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Názov etapovej úlohy: **Development of Documents Following from the WFD Implementation**

Názov výskumnej úlohy: **Methodology for the Cost-efffectiveness Evaluation of Measures**

Interné číslo úlohy: **6167**

Bratislava, March 2007

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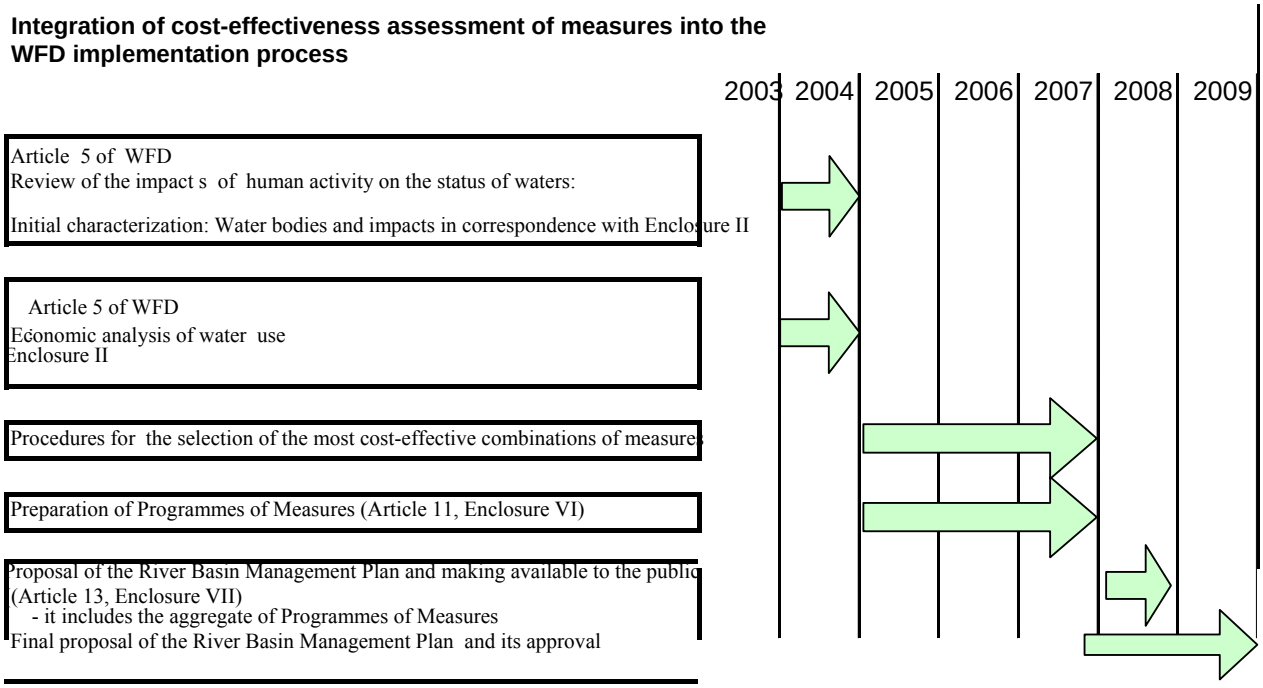
1. INTRODUCTION

The Water Framework Directive 2000/60/EC (hereinafter "WFD") stipulates that Member States shall to achieve good ecological and chemical status for natural surface water bodies, good ecological potential and good chemical status for heavily modified surface water bodies and good quantitative and chemical status for groundwater bodies by 2015. To achieve this objective it is necessary to do a lot of partial steps within the implementation process. More detailed information on these steps is included in the scheme of the Chapter 1.2. Economics has irreplaceable position within this process.

1.1 Methodology Objectives and Methodology Users

The objective of the *Methodology for assessment of cost-effectiveness* is to explain an approach to selection of the most cost-effective combinations of measures. This goal can be achieved through systematic use of the Cost-Effectiveness Analysis (CEA). This methodology pays attention to more detailed explanation of the term "cost-effectiveness analysis and its role in the process of the WFD implementation as well as relationship with cost-benefit analysis (CBA). The methodology contains particular categories of costs according to WFD that will be applied in the analysis and their brief description. The paper includes methodological steps for CEA as well as procedure for selection of the most cost-effective combination of measures.

Integration of the measure cost-effectiveness assessment into the process of implementation is described in the following figure.



The above integration of the assessment of cost-effectiveness of measures in the process of implementation has to be seen in the context of basic essential steps that shall assure in accordance with WFD an implementation of relevant programmes of measures to achieve ecological objectives by 2015. Programmes of measures will be a part of river basin management plans that should be approved and published in 2009 at the latest.

Sequence of steps of the WFD implementation required from all Member States:

- by the end of 2003: identify individual river basins situated on the territory, assign them to individual river basin districts (RBD) and define competent authorities (Art. 3, Art. 24)
- by the end of 2004: description of river basin districts with respect to assessment of pressures and impacts of human activity on water status and economic factors of water use including inventory of protected areas located in relevant river basin district (Art. 5, Art. 6, Annex II and III)
- by the end of 2006: inter-calibration comparison of ecological status classification systems (Art. 2(22), Annex V)
- by the end of 2006: providing the monitoring of water status
- by the beginning of 2009: based on reliable monitoring and analysis of river basin description define effective programme of measures to achieve ecological objectives under the WFD with respect to costs incurred (Art. 11, Annex III)
- by the beginning of 2009: develop and publish the River Basin Management Plan for all river basin districts including identification of heavily modified water bodies (Art. 13 and 14.3)
- by the end of 2010: implement price policy in relation to water with aim to increase sustainability of water resources (Art. 19)
- by 2015: review of achievement of the WFD objectives and updating of plan for the second planning cycle

The Slovak Republic will probably fail to achieve required objectives by 2015. In justified cases – WFD, article 4, paragraph 4 and 5 allows applying of exceptions from its requirements but the reasons shall be included in the river basin management plans (e.g. unreasonable costs, technical capacities, infeasibility, natural conditions). River basin management plans will be reviewed and updated by 2015 at the latest and then every six years.
The aim of this methodology is to manage those who will use it for assessment of effectiveness of measures and their integration into the programmes of measures and the users of the methodology will be represented by the members of working group for economic analysis together with economists working for authorities responsible for implementation of measures, working groups designing technical measures in cooperation with organizations implementing the measures (WRI, SWME, water companies) as well as other stakeholders participating in implementation of WFD who will decide on adoption and implementation of proposed measures (SWME, water companies, regional authorities, industry, agriculture, etc.). Methodology will serve as a fundamental document for decision-making process and development of river basin management plans.

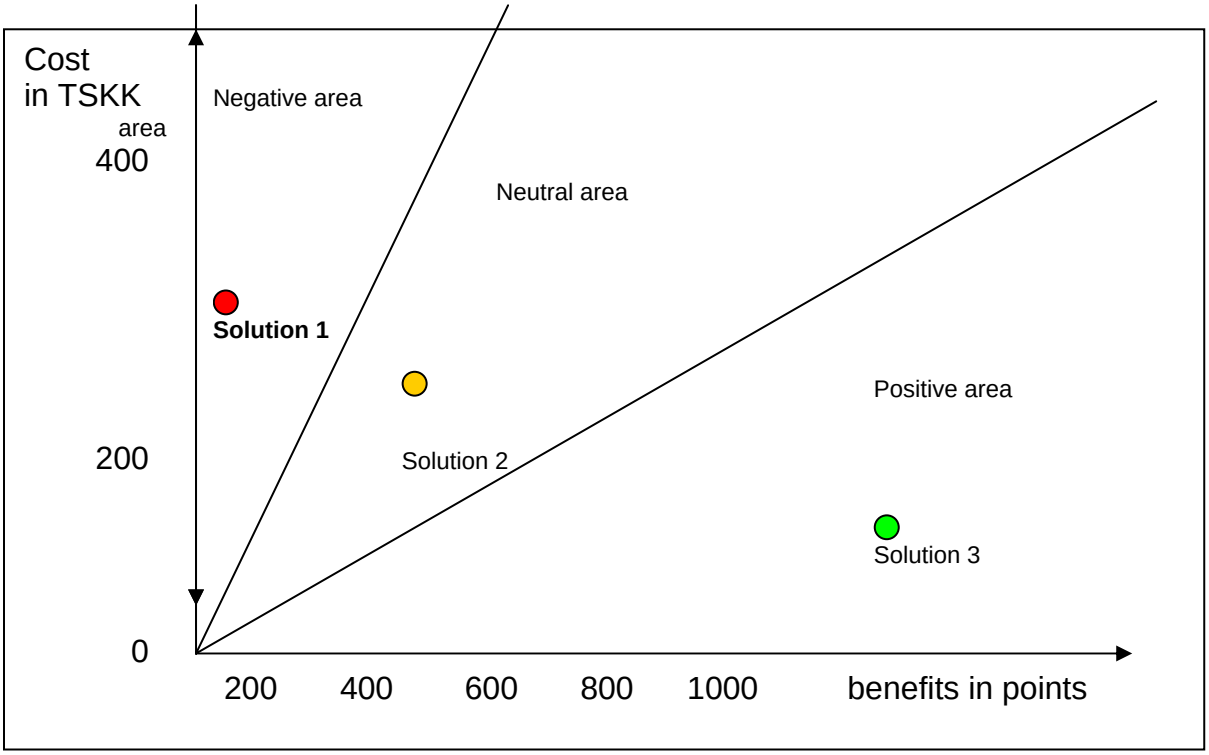
2. COST-EFFECTIVENESS ANALYSIS

The term "Cost-effectiveness analysis" (CEA)

CEA is a type of economic analysis. In general, it is one of the tools used for assessment of project effectiveness where the costs can be identified through the market prices; however, their benefits are not measurable in monetary units (e.g. ecological status) or where measurement in terms of money is perceived by society as substantial problem.
Effects of costs, i.e. their benefits are evaluated by using weighted point system. The result is an indicator of cost-effectiveness that matches each point of effectiveness scale with particular costs. Such indicator allows creation of order for individual solutions of a given

problem. The rule is as follows: scenario with the lowest cost-effectiveness ratio is more preferable. The results can be shown in a graphical form. Points with high values of effectiveness at low costs fall within "positive" area and vice versa.

CEA Chart



The CEA method serves as a supporting tool for decision-making process since it provides basic information for the assessment of various scenarios.

The CEA analysis is considered as methodologically simpler compared to the Cost-Benefit Analysis since there is no need to express an estimation of effect of any measure (environmental benefit) in monetary units. For non-monetary assessment of improved water status it is necessary first of all to develop the evaluation system. This system counts on determination of target values, i.e. potential measures are compared with respect to achievement of defined objective. The target values are defied based on ecological inevitability or as a result of political processes, national legislation or international agreements.

As far as time aspect is concerned there is a rule applied that values shall be time homogenous – i.e. both costs and benefits shall be discounted at common time point. (for example – date of CEA creation, date of financial statement, etc.).

CEA Results Interpretation

For the need of water management practice the results of the CEA analysis is an indicator of cost-effectiveness = cot-effectiveness ratio Ken = N/P_b (N=costs for measure in thousands SKK, P_b = benefit of measure in points). Low value of the ratio identifies the measures that should be prioritized and on the other hand high value of coefficient indicates ineffective

measures. First of all it is necessary to evaluate benefits of each particular measure (P_b) by points. One of possible methods is point evaluation (for instance in a range from 0 to 1000 points) as mentioned below. Final decision on method for evaluation of ecological effectiveness will be solved through the inventory of measures.

Described point evaluation is designed, based on the *Methodology for derivation of reference conditions and classification schemes for ecological status of water, Bratislava 2006*, according to ecological quality ratio (EQR). Relationships among categories of ecological status, EQR coefficient and P_b coefficient are shown in the following table:

Category of ecological status	EQR coefficient	P_b coefficient (= EQRx1000)
very good	0.8 – 1.0	800 – 1000
good	0.6 – 0.8	600 – 800
moderate	0.4 – 0.6	400 – 600
poor	0.2 – 0.4	200 – 400
bad	0.0 – 0.2	0 - 200

It means that the denominator of relationship $Ken=N/P_b$ is represented by the value of adjusted EQR coefficient obtained from the results of monitoring (future projection of these results for designed measures) and the numerator represents the costs for a given measure (combination of measures) expressed in monetary units.

CEA Goal

The goal of the CEA is to identify measures to achieve required environmental objective (good status of water) by applying the most cost-effective method. According to WFD the CEA shall be used for estimation of relative capacity of potential measures in achieving the environmental objectives set under this Directive and primarily it shall serve as a guideline for:

- decision-making process on the most cost-effective combinations of measures that could be implanted to overcome "potential shortage of water status" between basic scenario and the WFD objectives.
- assessment whether programmes of measures are disproportional (unreasonable) with regard to costs

WFD requires member states to identify and implement programmes of measures for achieving good ecological status for each water body by 2015. Minimum goal of CEA should lead to improved programmes of measures proposed for a given water body by focusing on the highest cost items and on main determinants of effectiveness of measures. Analysis shall facilitate creation of packages of the most cost-effective measures for achieving good water status. The goal of the CEA is to find the set of technical measures that facilitate achievement of predefined objective at the lowest costs. Considering that technical measures are taken into account it is important to realise that CEA is not done only by economists but also by the team integrating economical (costs) and technical expertise (ecological effectiveness). In practice it is not possible to carry out CEA in isolation. Therefore it is important to involve experts and representatives of all sectors participating in implementation. Their knowledge and expertise can be very useful (costs, effect of measures). Issues related to cost-effectiveness of measures will become so important and will result in the need to select and subsequently exclude in some cases the most costly measures. This selection shall be done in close cooperation with organizations implementing the measures. This will lead to fulfilment

of requirements under the methodological document WFD WATECO that economical aspect serves only to inform those who make decisions. Although this economical aspect is based on calculated effectiveness with regard to costs incurred following the CEA it is necessary to state that this economic analysis is not a crucial tool. It is only a supporting tool helping to make better decisions in such a way that it explains economical aspect and effect of proposed measures and their alternatives.

Approach to CEA

The level of effort put to CEA should be adapted in order to concentrate greater effort and more detailed approaches to significant water management problems, areas where conflicts of water use arise and where integration of environmental, economic and social issues is more difficult.
WATECO Guidance Document indicates that CEA should be done at the river basin district level wherever it is possible. More important is that this analysis should be done in extent in which the problem is identified to assure reliable calculation and analysis of costs. Determination of the extent depends on a level of environmental problem that may affect entire water body or only a part of water body.
There are also other factors having effect on decision making process as far as the most suitable space extent is concerned, for example:

- extent in which particular pressures and types of water use exist,
- extent in which various types of measures will be applied (water body or specified part of water body; WFD requires member states to identify objectives for each water body set as basic assessment unit),
- extent for which decisions will be made – i.e. extent in which the analysis will be done
- extent required for information, consultation and public participation

2.1 When will CEA be conducted?

CEA – cost-effectiveness analysis is not necessary for all measures. According to Art.11 WFD, each programme of measures will include "basic" measures and "additional" measures if necessary.
Basic measures are measures specified in Art.11, paragraph 3 a), including measures listed in part A of the Annex VI and measures specified in Art. 11, paragraph 3 b) up to l).
Additional measures are measures specified in Art. 11, paragraph 4 and 5.

Basic measures under the Article 11, paragraph 3 a) including measures listed in part A of the Annex VI are measures required by the following Directives:

- Council Directive 76/160/EEC concerning the quality of bathing water
- Council Directive 79/409/EEC on the conservation of wild birds
- Council Directive 80/778/EEC relating to the quality of water intended for human consumption amended by the Directive 98/83/EC
- Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (Seveso)
- Council Directive (85/337/EEC) on the assessment of the effects of certain public and private projects on the environment amended by the Council Directive97/11/EC
- Council Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture
- Council Directive 91/271/EEC concerning urban waste water treatment

- Council Directive 91/414/EEC concerning the placing of plant protection products on the market
- Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
- Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control

Basic measures according to Art. 11, paragraph 3 b) – l) are as follows:

- b): measures for the purpose of the Article 9, i.e. measures for return on investments of water management services
- c): measures supporting effective and sustainable water use
- d): measures for protection of waters used for drinking water abstraction (meeting the requirements of the Article 7), including measures for decreasing the rate of treatment I production of drinking water
- e): measures for regulation of fresh surface and ground water abstraction and impoundment of fresh surface water, including register or registers of water abstraction and requirements of previous permit for water abstraction and impoundment
- f): measures relating to regulation, including requirement on previous permit for artificial filling or augmentation of groundwater bodies
- g): measures relating to requirement on previous regulation of discharge from point sources of pollution that may cause pollution of water
- h): measure for prevention or regulation of pollutants from diffuse sources of pollution that may cause pollution of water
- i): measures for regulation of other significant adverse effects on water status, and in particular hydromorpholological impacts
- j): measures for restriction of direct discharge of pollutants into groundwater
- k): measures for elimination of pollution of surface waters by priority substances and for reduction of pollution caused by other substances that would lead to risk of failing to achieve objectives set in Article 4 for surface water bodies
- l): measures needed for prevention of significant leakage of pollutants form technical facilities and measures for prevention and/or reduction of the effect of accidental pollution (for example during floods)

Additional measures according to Art. 11(4) are:

- proposed and additionally implemented to support basic measures in achieving the environmental objectives under the WFD Art. 4 in case when basic measures are insufficient

Additional measures according to Art. 11 (5) are:

- proposed and implemented where the results of monitoring or other data will indicate that it is not possible to achieve objectives under Article 4 and if it is necessary, including measures for implementation of more stringent environmental standards; causes of potential failure shall be investigated and relevant permits shall be reviewed. Such review can be considered as a type of measures. Moreover, monitoring programmes shall be also reviewed and updated.
- where failure is due to events such as extreme floods, long-term droughts the additional measure can be considered as not feasible in accordance with Art. 4(6).

As mentioned above CEA – cost-effectiveness analysis is not required for each measure. The following text specifies the cases in which the CEA shall be applied:

I. It is not necessary to assess the basic measures under Art. 11(3) a), i.e. measures regulated by the EU Directives other than WFD already implemented in the national legislation – are not subject to CEA, i.e. cost-efficiency for these measures that can not be replaced by other and without exceptions.
II. Basic measures implemented by WFD according to Art. 11, paragraph 33 b) – l) that are defined under the sheets for economic analysis as "other basic measures," i.e. measures for return of investments of water management services (Art. 9), measures for support of effective and sustainable water use and other measures for elimination of particular adverse effects on water status as listed above require application of CEA - it is important to assess cost effectiveness.
III. Additional measures: in case that basic information is not sufficient additional measures are proposed to support them (Art. 11 (4 a 5)); at least two additional measures are proposed for which CEA shall be done

CEA is required for the following:
- selection of optimum measures,
- tests of heavily modified water bodies,
- justification of time exceptions in achieving the objectives by 2015 (time exceptions allow phased achievement of objectives in stages but there are limited to maximum two following updates of river basin management plans with exception of cases when natural conditions do not allow to achieve of the objectives during this period,
- justification of exceptions related to hydro-morphological changes of natural surface water bodies; justification of exceptions in groundwater pollution (old load) and other exceptions,
- proposal for less stringent ecological objectives (CEA with CBA - cost-benefit analysis in case when the total costs will be unreasonable compared to total benefits for environment

CEA should have always at disposal some alternative measures. It is important to take into account that in some cases alternative measures does not exist (for instance when wastewater treatment is only solution for reduction of municipal wastewater pollution).

2.2 Methodological steps for CEA

CEA is based on the result of risk analysis under the WFD, Art. 5. This analysis provides information on water bodies at risk and on sectors having an effect on water status. The main steps for CEA can be summarized as follows:

Step1: *Identification of potential measures*
Step 2: *Collection of information on costs and effectiveness for each measure*
Step 3: *Cost-effectiveness analysis*
Step 4: *Additional assessments (analyses) for selected measures*
Step 5: *River basin management plans*

Following the above steps it is clear that CEA requires close cooperation of those who propose technical measures, economists who will develop the river basin management plans and those who will implement the plans.

Identification of potential measures: it is important to identify a wide range of measures that are aimed at the major environmental problems and sectors affecting water environment; comprehensive list of measures should be proposed - not only those which are traditionally relevant for environmental protection; list of all possible measures will be included in the *Inventory of measures* (WG 2.1 for WFD implementation).

Collection of information on costs and effectiveness for each measure: besides basic description of measure, the Inventory of Measures contains also a part related to pressures and impacts of measures, time aspect as well as part related to identification of costs; in this part the technical unit for which the cost will be established in terms of money (unit price of costs – e.g. costs for removal of bridge construction in SKK/m^3, costs for 1m^3 of the total capacity of reservoir) is set for each measure. Working Group for economic analysis will calculate the costs and develop the databases of these costs together with other data important for CEA.

Carrying out the Cost-effectiveness Analysis: This step represents own assessment of effectiveness through combining the information on costs and effectiveness. Such combination will result in creation of the parameter of effectiveness, i.e. the ratio between costs and effectiveness will be calculated for each measure. Then the measures will be ranged from the lowest to the highest ratio. The next step is to select measures using bottom-up method to the point where increasing effect of selected measures is sufficient for achievement of good water status.

Additional assessment (analyses) for selected measures: After the previous steps we can calculate the total costs for combination of measures that will be included in the programmes of measures. Types of costs necessary to be included in CEA under the WFD are described in a specific part of the methodology.
In some cases, however, the sum of the total costs does not lead directly to selection of measures since the total costs can be considered as disproportional. Then, it is important to carry out additional analysis helpful for selection of measures – Cost-Benefit Analysis (CBA). This analysis can be applied for identification of effort level that would balance the costs and benefits – and in some cases it would serve as a starting point to request for exceptions in achieving the WFD objectives.

River basin management plans: obtained CEA results are presented through the programmes of measures in the first proposal of river basin management plan. The results will be submitted to the public and all stakeholders for consultation. The consultation may lead to a requirement to demonstrate the use of CEA for selection of measures. There also can be placed a requirement for additional assessment of measures not included in analysis but according to stakeholders they are considered as highly relevant for local situation or for socio-economic effect of the programme on a given economic sector or social group.

2.3 Process of selection of the most cost-effective measures

The following steps (1-3) shall be done prior to the work of the WG - Economics responsible for selection of the most cost-effective combination of measures.

1. risk analysis under Art. 5 according to specification in Annex II (compared expected status in 2015 with preliminary objectives; identification of water bodies as bodies at risk with respect to possibility of failing to achieve environmental quality objectives),
2. identification of potential measures,
3. estimation of effects and ecological effectiveness of measures, selection of individual relevant measures and combination of measures preferred based on ecological effectiveness.

The steps 4 – 6 are done by economists (i.e. WG for economic analysis in close cooperation with economists of stakeholders):

4. estimation of direct and indirect costs
5. cost-effectiveness analysis including analysis of using possible tools
6. selection of the most cost-effective combination of measures (optimum package of measures

For combinations of measures that are preferred based on ecological effectiveness, so-called "major combinations", the costs incurred for individual water bodies should be calculated until the objectives are achieved. From that point – costs calculation – the economists are involved in the process. It is important to distinguish between direct and indirect costs (point 4) according to a general principle set under the Water Framework Directive. The major combinations are reviewed in order to select cost-effective combinations of measures (point 5 and 6).

More particular method can be described as follows: Since combination of measures shall be done in order to achieve objectives it is necessary to select the most cost-effective measure with the most significant ecological effect. Moreover, it is important to conduct the cost-effectiveness analysis. Cost effectiveness of measures included in combination will be expressed via cost-effectiveness ratio that is calculated by dividing the costs/relevant effects:

$$\text{CE ratio} = \frac{\text{Annual costs}}{\text{Annual effects}}$$

The measures with the lowest costs per unit of benefit/effect are more cost-effective than measures with higher costs per unit of benefit/effect. It is also possible to interpret the results from the opposite view: measures with the largest effect per 1EUR are the most interesting.

Example:
Approach in which the cost-effectiveness is identified based on criterion of the lowest costs per effect unit is useful especially when the effect can be clearly defined. For example, through the application of particular measure (widening of aeration tanks) it is needed to reduce phosphorus (kg) discharged from WWTP by 25 % a year, i.e. it is important to reduce up to the certain point at which this objective will be achieved. The formula is as follows:

$$\text{CE ratio} = \frac{\text{Total annual costs}}{\text{Kg of phosphorus per year}} = \text{Costs for reduction of 1 kg of phosphorus}$$

If there are further measures that can be implemented for reduction of phosphorus discharged from WWTP per year (e.g. effluent filtration) it is important to calculate CE ratio (i.e. ratio of

kilograms of phosphorus reduced per year). If the costs for reduction of 1 kg of phosphorus are lower this then this measure is more cost-effective.
The above formula and comments prove the objective of CEA: it creates (shows) a ratio indicating the costs needed to achieve a change per unit of effect in specified tangible result (kg of phosphorus reduced per year); as an alternative the identification of minimum costs for specified tangible result can be used.

The numerator (or cost item) in the formula represents estimated financial or economic costs for achievement of specific objective focused on adoption of particular alternative, while the denominator reflects relevant tangible result.

2.4 Optimum package of measures

Optimum package of measures may include several measures or only one. The optimum package of measures has to have a potential to achieve environmental goal (ecological effect) at the lowest costs. The package of measures includes measures able to support achievement of environmental objectives and they are ranged from the cheapest to the most expensive with respect to costs. Then the optimum package of measures is prepared. In case that the first (cheapest) measure is sufficient for achievement of desirable ecological effect, the optimum package of measures will be defined by this one measure. If there is a need of combination of several measures to achieve desirable ecological effect further measures are included in the package according to their cost. For any further combination of measures it is investigated whether this combination will achieve desirable ecological effect.
There is also case when combination of the first and third measure according to cost will lead to expected ecological effect – without application of the second measure – and this combination will be more cost-effective than the package of measures consisting of the first, second and third measure. In case when the third measure is cheaper than combination of the first, second and third or first and third measure respectively the package will include only the third measure providing that application of this measure will result in achievement of desired environmental effect.
The above combinations indicate that the optimum package of measures will consist of combination of measures or only one measure that will prove the achievement of environmental goals at the lowest cost.

Example:
When measure is implemented to reduce pollution in kg at certain point on stream we have to know the limit of pollution level that corresponds with the objective. Package of measures will consist of measure which is expected to reduce pollution to desired level at the lowest costs. Initially the package of measures consists of only one measure with the lowest costs per unit of effect. It is necessary to assess this cheapest measure whether the objectives can be achieved by applying it. If it is possible the optimum package will include only this measure. Otherwise the combination with the second measure shall be considered. The next step is assessment whether the objectives will be achieved by combination of the first and second measure – the cheapest and second cheapest measure. If yes then the optimum package is defined. On the other hand the third measure shall be included in the package, etc.

2.5 Importance of information on effect of measures – ecological effectiveness

This methodology is based on a principle that for CEA it is important both information on costs and clear concept on effects of measures that are proposed which is to have clear

information on ecological effectiveness of measures (Chapter2.3 (3)). CEA is focused on achievement of environmental objectives and therefore the ecological effect of each measure has to be clear (it assumes defining the target value based on ecological quality – point evaluation of benefit – see Chapter 2).
Information on ecological effectiveness of measures is essential input for CEA and it will be provided by working groups proposing the measures in close cooperation with stakeholders.

What can practice bring?
For many of measures it is not easy to identify their effect on environment. For example it is difficult to identify effect of reduction of 1 kg Zn on biodiversity of macrofauna or fish species. Similarly, the effects of hydro-morphological measures on ecosystem can be described roughly only. It is very difficult to assess the effects of measures on ecosystem because each of ecosystems is different. Therefore it is important to describe at least the effects of measure in general way (extent of effect, quantitative description). It is necessary to take into account the fact that effects of measures will be significantly dependent on knowledge of local conditions. Information on conditions in a particular region is very important for detailed analysis. There can be considerable differences among regions and therefore in the item "costs" can be found such differences. When implementing certain measure in more regions the cost of measure can vary depending on the level of pollution.

3. COSTS

According to WFD the costs consist of three elements:
- financial costs
- costs for resources
- ecological costs

Pursuant to WFD and WATECO methodological document the costs for the purpose of CEA are perceived first of all as financial costs – direct costs. The WFD defines for the purpose of CEA also indirect costs (economic costs). Application of both categories is described below.

When estimating costs for CEA it is important to distinguish between financial and economical costs.

3.1 Structure of cost items

Direct costs (financial):
1. Investment costs:
   a) New investments (recommended method of annual equivalent costs)
   b) Depreciation (costs for future change of existing property transformed to annual amounts; estimate of depreciation requires the specification of the value of existing property and depreciation method)
2. Costs for operation (material, wages, energy)
3. Costs for maintenance and repairs
4. Administration costs (for administration and managing the water management resources – monitoring….; costs for tools – but in separate analysis not in CEA)
5. Other direct costs

Indirect costs (economic)

Significant part of these costs is so-called missed benefits from the costs of missed opportunities called opportunity costs (see the dictionary of terms). E.g.:

1) Decrease of profits / costs of missed opportunity (also called alternative costs or opportunity costs) due to lower production (e.g. in agriculture lower crops, decrease in stock-raising in a region per year)
2) Decrease of profits/opportunity costs of alternative land use
3) Decrease of profits/opportunity costs of alternative land use (mostly hydro-energy and irrigation)

Special group:

4) Ecological costs – they are not available for now, they are not specified; they represent the costs of damage caused by water use polluting the environment and ecosystems and those who use the environment
5) Costs for resources – they generate by the shortage of resources (e.g. costs related to excessive ground water drainage; value of this water shortage should be included into the estimate of economic costs).

Description and specification of direct costs

Direct (financial costs) relate the issues which will be really paid by the user (who implements the measure). Direct costs for measures are all the costs related directly to measure implementation. These costs are mainly shared by the organisations implementing the measure itself. They include the investment costs - for the purchase of machine equipment, for construction, common operational costs – including the costs for material, staff, energy, maintenance and repairs and administrative costs. So the direct costs are connected to the implementation of a specific measure (e.g. the price of structural measures for water conservation or administrative costs for tax collection). The lists of measures and tools should contain estimates and interval of direct costs. For a specific measure on a certain place the direct costs determined in the context of comparative operational analysis are important.

The costs for the operation and maintenance are normally expressed in the annual costs; however, this does not apply to investment costs. (Investment costs are calculated following the investments, economic lifetime – depreciation period and interests). This means that invested amount must be transformed to annual costs which can be done through the application of depreciation period and depreciation percentage. To make the costs transparent and comparable the analyses always have to state the amount of investments and depreciation period and used % of the interest rate (below there are two approaches to the comparison of the costs in the water management).

Calculation of direct costs with regard to their exact specification is less complicated than the calculation of indirect costs.

Description and specification of indirect costs

Indirect costs or economic costs – are all other costs which are not directly related to the implementation of measures but they generate as the result of the implementation of a measure/tool. Indirect costs are not shared by the organisation implementing the measure but by the other party. They are caused by measures and tools – the measures restrict or change the use of water body. Contrary to the direct costs a significant part of economic costs as stated above consists of "missed benefits" and the costs of missed opportunities. Therefore they are also called opportunity costs. Another part of economic costs are external costs. They can be economic costs of other branches which will probably be generated by the changes in

water condition, e.g. decrease, loss of productivity (production effects, internal sector links, etc.). So the calculation of these economic costs is complex and therefore it is necessary to know that different kinds of costs will be assessed.

3.2 Estimate of the costs for measures

In the assessment of the costs for the combination of measures firstly the costs generating in the connection to the implementation of specific combinations of measures are found out. These costs can be estimated through using the data from the list of measures and own experimental values (related materials are taken from the data of databases which have to be gradually created). The data from the list of values speed up the rough guess of the data on the basis of intervals. In the estimate of the costs the information on local specific costs and experience with the implementation of measures should be included. The indirect costs or economic costs for the combination of measures are estimated in a separate calculation only in the cases when they could influence the selection of measures.

Table no.1: Matrix of parameters of the costs - EXAMPLE

Measure	Alternative (combination)		
	1.	2.	3.
A2	290 million SKK	290 million SKK	290 million SKK
B1	400 million SKK	400 million SKK	400 million SKK
C1	15 million SKK		
5.1		50 million SKK	
4.3			150 million SKK
Estimate of the costs	705 million SKK	740 million SKK	840 million SKK
Ecological effectiveness	high	high	high
Time horizon of the contribution	Short-term	Middle-term	Long-term

The matrix above shows that the most favourable combination is the combination no. 1.

3.3 Estimate of the costs for tools

The cost-effectiveness analysis is focused on the selection of measures and not on the implementation itself or the tools necessary for the implementation and for the support of technical measures. In this issue the political decisions will play an important role. CEA contains only technical measures and not the tools. However, the application of tools generates the costs which should be estimated. Procedure stated in this methodology for CEA measures can be used for tools as well.

In many cases the costs caused by the application of tools can be just roughly guessed. This applies to administration costs and to the burden borne by the third party. Any available quantitative estimates of the costs for tools should be put into the list of tools. If possible the costs for different groups of users should be distinguished (agriculture, households, industry, etc.) because the related tools can be different as well.

Additional costs for the tools can be compensated by saving on measures. Using the tools can mean reduction of the costs for corrective measure which means that the polluter will have a bigger burden. Effectiveness is higher because the tool directly solves the problem. The tool in the cost-effectiveness analysis should be assessed as follows: the tool is effective when it leads to the change in the implementation of measures.

It is not always clear whether sectors in which the tool is applied can really change the implementation of measures. It is probable that regulations and prohibitions as a tool will have a bigger influence on supporting certain procedure and implementation of specific technical measure than for example price stimuli. Grants as a tool can stimulate the implementation of the measure but extensive application of grants will be a big burden for public finances. Next important criterion in selecting the tool is feasibility. Charging the point sources of pollution will be more feasible as a tool than charging the diffuse pollution sources. It is because the point pollution sources are easier to be monitored than the diffuse pollution sources.

It should be considered that different types of measures and different sectors will require using the different tools. For this it is necessary to estimate the effectiveness of the tools. It is possible to do so through the estimate of probability that sectors will change the implementation of works as a result of the tool and then to multiply the effectiveness of technical measures by this probability (that the tool will lead to the implementation of measures and consequently the effect will be visible). So, the most effective tools are those having the highest probability to reach required change at the lowest possible costs.

We distinguish direct and indirect costs in the estimate of costs for tools just like in the estimate of costs for measures. Direct costs for tools consist mainly of administrative costs and are relatively low. Also here we have to consider the costs for certain period of time. Indirect costs (economic costs) can exceed direct costs for tools. Example: taxation (tax = tool) for fertilizers and pesticides – direct costs of the implementing body will be low (only administrative), significant amount of the costs will be shared by the farmers paying taxes. If the farmers in the effort to avoid paying the taxes switch to alternative crops (with lower profit), the opportunity costs will generate (indirect, economic costs). These opportunity costs are a significant part of a burden.

3.4 Representation of the Costs

For the calculation of the costs the average costs and intervals should be available in case such information about costs is available. In dependence on the aim different referential variables are possible.

Total costs:

Calculation of total costs must include the following kinds of costs:

- investment costs (including planning costs - e.g. for preparation of a construction, for elaboration of town-planning documentation, for purchase of soil, spare investments and modernization)
- depreciation (inflation index)
- current operational costs (costs for material, staff, maintenance and repairs)
- financial costs (if they are applicable).

In every individual case it is necessary to consider in dependence on the specific intention which specific costs will be represented, e.g.:

- on inhabitant
- on household
- on river kilometre
- in relation to real net production in the river basin
- in form of annual costs (annuity).

Where the solution of certain influence has a specific impact on an inhabitant – the costs on inhabitant will be determining. General rule cannot be recommended. But the given costs always have to remain comparable and compatible among particular river basins. Another important thing is the duty to document all "basic" issues used for economic assessment (number of inhabitants, number of households, number of river kilometres, etc.) as well as all assessed range and all "problem" issues in dependence on a specific case.

3.5 Comparison of Costs in Water Management

The principle of comparability of costs applies generally not only in case of specific costs as mentioned above but also for the operational costs. It is important to remember that a period of using investments significantly differs for different measures and that the costs for measures generate at different time and can be distributed for longer period. To facilitate the choice of the most effective combination of measures the costs for measures have to be represented jointly in the course of specific time period to be comparable.

With regard to comparison of the costs in water management there are two approaches used:

- **present value of the costs**
- **annual costs.**

Present value of costs (present value of investment = PV = Present Net Value) is a method based on decreasing the future value which is done through discounting.

Present value of the costs is a method connecting (unifying) the costs which will generate during the whole period of measure duration starting with the present state (period 0 = initial investment). This method connects the costs needed for measure application in given present state (initial investment) with future costs deceased by uniform interest - discount rate (interest – discount rate is specified by the National Bank of the Slovak Republic in specific time period).

The method of the present value is based on decreasing the future value and it is done through discounting. This way the future value of investments is expressed in current value.

So the method of the present value of the costs (investment) means that future costs are discounted to be transferred to the level of current value (to know how much is the current value of the investment costs spent in the future).

Formula: *Present value * Discount rate = Future costs*

Derived from that:

$$\textit{Present value} = \frac{\textit{Future costs}}{\textit{Discount rate}}$$

With regard to the depreciation when using this method it is not assessed separately provided that amount of investment is depreciated during the duration of a measure (the costs are taken for initial investments). In case the period of depreciation exceeds the period of assessment the residual value of the investment will be subtracted from initial investments at the end of the period.

In the method of annual costs the total costs incurred during the measure duration are transformed to equal, nominal, annual costs. In this case the annual depreciation rates should be considered instead of initial investments. Annual costs should enable clear representation and not display the costs as such occurring during certain time period. This

method of annual equivalent costs (AEC = Annual Equivalent Costs) enables to transfer the net present value (NPV = Net Present Value) of new capital expenditure to annuity; so the annual costs will have the same value. Procedure:

1. a list of all capital expenditures is made
2. a net present value of expenditure is calculated using selected discount rate
3. a present value is transferred to annual equivalent costs (AEC) following the relation:

$$AEC = \frac{\text{net present value of the investment} * \text{discount rate}}{1 - (1 + \text{discount rate})^{-\text{lifetime}}}$$

Explanatory text:
AEC = Annual Equivalent Costs
NPV = Net Present Value
Discount rate: discount rate (the same as the one used for NPV calculation)
Lifetime = Lifetime of the capital equipment

Calculation of net present value

Discounting all the future cash flows (cash flow or outcashflow – because it is expenditure, investment cost) related to the investment we get the cash flow present value. The value of the investment is usually expressed already in present value. Comparing the present investment value and net present cash flow we get the total contribution of the investment and whether the investment is cost-effective.

$$\text{Net present value of the investment} = \sum_{i=0}^{n} \frac{CF}{1(+k)^{i}} - I$$

Explanatory text:
CF = Cash flow
I = Present value of the investment (costs for investment project)
k = discount rate
N = lifetime of investment
i = specific year of investment implementation

Definition: *Net Present Value of Investment* is the difference between discounted present value and the amount of the initial investment (at the 0 time).

For both methods of calculations the estimation has to be used for several items. In comparison of the costs it is required to use uniform preconditions. Particularly the uniform approaches for parameters have to be specified as follows:

- used interest rate
- depreciation period and method (according to the valid accounting principles for depreciation of capital goods
- price increase, inflation.

Achieved conclusions of the assessment should be displayed clearly to have a good overview of the results on the international level in the future.

3.6 Application of Indirect (Economic) Costs

The assessment of indirect (economic) costs is really difficult and therefore the methodology of the approach to their application is discussed in this part. To gain a clear conception of their not very often used application in water management we start with an example:

Economic costs (indirect cots) incur when economically relevant water use is restricted by the water protection measures. They incur for example in the case when due to renaturation measures (revitalization measures) the river use for inland water transport is restricted. This will be showed in the increase of the costs for water transport as well as the costs will be incurred in the companies which will have to use other, more expensive, kinds of transport.

The abovementioned example clearly indicates that the evaluation of the economic costs is a long and difficult process; therefore it is necessary to guide the application as follows:

Economic (indirect) costs should be assessed in details in the following cases:

- direct costs of different measures are almost identical, so on the basis of the direct costs it is not possible to make the preference
- important economic costs are assumed at least for one of favourable combinations of measures and instruments.

  Only in such cases there is a supposition that the economic costs will have an important influence on selection of measures and instruments.

In case the evaluation assumes that certain combination of instruments and measures leads to significant economic costs, first of all the evaluation based on information about water use in initial characterization should be made. The answers to the following questions are necessary:

- What water use is available for sub-basins?
- Is this use influenced by the measures?
- Are significant unfavourable economic impacts on water use related to this harm (measure)?

In the initial assessment of the economic costs it necessary to consider the results of the economic analysis within the Water Framework Directive which was planned to be performed till the end of 2004 (i.e. the information on water use). Also it is reasonable to consider existing general practical knowledge (e.g. reduction of diffuse effects can be done in cheaper way through the reduction of discharge than through introduction of technical measures).

Two possible conclusions of initial evaluation:

- if on the basis of initial evaluation there is the conclusion (participation of the public) that the significant economic costs are not applied, the reasons must be stated clearly (economic costs concern different sectors and user groups),
- if the results of the initial evaluation indicate that significant economic costs are anticipated, further detailed examination is needed during which it is necessary to decide to what extent the chosen measure harms economic use of water body. These consequences will be then the subject of economic evaluation (it can be financial evaluation or qualitative evaluation). In many cases the lists of measures and instruments contain the details of possibly affected sectors and economic activities. However, the following evaluation of economic costs can be done only through economic study in case the related estimation is not available yet.

4. RELATION BETWEEN THE COST - EFFECTIVENESS ANALYSIS AND THE COST – BENEFIT ANALYSIS

CEA and CBA are two kinds of economic analysis and their mutual interaction can play an important role in suggesting feasible and available objectives and related packages of measures. Appendix number III of the Water Framework Directive contains the requirement to create the combination of cost-effective measures what indicates the carrying-out the cost-effectiveness analysis (CEA). With regard to the duty to perform the cost-benefit analysis (CBA), it is not determined by the Water Framework Directive. However, CBA can help in the search for an optimal set of measures. CEA should identify the packages of cost-effective measures for achieving the ecological objectives of the WFD at the lowest costs. CBA consequently describes broader social impacts of this package of measures. On the basis of this knowledge the following reasoning of adapting the objectives is possible (stages, reduction). From the different point of view – these adapted objectives will form a new starting point for the cost-effectiveness analysis because looking for the optimal set of measures can be interactive process where both analyses – CEA and CBA and relation between them can play an important role. CBA considers the amount of the costs needed for reaching the ecological objectives. On the other hand CBA verifies whether the costs for certain measure (set of measures) will not be higher than benefits expressed in money caused by the implementation of a specific measure (set of measures).

5. DISPROPORTIONABLE COSTS AND CBA

After CEA is performed the evaluation whether the costs are disproportional or very high can be done. CEA identifies the package of cost-effective measures which is assessed in the next step whether it is too expensive. If this package of measures is not considered by CEA to be too expensive, the total costs of measures are calculated and these can be implemented. If it appears to be very expensive, i.e. the costs are disproportionable, it is the reason for requiring the time exceptions from the objectives required till 2015 or for certain water bodies for the reason of their natural condition less strict objectives can be determined (these can be determined for the reason of non-feasibility of originally determined objectives and for the reason of inappropriate price of the measures: for this reason CBA compares the costs and benefits and it can result to less strict objectives).

CBA should evaluate whether suggested measures generate certain public benefits (or losses) and to what extent. Thus CBA displays the relation of the costs and the benefit of these costs. For example if in the implementation of certain additional measures certain public benefits arise, these benefits must be higher than the costs. If the costs are higher than the benefits there is the question to what extent these costs must be higher than the benefits to be considered disproportional and very high. There must be stressed that benefits cannot be always expressed quantitatively but only qualitatively (for example the costs of households will be increased due to the measure leading to smaller amount of regionally produced agriculture products but the benefit for households will be better drinking water supply).

There is a question when the costs should be considered inappropriate and when adequate.

In economics there is neither definition of disproportionably high costs nor standard methods for identification of disproportionable costs. Neither the handbook for economic analysis for the purposes of WFD WATECO offers any definition of this kind. Implementation of WFD - implementation of environmental objectives (good ecological condition and potential) through the application of additional measures brings certain financial and economical consequences. Essentially it is the assessment of appropriateness or

inappropriateness of these consequences. Assessing this appropriateness or inappropriateness is made in the connection with the estimate of financial and economic impacts of additional measures. Implementation of environmental objectives is this way closely connected to economic possibilities. Deciding about appropriateness or inappropriateness of the consequences of the measures will always be linked with an answer to the question what we are willing or able to do for the implementation of the objectives for achieving good ecological condition and good ecological potential. "Disproportionateness" will always have the result of economic analysis.

Summary:
Those who will decide about disproportionateness of the costs will have to consider the following problems:
- comparison of the costs of the offered combinations of the measures (CEA)
- comparison of the costs and benefits of the combinations (CBA)
- costs versus the ability to pay the issues caused by the measures.

As results from the abovementioned stuff CEA and CBA are very helpful. Despite the fact that CBA is valid comparative economic method it is not fully prepared for the needs of water management and the European Commission. Therefore it is not possible to apply CBA method within water management of individual EU Member States without further modification in line with national particularities. For this reason it is necessary to watch this development on the European Commission level and accordingly correct the steps adapted to Slovak conditions.

6. DEFINING THE MOST EFFECTIVE COMBINATIONS OF MEASURES

Working groups together with future agents of measure implementation participating in the draft of correction measures or combinations of measures take the criterion of ecological effectiveness into consideration (see the Chapter 2.4 part: CEA: Necessity of information on the effect of measures (estimate of the influences of measures) – the need of information about ecological effectiveness). The result of the whole process should be the identification of the measure or combination of measures which will produces the biggest ecological effect in connection to the costs. Therefore the working group for economic analysis and the economists has to enter the process to make the calculation of the costs to find out the investments and the time needed for achieving the ecological objectives.

In identification of the most effective combination of measures several possibilities should be considered. The aim of this process is not to define theoretically possible "ideal solution" with the lowest costs submitted by the economists but it is description of different criteria in the same manner to be able to compare them within the context of the process. Identification of one optimal solution is really difficult mainly in the case when some costs and the probability of achieving the objective can be assessed only qualitatively.

If individual criteria are considered in selection process it should always be in accordance with the affected interest group (public participation). In more complex cases it is suitable to use more structured evaluation methods (on the basis of the analysis of more criteria or development and analysis of scenarios).

In definition of the most cost-effective combination of measures in practice there exist two main cases (in simplified conditions):

1. there is a situation of influences where the specific combination of measures and tools is clearly the most effective choice. In such case the most cost-effective combination of measures can be implemented.

2. there is a situation of influences consisting of significant multiple influences; dealing with such situations of influences is a complex process which is made even more difficult by lack of detailed information for quantification and comparison of cost-effectiveness of different combinations of measures. Therefore in some cases more detailed surveys are necessary.

In selection of the most effective combinations of measures the following criteria should be taken into consideration:

A Probability to achieve the objective till 2015
B Ecological effectiveness of the measure/tool
C Time range till achieving the effectiveness of the measure/tool
D Direct costs
E Indirect costs (not always applied – explained above)

In the selection process the influence of the combination of measures is firstly assessed in relation to the objectives of WFD. In the next step the costs for measures are compared.

6.1 Assessment of the effect of combinations of measures in relation to WFD

In the assessment of the effectiveness of the combinations of measures and tools the criteria A, B, C play the main role. First two criteria (A, B) must be assessed for each combination and individually for each related water body.

In selection of measures and tools the fist thing to assess is the probability of achieving the objective of good ecological condition till 2015 for each derived combination of measures and tools.

The following classification is recommended to be done:

- highly probable (HP): objectives will be achieved within the deadline, the risk of failure is minimal
- probable (P): risk of failure within the deadline exists with certain probability
- improbable (I): it is highly probable that the objectives will not be achieved till 2015.

In case no possible combination of measures and tools will achieve the objective it is necessary to give reasons and ask for less demanding environmental objectives (according to the Article 4, paragraph 5 WFD).

Mainly those combinations where the objective of good ecological condition will be probably achieved till 2015 should be examined in more details.

Information on ecological effectiveness is acquired from the stages before economical estimate of the costs based on the data in the lists of tools and measures and local information. Time needed for achieving the effectiveness of the measure combination (criterion C) can be assessed on the basis of the results acquired from preceding stages. In the time criterion C there is a moment when the work on the implementation of measure combination should start and when the additional measures will be necessary if the objective is endangered.

Time schedule till achievement of the effectiveness of the combination is divided into categories: short-term (S), middle- term (M) and long-term (L). Short-term schedule means that the combination will have effect on ecological condition before 2015. Middle-term combinations of measures will be effective in 2015 at the latest and long-tem measures will be effective after 2015.

6.2 Assessment of the effect of combinations of measures on the basis of the costs

In the assessment of combinations of measures and tools the costs for these combinations must be considered. *Direct costs* (criterion D) of selected combinations are assessed first. Estimate of the costs is done by the working group for economic analysis in close cooperation with the economists. In comparing the direct costs in most cases there will be one combination of measures and costs clearly most effective. In cases when there is no such combination *indirect costs* have to be additionally taken into account (criterion E). These indirect or economic costs will be estimated in the separate calculation because now they can influence the result of selection of measures. *Again we emphasize that indirect costs of different combinations should be included as decision criterion only in cases when* direct costs for combinations are approximately the same and/or in cases where at least some of preferred combinations probably produce significant indirect costs. If indirect costs are not taken into account it is necessary to explain why they are ignored. If there are no estimates of indirect costs available because they were not considered necessary for specific combination then minimum costs are essential. Since indirect costs affect particularly other sectors and interest groups, in this stage a transparent and well-documented progress is important for mediation of the decision within the context of public participation.

Table no. 2: *Matrix of identification of the most effective combination of measures*

Combination of measures	Achieving the objective till 2015	Ecological effectiveness of measure/tool	Direct costs	Indirect costs	Time schedule
See the list of measures	A,L	3,2,1,0	Mil. EUR	A,L,H	S,M,L
Combination 1					
Combination 2					
Combination 3					

Classification for indirect costs: A-appropriate, L – low, H - high

Explanation:
Stages of ecological effectiveness are expressed by 4 grades classification (0, 1 2, 3):
High grade of ecological effectiveness = 3
Medium grade of ecological effectiveness = 2
Low grade of ecological effectiveness = 1
Zero grade of ecological effectiveness = 0.
Values lower than 1, i.e. measures with no or marginal positive effect on ecological condition of water body will be dropped and not included in further stages of works related to creation of combinations of measures.
Information on ecological effectiveness will be submitted to the economists by the working groups drafting the measures.

Example for testing the methodology on randomly selected water body (on the selected section of Morava River) is given in the appendix of this methodology.

7. COORDINATION WITH OTHER RIVER BASINS

The process resulting into identification of the most effective combinations of measures for sub-basins must be coordinated with other programmes of measures in the same area of the river basin. This stage should be integrated into the process from the beginning because the measures and tools concern other sub-basins as well. In the cases when the

benefit of measures is much reflected also in other sub-basins it is probable that cost-effectiveness should be assessed from another viewpoint (over-regional) as well, i.e. it is necessary to find out whether more effective procedure is possible if anticipated measures and tools are considered for the whole area of the river basin. Local programmes of measures are combined and compared for the whole area of the river basin and the effectiveness of measures is compared as well. Comparing must be coordinated among sub-basins and within the whole area of river basin as well, i.e. the same approaches must be used. This coordination has another meaning within the international cooperation in boundary areas of river basins. When it comes to uniform methods and approaches in certain stages these will allow avoiding a useless activity in each river basin. For the abovementioned reasons the coordinators must be designated within the whole area of the river basin and in the boundary areas of the river basins.

In the preparation of the cost-effective programmes of measures it is necessary to consider also coordination with other planning tools. This coordination includes for example plans of land use, landscape plans, agriculture development plans, flood protection and special plans in the area of planning the transport and consolidation of agriculture soil. These planning tools and their assessment could be very beneficial because they can provide important ecological and economic data as well as they represent the link to the implementation of the measures (mainly in agriculture). Coordinators provide the coordination with other necessary tools of planning; however, the responsibilities for provision of these planning tools have to be settled.

Compatibility and comparativeness of different programmes of measures are inevitable. Deciding on measures and tools affecting the whole area of river basin (in the area of flood protection) is much simpler if information from individual sub-basins is based on uniform methodology. To assure the compatibility of results from sub-basins it is necessary to apply the same procedures, to follow the same suppositions and draft solution in logical sequence mainly in calculation of the costs. In this connection it is necessary to use uniform categories of the costs, depreciation periods and their modes, the same interest rates and comparable methods for determination of indirect costs. This stage should include collecting and distribution of data which can be used for acquiring the experimental values for direct and indirect costs. These databases can also serve the purpose of the important background materials for other parts of economic analysis within WFD.

8. DICTIONARY OF TERMS

Initial characterization: according to the Article no. 5 the Water Framework Directive includes the analysis of characteristics of the river basin area including the overview of environmental impacts of human activity and economic analysis of water use. Detailed specification of lists is in the appendixes II and III, appendix III requires the most effective combination of measures. Initial characterization was about to be prepared till December 2004.

Tools: they are drafted for modification of framework conditions to influence indirectly managing the related agents. The tools can change legal and financial framework conditions but can also help in the changes of social behaviour through better education. This way the tools help in the implementation of measures. Following the terminology of WFD the tools are classified as "additional tools" pursuant to the appendix VI, part B WFD, although it is necessary to say that WFD does not distinguish clearly between measures and tools.

Measures: measures concern the actions leading directly to improvement of the condition of water body though removal of the effects or remediation. This mostly concern construction measures and measures implemented directly in the water body. With discharge decrease it includes the measures in the end of the pipes and integrated measures. The measures are effective in a short time within restricted area with high degree of probability; their effectiveness can be anticipated easily. *Decision regarding using the measures is generally made locally through competent water management bodies.*

Programme of measures: the Article 11 of WFD requires preparation of effective programmes of measures within the area of river basin for the purpose of reaching the objectives of WFD as written in the Article 4. The programmes of measures must be prepared till 2009 and described measures must be implemented till 2015. From 2015 the programmes will be regularly examined every 6 years.

Operational costs: costs invested directly for the implementation of the measure or application of tools. According to the general rule these costs must be paid by those who will implement the measure. This includes for example the costs for construction in the building measures, costs for human resources and administrative costs caused by authorities as a result of the implementation of measures or tools.

Investment costs: they include new investments, depreciations of existing investments and opportunity costs (costs corresponding with the lost benefit from not accepted solution) (WATECO handbook)

Opportunity costs: opportunity costs for measures concern the lost benefit from the next best alternative of the solution. For example the opportunity costs of the investment project could include added interests if the money is in the accounts with high interest rate. Opportunity rates represent the part of investment costs.
Opportunity costs are also called alternative costs or costs of foregone opportunity and represent the value of goods and services which were given up due to another alternative. The value of expendable opportunity is a value of goods given up because of other goods (through investing into the selected project we lose potential benefit from alternative use of investments for alternative project).

Economic costs (indirect costs): costs incurring indirectly from the implementation of measures/tools. Indirect costs are not shared by executive bodies but other agents: indirect costs originate to the users of water body if their usage is restricted/ forbidden from the environmental viewpoint. An example can be decrease of profit for farmers forced to change the agricultural production or to make agriculture more intensive. Furthermore these costs cause the origin of indirect costs of secondary or third-rate kind: they originate when the total amount of individual profit losses leads to weakening the regional economic power. These following affects can be assessed through extensive economic modelling.

Environmental costs: financial value of damage caused in the environment and ecosystems as a result of water use, i.e. decreasing ecological quality of water ecosystem or soil salination. Environmental costs generally belong to external costs (WATECO handbook).

Resource Costs: these costs specify the price of lost opportunities not provided by other users because the resource is overused (over the level of regeneration ability). In connection to WFD it concerns mainly ground water: in the cases when the costs are spent if the rate of water abstraction increases for the reason of tourism development in coastal region. Therefore lower amount of water is available for agricultural irrigation. From the economic viewpoint these costs for resources are kind of opportunity costs. They are external costs for the user.

Return on costs: range into which the costs for provision of certain goods or service are covered by the related revenues.

Discount rate: according to the economic theory the present consumption is more valuable for consumers than future consumption (time preference) and therefore the money available at present have higher value then future profits. In financial industry the investments must create at least the same profit to produce investments with comparable risk (occasional costs). For this reason the costs and profits are "discount", i.e. decreased by steady percentage rate. Standard discount rate for costs and profits from projects of environmental protection is 3% (source: Environmental agency US EPA).

The principle "polluter pays": this principle is generated from the fact that those causing operational pollution (made by human activity) should compensate these effects by compensation of caused damage or by taking preventive measures which would prevent pollution.
This principle means the inclusion of environmental costs into the price of products and services. This way the public must ultimately bear the expenses which are done through the bought products and services (and not for example through general taxation). The concept "polluter pays" means that the user (of product or service) pays.

The category of polluter: for each selected category of effects it is necessary to specify related category of polluter. Polluters concern every human activity decreasing the quality of water body. Categories of polluters include for example waste water discharge, abstraction of cooling and irrigation water.

Category of effects: according to the appendix II, point 1.4 WFD the Member States are required to collect and keep the information on the type and importance of significant anthropogenic effects. In preparation of methodology for evaluation of cost-effectiveness the basic point was the inseparability of cost-effectiveness and ecological effectiveness assessing the following categories of effects: point sources, diffuse sources, discharge control, water abstractions and morphological changes, discharge into ground water.

Public participation: According to the Article 14 WFD the public participation is prescribed in several different points including the preparation of the plan of management and the programme of measures. This procedure is drafted primarily for including the local knowledge of the public into the plan of management and for involving the public into checking and verifying the credibility of assessments and selection of measures. This is significant in calculation of economic costs, considering different decision parameters and coordination with other tools of planning.

The area of river basin: according to the Article 3, paragraph 1 WFD it is the area of continent or sea defined as the main unit of river basin management consisting of one or more neighbouring basins and related ground waters and coastal waters.

Managing influence: using the financial tools which possess managing and financial influence. Managing influence is based on the fact that certain modes of activities are deliberately done to be

more or less costly through taxation or grants. This creates a bigger stimulus for changing the actions without being forced.

Water body: in line with WFD the surface water body represents independent and significant element of surface water, i.e. lake; water reservoir; water course; river or canal; part of water course, river or canal; transitional waters or part of coastal waters. The ground water body is defined as large volume of water within one or more hydro-geological collectors (Article 2 (10 and 12) WFD). The Article 4 WFD says that all surface water bodies have to be preserved and developed with the objective to reach a good condition of surface water till 2015. The water body is a unit related to the assessments and potential measures for reaching the good condition.

Water management services: according to the Article 2, point 38 WFD this concerns all services provided for the households, public institutions or any economic activity: abstraction, accumulation, treatment and distribution of surface and ground waters as well as the equipment for collection and treatment of waste water discharged into surface waters.

Water use: besides water management services the use of waters includes all other activities which can have a significant impact on water condition on the basis of the Article 5 and the appendix II WFD, e.g. extending the water body for the purposes of water transport.

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APPENDIX

Testing the methodology for assessing the cost-effectiveness on randomly selected water body on the Myjava River

For testing the methodology the water body on the River Myjava SKM005 was randomly selected. On the tested section 41, 2 river km on the periphery of the Osuské village there is one stable dam 3 metres high which is a remnant of an old mill. At present this dam functions as a small hydro-electric power plant with total installed output 0,0185 MW and it is operated privately creating the barrier for the migration of ichtyofauna.

On the basis of the statement of the Department of Hydrology and Hydraulics and after gaining the data on hydro-morphological changes the related water body was assessed as heavily modified water body. Drafted measures for reaching a good ecological condition will be mainly focused on the possibility of removing the migration barrier and reaching the migration of ichtyofauna. Removing the dam and impoundment (odstránenie hate a vzdutia) over the barrier and making the migration of ichtyofauna free should create almost natural conditions. The next measure is drafted construction of functional fish way, by-pass or bio-corridor.

According to the biologists, the drafted measures i.e. liquidation of the Osuské Dam or construction of functional fish way does not mean an immediate improvement from the viewpoint of biological elements of water quality because the Myjava River is heavily contaminated. Besides the communal pollution there are sediments contaminated by heavy metals or toxic substances which will require the analysis of sediments and detailed hydrological research to be able to decide to what extent it is possible to eliminate these pollution sources and under what financial conditions. Following the materials submitted by the Department of Hydrology and Hydraulics it is not clear enough what the bottom of the water course looks like before damming which is very important for the biological viewpoint.

Drafted measures:

Measure no. 1: Construction of the bio-corridor – the most appropriate solution for reaching the improvement of the water body condition and the most real possibility how to assess the water body as natural (anticipated costs 2.100.000,- SKK),

Measure no. 2: Complete removal of the dam – the immediate improvement does not have to happen from the viewpoint of the biological elements of water quality (anticipated costs 1.500.000,- SKK),

Measure no. 3: Construction of the by-pass – the improvement of water body condition is not assured (anticipated costs 4.200.000,- SKK),

Measure no. 4: Construction of fish way – will have an effect only from the viewpoint of fish as a biological element of quality but other elements of water quality are not supposed to be improved (anticipated costs 170.000,- SKK).

Economic evaluation:

On the basis of drafted measures for reaching a good condition of water body the overview of financial costs for implementation of these measures was prepared. The overview of

financial costs was elaborated on the basis of the materials of the Slovak Water Management Enterprise, Banská Štiavnica, Ekospolu Banská Bystrica and Povodie stredného Hrona Zvolen. The materials for the financial costs are taken from the prices of construction works done in the past and were re-priced to current prices.

The prices are drafted for the measures individually because the combinations of measures for improvement of water body condition were not drafted.

Matrix of parameters of the costs

Measure	Unit of measure	Number of units	Alternative (combination)			
			1.	2.	3.	4.
1.			2 100 000,-			
2.				1 500 000,-		
3.					4 200 000,-	
4.						170 000,-
Estimate of the costs			2 100 000,-	1 500 000,-	4 200 000,-	170 000,-
Ecological effectiveness / degree			Medium/2	High/3	Medium to High/ 2-3	Medium to Low/2-1
Time horizon			Short-term	Short-term	Short-term	Short-term

Note: in the measure no. 2 the total price would be probably higher because it would be necessary to compensate the loss of property to the operator.

According to technical expertises and financial specification of the price of drafted measures, the most appropriate measure for reaching the improvement of water body condition is the construction of bio-corridor which is not the cheapest measure but after the implementation it will be possible to assess the water body as natural.