COMPLEX AND INNOVATIVE MONITORING SYSTEM FOR RIVER BASINS

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CONTENT

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II. TRIPLE HELIX concept (university – industry – government)

III. METHODOLOGY OF PLANNING

- Mapping of pollution sources; Selection of measurement spots
- Choosing measurement parameters; Measurement frequency; Measurement toolkits

IV. LOGICAL ARCHITECTURE OF EWS

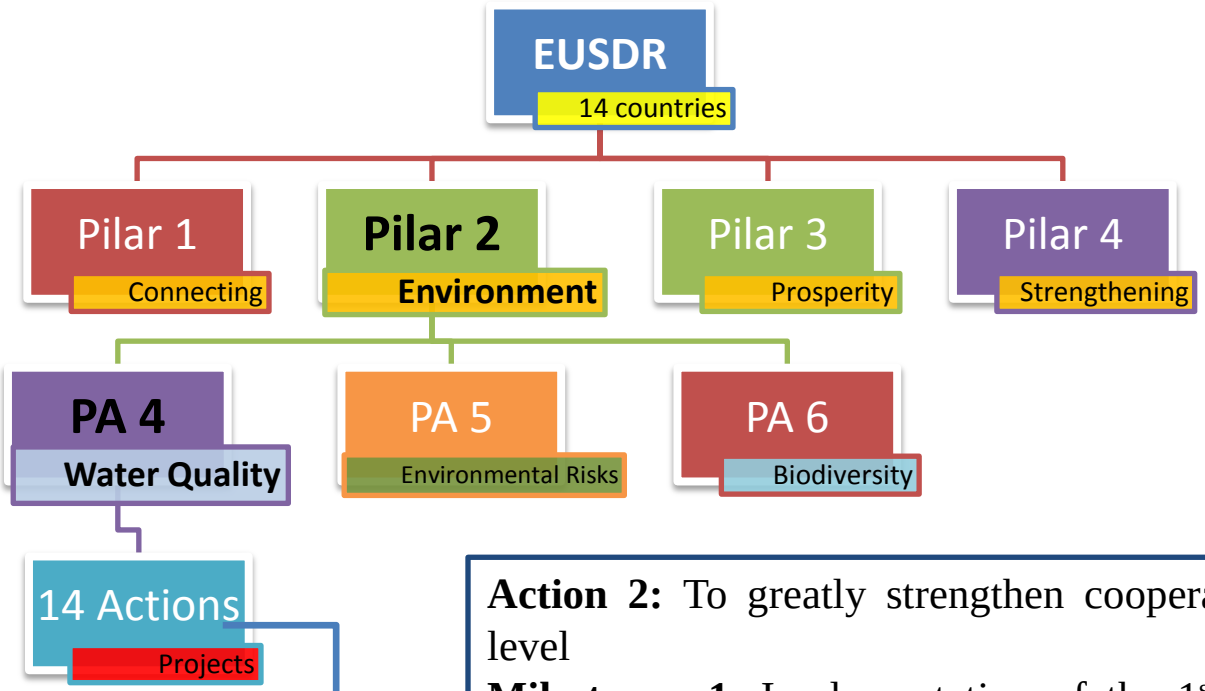
- Devices, Front-End, Databases, Users, Communication system
- Alert system, External connections

V. BIOLOGICAL MONITORING

- Emerging priority substances; Endocrine disruptors; Effect directed analysis and monitoring
- Brand new concept (digital holographic microscopy - DHM

VI. CONCLUSIONS

I. EUROPEAN UNION STRATEGY FOR THE DANUBE REGION (EUSDR)



Action 2: To greatly strengthen cooperation at sub-basin level

Milestone n1: Implementation of the 1st Integrated Tisza River Basin Management Plan

2. PROJECT: EARLY WARNING WATER QUALITY MONITORING SYSTEM ON TRANSBOUNDARY RIVERS

ON-LINE MONITORING - EARLY WARNING SYSTEM (EWS)

ON-LINE MONITORING

- Indication of short-term and long-term changes in water quality parameters to establish a basis for water management measures and actions (prevention).
- Early detection of incidents and illegal discharges
- Continuous data collection for decision making

*A **new analytical monitoring technology** is **required** to discover pollution (peaks) discharges which last **only for about 0.5-2 hours mostly at night and during the weekends.***

EARLY WARNING SYSTEM (EWS)

Needs/Requirements

- River basin (or catchment area)
- Integrated network
- Modular/extended services
- Standardization
- Alert system
- Cost efficient

Opportunities

- New measurement technology (sensors, on-line analyzer)
- Information Communitation Technology (ICT) (WEB2, Wireless, integrated smartphone, tablet)

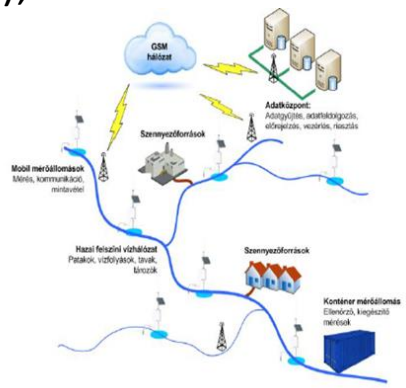
It is an effective integrated system used for:

- developing monitoring technology,
- analyzing, interpreting data and
- utilizing the results to make decisions to protect people.

CORRELATION OF EARLY WARNING SYSTEM TO ELEMENTS

Main aspects of river basin network monitoring:

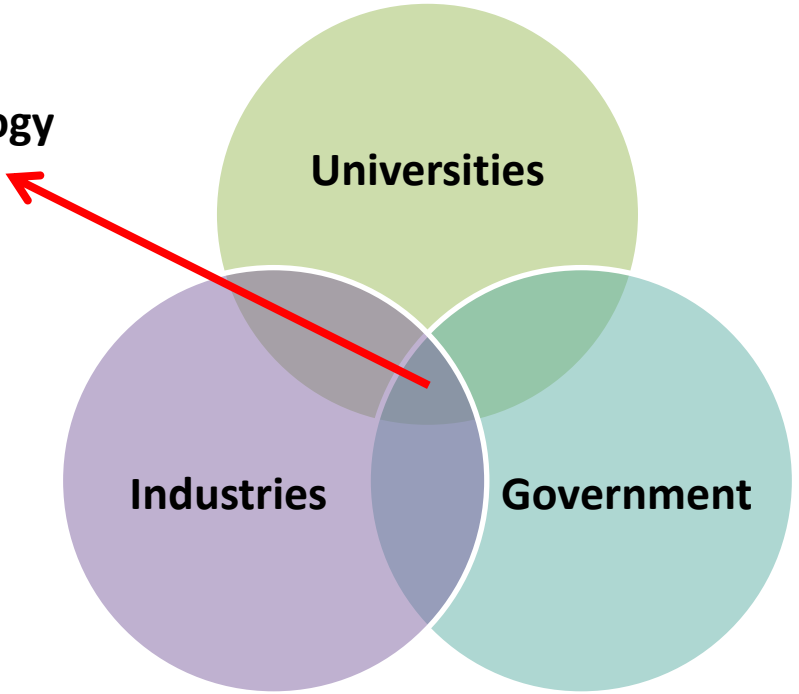
- ✓ Application of adequate international standard methods
- ✓ Assessment of existing monitoring system
- ✓ Description of river basin (or catchment area) -background information
- ✓ WFD typology of water bodies (high-, mid-, lowland altitude)
- ✓ Identification of pollution sources (hot spots; diffuse sources)
- ✓ Determination of pollutants (physical-chemical, biological parameters); optimization of chemical parameters (indicator component)
- ✓ State of tributaries
- ✓ Assignment of sampling sites and water sampling methods
- ✓ Power supply /power consumption
- ✓ Optimization of sustainable and maintenance cost



II. TRIPLE HELIX MODEL

Promoting innovation through collaborations between national businesses (industries, IT experts), universities and government.

Science and Technology Parks -STPs



- The three major areas in the development of a knowledge center are universities, industry and the government.
- The development of a knowledge economy requires a thorough understanding of the dynamic interplay between research, invention, innovation, and economic growth.

III. METHODOLOGY OF PLANNING

1	**Collection of background information**	**Integration of EWS system** - **Existing monitoring systems** - **WFD monitoring sites and results.**
2	Mapping of pollution sources in the watershed	Pollution from point and diffuse sources: Hot spots: Sewage treatment plant, industrial and urban wastewater discharges, thermal spa effluents Diffuse pollution sources: agricultural areas, farm runoffs
3	Selection of measurement spots	After point sources, at connection of tributaries
4	Choosing measurement parameters	Knowing the sources of pollution we can decide, which parameters are important from the perspective of setting up an alarm system costumized to the local hazards. These parameters can be physical (conductivity, heat), or chemical (pH, contentrations of organic or inorganic compounds, etc) tailored to the local needs. Cost effectiveness of choosing the appropriate parameters is also of importance,
5	Measurement frequency	Mixture of pollutants, pollutant plume alarm may influence measurement, bringing the need of more frequent measurements. Chemical requirements and energy supply can also modify frequency, when cost effectiveness is important.
6	Measurement toolkits	Measurement methods and tools fitting to WFD typology (high or low altitude streams, rivers, lakes, etc.) and local needs, legal regulations.

METHODOLOGY OF PLANNING

1	Collection of background information	Integration of EWS system - Existing monitoring systems - WFD monitoring sites and results.
2	**Mapping of pollution sources in the catchment area (watershed)**	**Pollution from point and diffuse sources: Hot spots: Waste Water Treatment Plant, industrial and urban wastewater discharges, thermal spa effluents Diffuse pollution sources: agricultural areas, farm runoffs**
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MODULAR SYSTEM –Physical and chemical parameters

Standard parameters

- temperature, pH-level, conductivity, dissolved oxygen, turbidity, chlorophyll-a, blue algae, COD,TOC, PO_4^{3-}, NH_4^+, NO_2^-, NO_3^-

EXTENDED

Extended parameters:

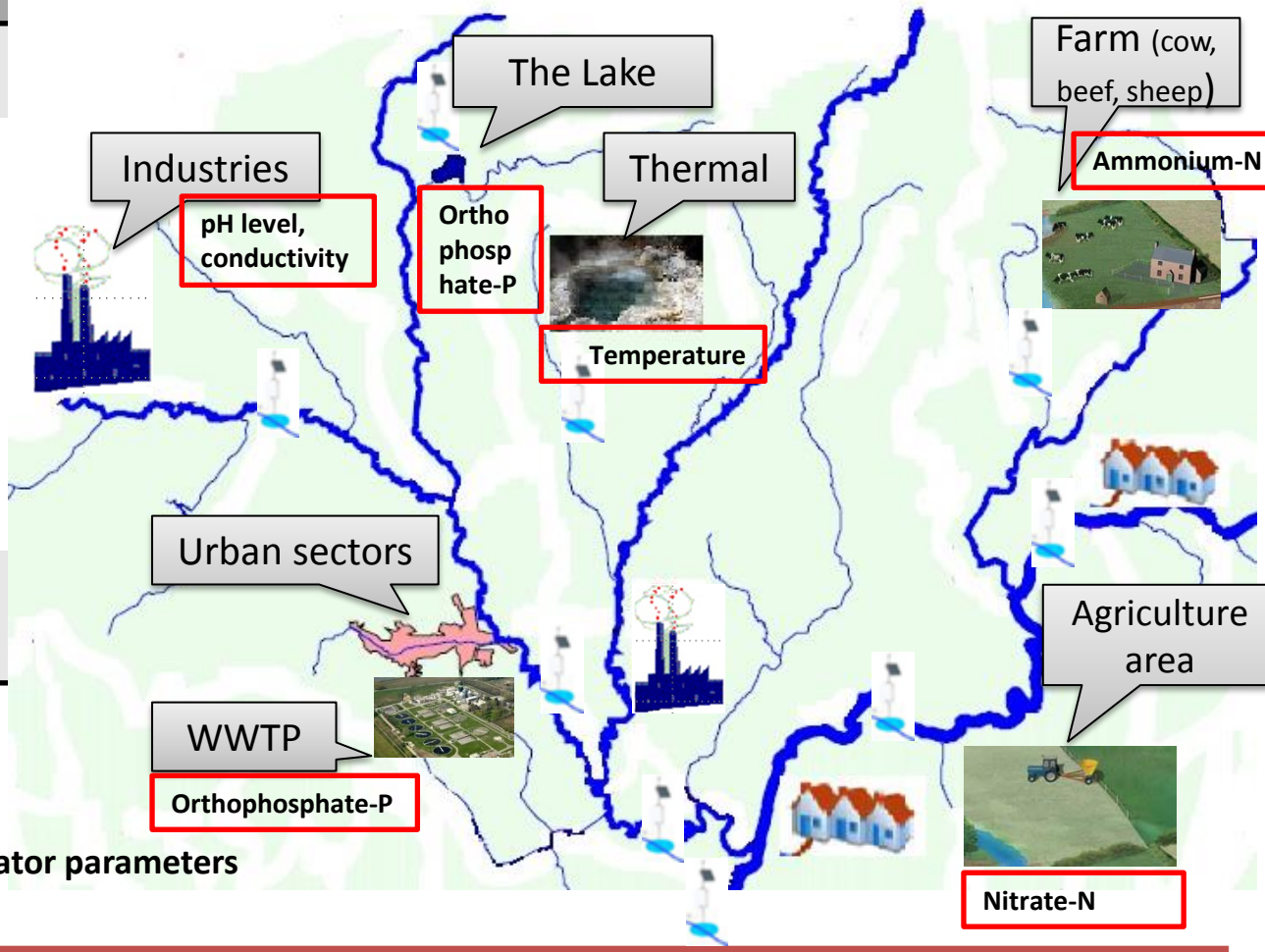
Poliaromatic hydrocarbon (PAH), SO_4^{2-}, Na^+, Ca^{2+}, Mg^{2+}, K^+, Zn, Cd, Co, Fe, Pb, Cu, Ni, Mn, Cr, BTX, pesticides, pharmaceutics residues
Special parameter – radiation measurement

INTEGRATED

- Physical-chemical parameters have to measured by Water Framework Directive.
- On-line monitoring for plankton constituents of surface water (digital holographic microscopy – DHM).

EWS NETWORK MONITORING in RIVER BASIN

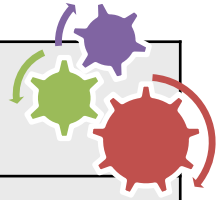
Pollutant sources	Indicator parameters
Industries	pH level, conductivity, chloride, toxicity)
Urban sectors	**Waste Water Treatment Plant (WWTP)** Ammonium-N, orthophosphate-P, chlorophyll-a **Thermal** (temperature) **Discharge of drainage and the bus station** (oil pollutant, PAH)
Agriculture area	Farm area (nitrate-N) Farm runoff (ammonium-N)



Monitoring stations

Measure of chemical indicator parameters

METHODOLOGY OF PLANNING



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MEASUREMENT TOOLKITS

MOBILE WATER QUALITY STATION

Equipment of each monitoring station are installed as per customer demand.

- digital and analog sensors
- UV and fluorescence probe
- ion selective electrode
- different analyser
- flow meter
- transportable refrigerated sampler

WATER MONITORING BUOY

Buoy can be used digital and analog sensors, ion selective electrode UV and fluorescence probe.
Energy supply: accumulator, solar collector
Limit value: weight, volume

ROBOTIC ANALYSER SHIP (small ship with remote control)

Determination of water quality in the Lake.

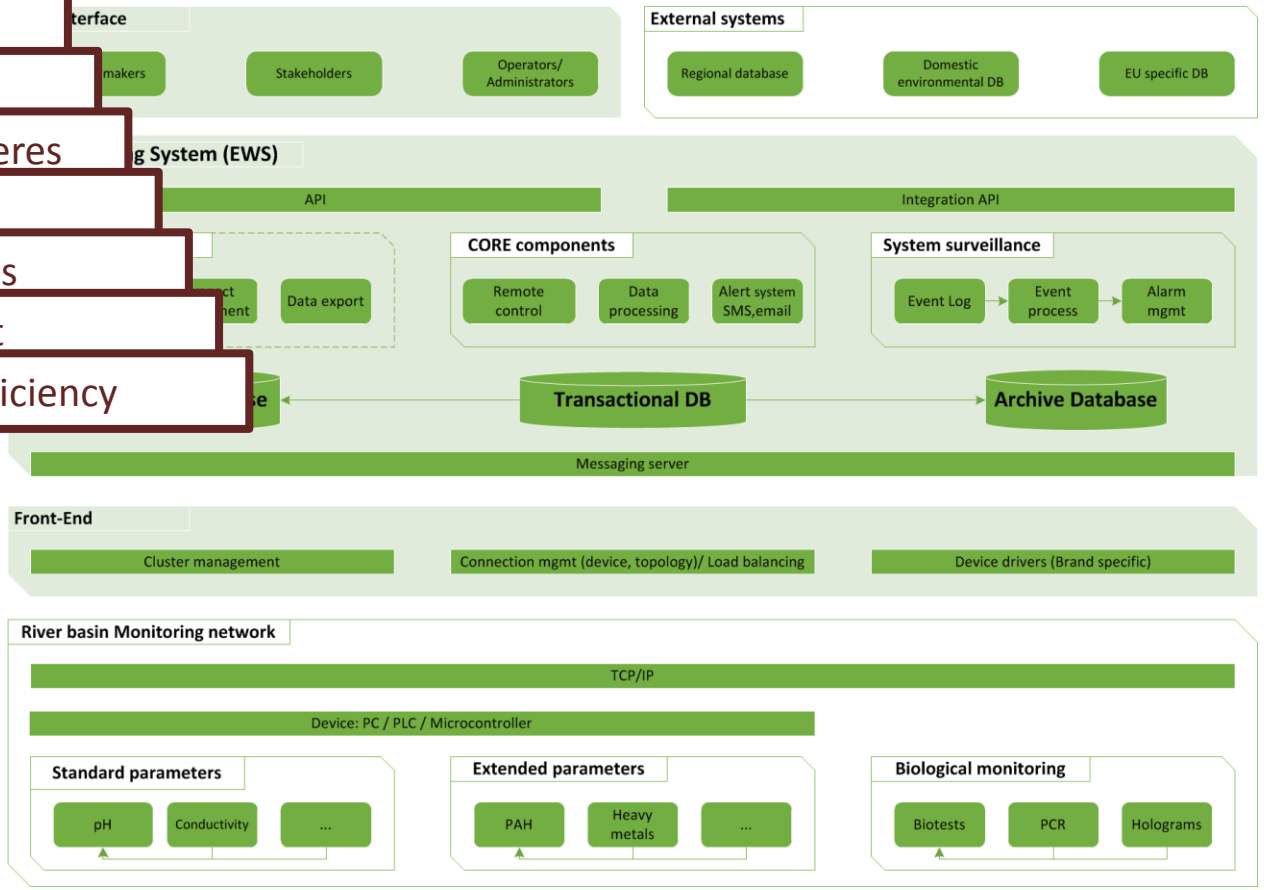
The user can be control manual/automatic operation (GPS coordination).

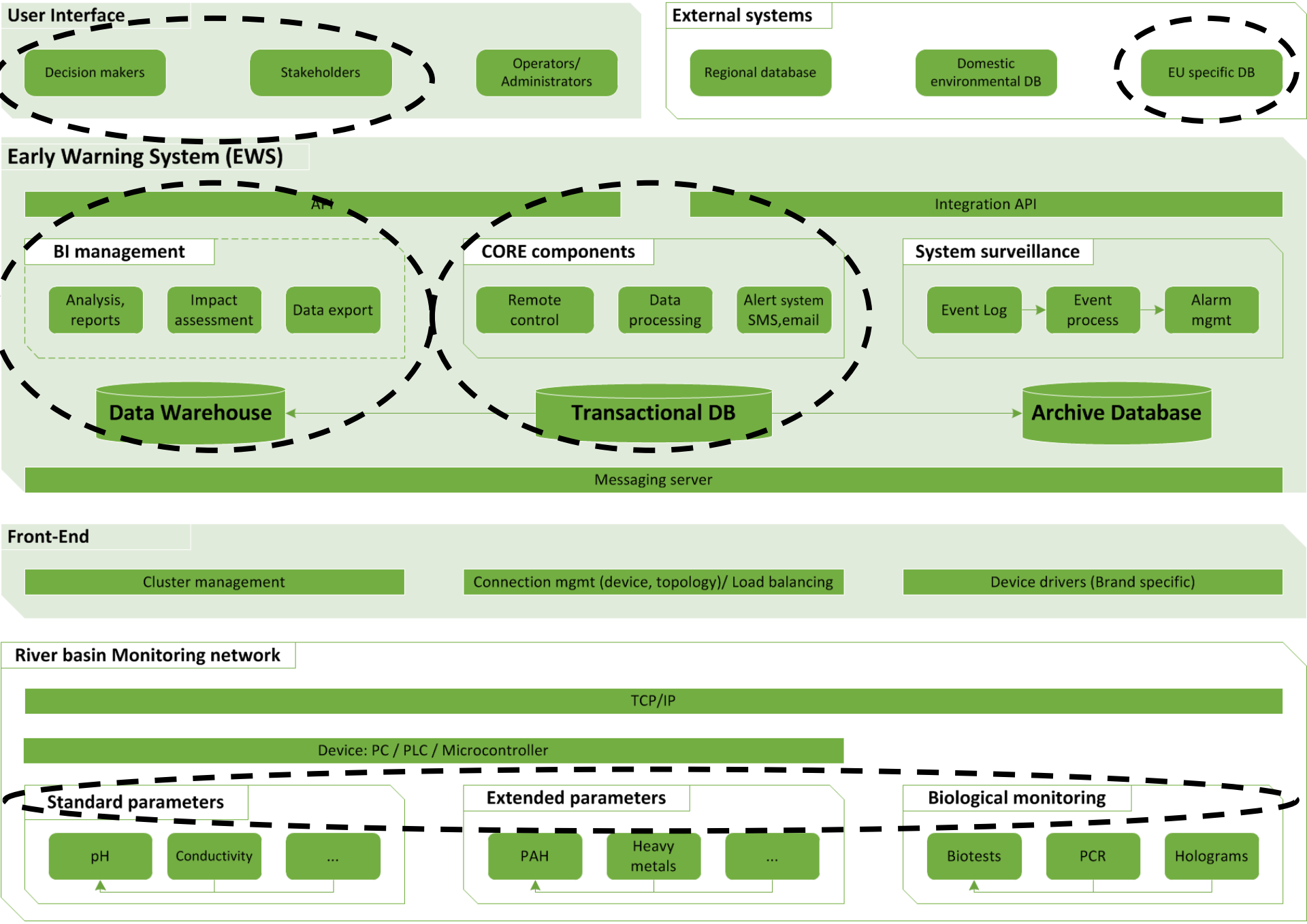
Sampling: from 0 to 10 m depth.

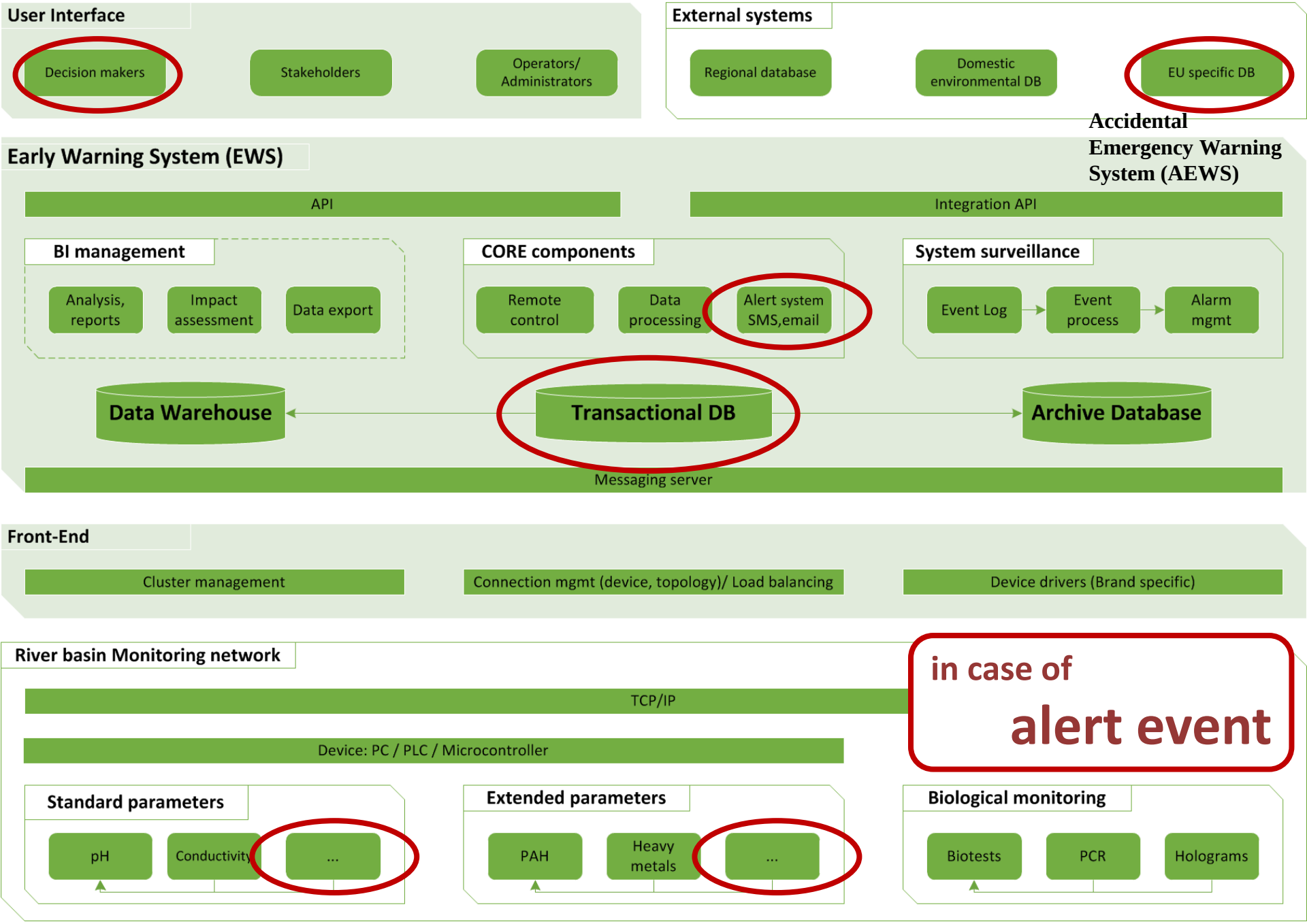
Max. water sample (6 liter)

IV. Logical architecture diagram of EWS

- River basin
- Network
- Indicator parameteres
- Modularity
- Standards
- Alert
- Cost efficiency




User Interface
Decision makers
Stakeholders
Operators/ Administrators
External systems
Regional database
Domestic environmental DB
EU specific DB
Early Warning System (EWS)
API
Integration API
BI management
Analysis, reports
Impact assessment
Data export
CORE components
Remote control
Data processing
Alert system SMS,email
System surveillance
Event Log
Event process
Alarm mgmt
Data Warehouse
Transactional DB
Archive Database
Messaging server
Front-End
Cluster management
Connection mgmt (device, topology)/ Load balancing
Device drivers (Brand specific)
River basin Monitoring network
TCP/IP
Device: PC / PLC / Microcontroller
Standard parameters
pH
Conductivity
...
Extended parameters
PAH
Heavy metals
...
Biological monitoring
Biotests
PCR
Holograms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Integration API
BI management
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Impact assessment
Data export
CORE components
Remote control
Data processing
Alert system SMS,email
System surveillance
Event Log
Event process
Alarm mgmt
Data Warehouse
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Front-End
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Device drivers (Brand specific)
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in case of
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V. BIOLOGICAL MONITORING

EMERGING PRIORITY SUBSTANCES IN SURFACE WATERS

2000/60/EC (WFD) + 2008/105/EC (EQS)

Revision (Regulation REACH No1907/2006)

33+12 substances to be monitored

3 pharmaceutical substances on watch list

(diclofenac, 17-beta-estradiol, 17-alpha-ethinylestradiol)

ENDOCRINE DISRUPTORS

- US EPA – 100 thousand chemicals should be tested if endocrine disrupting effect were possible
- EEA – Europe is a producer of chemicals in 40% of the world

Cannot be tested all of them by chemical analyses

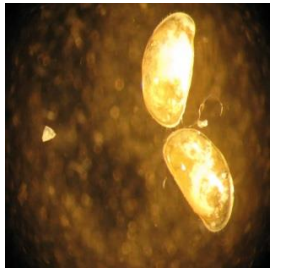
EFFECT DIRECTED ANALYSES AND MONITORING

- Impossibility of chemical analyses for more thousands substances
- In water always a mixture of unknown and known substances
- Biological effects (additive, synergic, antagonistic joint effects)

Where biological effect - there targeted chemical analyses, but only there

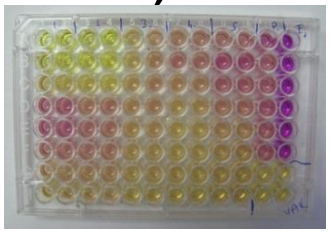
BIOLOGICAL MONITORING

- Standardised ecotoxicological biotests on every trophic level (on-line systems if possible) – less sensitive
- Completed by genotoxicity(SOS chromotest)
- Sediment direct contact test (Ostracod test)



BIOLOGICAL MONITORING 2 (molecular level)

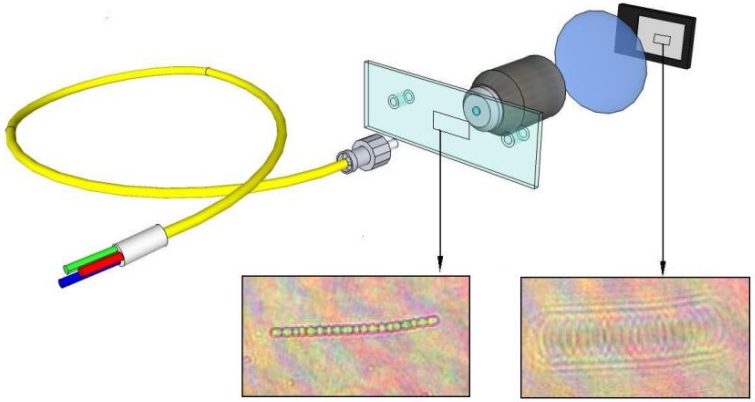
- Detection of oestrogenic, androgenic effect by recombinant yeast strains (YES, YAS – BLYES, BLYAS, BLYR)



- Real-time PCR for vitellogenin gene expression measurement in fish and mollusc species
- Ecotoxicogenomics – Whole genome DNA microarray analysis
  Daphnia pulex - water
  Caenorhabditis elegans – sediment

ONE EXAMPLE: ON-LINE MONITORING FOR PLANKTON CONSTITUENTS OF SURFACE WATER

- Brand new concept (digital holographic microscopy - DHM) developed in HAS CARI

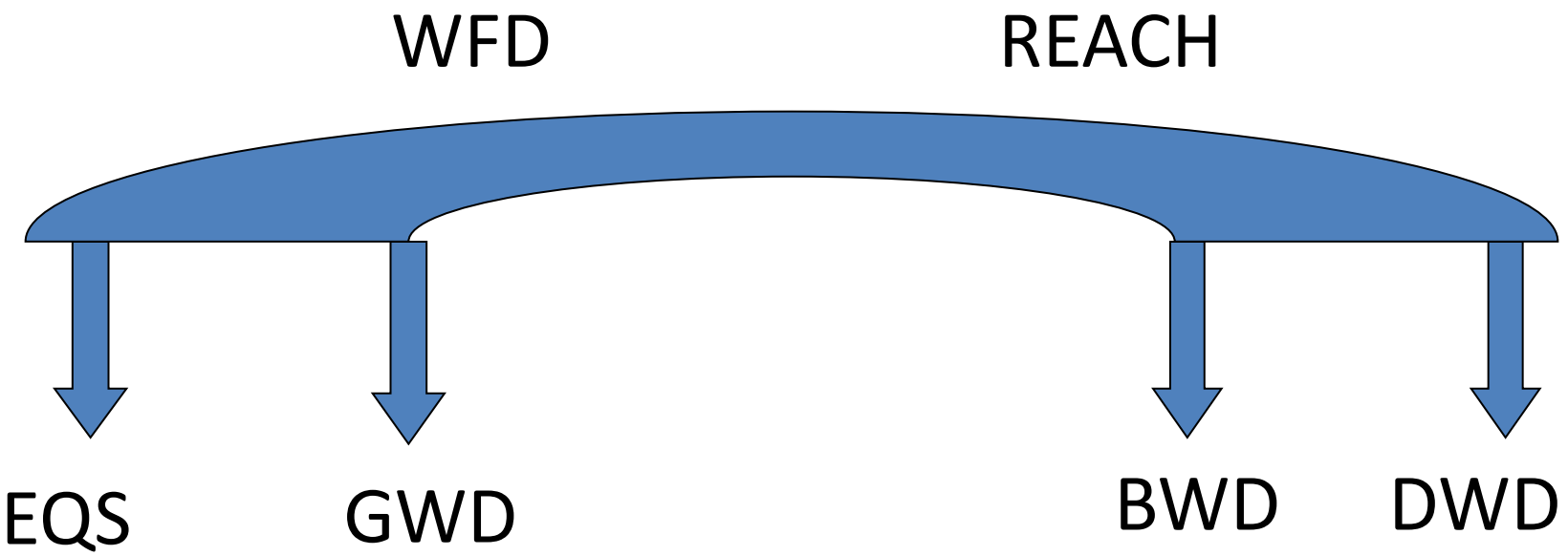


- Holograms converted digitally into pictures giving in-time and real time data on plankton taxa because of flow through chamber

CONCLUSIONS

- On-line monitoring is the way for getting in-time and real-time data on water quality
- EDA is to be used for emerging challenges of chemical pollution in surface water to reduce the cost of targeted chemical analyses (GC-MS/MS-MS/HRMS, etc.)
- Brand new, sensitive and group-selective methods should be involved into the monitoring to find the hot spots and to describe water quality
- Interaction between the legal background and the new challenges is to be solved

CONCLUSIONS 2



DEPENDENCE AND INTERACTIONS AMONG LEGISLATIONS

Thank you for your attention !

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