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Ecological flow estimation in Latvian – Lithuanian Transboundary river basins (ECOFLOW) LLI-249

REVIEW
OF NATIONAL LEGISLATION
IN THE FIELD OF WATER USES

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Abbreviations

AWB	Artificial Water Body;
E-flow	Ecological Flow;
ECOSTAT	WFD CIS working group on Ecological Status;
EEA	European Environment Agency;
EIA	Environmental Impact Assessment;
EU	European Union;
GD	Guidance Document;
GWB	Groundwater Body;
HMWB	Heavily Modified Water Body;
HP	Hydropower;
HPP	Hydropower Plant;
LT	Lithuania;
LV	Latvia;
MoE	Ministry of Environment;
RBMP	River Basin Management Plan;
RHMI	River Hydromorphological Index;
SEA	Strategic Environmental Assessment;
WB	Water Body;
WFD	Water Framework Directive;
WFD CIS	Water Framework Directive Common Implementation Strategy.

I. INTRODUCTION

The legal framework for implementation of Ecological flow in the EU is set out in the WFD and in the Birds and the Habitats Directives. WFD main objective is to prevent deterioration of the status of water bodies and to protect, enhance and restore all water bodies, with the aim to achieve good ecological status [1]. The aim of the Birds and Habitats Directives is to conserve important habitats and species [2, 3].

Flow regime is critical for most of the aquatic ecosystems, having strong impact on the conservation status of water-dependent habitats and species.

The WFD and the Birds and Habitats Directives set binding objectives on protection of water-dependent ecosystems. These objectives can only be reached if supporting flow regimes are guaranteed. Therefore, consideration of Ecological flow has to be included in the national legal frameworks of the EU Member States.

II. EU REQUIREMENTS WITH REGARD TO E-FLOW

Aside from the WFD and the Birds and the Habitats directives, main pieces of EU legislation, describing and explaining in detail the necessity and the concept of Ecological flow, are: the Blueprint to Safeguard Europe's Water Resources; WFD CIS Guidance Document No. 31 “Ecological flows in the implementation of the Water Framework Directive”; and WFD CIS Guidance Document No. 34 “On the application of water balances for supporting the implementation of the WFD”.

Another important document in connection with the concept of Ecological flow is the report of the WFD CIS working group ECOSTAT on Common understanding of using mitigation measures for reaching good ecological potential for heavily modified water bodies impacted by water storage.

2.1. THE BLUEPRINT TO SAFEGUARD EUROPE'S WATER RESOURCES

The Blueprint to Safeguard Europe's Water Resources [4] aims to tackle the obstacles which hamper action to safeguard Europe's water resources.

The document underlines that the main causes of negative impacts on water status are interlinked and include climate change; land use; economic activities such as energy production, industry, agriculture and tourism; urban development and demographic change. Pressure from these causes takes the form of pollutant emissions, water over-use (water stress), physical changes to water bodies and extreme events such as floods and drought.

The Blueprint stresses that, according to the EEA State of Water report and the European Commission's assessment of the 1st RBMPs, good ecological status is achieved only in 43 % of the freshwater bodies reported in 2010. Additional measures included in the RBMPs are expected to increase this to 53 % by 2015. It appears that the most widespread pressure on ecological status in the EU originates from hydromorphological pressures to water bodies which affect about 40% of the WBs, like dams for hydropower or embankments for flood protection. The Blueprint reminds about known ways to address these pressures. Where existing structures break river continuity and impact fish migration, mitigation measures such as fish passes and fish lifts should be standard practice. It is important to progressively retrofit existing structures in order to improve water status.

When there are plans to make significant new changes to water bodies, SEA should be made in addition to EIA. For instance, national and regional plans to develop hydropower should be subject to a SEA to identify where the dams could be located to minimise negative environmental effects, or to compare the plans with alternative renewable energy sources development.

There is a need in many EU river basins to put quantitative water management on a more solid foundation: namely to identify the **ecological flow**, i.e. the amount of water required for aquatic ecosystems to continue to thrive and provide the services people rely upon. Fundamental to this is the recognition that water quality and quantity are inevitably related with the concept of "good status".

It is possible and necessary for Member States to improve implementation of the WFD and reduce hydromorphological pressures by restoring river

continuity. We must respect the needs of nature: the ecological flow. The Blueprint proposed the development of a guidance document under the WFD that would provide an EU definition of ecological flow and a common understanding of how it should be estimated.

2.2. GUIDANCE DOCUMENT NO. 31 ON ECOLOGICAL FLOW

WFD CIS Guidance Document No. 31 “Ecological flows in the implementation of the Water Framework Directive” [5] has been developed in accordance with the proposal of the Blueprint to Safeguard Europe’s Water Resources.

Gradual and incremental consideration of the recommendations in this GD is expected from Member States in their implementation of WFD.

GD No. 31 addresses the situation of rivers and mainly focuses on natural water bodies. This reflects the need to initially focus on these WBs as a starter and the lack of information and examples that could be collected about other water categories in the process of development of this GD. Nevertheless, its requirements mostly apply to HMWB, too. Specific requirements for HMWB are provided additionally in a separate chapter.

GD No. 31 reminds that E-flow is also relevant to groundwater quantitative status. In order to achieve good groundwater quantitative status, the level of groundwater should not be subject to anthropogenic alterations which would cause failure to achieve the environmental objectives for associated surface waters. For a GWB to be of good status, long-term annual average abstraction from this GWB must not exceed long-term average recharge **minus** the long-term ecological flow needs.

2.2.1. E-flow in status assessment and environmental objectives

Ecological flow is considered within the context of the WFD as “hydrological regime consistent with the achievement of the environmental objectives”. These environmental objectives refer to:

- non-deterioration of the existing status;
- achievement of good ecological status;
- compliance with standards and objectives for protected areas, including the ones designated for the protection of habitats and species, where status of water is an important factor for their protection.

Ecological status of a water body (and ecological potential of HMWB and AWB) consists of three groups of parameters: biological, physico-chemical, and hydromorphological. The latest includes, for rivers, three components or so-called quality elements: hydrological regime; river continuity; and morphological conditions. **Ecological flow** is a necessary component of hydrological regime and hence of the hydromorphological quality that has, according to the WFD, to be consistent with the achievement of good status for the biological quality elements.

If protected areas designated under the Birds and the Habitats Directives are present in a water body, hydrological regime needed for the protection of habitats and species must be achieved.

Structure and functioning of aquatic ecosystems are shaped by different kinds of flow. Extreme situations (floods and droughts) regulate ecosystem process rates and exert selective pressure on populations. On the other hand, normal conditions imposed by regular flows allow habitat fidelity. The so-called “environmental flow components” are generally distinguished between base flows (including low flows) and the flood regime (magnitude, frequency, duration and timing of high flow pulses).

Variations of hydrological regime are reflected in hydromorphological parameters, such as water depth, flow velocity, substrate composition, and channel geometry which in turn form the ecological habitat and influence the status of biological quality elements.

The objectives of the WFD and the Birds and Habitats Directives can only be reached if supporting flow regimes are guaranteed in a water body. Therefore, consideration of ecological flow has to be included in national legal frameworks, **referring clearly** to the different components of the natural flow regime (and not only to minimum flow) and the necessity to link their definition to biological requirements according to the objectives these Directives.

2.2.2. Establishment of monitoring programmes

GD No. 31 sets the following requirements to the design of monitoring programmes under the WFD:

- Proper definition and efficient implementation of ecological flows require a significant amount of hydrological data derived from

monitoring the hydrological regime (modelling approaches may to some extent supplement insufficient monitoring data).

- Monitoring programmes should be adapted to provide a picture of hydrological alterations and their impact on morphology and biology, and to effectively support the achievement of ecological flow.
- Sufficient hydrological information should be collected to enable estimation of the current flow regime and how it deviates from the natural flow regime.
- The integrated monitoring of hydrological, morphological and biological quality elements enables the estimation of the effectiveness of flow restoration action as part of the programme of measures within RBMP.

2.2.3. Defining E-flow and analysing the gap with the current situation

GD No. 31 stresses that, to be consistent with the environmental objectives of the WFD and the Birds and Habitats Directives, the definition of E-flow has to be the result of a technical / scientific process with **no consideration** of the associated socio-economic impacts. These impacts should only be considered when estimating the necessary flow regime for HMWB or water bodies subject to an exemption (less stringent environmental objectives, or prolonged deadline for achievement of the objectives, justified according with the requirements set in the WFD).

2.2.4. Heavily modified water bodies and exemptions

According to the WFD, a heavily modified water body is a WB which has been substantially changed in character, as a result of physical alterations by human activity. Generally, designation of HMWB should be based on the identification of substantial change in morphology.

The necessary prerequisites for the designation of HMWB are:

- to achieve good ecological status of this water body, there would be necessary such changes to its hydromorphological characteristics that would result in significant adverse effects on the wider environment or on important sustainable human development activities;
- the beneficial objectives served by the modified characteristics of that water body cannot, for reasons of technical feasibility or

disproportionate costs, reasonably be achieved by other means, which are a significantly better environmental option.

Instead of good ecological status, in HMWB there has to be achieved good ecological potential. Characteristics of good ecological potential have to be determined based on the characteristics of the closest comparable water body type.

GD No. 31 states that definition of Ecological flow (and identification of the necessary measures to deliver it and achieve good ecological status) should, where hydrology is significantly altered, be considered as part of the designation test for HMWB. Justification why these measures cannot be taken has also to be provided.

An assessment of the hydrological regime to be delivered should be carried out in the definition of good ecological potential, together with the mitigation measures to improve the flow conditions. Depending on the nature and severity of morphological alteration, the hydrological regime consistent with good ecological potential may be very close to the Ecological flow.

Similarly, an exemption under Article 4(5) of the WFD (less stringent environmental objectives for a water body that is not a HMWB) can be justified with a significant hydrological pressure. This justification will require the definition of Ecological flow and identification of the necessary measures to deliver it. The flow regime to be implemented in the water body should be the closest possible to Ecological flow. When hydrology is not the cause for exemption, the hydrological regime should be as a default the Ecological flow identified to support good ecological status.

2.2.5. Recommendations for national legislative frameworks

GD No. 31 recommends that national legislative frameworks with regard to the definition of E-flow include:

- a conceptual definition of Ecological flow with a clear reference to both flow quantity and dynamics and to their consistency with the environmental objectives required under the WFD;
- Ecological flow as a binding requirement where relevant:
    - to all water uses (in particular abstraction, impoundment, flow regulation) in their different characteristics (surface and

groundwater, reversible and irreversible, periodic and permanent),
    - in the strategic planning for development of impacting uses,
    - in the delivery of new permits,
    - in the review of existing water rights;
- clear responsibility for validating the definition of Ecological flow and the inspection of its achievement;
- penal provisions when regulatory requirements are breached.

It is also recommended that national methodologies or guidelines include:

- the methodological approach for determination of E-flow that include relevant elements of river ecosystem, at least quality elements of WFD;
- a range of procedures which can be selected according to the kind of use, the river type and the linkage between surface and groundwater where relevant;
- the data required for E-flow determination;
- the requirements for monitoring and reporting to the competent authorities;
- the requirements to ensure the transparency of methodologies and results to all interested parties, including water users.

2.3. GUIDANCE DOCUMENT NO. 34 ON WATER BALANCES

WFD CIS Guidance Document No. 34 “Guidance document on the application of water balances for supporting the implementation of the WFD” [6] has been developed with an aim to support the development and use of water balances at the river basin and / or catchment scales in the context of the WFD, as pre-requisite to sustainable quantitative management of water resources.

A water balance is based on mass conservation. It reflects that the rate of change in water stored in a hydrological unit (e.g. catchment) is balanced by the rate at which water flows in and out of the unit.

With regard to the concept of Ecological flow, GD No. 34 reminds that the percentage of the mean annual river flow or baseflow that needs to be allocated to freshwater-dependent ecosystems to maintain them in good ecological status should consider the **temporal variability** of the

environmental demand and the seasonal natural variations, to account for the functioning of river ecosystems.

GD No. 34 also states that environmental water requirements for different large European basins (Danube, Dnieper, Elbe, Oder, Rhine, Seine) are presented in some studies, as a percentage of the available water required to be maintained for environmental purposes. These percentages generally are around 40%. In the case of **smaller rivers**, precautionary assessment often assumes that only 10-20% of low flow can be impacted by withdrawals.

2.4. ECOSTAT REPORT ON MEASURES FOR HMWB WATER STORAGE

One of the core activities for the WFD CIS working group ECOSTAT between 2013 and 2016 has been to compare the ecological quality expected by different countries for water bodies impacted by water storage (incl. for hydropower). ECOSTAT report “On common understanding of using mitigation measures for reaching Good Ecological Potential for heavily modified water bodies impacted by water storage” [7] is based on information collected in a survey, which was completed by 23 countries.

ECOSTAT report stresses that, taking into account the provisions of the WFD CIS Guidance Document No. 4 on HMWB designation [8], physical alterations due to **small scale hydropower** (without relatively large water storage dams) **normally do not fulfil the requirements for HMWB designation**.

ECOSTAT report emphasises various impacts of HPP water storage reservoirs on river ecosystems. A changed flow regime through reservoirs commonly causes artificially extreme low flows or extended low flows. Loss of or reduction in flows which are sufficient to trigger and sustain fish migration can be the result. In addition, loss, reduction or absence of variable flows, compared to undisturbed conditions, is an important issue.

HPP operation can also lead to rapidly changing flows and water level fluctuations downstream of tailrace. This can cause artificially extreme changes in water level, which leads to reductions in quality and extent of shallow water and shore zone habitats.

Storing water in a reservoir often leads to depleted river stretches downstream with regard to quantity and dynamics of flow.

ECOSTAT report also describes the effect of hydropeaking when HPP operating for short term peak load production on demand are causing artificial rapid flow / water level fluctuations downstream of the tailrace, with extreme low flow and sudden high flow situations. These rapid flow alterations differ significantly from natural flow changes in case of floods.

III. NATIONAL LEGISLATIONS WITH REGARD TO E-FLOW

3.1. LATVIAN LEGISLATIVE FRAMEWORK

Latvian **Water Management Law** [9] includes a requirement transposed from the WFD, to maintain and improve the status of all surface water bodies, with an aim to achieve good ecological and chemical status of natural surface water bodies, and good ecological potential and good chemical status of artificial and heavily modified water bodies.

Criteria for the definition of good ecological status and potential are included in the subordinated **Regulation No. 858** (19.10.2004) of the Cabinet of Ministers of Latvia “Regulations Regarding the Characterisation of the Types, Classification, Quality Criteria of Surface Water Bodies and the Procedures for Determination of Anthropogenic Loads” [10]. These criteria have also been transposed from the WFD. Main points with regard to E-flows are as follows:

- Hydromorphological quality is an essential integral part of the ecological status of natural surface water bodies, and of the ecological potential of artificial and heavily modified water bodies.
- For natural river water bodies, hydromorphological quality includes following quality elements: hydrological regime; river continuity; morphological conditions. Corresponding description of high, good, and moderate status for these quality elements in the Regulation No. 858 is given in Table 1.

Table 1. Status class descriptions for hydromorphological quality elements in rivers

Quality element	High status	Good status	Moderate status
Hydrological regime	The quantity and dynamics of flow, and the connection to groundwaters, reflect totally, or nearly totally, undisturbed conditions.	Conditions consistent with the achievement of the values corresponding to good status class for the biological quality elements.	Conditions consistent with the achievement of the values corresponding to moderate status class for the biological quality elements.
River continuity	The onflow of the river is not disturbed by anthropogenic activities, undisturbed migration of aquatic organisms and sediment transport is possible.	Conditions consistent with the achievement of the values corresponding to good status class for the biological quality elements.	Conditions consistent with the achievement of the values corresponding to moderate status class for the biological quality elements.
Morphological conditions	Channel pattern, width and depth variations, flow velocity, substrate composition, structure and condition of the riparian zone correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values corresponding to good status class for the biological quality elements.	Conditions consistent with the achievement of the values corresponding to moderate status class for the biological quality elements.

- According to the WFD Guidance Document No. 4 “Identification and Designation of Heavily Modified and Artificial Water Bodies”, heavily modified water bodies (HMWB) are bodies of water which, as a result of physical alterations by human activity, are substantially changed in character and cannot achieve good ecological status. Artificial water bodies (AWB) are water bodies created by human activity. Instead of good ecological status, the environmental objective for HMWB and AWB is good ecological potential.
- Maximum ecological potential is the state where HMWB or AWB status reflects, as far as possible, that of the closest comparable surface water body, taking into account its modified characteristics. Good ecological potential, in its turn, means “slight changes” from the maximum ecological potential. The relevant quality elements for a HMWB or AWB are those for the most closely comparable water category (river, lake, transitional water, or coastal water).
- Description of maximum, good, and moderate ecological potential for hydromorphological quality elements in HMWB and AWB that is provided in the Regulation No. 858 is given in Table 2.

Table 2. Descriptions for hydromorphological quality elements in HMWB and AWB

Quality element	Maximum potential	Good potential	Moderate potential
Hydromorphological quality elements	The hydromorphological conditions are consistent with the impacts resulting from the creation of artificial or heavily modified water body once all mitigation measures have been taken to ensure the best approximation to ecological continuum, in particular with respect to migration of fauna and appropriate spawning and breeding grounds.	Conditions consistent with the achievement of the values specified for the biological quality elements.	Conditions consistent with the achievement of the values specified for the biological quality elements.

According to the Water Management Law, **state surface water monitoring programme** must specify the extent of monitoring of the quantity and dynamics of flow that is needed for the estimation of ecological status and ecological potential.

Similarly to the Pollution Law that poses the requirement to obtain a licence (permit) for polluting activities, **Water Management Law** poses the requirement to obtain water use permits for certain activities that have or may have an impact on the amount or quality of water resources, or on water ecosystems, including:

- operation of hydrotechnical constructions, incl. those of hydropower plants;
- activities that may result in creation of a new artificial or heavily modified water body;
- other activities that result in systematic changes in water level or hydrological regime.

Water use permits are issued by State Environmental Service Regional Environmental Boards on the basis of an application submitted by a (physical or legal) person that is planning to start that particular activity.

When issuing water use permits, Regional Environmental Boards take into account the environmental objectives set for that particular area.

Water Management Law also requires to include in water use permits that are issued for the operation of hydrotechnical constructions, the requirement to

perform fish protection activities, like construction of fish passes, if this is recognized necessary by a fishery research expertise, and is considered technically possible by certified experts in hydrotechnical engineering and persons who, according to the Law on Construction, have a right to design hydrotechnical constructions.

Theoretically, that means that the argument against fish pass construction "technically not possible" would allow to design a hydrotechnical construction without a fish pass, that would lead to deterioration of the ecological status of a water body, despite the requirements of the Water Management Law. In practice, nevertheless, such occasions are not possible, as explained by a State Environmental Service representative in verbal communication.

Procedure that is necessary to obtain a water use permit is described in the Water Management Law subordinated **Regulation No. 736** (23.12.2003) of the Cabinet of Ministers of Latvia "Regulations on water resources use permits" [11]. To apply for the permit, additional documents are needed, including (for hydrotechnical constructions):

- expert evidence on the allowable changes of hydrological or hydrogeological regime;
- copy of the management regulations developed for that particular water body;
- conclusions of fishery research expertise, regarding the assumed impact on fish population and necessary compensatory actions, as well as recommended ecological flow that ensures natural reproduction of fish;
- expert evidence regarding the assumed impact on the state of the environment (including the impact on protected habitats and species), as well as recommended ecological flow that ensures ecosystem protection;
- conclusions regarding possible technical solutions to implement compensatory actions for fish population proposed in the conclusions of fishery research expertise.

If the activity for which water use permit is necessary needs environmental impact assessment, then the permit can be issued only after the environmental impact assessment procedure is finished.

Regulation No. 736 also states that water use permit has to include provisions for the protection of surface water and groundwater from contamination and depletion, and for the achievement of environmental objectives that have been set for the particular water body.

It should be noted that Regulation No. 736 does not include precise instructions on the estimation of ecological flow. But it states that water use permit for the operation of hydrotechnical constructions must include the values of the minimum guaranteed flow and of the ecological flow, as well as technical prerequisites necessary to ensure these values.

Minimum guaranteed flow is the amount of water flow that has to be preserved downstream hydrotechnical construction (if provided by natural flow). It is calculated as average summer 30-days period low flow with 95% probability. On the other hand, ecological flow has to be preserved in the following cases:

- when, according to the results of fishery research expertise or the conclusion of environmental expert, there is a risk of negative impact on fish populations, or damage to water ecosystems and terrestrial ecosystems that depend on them;
- when the status of water ecosystems and of the environment downstream hydrotechnical construction is deteriorated and, according to the results of fishery research expertise or the conclusion of environmental expert, minimum guaranteed flow does not ensure natural reproduction of fish and good status of surface waters.

The content of the Water body management regulations is defined by the **Regulation No. 1014** (27.12.2005) of the Cabinet of Ministers of Latvia "Procedure for elaboration of water body management regulations" [12]. It is necessary to elaborate water body management regulations if activities like creation of amelioration systems or hydrotechnical constructions are planned in that particular water body. These regulations must include, *inter alia*, the values of the minimum guaranteed flow (defined as "Q min 30d. 95%") and the ecological flow, as well as a description of technical prerequisites necessary to ensure these flow amounts in the water body.

Another legislation act that regulates hydrotechnical construction works is **Regulation No. 329** (30.06.2015) of the Cabinet of Ministers of Latvia "On the

construction standard LBN 224-15: Amelioration systems and hydrotechnical constructions" [13]. It does not consider class A hydropower plants (these are HPPs that, in case of failure, pose threat to life and health of people, inflict significant damage to property of physical or legal persons, and have significant negative impact on the environment).

In its glossary section, Construction standard LBN 224-15 states that "ecological flow" is a part of water inflow that has, at any working conditions of the hydrotechnical construction, to be guaranteed downstream of that construction. On the other hand, definition of term "minimum guaranteed flow" is not provided in this section[1].

Construction standard LBN 224-15 requires that, to preserve the natural condition of the watercourse downstream HPP reservoir during low-flow periods (if allowed by natural inflow, evaporation, and the lowest water level in the reservoir), in the construction documentation there must be stated, and technically ensured:

- minimum guaranteed flow calculated as minimum summer 30-days period low flow with 95% probability;
- in the watercourses especially important for fishery, based on the results of fishery research expertise, Regional Environmental Board may define higher (up to minimum summer 30-days period low flow with 50% probability) ecological flow;
- to ensure protection and preservation of natural biological resources and ecosystems, Regional Environmental Board may, based on the expert evidence regarding the assumed impact on the state of the environment, define the ecological flow.

Construction standard LBN 224-15 also states that in the watercourses especially important for fishery, HPP and other dams have to be designed with fish passes.

Regulation No. 505 (01.09.2015) of the Cabinet of Ministers of Latvia "On the construction standard LBN 229-15: Hydrotechnical constructions of class A hydropower plants" [14] states that:

[1] As explained by State Environmental Service representative (verbal communication), ecological flow for the hydropower plants has to be calculated obligatory. That means that term "minimum guaranteed flow" can be considered less important. On the other hand, in practice there are examples when ecological flow is defined equal to minimum guaranteed flow.

- when designing these hydrotechnical constructions, technical solutions should be chosen that allow the HPP to work, whenever possible, in natural inflow operation mode, so that it is possible to ensure minimum guaranteed flow or ecological flow downstream HPP;
- when designing hydrotechnical constructions operating in cascades, their coordinated work should be foreseen under different hydrological conditions;
- fish passes, or space for future fish passes, should be foreseen in the class A hydrotechnical constructions located in watercourses important for fishery, if required according to the results of fishery research expertise.

Regulation No. 27 (15.01.2002) of the Cabinet of Ministers of Latvia "On rivers (river stretches) where, in order to protect fish resources, construction and renovation of hydropower plant dams, and creation of physical obstructions of any kind is forbidden" [15] defines in total 214 such rivers or river stretches.

Regulation No. 118 (12.03.2002) of the Cabinet of Ministers of Latvia "On the quality of surface water and groundwater" [16] defines in total 123 rivers or river stretches and 45 lakes that are considered to be waters of priority importance for freshwater fish. In these waters, it is necessary to perform water quality protection or improvement activities, to ensure favourable environment for fish resources.

Nevertheless, it is not clearly stated that rivers or river stretches listed in the Regulation No. 27 or Regulation No. 118 are those "watercourses especially important for fishery" that are mentioned in the Construction standards LBN 224-15 and LBN 229-15.

Other legislation acts that touch on the environmental aspects of hydrotechnical construction works are Law on Environmental Impact Assessment and its subordinated Regulation, as well as Regulation "On river basin management plans and programmes of measures".

Law on Environmental Impact Assessment [17] states that, amongst other activities that need environmental impact assessment before they start, there are:

- dams or other hydrotechnical constructions that are intended for water storage, if the volume of water stored exceeds 10^7 m^3.

Additionally, as activities that require *preliminary* environmental impact assessment there are listed:

- construction of new hydropower plants;
- reconstruction of existing hydropower plants that has an impact on hydrological or hydrogeological regime;
- dams or other constructions that are intended for water storage, if the volume of water stored exceeds 3 x 10^6 m^3.

Preliminary environmental impact assessment, or environmental impact assessment where appropriate, has to be finished to obtain water use permit issued by Regional Environmental Board, as stated by Regulation No. 736.

Regulation No. 157 (23.03.2004) of the Cabinet of Ministers of Latvia "Procedure of the Strategic Environmental Impact Assessment" [18], that is subordinated to the above-mentioned Law, defines that State Environmental Service is responsible for the coordination and supervision of preliminary environmental impact assessment, and makes a decision whether full environmental impact assessment procedure is necessary. If so, further coordination and supervision is performed by State Environmental Bureau.

In case when full environmental impact assessment procedure is not necessary, State Environmental Service provides technical prerequisites for the proposed activities. These technical prerequisites are included in the water use permit.

Regulation No. 646 (25.06.2009) of the Cabinet of Ministers of Latvia "On River basin management plans and Programmes of measures" [19] defines requirements to the content of these planning documents, transposed from the WFD.

In the frame of development of RBMP, status of water bodies has to be classified according to the criteria, incl. hydromorphological, that are generally specified in Regulation No. 858. RBMP also includes pressure analysis, in particular:

- analysis of pressures on the quantitative status of surface water bodies and groundwater bodies;

- description of flow regulation activities (incl. irrigation and drainage construction) and their impact on the flow regime or water balance;
- analysis of significance of pressures posed by water abstraction, or systematic change of water level or hydrological regime;
- list of HMWB and AWB and information regarding their hydromorphological properties substantially changed by human activity.

RBMP also set environmental objectives for surface water bodies and groundwater bodies. Programmes of measures are an integral part of RBMP and include measures (so-called "basic" and "supplementary" measures) that have to be implemented in order to achieve environmental objectives. Basic measures are measures that have to be implemented to fulfil the requirements posed by existing legislation. Supplementary measures can be selected for a particular water body, if basic measures are not enough to achieve environmental objectives and ensure improvement / no deterioration of status of surface waters and groundwater, as required by Water Management Law.

Definitions provided in Latvian legislation for the minimum guaranteed flow and for the ecological flow are summarized in Table 3.

Table 3. Definitions of "minimum guaranteed" and "ecological" flow

Legal act	Minimum guaranteed flow	Ecological flow
Regulation No. 736	· Has to be included in water use permit. · The amount of water flow that has to be preserved downstream hydrotechnical construction (if provided by natural flow). · Calculated as average summer 30-days period low flow with 95% probability.	· Has to be included in water use permit. · The amount of water flow that has to be preserved, if there are specific requirements for that, according to relevant experts' conclusion. · Ensures natural reproduction of fish. · Ensures ecosystem protection. · Instructions for calculation are not provided.
Regulation No. 1014	· Has to be included in water body management regulations. · Calculated as Q min 30d. 95%.	· Has to be included in water body management regulations. · Instructions for calculation are not provided.
Regulation No. 329 / Construction standard LBN 224-15	· Definition for the minimum guaranteed flow is not provided. · Is calculated as minimum summer 30-days period low flow with 95% probability.	· A part of water inflow that has, at any working conditions of the hydrotechnical construction, to be guaranteed downstream of that construction. · Up to minimum summer 30-days period low flow with 50% probability, in watercourses important for fishery. · Ecological flow can be defined to ensure protection and preservation of natural biological resources and ecosystems of the watercourse (instructions for calculation not provided).

3.2. LITHUANIAN LEGISLATIVE FRAMEWORK

Water use and protection in the Republic of Lithuania is regulated by the **Law on Water** (21 October 1997 No VIII-474, last amendment 14 April 2016) [20]. This Law shall regulate the ownership of the internal bodies of water of the Republic of Lithuania, the management, use and protection of their water resources, relations between the owners and users of water bodies and the rights and obligations of legal and physical persons using internal bodies of water and their resources. The aim of the Law is:

1) to prevent the deterioration of status of aquatic ecosystems and ecosystems directly dependent on water, to protect it and (or) enhance;
2) to improve the water quality by implementing the measures to consistently reduce the input of hazardous substances and to interrupt discharging priority substances into water;
3) to use water in rational and sustainable way;
4) to reduce the harmful effects of water (occurrence of floods and droughts).

The law has been amended 7 times in order to comply with EU Water Framework Directive and establish new rules and orders of national legislation.

According to this law, water users are obliged:

- to ensure a sustainable use of water;
- not to exceed the established water usage limits;
- not to destroy aquatic flora and fauna;
- to maintain accounting records for the use of water in the established procedure;
- to conduct monitoring according to the Law on the Monitoring of the Environment, etc.

The Law on Water states that hydrotechnical structures for energy needs may be built on water bodies. The water reservoirs shall be installed according to this Law, **Law on Construction** [21], **Law on Territorial Planning** [22], **Law on Protected Areas** [23] and **Law on Environmental Impact Assessment of the Proposed Economic Activity** [24]. For installation and exploitation of hydrotechnical structures, a separate water use permit is not required.

Minister of Environment establishes the order of the use and exploitation of water reservoirs and impounded lakes.

According to the amendment of the Law on Water in 2004, the construction of dams on the Nemunas and other ecologically and culturally important rivers is prohibited. The list of 169 ecologically and culturally valuable rivers or river stretches (where construction of HP plants is prohibited) was approved by the Regulation No 1144 of the Government (8 September 2004) [25].

Annex 1 to the **Law on Environmental Impact Assessment (EIA) of the Proposed Economic Activity** of the Republic of Lithuania (15 August 1996 No I-1495, last amendment 14 April 2016) lists the proposed economic activities that are subject to an EIA. Among such activities, installation of dams for water collection or long-lasting storage (when their water volume is greater than 5 billion m^3 or their surface area is greater than 250 ha) is included. In Annex 2, economic activities that are subject to screening for EIA are put down; among them:

- installation of dams and other structures for water collection or permanent storage (when their water volume is less than 5 billion m^3, but more than 200 000 m^3 or their surface area is less than 250 ha, but more than 10 ha);
- installation of water plants (HPPs, mills, lumbermills or other plants that use accumulated water energy) if their capacity is more than 0.1 MW.

The Government of Lithuania released the **Decree on Special Conditions for Land and Forest Use** (12 May 1992 No 343, last amendment April 26, 2017) [26]. These special conditions (clause 124) prohibit:

- regulation of natural rivers and alteration of river channel and of lake water natural level;
- regulation of water level of artificial water bodies by greater amplitude than it is defined in regulations for their exploitation, to decrease the level without permission of MoE;
- dam rivers, restore former dams, other hydrotechnical structures without permission of MoE;
- use more than 10 cubic meters (m^3/d) of water daily, without the MoE permit to use natural resources.

According to the Law on Water physical and legal persons, who install and exploit hydrotechnical structures, shall (among others):

- not violate the regime of water level fluctuation that is established by the order of the Minister of Environment;
- ensure that hydrotechnical structures release not less water than ***environmental discharge*** that is calculated according to the established order of the Minister;
- carry out accounting of water that passes through hydrotechnical structures and provide these data according to the established order of the Minister;
- install and use effective means for fish protection and ensure possibility for fish to migrate according to the established order of the Minister.

The Law on Water also notes that among the objectives of water protection is to achieve good chemical state and good ecological potential of artificial and heavily modified water bodies (what is directly related to HPP exploitation).

The Order of the Minister of Environment of April 12, 2007 No D1-210 (last amended 4 August 2016) on **Methodology for Assessment of the State of Surface Water Bodies** [27] declares that ecological status of Lithuanian rivers is evaluated according to physico-chemical, hydromorphological and biological quality elements. The hydromorphological elements consist of hydrological regime (water runoff volume and dynamics), river continuity and morphological conditions (bank and riverbed structure; runoff amount and character; condition of riparian vegetation; soil composition). River ecological status according to the quality of hydromorphological elements is expressed by the river hydromorphological index (RHMI). There are three classes of hydro-morphological quality: very good (RHMI 1.00-0.91), good (RHMI 0.90-0.80), and worse than good (RHMI $<$0.80) and, as already written above, they greatly depend on water flow dynamics and river continuity.

Typical Regulations for the Use and Maintenance of Water Reservoirs (LAND 2-95) issued by the MoE in March 7, 1995 by the Order No 33 (last amendment 3 March 2014) [28] establish the rules for water reservoir use and maintenance, the main data that have to be presented regarding water reservoir and its hydrotechnical structures, operating regime of water

reservoir, the main environmental requirements for exploitation process. Such regulations shall be prepared for all water reservoirs and impounded lakes that are larger than 5 ha. For water reservoirs smaller than 5 ha, the regulations are obligatory, if:

- water user utilises not less than 10 cubic meters (m^3/d) of water daily;
- head is not less than 3 m;
- HPP or fish ladder (pass) is installed;
- water reservoir is installed on migration route of preserved and protected fish species or is significant due to other environmental issues; etc.

Typical Regulations define that during the dry period of the year, not smaller amount of water than ***environmental discharge*** that is defined according to description of **Procedure for Environmental Discharge Calculation** that is approved by the Order of the Minister of Environment of July 29, 2005 No D1-382 (last amended 6 August 2014) [29] shall be released downstream the impoundment (except the provided cases in clause 20 of the **Regulations** (LAND 2-95)).

The **Procedure** describes ***environmental discharge*** as the minimum water discharge required to ensure minimum conditions for ecosystem survival. This document explains that ***environmental discharge*** (Q_E, m^3/s) is the mean of minimum discharges of 30 days in low period (May-October) with 80% or 95% probabilities (depending on a level of river hydrological regime regulation – the river baseflow index φ). For the rivers characterised by irregular flow regime ($\varphi \leq 0.65$),

$$Q_E = Q_{30min80\%},$$

whereas for the rivers of regular flow regime ($\varphi > 0.65$),

$$Q_E = Q_{30min95\%}.$$

The **Procedure** states that the rate of ***environmental discharge*** can be increased or decreased only by the written consent of Environmental Protection Agency.

The appropriate supervision of hydrotechnical structures that is of great importance with regard to environmental impacts is ensured by Chapter VI of the Order of the Minister of Environment on Technical Regulation of

Construction STR 1.07.03:2017 **Procedures for Technical Maintenance and Use of Buildings. Procedure for Formation of New Objects of Real Estate Cadastre** [30].

Article 125 of the **Law on Environmental Protection of the Republic of Lithuania** (21 January 1992 No I-2223, last amendment 17 May 2016) [31] provides sanctions for violation of the **Regulations** (LAND 2-95) highlighting importance of maintaining the defined environmental discharge and water levels.

The **National Environmental Protection Strategy** (approved by Seimas of the Republic of Lithuania in 16 April 2015 No XII-1626) [32] declares about significant impact of HPPs on water bodies due to frequent and sudden changes of water level, insufficient number of fish passes, fish injuring turbines, etc. and their damage to water ecosystems. The Strategy identifies hydro power plants as one of the key factors of economic activities affecting the status of surface water bodies.

IV. CONCLUSIONS

4.1. CONCLUSIONS FOR LATVIA

After the analysis of the requirements specified in LV legislation with regard to E-flow definition, and the comparison of these requirements with the obligations posed by EU legislative framework, it is possible to draw the following main conclusions:

- Definitions of ecological flow and minimum guaranteed flow are sometimes contradictory in different legislation acts. It is stated in Regulation No. 329 / Construction standard LBN 224-15 that ecological flow has to be guaranteed downstream of hydrotechnical constructions. At the same time, Regulation No. 736 gives the same definition for the minimum guaranteed flow and specifies particular cases when ecological flow has to be ensured. The latest is **in contradiction** with the requirements of the WFD and the Guidance Document No. 31, because E-flow is a **necessary component** for the achievement of good ecological status in natural water bodies (and small HPPs are,

according to the information provided by ECOSTAT, generally of insufficient importance to be designated as HMWB). Ecological flow has to be a **binding requirement** to all water uses – in particular, for water abstraction, impoundment, and flow regulation.

- Although, according to the information provided by State Environmental Service, ecological flow for the hydropower plants has to be calculated obligatory, in practice there are examples where ecological flow is defined equal to minimum guaranteed flow.
- Instructions for the calculation of minimum guaranteed flow are provided in legislation but have differences, namely, average or minimum summer 30-days period low flow with 95% probability? It also has to be taken into account that “Q min 30d. 95%” is a low value.
- On the other hand, instructions are less clear for ecological flow, e.g. “value up to minimum summer 30-days period low flow with 50% probability” is given just for the watercourses important for fishery, and it seems that in other cases ecological flow has to be estimated based on expert judgement.
- The definition of ecological flow in LV legislation is based on the minimum flow and does not include different components of the natural flow regime. **New conceptual definition of ecological flow is needed**, with a clear reference to both flow quantity and dynamics and to their consistency with the environmental objectives.
- No clear evidence is provided that values of the minimum guaranteed flow and ecological flow are set high enough to ensure good hydromorphological status – that is, are sufficient to **maintain biological quality elements at good status**.
- Ecological flow has to be a necessary component in the delivery of new water use permits, and in the review of existing ones.
- There has to be clear responsibility for validating the definition of ecological flow and the inspection of its achievement, as well as clear penal provisions when regulatory requirements are breached.

- **ECOFLOW project activities will make it possible to evaluate if the definition of environmental flow within Latvian legislative framework ensure protection of good ecological status of surface waters as specified in the Water Management Law and Regulation No. 858, according to the requirements posed by the WFD.**

4.2. CONCLUSIONS FOR LITHUANIA

After the analysis of the requirements specified in LT legislation with regard to E-flow definition, and the comparison of these requirements with the obligations posed by EU legislative framework, it is possible to draw the following main conclusions:

- Many legislative documents related to planning, use and maintenance of HPPs and HPP dams exist in the Republic of Lithuania. However, they do not protect fully river ecosystems from these anthropogenic activities. Although water users must ensure that hydrotechnical structures release not less water than so called environmental discharge, this is not sufficient for river ecosystem.
- The term “environmental discharge” (*gamtosauginis debitas* in Lithuanian) emerged in Lithuanian legislation in 1997, when already mentioned Procedure for Environmental Discharge Calculation for the first time was signed (later it was several times amended). However, the problem is an origin of this term and procedure, as it came from the Soviet times: then it was called “sanitary discharge” and used for estimation of dilution of wastewater coming from factories down to clean river water. Estimation of “sanitary discharge” was necessary in calculation and justification of polluted water treatment level in former construction regulations and orders. Since the change of the term “sanitary” to “environmental” did not substantially change the essence of procedures, it was not correct to use it for hydro power plants that do not release polluted water, but significantly alter hydrological regime of the rivers.
- Although environmental discharge in the current edition/version of the Procedure is defined as the minimum water discharge required ensuring minimum conditions for ecosystem survival, such discharge is

not environmentally friendly. The established environmental discharge is related to probability of multiannual runoff reoccurrence, whereas constant flow cannot fulfil requirements of river ecosystem. River biotic communities are adjusted to natural flow fluctuations that may vary throughout of hours, days, seasons, years (climate change should be considered as well): any flow alterations may cause ecological response. However, the Procedure allows for unlimited time to release downstream such a small amount of water that naturally, in the river, occurs only once in 5 or 20 years. Moreover, this probability amount is permitted to be constantly released no matter whether particular year is watery or dry.

- Definition of environmental discharge allows high water level fluctuations - artificial repeatable floodings (i.e. hydropeaking), which occur downstream from the HPPs, which are operating only a few hours per day. Instead, as many researchers agree, natural flow regime fluctuations and required much greater discharge downstream should be preserved in order to minimize negative impact on river ecosystem.
- The minimum water discharge called environmental discharge is declared as ensuring minimum conditions for ecosystem survival; however, any substantial justification of this like scientific background does not exist.
- On opposite, HPPs released water discharges do not have any regularities and such irregular flow may lead to stressful situations, since only natural water flow fluctuations can assure river ecosystem sustainability. Many aquatic organisms are sensitive to changes in the frequency, duration, and timing of certain flow regime phases/events. These changes may be signals of vital importance (to migrate, spawn, etc.).

As the WFD aims at maintaining and improving the aquatic environment and Member States are obliged to achieve the objective of at least good water status by defining and implementing the necessary measures. A current conception of environmental discharge in Lithuanian legislation should be re-evaluated.

Environmental flow (E-flow) in the downstream regulated river has to:

- be based on scientific criteria;
- encompass and/or repeat a full range/complexity of flow natural regime variability (i.e. no artificial droughts, hydropeaking, etc.);
- comply with biological / habitat requirements of a certain regulated river;
- be constantly supervised and monitored by environmental authority.

The ecohydrological approach to definition of environmental flow demands an evaluation of surficial needs, to provide for human and other ecosystem needs water of sufficient quantity and quality at the correct temporal sequence. In other words, the challenge here is to operate HPP according to natural river runoff regime, refusing to operate in regime of maximum needs, in order to mitigate the impact on regulated river downstream.

ECOFLOW project aims at estimation of environmental flow (E-flow) in compliance with CIS guidance document no 31 for improving of ecological status of water bodies in the selected river basins.

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