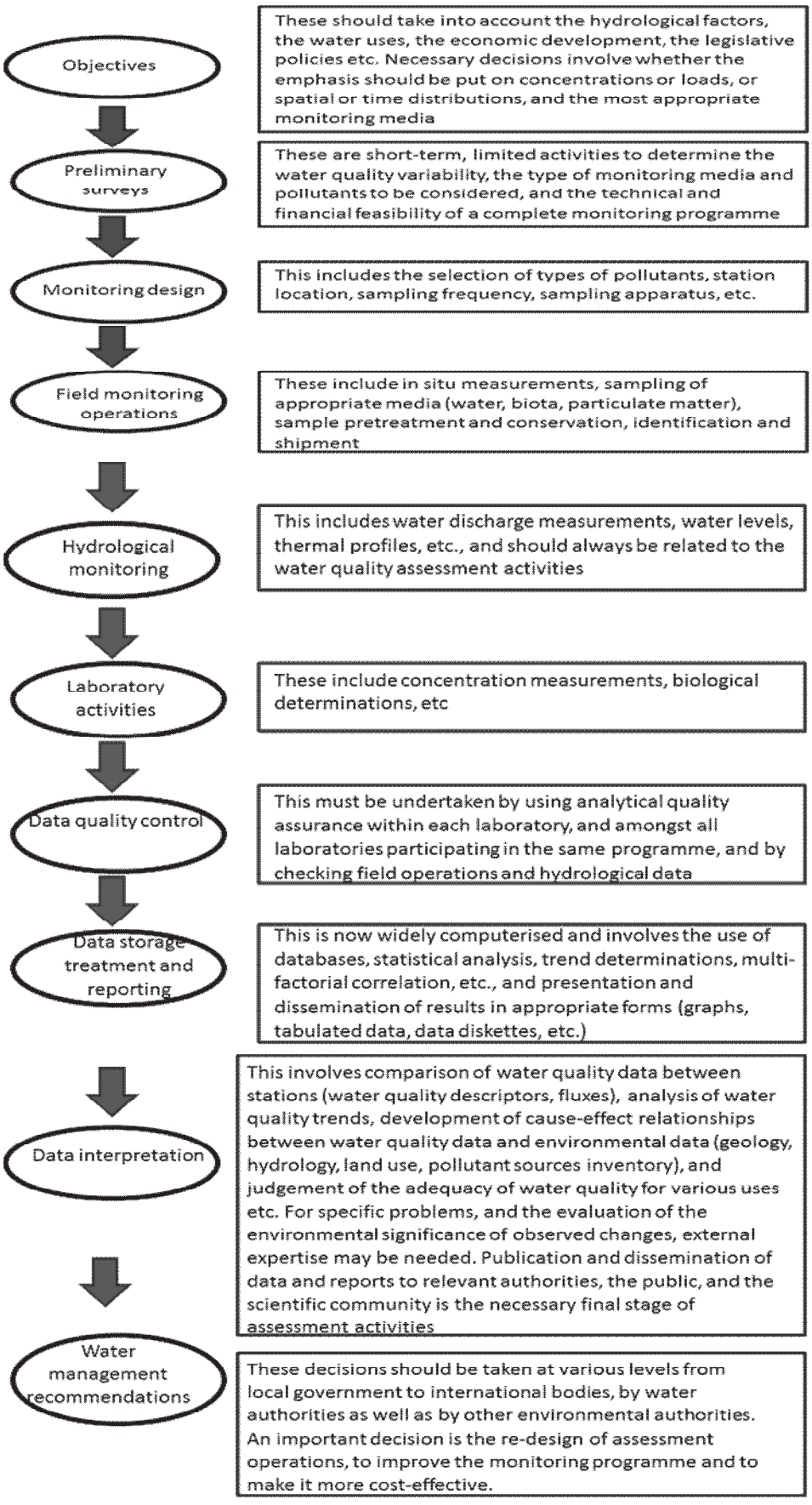


*Fig. 1. The key elements of a water assessment programme 0*

- Thermal regime major,
- Bathymetric map,
- Water balance,
- Lake level at sampling,
- Lake level between sampling,
- Tributary discharge and lake water budget.

At the same time the geographical localization of the reservoir as the river basin and the possible pollutant sources should be investigated. The water quality of unpolluted water bodies is dependent on the local geological, biological and climatological conditions 00, therefore the knowledge of the background quality is necessary to know.

In the third step we have to choose the pollutants which we want to investigate, the indicators and apparatus for measuring. It is necessary to compare between the objective of the work, plans and our measuring possibilities. Based on the former collected information we choose the station location and frequency of the measurements. If we want to measure the influence of reservoir on the pollutant migration the water balance is necessary to define and measure the pollutant load at every inlet/outlet. Moreover, the measuring points should be located in the reservoir in the x, and z dimension. To define the load accumulation in reservoirs the samples from sediment and plants should be taken as well. At least one check point should be located at non disturbed inlet as woodland flow – this result will give the information about geological background 0.

Type of indicators which will be measured depends on the objectives of our work. Generally water assessment can be use-oriented (define the water quality which is necessary to use it) or impact-oriented (define the disturbances in water quality) 0. Measuring of the pollutant from non-point agriculture sources can be described by the impact-oriented factors 0. Indicators which are the most important in water quality assessment from non-point agricultural sources with the wage 1-3 where 1 means low and 3 means high likelihood that the concentration of the variable will be affected by source are presented in tabl.

**Selection of variables for the assessment of water quality in relation to agricultural pollution sources 0**

| *General variables* | | *Organic matter* | | *Trace elements* | |
|---|---|---|---|---|---|
| Temperature | 1 | TOC | 1 | Copper | 2* |
| Colour | 1 | COD | 1 | Mercury | 3* |
| Odour | 1 | BOD | 3 | Zinc | 2* |
| Residues | 3 | *Major ions* | | Arsenic | 3* |
| Suspended solids | 3 | Sodium | 2 | Selenium | 3* |
| Conductivity | 2 | Potassium | 1 | *Organic contaminants* | |
| pH | 1 | Calcium | 1 | Pesticides | 3** |
| Eh | 1 | Magnesium | 1 | Surfactants | 1 |
| Dissolved oxygen | 3 | *Carbonate components* | | *Microbiological indicators* | |
| Hardness | 1 | Chloride | 3 | Faecal coliforms | 2 |
| *Nutrients* | | Sulphate | 1 | Other pathogens | 2 |
| Ammonia | 3 | *Other inorganic variables* | | | |
| Nitrate/nitrite | 3 | Sulphide | 1 | | |
| Organic nitrogen | 3 | Boron | 1 | | |
| Phosphorus compounds | 3 | | | | |

**Need only be measured when used locally or occur naturally at high concentrations.*

***Specific compounds should be measured according to their level of use in the region.*

With prepared plan of measuring, and necessary equipment it is possible to start the fieldworks. Some of measurements should be done during field operation but some of them need to collect samples

and ship it to laboratory. The samples should be protected before external contaminations and well described. Indicators to measure in field: Temperature, Eh, pH, dissolved oxygen, conductivity 0.

The fieldworks should include the hydrological monitoring as well. The inlets and outlets from reservoir should be measured, not only the flows but also evaporation, precipitation and inlets from groundwater should taken into account 0.

The fieldworks should be taken with frequently before planned, monitoring should be provide during one whole hydrological year at least. The samples take in field should be check in laboratory and then the results should be process and presented in desired form. The number of samples and results should be enough to reject the errors. However, the laboratory works and data processing are not a part of this paper, it will be discussed in another issues.

## Conclusions

Measurements of continual but not steady process as natural water purification in artificial reservoirs are complex and long-term. Well planed measurements can realize better results and save resources. At planning stage it is necessary to take into account many variables and factors. In the work it is important to treat reservoir as the element of the water balance system and locate measuring stations in well chosen points of the system.

*1. Absolona D., Matysik M., Ruman M., Novel methods and solutions in hydrology and water management, Komisja Hydrologiczna Polskiego Towarzystwa Geograficznego, Oddział Katowicki, Sosnowiec 2015. 2. Duda Marcin, Znaczenie zbiornika retencyjnego w ochronie jeziora przed zanieczyszczeniami ze zlewni rolniczej – dissertation work, UWM Olsztyn, 2011. 3. Goodall D. C., Quigley R. M., Pollutant migration from two sanitary landfill sites near Sarnia, Ontario, Canadian Geotechnical Journal, 1977, 14(2): 223–236. 4. Lenhart Brigitte, Bodies of Water in the foothills of the Alps rate good to excellent thanks to long term Water Quality Monitoring, 2011, http://www. globalw.com/ support/WQField.html. 5. Water Quality Assessments – A Guide to Use of Biota, Sediments and Water in Environmental Monitoring – Second Edition 1996, 651 pages published on behalf of WHO by F & FN Spon.6. Zhenyao Shen, Qian Liao, Qian Hong, Yongwei Gong, An overview of research on agricultural non-point source pollution modelling in China, Separation and Purification Technology 84 (2012) 104–111.*