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Draft Recommendations for Project Support for National Water Laboratories

by

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Abbreviations and acronyms

AAS	Atomic absorption Spectrophotometry/ spectrophotometer
BMI	Benthic Macro Invertebrates
BOD	Biochemical oxygen demand
BUVR	Basin Management Authority of Water Resources
COD	Chemical oxygen demand
DO	Dissolved oxygen
CWM	Country Water Manager
DAT	Diode Array Detector
EIMC	Environmental Impact Monitoring Centre
EC	Electrical Conductivity
EPA	Environmental Protection Agency
EQR	ecological quality ratio
EQS	environmental quality standard
FLD	Fluorescent Detector
GC/ECD	gas chromatograph with electron capture detector
GC/FID	gas chromatograph with flame ionization detector
GC/MS	gas chromatograph with mass spectrometer
GLC	gas liquid chromatograph
GOST	Russian: ГОСТ, an acronym for gosudarstvennyy standart (Russian: государственный стандарт), meaning 'State Standard'
HPLC	high performance liquid chromatograph
ICP/MS	Inductively coupled plasma mass spectrometer
JFS	Joint Field Survey
KE3	Ecology & Biological Key Expert 3
LIMS	Laboratory Information Management Systems
MAC	Maximum allowable concentration
MNREP	Ministry of Natural Resources and Environmental Protection
MoE	Ministry of Environment
n.a.	not available; not applicable
NEA	National Environmental Agency
NEMD	National Environmental Monitoring Department
NPD	Nitrogen Phosphorous Detector
NKE	Non- Key Expert
OECD	Organisation for Economic Co-operation and Development
RCACFEP	Republican Centre of Analytical Control in the Field of Environmental Protection
RCRCEM	Republican Centre for Radiation Control and Environmental Monitoring
SHS	State Hydrometeorological Service
ToR	Terms of Reference
TOC	Total Organic Carbon
WFD	Water Framework Directive

Introduction

The objective of this draft report is to summarise the findings of a recent series of visits and reviews made of each national water laboratory by Key Expert 3, which are detailed in his recent mission report. In addition, this report takes into account the results submitted by each country's checklists and wish lists summarised in appendix 1, to derive recommendations for the countries to improve their analytical capabilities for the components required by the WFD.

It is proposed to use this report as a guideline for future support for each country by the Project to improve the capacities of their laboratories.

1. ARMENIA

The main agency responsible for surface water resources quality monitoring is the "Environmental Impact Monitoring Centre" (EIMC) under the Ministry of Nature Protection of the Republic of Armenia. The surface water quality monitoring network comprises 131 sampling points. The sampling frequency varies between 7-12 times per year, with most of the sampling sites being sampled once every month. The routine surface water quality monitoring programme are analysed for some 45 – 50 parameters, comprising the more traditional water quality parameters, heavy metals, organic micropollutants (notably organochlorinated pesticides) and microbiological parameters (Coliforms total, intestinal Enterococci, Escherichia coli).

The EICM has 90 staff throughout country and has been assisted by a number of projects which are detailed below. The centre has already been provided with support from various donors, and particularly USAID, EU and GIZ. It is proposed that the EPIRB project capitalises on these projects by focusing on the gaps and highlighted requirements.

Micro-pollutants

The laboratory has advanced analytical equipment including: GC/MS, GC/FID, GC/ECD, ICP/MS, IC and TOC. It is recommended that training is submitted for the application of this equipment to improve the current analysis and increase the number of organic micropollutants can be analysed.

The TOC requires installation, and commissioning. It is recommended that if the EIMC agrees to fund this and the commissioning is timed at the same time the Project Expert is present, then assistance with training could be provided by the Project.

A similar arrangement is recommended for the microwave digester system used for pre-treatment for the river sediments.

Hydrobiological Elements

Limited hydrobiological studies using benthic macroinvertebrates, phytobentos have been undertaken and currently phytoplankton is being studied. However the training for these elements has been limited and more advance training is now urgently required, which the Project could provide, so that the staff improve their skills in four of the WFD biological elements, though fish monitoring would not be included.

Similarly, the staff requires further training by the Project on the calculation of biotic indices and also to calculate the individual Ecological Quality Ratios for each element. Following this, they will be trained on how to compound all the measured elements to derive the Total EQRs.

Quality Control

The staff have been trained on certain aspects of quality control, and participated in a number of inter laboratory exercises. However there were a number of issues that need to be addressed by the Project including:

i. Application of internal analytical quality controls.
ii. The procedure and software for validating analytical methods
iii. Development of International Accreditation Procedures
iv. Laboratory Auditing Procedures
v. An introduction to Laboratory Information Management Systems (LIMS).

Sampling and Monitoring

The EIMC has previously been trained on water sampling for different types of parameters. However this needs to be complemented by further training during the field surveys on the Project's pilot areas and also by co-operating with the GIZ Biodiversity Project.

2. AZERBAIJAN

Surface water quality monitoring is monitored by the National Environmental Monitoring Department (NEMD) of the Centre for Environmental Pollution Monitoring of the Ministry of Ecology and Natural Resources of the Azerbaijan Republic. The central laboratory of the NEM is the Geochemical- regime and pollution monitoring laboratory of natural waters, located in Baku.

There are two more analytical laboratories in Kazakh and Beylagan, only equipped for analysis of the classical parameters. Routine surface water quality monitoring programmes comprise 44 locations with monthly analysis of surface water samples for common physical-chemical parameters, and quarterly analyses of a limited number of heavy metals.

Micro-Pollutants

The laboratory has obtained a new Agilent GC/MS, which requires installation, and commissioning. It is recommended that if the NEMD agrees to fund this and the commissioning is timed at the same time when the Project Expert is present, and then assistance with training could be provided by the Project. This would include training on the analysis of selected micro pollutants.

Hydrobiological Elements

The Baku laboratory has one hydrobiologist, who has been trained by previous projects on the sampling and identification of benthic macroinvertebrates, but further training is still required including:

i. Advance training on the identification of certain taxa of benthic macroinvertebrates.
ii. Training on the assessment of the biotic indices and the calculation of Ecological Quality Ratios

Furthermore, the Project should try to involve the Caspian Sea Laboratory and also other national biological institutes to participate in this training, so that there are more people available to undertake this important monitoring.

Quality Control

The staff have been trained on certain aspects of quality control, and participate in a number of inter laboratory exercises. However there were a number of issues that need to be addressed by the Project including:

i. Application of internal analytical quality controls.
ii. The procedure and software for validating analytical methods.
iii. Development of International Accreditation Procedures, which could include working with an international accreditation agency such as TURAK from Turkey.
iv. Laboratory Auditing Procedures.
v. An introduction to Laboratory Information Management Systems (LIMS).

Sampling and Monitoring

The NEMD has previously been trained on water sampling for different types of parameters. However this needs to be complemented by further on-site training during the field surveys in the Project's pilot areas.

3. BELARUS

In 2010, surface water in Belarus was monitored at 292 stations. Regular observations cover 81 rivers, 50 lakes, 21 water reservoirs and 1 canal. Most observation points are located in major residential and industrial areas, i.e. at water sites having the biggest load from concentrated sources of pollution. Observations are carried out monthly (i.e. 12 times a year) or during the main phases of the hydrological regime (i.e. 7 times a year). Observations at water reservoirs are also conducted during the main phases of the hydrological regime but their frequency is 4 times a year. More than 90 components and parameters characterizing the conditions of natural water are identified in water samples, e.g. elements of the basic salt content (e.g. chlorides, sulphates etc.), suspended solids and organic matter, biogenic components (e.g. compounds of nitrogen, phosphorous, iron, silicon), main pollutants (e.g. oil products etc.), heavy metals (e.g. copper, zinc, nickel, chromium, manganese etc.), pesticides etc. Hydrobiological monitoring is performed for 4 parameters (phytoplankton, phytoperiphyton, zooplankton and macrozoobenthos).

During the period 2011/2012, monitoring tasks and responsibilities have been partly re-allocated. Monitoring of physical-chemical parameters has been fully transferred to the Republican Centre of Analytical Control in the Field of Environmental Protection (RCACFEP) under the Ministry of Natural Resources and Environmental Protection. Earlier, most monitoring of physical-chemical parameters used to be conducted under the auspices of the Republican Centre for Radiation Control and Environmental Monitoring (RCRCEM)) under the Department of the hydrometeorology of the Ministry of Natural Resources and Environmental Protection. The latter Centre remains responsible for the monitoring of hydrobiological parameters as well as storage and processing of all surface water quality (and other environmental) data.

Micro-pollutants

The RCACFEP has advanced equipment ideal for analysing most of the micropollutants including:

i. Agilent Quaternary HPLC with Fluorescent Detector) FLD & Diode Array Detector (DAT).
ii. GLCs with ECD & MS detectors used for the analysis for certain pesticides such as organo-chlorine and PCBs parameters.
iii. A GLC with NPD & FID Detector for the analysis of nitrogen & phosphorus pesticides such as simazine and atrazine.

The staff appear to be well trained and can analyse many of the micropollutants, and therefore could analyse others if time permitted. The department have requested that to assist in these further developments they believe that visiting other European centres of excellence would be most appropriate. It is recommended that following the field study in July, it would be clear for which parameters extra help is required and then to then decide which locations would best serve for these.

Hydrobiological Elements

The RCRCEM has near 50 years experience on monitoring at least three of the hydrobiological elements and as such could be an excellent centre of excellence together with the Ukraine's Academy of Science for training the other member countries. However there were some issues that the centre requested further assistance including:

i. Training on Typology especially in the reference sites.
ii. Facilitating a common approach for hydrobiological sampling with Moldova and Ukraine using the same type of equipment and methods.
iii. Assisting with hydrobiological intercalibration.
iv. Providing training and western keys for better identification of biological elements- a list of suggested keys was submitted by RCRCEM and is shown in appendix 3.
v. Guidelines on the above monitoring would be appreciated.
vi. Training on the analysis of Macrophytes was also requested.

These are reasonable requests and it is recommended that a Hydrobiological Working Group is established, which may be facilitated by the Project as a development of the Field study in July. Then to discuss these hydrobiological requests with the other countries to produce recommendations which would be helpful to all member countries.

It is recommended that the training on Typology is undertaken by the Project Hydromorphological Key Expert.

Quality Control

For the analysis using chromatographic and concentration techniques expensive deuterated organics analogues are used as internal standards, which are excellent analytically but also very expensive.

The laboratory also use internal analytical quality controls and apply Shewhart charts, the department has also participated with inter-laboratory exercises such as Aquacheck.

The laboratories are nationally but not internationally accredited. The RCACFEP maintains that as the national accreditation complies with ISO 17025, then international accreditation is not currently required.
There are internal quality controls in place with limited method validation. The department is keen to upgrade the method validations. The KE3 submitted an extra training course on method validation with the application of the UK software to Veronika Selitskay, and Tischikov Igor, to be trainers and have agreed to train the chemical laboratory staff.

For the RCRCEM the international accreditation of a Hydrobiological Laboratory, it could be difficult to find an accrediting agency fully competent to undertake this. However the project could assist in assisting the laboratory to ensuring that the laboratory does have procedures in place that are of international quality.

Sampling and Monitoring

The RCRCEM have defined 250 sampling points taking over 900 samples/year. The Dnieper river basin accounts for 57% of the whole of Belarus with 58 sampling points in the pilot site. Regional sampling in Oblasts by is undertaken by local technicians who have been trained by the Centre.
The Sampling Procedure differs from the EU method as the rivers are larger in Belarus and alternative methods are used. They have been trained by Finnish, Slovakian institutions and also co-operate with The Science Academy in Ukraine.

The RCACFEP national centre headquarters is responsible for the sampling and analysis of the trace metals and the organic micropollutants. There are also 26 regional associate (Oblast) laboratories in Belarus which assist with the sampling and which analyse the other basic physical-chemical parameters.

4. GEORGIA

Background

The Department of Environmental Pollution Monitoring of the National Environmental Agency (NEA) of the Ministry of Environment Protection of Georgia is responsible for the ambient surface water quality monitoring Georgia. Three laboratories are involved: the Laboratory of Atmospheric Air, Water and Soil Analysis (the central laboratory of NEA, located in Tbilisi), the Laboratory of Environmental Pollution Monitoring in Kutaisi and the Black Sea Monitoring Division Laboratory in Batumi. The Department undertakes monitoring of fresh surface water quality within Georgia on regular basis.

Monitoring is conducted at 43 locations of 22 rivers and at one location in Paliastomi Lake. The sampling frequency is once per month. Samples are analysed for a suite of more than 33 different parameters. The monitoring of bathing areas, Lake Ku, Lake Lisi, and Tbilisi Sea, commenced in May 2009. The latter monitoring includes microbiological (total coliforms, Escherichia Coli, faecal streptococcus) in addition to physico-chemical parameters.

Micro-pollutants

The organic compounds are analysed by a number of GLCs, including ones with ECD and MS detectors, which are currently being used to analyse six organic micro-pollutants. However this could be expanded to increase the number of parameters by further training by the Project especially in the identification of chromatographic peaks.

There are two AAS's made and a Luminescence Spectrophotometer, which require attention; it is proposed that whilst the Project Expert is undertaking training, assistance could be provided to resolve these issues.

Hydrobiological Elements

Training has been submitted by a number of other projects on the sampling and identification of benthic macroinvertebrates. However further advanced training is required on this together with training on the assessment of other biological elements, such as benthos phytoplankton, and macrophytes.

It is recommended that the Project facilitates the participation of the experienced hydrobiologists at Batumi Laboratory within this training and supplements this with more training on the WFD monitoring methodology.

Quality Control

The staff have been trained on certain aspects of quality control, and participated in a number of inter laboratory exercises. However there were a number of issues that need to be addressed by the Project including:

i. Application of internal analytical quality controls.
ii. The procedure and software for validating analytical methods
iii. Development of International Accreditation Procedures.
iv. Laboratory Auditing Procedures.
v. An introduction to Laboratory Information Management Systems (LIMS).

Sampling and Monitoring

The department has specific technical staff responsible for sampling monthly from each site, including on-site analysis for pH, DO, salinity, EC, & Temperature, and completing a visual assessment form for each sampling point. Also the trained Hydrobiologists are responsible for the sampling of benthic macroinvertebrates.
However this needs to be complemented by further training during the field surveys on the Project's pilot areas and should also involve the staff at the Batumi Laboratory.

5. MOLDOVA

Background

The State Hydrometeorological Service (SHS) under the Ministry of Environment (MoE) is the key organisation for ambient surface water quality monitoring in Moldova.

The surface water quality monitoring programme of SHS comprises both physical-chemical as well as hydrobiological quality elements. The network comprises about 50 locations, with samples for physical-chemical parameters taken 4 – 12 times per year.

Micro-pollutants

The organic compounds are analysed by a number of including ones with ECD and MS detectors and are currently being used to analyse 15 organic micro-pollutants. However this could be expanded to increase the number of parameters by further training by the Project.

The problems with the mercury analyser could also be investigated and further training could be provided whilst the Project Expert is on-site.

Hydrobiological Elements

Six biological parameters are measured but at different levels: phytobentos, phytoplankton (including, chlorophyll A) benthic macroinvertebrates, zooplankton, macrophytes and microbiological parameters. Five staff persons are responsible for these analyses. However further advanced training is required on four of the WFD biological element though not including fish.
Similarly, the staff requires further training by the Project on the calculation of the Ecological Quality Ratios for each element, and then the procedure to compound all the measured elements to derive the Total EQRs.

Quality Control

Moldova is one of the leading member countries for quality control, as it has been not only nationally but also has been internationally accredited. Hydromet has some excellent software for constructing Shewhart Charts, calculating the method validation and the limit of detection. A training workshop was held on site to further improve these systems and to provide international training to Ukraine's laboratory managers. It is recommended that the Hydromet Laboratory is used a training centre for other Project member countries.

Sampling and Monitoring

Substantial Training on sampling has been submitted by an EU governance project. However this needs to be complemented by further training during the field surveys on the Project's pilot areas.

6. UKRAINE

Background

There are a number of complications when dealing with surface water quality monitoring in the Ukraine, the largest country of the six effectively remaining project's beneficiary countries. First, there are several authorities involved in monitoring of surface water quality, being: the Ecological Inspectorates of the Ministry of Environment and Natural Resources; the State Hydrometeorological Service of the Ministry of Emergency Situations and Chernobyl Affairs; the State Sanitary-Epidemiological Services of the Ministry of Health; the State Agency for Water Resources of Ukraine.

Second, there can be big differences in the capacities for monitoring/laboratory analysis. Not only between the various authorities, but also within one authority throughout the various oblasts. These rather complex settings make it virtually impossible to summarise the situation in a nutshell. Nevertheless, some generic statements could be made. The more traditional physical-chemical parameters are monitored all over the country, but there are relatively few laboratories having the capacity for analysing a wider range of the more sophisticated parameters (organic micropollutants and heavy metals). These laboratories are scattered over the country and not necessarily headed under one and the same authority.

Hydrobiological monitoring is not systematically conducted on a routine basis all over the country. In those cases where hydrobiological parameters are included in the routine monitoring, this is often limited to benthic invertebrate fauna. There are a number of experts who meanwhile became quite familiar with monitoring and assessment of hydrobiological parameters under the WFD, but they would not be able to cover WFD compliant monitoring and assessment for the whole of Ukraine.

To simplify this, it was decided to focus the two key authorities responsible for monitoring the rivers basins in the pilot regions.

1) Prut Basin Management Authority of Water Resources (BUVR) Chernivtsi.
2) Dnieper Basin Management Authority of Water Resources (BUVR) (Vyshhorod).

Micro-pollutants

The Dnieper River Basin Management Authority of Water Resources (BUVR) has a GLC and staff could be trained on the analysis of a number of micro-organic pollutants, which could involve the co-operation of The National Academy of Sciences of Ukraine, Institute of Hydrobiology.

Hydrobiological Elements

Both organisations appear to not have sufficient staff and resources to undertake this analysis. Further discussions are required between the Project and both organisations to determine how this could be resolved.
One option is that The National Academy of Sciences of Ukraine, Institute of Hydrobiology or a similar institution could be sub-contracted to undertake this analysis, which could also train staff that could be made available from both organisations.

Quality Control

There appear to be limited internal or external quality controls in place. Therefore a manager from each laboratory was invited to attend the training workshop in Moldova, and further training is currently being prepared. It is hoped that the managers will train their staff on these new techniques. It is recommended that the Project provides further assistance to progress this issue.

Sampling and Monitoring

Trained laboratory staff also undertakes regular sampling, however, further training during the field surveys on the Project's pilot areas, would assist the staff to improve their sampling techniques.

SUMMARY

Most countries have similar requirements on training for quality control, for more hydrobiological support. Reviews have been made of the status of the Benthic Macro Invertebrates (BMI) monitoring of each of the six project countries by the Ecology & Biological Key Expert 3 (KE3). It has been noted that the water management agencies in the six countries are at differing levels of expertise and so require differing support - e.g. from Ukraine BUVRs , which have a very limited level of BMI experience, to Belarus, which has over 30 years of experience.

For specific physical/ chemical parameters there are also individual issues that need to be addressed. Most countries are limited especially in the analysis of micro-pollutants and have requested further assistance in these parameters.

The application of quality controls and accreditation was also found to be variable such as in Moldova they appear to be internationally accredited, have introduced customised method validation software, internal AQC Shewhart Charts to Ukraine, which is only nationally accredited and has no such internal AQC systems.

All countries have water quality monitoring schemes in place but will need to be adapted in the pilot areas.

It is recommended that where there is a common need, the Project should to try to integrate the training in one or two agreed locations.

This concept was trialled in Moldova and Belarus where Laboratory Quality Control Workshops were held, which the delegates found to be very useful in improving their AQC systems and was much appreciated. The most recent workshop was integrated well by all three Eastern European counties and included training on quality control software for hydrobiological elements. The agenda for the workshop is detailed in appendix 4.
It is proposed that a similar workshop should be held for the Caucasus Countries in Georgia.

The summary of the requirements for each country is tabled in appendix 2.

STRATEGY FOR 2013

There are many gaps in the capacities of the laboratories to be able to be compliant with the important requirements of the WFD, which includes adequate quality controls of the analysis and methods that can reach to acceptable limits of detection. Owing to this it is very unlikely that the countries will be able to meet all these requirements during time of the Project. It is therefore proposed to aim to achieve proposed as much compliance as possible.

Therefore in the 2013 it is proposed, as a minimum, to focus on the following parameters:

i. General Conditions
ii. Nutrient Conditions
iii. Salinity
iv. Acidification Status
v. Trace Metals
vi. Organic Micropollutants- Organo-Chlorine Pesticides
vii. Macro Invertebrates (Note the other biological elements will be undertaken in the subsequent years)

All countries currently appear to be capable of analysing these parameters, albeit at differing levels. Therefore it is believed that this would be a good first baseline for all countries to achieve. The Project will aim to ensure that firstly all countries should be able to analyse these parameters to the same standard, which will include: ensuring that all the optimum analytical methods, standards quality controls, method validation software, and sampling procedures are in place.

The following years it is proposed to increase these parameters to meet each country's requirements. All the countries have some similar needs, albeit at differing levels, which are as follows:

1) Physical/Chemical Parameters

All countries are able to analyse the basic parameters well, but some have problems with the organic analysis using GLC. It is proposed that the Key Expert 3 (KE3) will visit those pertinent countries to ensure that they are able to analyse the organo-chlorine pesticides using the optimum analytical methods and standards. Furthermore, some countries have problems with the analysis of mercury, which will also be investigated and improved. In addition this training will link in with the quality control training noted below.

2) Benthic Macroinvertebrates

All countries have requested assistance on benthic macroinvertebrates on an individual basis, and it is a recommended that initially a Non-Key Expert on Benthic macroinvertebrates (NKE-BMI) would produce Guidelines identification and the calculation of the biotic indices for Macro-invertebrates. The Senior NKE in biology would then provide on-site training for sampling macroinvertebrates in the field study with target date June/July. Then finally the NKE–BMI would follow this up by visiting each country to assist with the identifications and provide the required extra individual training each laboratory requires and finally produce a guidance manual customised for each country.

3) Quality Control

The KE3 will submit training a regional workshop on quality control for the Caucasus Countries in February in Georgia. During that mission the KE3 will then continue to work in Georgia to focus on further training on method validation training using dedicated software and also improving the organo-chlorine pesticide and mercury analysis. This extra follow up training will be then carried out in each pertinent country to be completed by July 2013.

4) Sampling & Monitoring

All countries appear to have satisfactory monitoring programmes in place; however none have set up any quality control systems in place for the sampling. Therefore it is proposed that sampling guidelines including quality control procedures will be produced by April 2013 by KE3, which will be supplemented by practical sampling training during the field studies.
The BMI Expert would produce guidelines on sampling benthic macroinvertebrates and the senior NKE would carry out on–site training at the field studies in June/July. The proposed work schedule for 2013 is detailed in appendix 5.

5) Data Processing

Following the field studies and the laboratories analyses, the results will need to be processed to determine the EQRs and then the subsequent status of each water body. It is proposed that this will be carried out from September onwards and will include training and workshops including the whole Project Team.

6) Organisation

These recommendations needs to be negotiated and agreed with each country so that that the details of the tasks can be finalised according to each individual requirements.

It is recommended that to improve cooperation and integration between trans-boundary countries, River Basin Management Committees or any other bodies for the discussion between stakeholders on RBMP development should be considered. Furthermore, within these, technical working groups should be set up to combine training and resources for Hydrobiological and Chemical analysis, which could assist and improve the Project's support. However, if this is not feasible the Project will ensure that there is co-operation between the countries on technical issues by organising regional technical training workshops, which has already been implemented. In addition the transboundary JFS will also be a means of technical co-operation between countries.

Appendix 1 - Summaries of Checklists and Wish lists

Summary of Physical Chemical Check lists & Wish list

		AM	AZ	BY	G	MD	UA
	PARAMETERS	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED
№	Parameter (group)	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R
	GENERAL CONDITIONS						
	Thermal conditions						
1	Water temperature	Yes	Yes	Yes	Yes	Yes	Yes
	Oxygenation conditions						
2	Dissolved oxygen (O_2)	Yes	Yes	Yes	Yes	Yes	Yes
	Nutrient conditions						
3	Kjeldahl nitrogen / organic nitrogen	No	No	Yes	No	No	R
4	Nitrite (NO_2)	Yes	Yes	Yes	Yes	Yes	Yes
5	Nitrate (NO_3)	Yes	Yes	Yes	Yes	Yes	Yes
6	Ammonium (NH_4)	Yes	Yes	Yes	Yes	Yes	Yes
7	Total phosphorus	Yes	No	Yes	No	Yes	Yes
8	Ortho-phosphates (PO_4)	Yes	Yes	Yes	Yes	Yes	No
	Salinity						
9	Total mineralization	Yes	yes	Yes	yes	Yes	Yes
10	Chloride (Cl)	Yes	yes	Yes	yes	Yes	Yes
11	Sulphates (SO_4)	Yes	yes	Yes	yes	Yes	Yes
12	Conductivity	Yes	yes	Yes	yes	Yes	No
	Acidification status						
13	pH	Yes	Yes	Yes	Yes	Yes	Yes
	SUB-TOTAL	**12**	**11**	**13**	**11**	**12**	**10**
	OTHER PARAMETERS						
14	Biochemical oxygen demand (5 days, BOD_5)	Yes	yes	Yes	Yes	Yes	Yes

		AM	AZ	BY	G	MD	UA
	PARAMETERS	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED
№	Parameter (group)	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R
15	Chemical oxygen demand (COD), permanganate	No	No	R	No	No	No
16	Chemical oxygen demand, potassium dichromate	Yes	yes	Yes	yes	Yes	Yes
17	Total iron (Fe^{2+} and Fe^{3+})	Yes	Yes	Yes	Yes	Yes	Yes
18	Manganese	Yes	YES	Yes	YES	Yes	Yes
19	Odour (20 ^{o}C and 60 ^{o}C)	Yes	Yes	R	Yes	Yes	Yes
20	Colour	Yes	Yes	R	Yes	Yes	Yes
21	Phenols	Yes	Yes	Yes	No	Yes	Yes
	SUB TOTAL	**7**	**7**	**7**	**7**	**7**	**7**
	TRACE METALS						
22	Cadmium (Cd)	Yes	Yes	Yes	Yes	Yes	No
23	Lead (Pb)	Yes	Yes	Yes	Yes	Yes	Yes
24	Mercury (Hg)	R	No	Yes	No	R	No
25	Nickel (Ni)	Yes	Yes	Yes	Yes	Yes	Yes
26	Copper (Cu)	Yes	Yes	Yes	Yes	Yes	Yes
27	Zinc (Zn)	Yes	Yes	Yes	Yes	Yes	Yes
	SUB TOTAL	**5**	**5**	**6**	**5**	**5**	**4**
	ORGANIC MICROPOLLUTANTS						
28	1,2-Dichloroethane	R	No	R	R	R	No
29	Alachlor	R	No	R	R	R	No
30	Aldrin	R	No	Yes	R	Yes	No
31	Anthracene	R	No	Yes	R	Yes	No
32	Atrazine	R	No	Yes	R	Yes	No
33	Benzene	R	No	Yes	R	Yes	No
34	Benzo(a)pyrene)	R	R	Yes	Yes	Yes	No
35	Benzo(b)fluoranthene	R	R	Yes	Yes	Yes	No

PARAMETERS		AM	AZ	BY	G	MD	UA
		CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED
№	Parameter (group)	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R
36	Benzo(g,h,i)perylene	R	R	Yes	Yes	Yes	No
37	Benzo(k)fluoranthene	R	R	Yes	Yes	Yes	No
38	C10-13-chloroalkanes	R	R	No	R	No	No
39	Carbontetrachloride	R	R	R	R	R	No
40	Chlorfenvinphos	R	R	No	R	R	No
41	Chlorpyrifos	R	R	No	R	R	No
42	DDT total	Yes	R	No	Yes	Yes	Yes
43	Di(2-ethylhexyl)phthalate	No	R	No	No	No	No
44	Dichloromethane	R	R	No	R	R	No
45	Dieldrin	R	R	Yes	R	Yes	No
46	Diuron	R	No	No	R	No	No
47	Endosulfan	R	R	Yes	R	Yes	No
48	Endrin	R	R	Yes	R	Yes	No
49	Fluoranthene	R	R	Yes	R	No	No
51	Hexachlorobenzene	R	R	Yes	R	No	No
52	Hexachlorobutadiene	R	R	No	R	No	No
53	Hexachlorocyclohexane	R	R	Yes	R	Yes	No
54	Indeno(1,2,3-cd)pyrene	R	R	Yes	R	Yes	No
55	Isodrin	R	R	No	R	No	No
56	Isoproturon	R	R	No	R	No	No
57	Naphthalene	R	R	Yes	R	R	No
58	Nonylphenol	R	R	No	R	Ro	No
59	Octylphenol	R	R	No	R	R	No
60	para-para-DDT	Yes	R	Yes	Yes	R	No
61	Pentabromodiphenylether	No	R	No	No	No	No
62	Pentachlorobenzene	R	R	R	R	No	No
63	Pentachlorophenol	R	R	No	R	No	No

	PARAMETERS	AM	AZ	BY	G	MD	UA
		CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED	CAN BE ANALYSED
№	Parameter (group)	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R	Yes/No/R
64	Simazine	No	No	R	No	Yes	No
65	Tetrachloroethylene	R	R	R	R	No	No
66	Tributyltin compounds	R	R	R	R	No	No
67	Trichlorobenzenes (all isomers)	R	R	R	R	No	No
68	Trichloroethylene	R	R	R	R	No	No
69	Trichloromethane (Chloroform)	R	R	R	R	No	No
70	Trifluralin	No	No	No	No	No	No
	SUB TOTAL	**2**	**0**	**16**	**6**	**15**	**0**
	MORE PARAMETERS						
	Total oil and oil poduc.	Yes	Yes	Yes	Yes	Yes	Yes
	Detergents	Yes	Yes	Yes	Yes	Yes	Yes
	Transparency	Yes		Yes	Yes		
	Total suspended solids	Yes	Yes	Yes	Yes	Yes	Yes
	Hardness	Yes	Yes	Yes	Yes	Yes	Yes
	Calcium	Yes	Yes	Yes	Yes	Yes	Yes
	Alkalinity	Yes	Yes	No	Yes	Yes	Yes
	TOC	Yes		No			
	Arsenic	Yes	Yes	Yes			
	Selenium	Yes	Yes	Yes			
	Lithium	Yes		Yes			
	Berilium	Yes		Yes			
	Strontium	Yes		Yes			
	Barium	Yes		Yes			
	Boron	Yes		Yes			
	Aluminium	Yes		Yes			
	Molybdonim	Yes		Yes			

		AM	AZ	BY	G	MD	UA
	PARAMETERS	**CAN BE ANALYSED**	**CAN BE ANALYSED**	**CAN BE ANALYSED**	**CAN BE ANALYSED**	**CAN BE ANALYSED**	**CAN BE ANALYSED**
№	**Parameter (group)**	**Yes/No/R**	**Yes/No/R**	**Yes/No/R**	**Yes/No/R**	**Yes/No/R**	**Yes/No/R**
	Vanadium	Yes		Yes			
	Titanium	Yes		Yes			
	Chromium	Yes		Yes			
	Tin	Yes		Yes			
	Potassium	Yes		Yes	Yes	yes	
	Silver	Yes		Yes			
	SUB TOTAL	**23**	**8**	**21**	**8**	**7**	**6**
	GRAND TOTAL	**49**	**31**	**62**	**37**	**46**	**27**

Yes= Yes this analysis and monitoring is currently undertaken
No= No this analysis and monitoring is not currently undertaken and is not feasible
R= Training for this analysis and monitoring has been requested and is feasible

Summary of Checklist/ Wish List for Hydrobiological Analysis for the Six Countries

		AM				AZ				BY				G				M				UA			
	PARAMETERS	C	A	Bio	EQR	C	A	Bio	EQR	C	A	Bio	EQR	C	A	Bio	EQR	C	A	Bio	EQR	C	A	Bio	EQR
1	benthic invertebrates	Y	Y	R	R	Y	Y	R	R	Y	Y	Y	F	Y	Y	R	R	Y	Y	Y	R	R	R	R	R
2	phytoplankton	R	R	R	R	R	R	R	R	Y	Y	Y	F	Y	R	R	R	Y	Y	Y	R	N	N	N	N
3	phytobenthos	R	R	R	R	R	R	R	R	Y	Y	Y	F	R	R	R	R	Y	Y	R	R	N	N	N	N
4	macrophytes	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	Y	R	R	R	N	N	N	N
5	fish fauna	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

C= Composition
A= Amount
Bio= Biomass
Y= Yes this analysis and monitoring is currently undertaken
N= No this analysis and monitoring is not currently undertaken and not feasible
R= Training for this analysis and monitoring has been requested and is feasible
F= It is feasible that this analysis and monitoring could be undertaken

Appendix 2 - Table 1 Summary of Requirements

Country / Component	Armenia	Azerbaijan	Belarus	Georgia	Moldova	Ukraine
Micro-pollutants	Training on GLC Analysis to assist on current analysis & Determine more parameters	Supplementary training for new GC/MS to analyse more parameters	Assistance in the analysis of more parameters	Supplementary training for new GC/MS to analyse more parameters especially in Peak identification	Training on GLC Analysis to assist on current analysis & Determine more parameters	Introductory Training of GLC Analysis for the analysis of chlorinated Pesticides
Hydrobiological	Advanced Training on identification of Benthic Macro-invertebrates. Advanced Training on identification of PhytoBenthos. Training on Phytoplankton	Advanced Training on identification of Benthic Macro-invertebrates. Advanced Training on identification of PhytoBenthos.	Advanced Training on identification of Benthic Macro-invertebrates, phytoplankton, & Phytobenthos, with Western Identification Keys Training on the identification Macrophytes	Advanced Training on identification of Benthic Macro-invertebrates. Advanced Training on identification of PhytoBenthos. Training on the identification Macrophytes .	Supplementary Training on: of Benthic Macro-invertebrates, PhytoBenthos, Phytoplankton.	Introductory Training for Training on: of Benthic Macro-invertebrates,
	Training on the calculation of EQRs	Training on the calculation of EQRs & Biotic Indices	Supplementary Training on the calculation of EQRs	Supplementary Training on the calculation of EQRs	Training on the calculation of EQRs	Training on the calculation of EQRs
Sampling	Supplementary Training submitted on-site	Supplementary Training submitted on-site	Supplementary Training submitted on-site during Field	Supplementary Training submitted on-site during Field	Supplementary Training submitted on-site	Introductory Training submitted on-site during

	during Field Study for sampling of: Benthic Macro-invertebrates, PhytoBenthos, Phytoplankton Physical/Chemical samples	during Field Study for sampling of: Benthic Macro-invertebrates, PhytoBenthos, Phytoplankton Physical/Chemical samples	Study for sampling of: Benthic Macro-invertebrates, PhytoBenthos, Phytoplankton Physical/Chemical samples	Study for sampling of: Benthic Macro-invertebrates, PhytoBenthos, Phytoplankton Physical/Chemical samples	during Field Study for sampling of: Benthic Macro-invertebrates, PhytoBenthos, Phytoplankton. Physical/Chemical samples	Field Study for sampling of: Benthic Macro-invertebrates, Physical/Chemical samples
	Sampling Guidelines	Sampling Guidelines	Sampling Guidelines	Sampling Guidelines	Sampling Guidelines	Sampling Guidelines
Quality Control	Application of internal analytical quality controls.	Application of internal analytical quality controls.		Application of internal analytical quality controls.	Application of internal analytical quality controls.	Application of internal analytical quality controls.
	Procedures and software for validating analytical methods	Procedures and software for validating analytical methods	Procedures and software for validating analytical methods	Procedures and software for validating analytical methods	Procedures and software for validating analytical methods	Procedures and software for validating analytical methods
	Development of International Accreditation Procedures	Development of International Accreditation Procedures		Development of International Accreditation Procedures	Development of International Accreditation Procedures	
	Laboratory Auditing Procedures	Laboratory Auditing Procedures	Laboratory Auditing Procedures	Laboratory Auditing Procedures	Laboratory Auditing Procedures	Laboratory Auditing Procedures
	Introduction to Laboratory Information Management Systems (LIMS	Introduction to Laboratory Management Systems (LIMS)	Introduction to Laboratory Information Management systems (LIMS)	Introduction to Laboratory Information Management systems (LIMS)	Introduction to Laboratory Information Management systems (LIMS)	Introduction to Laboratory Information Management Systems (LIMS)

Additional Issues	TOC Analysis Supplementary assistance			Support the NEA Laboratory to resolve the problems with the AAAs and install the Luminescence Spectrophotometer		Support the Dnieper River Basin Management Council to install the Foss Kjeldahl Nitrogen (2300) analyser & the Leica Microscope (MZ75)
Comments	Link the training with the GIZ Biodiversity Project	Link the training with the Caspian Sea Monitoring Department	Support the RCACFEP laboratory to be the a training centre for HPLC analysis	Link the training with the Batumi Laboratory	Support the Hydromet Lab as a training centre for International Accrediatation.	Link the training with the the National Academy of Sciences of Ukraine, Institute of Hydrobiology

Appendix 3 - List of Hydrobiological Identification Keys Requested by Belarus (RCRCEM)

1. Aquatic Plants in Britain and Ireland
CD Preston and Jane Croft
365 pages, 72 line illus, 200 distribution maps
Apollo Books (€48)

2. Distribution and Ecological Preferences of European Freshwater Organisms, Volume 1: Trichoptera
Series: Distribution and Ecological Preferences of European Freshwater Organisms 1
W Graf, J Murphy, J Dahl, C Zamora-Munoz and MJ Lopez-Rodriguez
388 pages, Pensoft Publishers, Distributed by NHBS (€108)

3. Distribution and Ecological Preferences of European Freshwater Organisms, Volume 2: Plecoptera
W Graf, AW Lorenz, JM Tierno de Figueroa, S Lucke and MJ Lopez-Rodriguez (€65)

4. Distribution and Ecological Preferences of European Freshwater Organisms, Volume 3: Ephemeroptera
A Buffagni, M Cazzola and MJ Lopez-Rodriguez
Paperback | Sep 2009 | #182588 | ISBN-13: 9789546425089 ($85/€66).

5. Chironomidae Larvae, Volume 1 General Ecology and Tanypodinae
Henk J Vallenduuk and Henk K M Moller Pillot
Hardback | Jul 2007 | #169169 | ISBN-13: 9789050112598 (€78)

6. Irudinei (Hirudinea) Alessandro Minelli
Paperback | Dec 1977 | #71523 (€16)

7. Chironomidae: The Biology and Ecology of Non-Biting Midges
P Armitage, PS Cranston and PSL Pinder
Paperback | Dec 1994 | #32905 | ISBN: 041245260X (€491)

8. Ephemeroptera and Plecoptera Biology-Ecology-Systematics
Peter Landolt and Michel Sartori
Hardback | Dec 1997 | #68986 | ISBN: 2940187010 (€58)

9. British Fresh-Water Copepoda, Volumes I-III
Robert Gurney
Compact Disc | Dec 2005 | #157032 | ISBN: 1904690335 (€84)

10. A Key to the Case-bearing Caddis Larvae of Britain and Ireland
FBA Scientific Publication No. 61
I D/ Wallace B Wallace and G N Philipson
Paperback | Dec 2003 | #144636 | ISBN: 0900386703 (€36)

11. Field Guide to the Dragonflies of Britain and Europe
Klaas-Douwe B Dijkstra and Richard Lewington
Paperback | Dec 2006 | #159516 | ISBN: 0953139948 (€27)

12. Britain's Dragonflies: A Field Guide to the Damselflies and Dragonflies of Britain and Ireland
Dave Smallshire and Andy Swash
Paperback | Nov 2009 | #180949 | ISBN-13: 9781903657294 (€22)

Requested Keys for Phytoplankton

1) Süsswasserflora von Mitteleuropa, Bd 19/1: Cyanoprokaryota: Chroococcales. (120 Euro)

http://www.nhbs.com/susswasserflora_von_mitteleuropa_bd_191_cyanoprokaryota_tefno_32955.html

2) Süsswasserflora von Mitteleuropa, Bd 19/2: Cyanoprokaryota: 2.Teil: Oscillatoriales. (136 euro)

http://www.nhbs.com/susswasserflora_von_mitteleuropa_bd_192_cyanoprokaryota_tefno_128079.html

3) Süsswasserflora von Mitteleuropa, Bd 6: Dinophyceae (Dinoflagellida).(89 Euro)

http://www.nhbs.com/susswasserflora_von_mitteleuropa_bd_6_dinophyceae_dinoflagellida_tefno_32969.html

4) Süsswasserflora von Mitteleuropa, Bd 18: Charales (Charophyceae). (84 Euro)

http://www.nhbs.com/susswasserflora_von_mitteleuropa_bd_18_charales_charophyceae_tefno_32954.html

5) Süsswasserflora von Mitteleuropa, Bd 3: Xanthophyceae 1. (125 Euro)

Appendix 4 - Final Agenda for the Workshop in Minsk for Laboratory Accreditation and Quality Control

Technical Assistance & Capacity Building	
Course	**Laboratory Accreditation and Quality Control**
Date	11th December 2012 (1 day)
Objectives	Introduction to the procedures and techniques required for international accreditation for water laboratories
Target group	Staff involved in River Basin Management Monitoring
Materials	Computer PowerPoint Presentations with Projector, Flip Charts, supporting information and software
Location	Hydromet, Minsk, Belarus

DAY 1			
Time	**Method**	**Content**	**Lecturer**
9.00 -9.15		Welcome to delegates	Oleg Maksuta, Director Departament of hydometeorology
9.15-9.45		Introduction to the Project and the Training Workshop	Andriy Demydenko, Team Leader Project "Environmental Protection of International River Basins"
9.45 – 10.30	Lecture 1	Introduction to Laboratory Accreditation 17025	Michael Jackman, Project Biology & Ecology Expert
10.30– 10.45		*Coffee Break*	
10.45- 11.45	Lecture 2	Production of Standard Operating Procedures (SOPs) & Laboratory Information Management Systems (LIMS) Introduction to Analytical Quality Control, Precision and Accuracy	Michael Jackman, Project Biology & Ecology Expert
11.45- 12.30		Questions and Discussions	Alexandr Stankevich
12.30 – 13.30		*Lunch*	
13.30 – 14.30	Lecture 3	Validation of Analytical Methods & Associated Software	Michael Jackman, Project Biology & Ecology Expert
14.30 – 15.00	Lecture 4	Guidance on the classification Benthic Macro Invertebrate by applying customised software	OLena Leititske, Expert Hydrobiologist
16.00 – 16.15		*Coffee Break*	
16.15 –	Lecture	Sampling Benthic Macro Invertebrates & associated software	OLena Leititske, Expert Hydrobiologist

16.45	5		
16.45 – 17.30		Questions and Discussions	Alexandr Stankevich

Appendix 5 - Draft Hydrobiological & Chemical Monitoring Training Work Schedule 2013 proposed in December 2012

Month	1	2	3	4	5	6	7	8	9	10	11	12
Training and improving on GLC Analysis for organochlorine pesticides & AAS analysis of Mercury		*		*		*						
Training on identification of Benthic Macro-invertebrates.								*	*	*		
Training on the calculation of EQRs									*	*	*	*
Supplementary Training submitted on-site during Field Study for sampling of: Benthic Macro-invertebrates & Physical/Chemical samples							*	*	*			
Sampling Guidelines for Benthic Macro invertebrates & Physical Chemical samples				*	*	*						
Application of internal analytical quality controls		*		*		*						
		*		*		*						
Procedures and software for validating analytical methods		*		*		*						
		*		*		*						
Development of International Accreditation Procedures		*		*		*						
		*		*		*						
Introduction to Laboratory Information Management Systems		*		*		*						