# REVIEW

by Assoc. Prof. Dr. Tatiana Vasilevna Orehova – member of the scientific jury in a competition for the academic position "Professor"
in professional field 5.7. "Architecture, civil engineering and geodesy", scientific specialty "Engineering hydrology, hydraulics and water management" (Quantitative assessment of water resources and runoff regime under drought and climate variations)

This review was prepared on the basis of the order of Acting Director General of NIMH НД-05-33 from 01.12.2025 and the decision of the scientific jury taken at the meeting on 12.12.2025. It is in accordance with the requirements of the Law for the development of the academic staff in the Republic of Bulgaria (ZRASRB), the Regulations for its implementation (PPZRASRB) and the Regulations of NIMH under ZRASRB. The review consists of three parts and a conclusion.

## I. Requirements to the candidate

under Art. 29(1) and Art. 29b of ZRASRB, art.60 of PPZRASRB and Art. 56 (1), (2) and Art. 57 (1) of the Regulations of NIMH under ZRASRB

Assoc. Prof. Dr. Eng. Elena Kirilova Bozhilova graduated from the Higher Institute of Architecture and Civil Engineering (now UACG) in 1990, receiving a diploma in "Hydromelioration systems". In 1997, she received a Master's degree in Hydrological Engineering from the International Institute of Infrastructure, Hydraulics and Environmental Engineering in Delft, the Netherlands. She improved her qualifications thanks to a number of specializations abroad. In 2003, Elena Bozhilova obtained the scientific and education degree "doctor" (PhD) in the scientific specialty "Engineering Hydrology, Hydraulics and Water Management".

After completing her higher education, E. Bozhilova successively held the positions: research associate III, II and I degree, and since 2007 she has been an associate professor II degree at the National Institute of Meteorology and Hydrology at Bulgarian Academy of Sciences. Since 2012, after winning a competition, she has held the academic position of "associate professor" in the professional field 5.7. "Architecture, construction and geodesy" from the field 5 "Technical Sciences".

Since 03.03.2025, she has held the position of Deputy General Director "International Activity and Projects" at NIMH. Since 2003, Assoc. Prof. Bozhilova has been a member of the International Association for Hydrological Sciences (IAHS).

During the inspection of the materials submitted for the competition, no violations in the procedure were found. The candidate fulfilled the formal regulatory requirements and has the right to participate in the competition.

## II. Requirements regarding scientific and research-applied activities

In accordance with Art. 29 (1), item 1, item 3, item 4, item 5, item 6, (2) and (3), Art. 29b (1) of ZRASRB, Art. 60 (1), item 3, item 4, item 5, item 6, (2) and (4) of PPZRASRB, art. 56 (1), item 1, item 4, item 5, item 6, item 7, (2), (3) of the Regulations of NIMH under ZRASRB is presented:

For her participation in the competition, Assoc. Prof. Dr. Elena Bozhilova submitted one monograph, a list of 14 publications (13 of them in English and one in Bulgarian) and one chapter in a collective monograph, all after obtaining the academic title of "Associate Professor".

Of the 14 articles submitted, five are independent, and the candidate is the first author of three. Ten have been published in the SGEM Proceedings (indexed in Scopus), and three in the Journal of Balkan Ecology (ISSN 1311-0527, indexed in Web of Science – CABI) published in Bulgaria. One article has been published in the non-refereed journal with scientific review Bulgarian Journal of Meteorology and Hydrology published by NIMH (N 516 from the National Reference List).

The candidate demonstrated proficiency in a number of methods that were used in the publications specified for the competition. Stochastic models were used to predict the inflow to dams (Г.7.3; Г.7.12). Disaggregation models (a type of stochastic models) were applied to model the outflow of the Osam River (Г.7.1). Statistical methods were used to estimate high waters (Г.7.2; Г.7.6), low waters (Г.7.4; Г.7.7), and regionalization (Г.7.5; Г.8.1; Г.7.13).

Among the candidate's publications, a number of articles dedicated to ecological flow in rivers stand out (Г.7.8 – Г.7.11, В.3). Based on Guide 31 and Technical Guidelines (from 2022) dedicated to ensuring ecological flow, Assoc. Prof. Bozhilova has carried out several pilot studies for Bulgarian rivers. The regionalization method was used to identify uniform hydrological zones. According to the recommendations, she has distinguished three periods with different water availability typical of the intra-annual distribution of runoff. The conclusion is that the application of a combination of two thresholds (10% of the multi-year mean discharge and a yearly minimum monthly mean discharge with 95% probability of occurrence) for each of three periods with different water availability requires a review of the issued water abstraction permits in order to preserve the ecological runoff in the river (especially for periods with higher water availability).

The chapter (Г.9.1) in a collective monograph (published by NIMH in 2023) is entitled "Hydrological Research". It is a short but valuable overview of the country's water resources, covering both long-term indicators and those during very wet and dry years. A comparison is made of the norms of the surface water resource in Bulgaria for the periods 1961–1990 and 1991–2020. The alternation of dry, average and wet years is graphically presented. It is shown that the annual resource increases until 1981, then decreases until 1995, and subsequently increases slowly, but with significant fluctuations. The methodological approaches and technologies used at NIMH for water resource assessment are briefly described. The chapter was written by K. Krumova, E. Bozhilova and M. Rankova.

The monograph "Yantra River – Hydrological Analyzes and Modeling of River Runoff" by Assoc. Prof. Elena Bozhilova (in volume 234 pages, B.3) covers numerous aspects of her research: (i) Information on the annual river runoff in the Yantra River catchment basin is summarized and systematized. (ii) The homogeneity of the annual runoff series is studied. (iii) The multi-annual course of the river runoff is analyzed. (iv) The role of more important tributaries in the runoff of the Yantra River is assessed. (v) The hydrological regionalization method is applied for the average multi-annual runoff. (vi) The median (with 50% probability of occurrence) runoff is studied, and the difference between the median and the average annual runoff for 13 hydrometric stations for the period is analyzed. (vii) Monthly and seasonal distribution of runoff in the Yantra River basin was studied, which is important due to the different intensity of water use throughout the year.

In her monograph, E. Bozhilova was the first in Bulgaria to apply for high water analyses an index originally proposed by Dalrymple (1960) as the "index-flood method", subsequently used, in particular, by Caissie et al. (2009). This is a promising approach for assessing high waters (with a recurrence period of once every 5, 10, 20, 50 or 100 years) as a ratio, for example, of a 50-year high wave to a more easily calculated 2-year high wave.

A separate chapter in the book is devoted to modeling the river runoff in the Yantra River catchment. Modeling studies play an important role in implementing climate change scenarios. The results of using Hydro-BEAM and HEC–HMS models are described. Thanks to the successful calibration of the latter model, it is used in the operational practice of the NIMH for short-term runoff forecasting in a number of hydrometric stations along the Yantra River.

The mentioned monograph is truly a valuable book for hydrologists and water management specialists. The numerous graphs, maps and tables provide the necessary specificity and help to adequately perceive the extensive factual and authorial material.

Fifty citations were submitted for the competition (I do not count two reviews of the book as citations). The cited articles (22 in number) were written during the period 2001–2024. The most cited of them are: Ninov et al., 2017 (8 citations), Bojilova, 2017 (4 citations), Gerassimov, Bojilova, 2008 (3 citations), Orehova, Bojilova, 2001 (3 citations). The first two mentioned articles are from the Danube Conference held in Bulgaria. The third article was published in a prestigious journal published by Elsevier. The fourth article was published in the proceedings of the International Association for Hydraulic Research (IAH) Congress held in China. Although the majority of the cited articles are written in English, they are cited mainly by Bulgarian authors. Only two citing articles are written by foreigners. It is obvious that the results of the research on Bulgarian rivers are of paramount importance for our country.

The submitted reference proves the active participation of the candidate in both national and international projects. The commitment of the Ministry of Environment, as well as the funding under the Operational Programs "Environment" or IHP-UNESCO are a clear sign of the importance of the assigned tasks on hydrological assessments for different watersheds and periods. It is important to emphasize that E. Bozhilova has led several national and international projects.

As an implementation of scientific research in the national economy, I evaluate the adaptation by Assoc. Prof. Bozhilova of the HEC–HMS model, which since the beginning of 2013 has been providing a short-term forecast of the runoff in the Yantra River basin.

The scientific indicators of Assoc. Prof. E. Bozhilova are reflected in a Table, which confirms that the candidate meets the minimum requirements for acquiring the academic position of "professor".

SUMMARY TABLE

ON THE SCOPE AND TYPE OF SCIENTIFIC OUTPUT under Art. 1a (1) and (2) of the Rules for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria (PPZRASRB) and Art. 2 (4) of the Regulations of NIMH under the LDASRB of Assoc. Prof. Dr. Eng. Elena Kirilova Bozhilova

| Group of indicators | For participation in the competition for Professor | |
|---|---|---|
| | Number of points of the candidate | Required number of points |
| А | 50 | 50 |
| Б | | — |
| В | 100 | 100 |
| Г | 300 | 200 |
| Д | 356 | 100 |
| Е | 300 | 150 |

I acknowledge the contributions indicated by the candidate. From my point of view, I would formulate them as follows. They are scientific, applied and methodological:

1. Comprehensive hydrological characteristics of the Yantra River catchment basin, based on long-term information on river runoff from 13 hydrometric stations. It is the result of many years of research work by the candidate and includes numerous hydrological analyses, assessments and model studies, useful both from a scientific point of view and for the practice of water management.

2. A prospective approach to assessing high waters (HV) has been applied using a ratio of HV with different recurrence periods, which is important for assessing high waters with a recurrence period of once every 50 or 100 years.

3. Regarding the provision of ecological runoff in rivers, it has been proven that for three periods with different water availability, the simultaneous application of two thresholds (10% of the multi-year mean discharge and a yearly minimum monthly mean discharge with 95% probability of occurrence) requires a review of the issued water abstraction permits in order to preserve the ecological flow in rivers.

4. Creative application of a number of specialized hydrological methods (statistical, regionalization, compositional method, modeling) with a practical demonstration of their broad applicability for Bulgarian conditions in the following areas: water resources, river runoff regime, assessments of high waters, minimum and ecological runoff; inflow into dams, establishment of statistically significant dependencies, of hydrologically homogeneous watersheds, etc.

5. The HEC–HMS model has been adapted for short-term runoff forecasting in the Yantra River basin. This useful model has been used in NIMH since 2013 for operational purposes.

6. A technological approach has been developed for determining the water resources of surface water bodies using the example of the Yantra River basin.

The above contributions are undoubtedly the personal work of the candidate. Assoc. Prof. Bozhilova successfully works both independently and in a team, where she often has a leading role.

## III. Opinions, recommendations and notes

I know Elena Bozhilova from my work at NIMH until 2003. Subsequently, I followed her scientific development with interest. We also had several joint publications in the period 2001–2008. I was convinced that she is able to create a favorable atmosphere for fruitful joint scientific research work. Currently, the candidate successfully combines her scientific research activities with administrative responsibilities in the field of international activities of NIMH.

I have some comments on the approach to determining the base flow index (BFI) based on the Q90/Q50 ratio (Г.7.4 – p. 124; В.3 – p. 74). Indeed, Smakhtin (2001) suggests using the Q90/Q50 ratio as an estimate of the BFI. According to Table 2 (Г.7.4), the base flow index is calculated as the average value of the annual indices for a 6-year period. However, the multi-year average values of Q90 and Q50 should be found, and then their ratio should be calculated (a long-term flow duration curve can also be used). Table 2.8 (В.3) presents the baseflow values for 13 catchments, many of which are severely disturbed, especially after large dams. It should be noted that the actual BFI values would be obtained under an undisturbed runoff regime, which is more likely during the initial period of measurements – until the mid-1970s (the Q90 values are quite affected by numerous regime disturbances – water withdrawals or the influence of dams). Finally, I believe that it is incorrect to average the values obtained for overlapping catchments.

I recommend Assoc. Prof. Bozhilova to focus her efforts on publishing scientific articles in reputable international journals. My advice is to follow the latest trends in hydrology, to master and apply new methods for Bulgarian conditions.

**Conclusion**

Based on the verification of the materials submitted for the competition, no procedural violations have been identified. The requirements have been met of Art. 29 (1), (2), (3) of ZRASRB, Art. 60 (1), (2) and (4) and Art. 61 (1), (3) of PPZRASRB art. 56 (1), item 1, item 4, item 5, item 6, item 7, (2), (3) of the Regulations of NIMH under ZRASRB.

After becoming acquainted with the documents of the candidate in the competition for the academic position of "professor", I give a positive conclusion. I propose to the esteemed members of the Scientific Jury to recommend to the Scientific Council of the NIMH to elect the candidate Assoc. Prof. Elena Kirilova Bozhilova as a professor in the field of higher education 5. Technical sciences, professional field 5.7. Architecture, construction and geodesy, scientific specialty "Engineering hydrology, hydraulics and water management".

Date

Sofia

Reviewer

/Assoc. Prof. Dr. Tatiana Orehova/

CAWRI-BAS (associate member)