VIETNAM NATIONAL UNIVERSITY
HO CHI MINH CITY
UNIVERSITY OF TECHNOLOGY

SOCIALIST REPUBLIC OF VIETNAM
Independence – Liberty – Happiness

INFORMATION OF THE DISSERTATION

Dissertation's title: **Development of a numerical model for surface water - groundwater interaction and applying it experimentally to the dunes along Luy River, Bac Binh District, Binh Thuan Province**

Major: **Water Resources Engineering**

Major code: **9580212**

PhD candidate: **Nguyen Thi Thanh Hoa**

Scientific superviors: **Assoc. Prof. Le Song Giang**

Institution: **Ho Chi Minh City University of Technology, Vietnam National University - Ho Chi Minh City**

Summary of new academic and theoretical contributions of the thesis:

The demand for freshwater globally and in Vietnam is rapidly increasing due to population and economic growth. Addressing water shortages includes seeking new water sources, enhancing water storage for dry seasons, and using water efficiently and effectively. Binh Thuan is one of the most water-scarce provinces in Vietnam. Groundwater is a crucial supply source for the province's coastal areas, with the dunes south of the Lu River in Bac Binh district being a notable example. In the future, due to changing environmental conditions, the recharge rate of groundwater in the dunes south of the Lu River may also change, leading to potential fluctuations in water resources.

Mathematic modeling methods have been employed to assess this potential change. As part of this thesis, two computational programs named BLUE1D and BLUE3D were developed using the Fortran language. Additionally, to facilitate data editing and presentation of calculation results, a Visual Basic 6.0 version for both BLUE1D and BLUE3D was also created with a menu and graphical system to support the computational processes. The 1D model is a critical foundation for developing the equivalent 3D model; therefore, this model was developed first, resulting in the BLUE1D computational program. Subsequently, a computer program named BLUE3D, which allows for the calculation of equivalent 3D flow at the basin scale, was developed: Layer 1 - a sub-model for 2D overland flow on the surface; Layer 2 - a sub-model for 1D vertical groundwater flow in the unsaturated zone; Layer 3 - a sub-model for 2D groundwater flow in the saturated zone.

The fundamental equations in these layers are solved using the finite volume method. The sub-models are interconnected based on the principle of mass conservation to calculate the interaction between these flows. Since the flow in the saturated and unsaturated zones is described by different equations, the boundary between these two zones - the saturation line - needs to be determined, and the accuracy of the simulation calculations depends on the accuracy of determining the saturation line. In both BLUE1D and BLUE3D, the position of the saturation line is an unknown that is directly solved.

Using BLUE3D, the flow model for the area south of the Lu River was developed and calculated. The results show that groundwater in the area is formed from rainwater and from the high hills, with part flowing north to the Lu River and part flowing southeast to the sea. Currently, the average amount of groundwater from the sand dunes flowing to the Lu River is 36.5 million m^3/year, and flowing to the sea is 44.9 million m^3/year. In the future, due to titanium mining, the permeability coefficient will change. This change will lead to the average amount of groundwater from the sand dunes flowing to the Lu River increasing by 16% to 42.4 million m^3/year and flowing to the sea increasing by 28% to 57.7 million m^3/year.

Scientific superviors	**PhD Candidate**
Assoc. Prof. Le Song Giang	**Nguyen Thi Thanh Hoa**