ABSTRACT

thesis for the academic degree - Doctor of Philosophy (PhD)
with a specialization in 6D075500 – «Hydro-geology and Engineering geology»

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Topic: «How to create and apply geographic information system for reasonable planning and setting of hydro-geology survey»

The great scientist Vladimir Ivanovich Vernadsky attached importance to natural water. He noted that: "Water stands apart in the history of our planet. There is no natural body to be compared with it in the impact on the main great geological processes. There is no earth material such as mineral, rock, living body, which does not contain it. Natural water covers and creates all human life".

At all times, groundwater is the most important mineral. The continuous growth of demand for water for household needs, for water supply of industrial and agricultural facilities make it necessary to explore underground water regularly.

Timeliness. The President of the Republic of Kazakhstan prioritizes the issue of providing Kazakhstan people with high-quality drinking water as the most important task to improve the health of the population in his message to Kazakh people since 2011

Today not all villages in Kazakhstan have high-quality drinking water. According to the normative legal acts for drinking water supply, the available resources of underground water should be used to the maximum extent. This determines to carry out exploration works to find underground water. For Kazakhstan with its dry climate, rare river net and continuous deterioration of surface water quality, groundwater is also a strategic resource that plays a special role in providing drinking water to the population and production facilities.

The results of hydro-geology survey depend on the quality and information content of the available data for the region where the survey is maintained. It is difficult to meter all available data for the region due to disunity of large number of archival (stock) and published materials, and the lack of unified information databases.

To date, the Republic of Kazakhstan does not have integrated, permanent geographic information system with continuous update of information concerning hydro-geology conditions to solve the most important daily practical and scientific problems of hydro-geology.

There is no doubt that it is necessary to create a geographic information system, that will be permanent geographic information model for hydro-geologic conditions of Kazakhstan, designed for operational and quality performance of not only exploration, monitoring (operational exploration) of groundwater, but also monitoring compliance with the laws of the Republic of Kazakhstan in subsoil use and water use.

It is necessary and relevant to create GIS with hydro-geology conditions of Kazakhstan

Talgar underground water deposits are selected as **the exploration target** when creating and using geographic information system for reasonable planning and setting exploration survey. It is decided to choose Talgar underground water deposits since hydro-geology conditions of this region is thoroughly studied and it is possible to show the capability of developed geographic information system.

The purpose and objectives of research work. The main purpose of the thesis is to develop a geographic information system with permanent geoinformation model of hydro-geology conditions of Talgar underground water deposits to demonstrate its capability in solving the problems of exploration, monitoring changes in hydro-geology conditions and compliance with the laws of the Republic of Kazakhstan in subsoil use and water use.

To achieve this goal, the following tasks were solved:

- to study the natural conditions of the region, to analyze and process hydrological features on the basis of previous studies to clarify the boundary conditions of the Talgar underground water deposits;
- to collect, study and analyze geological and morphological information (lithological and facies composition, power of aquifer and water-resistant rocks, depth and degree of dismemberment of the earth relief, etc.); hydrogeological (hydraulic gradient, water mineralization, its chemical composition, filtration and reservoir properties of rocks, etc.) and technical (diameter, depth of the well, the type of its filter, technical condition, etc.) information on wells;
- to create geographic information system on the example of Talgar underground water deposits to improve the quality, reliability and correctness of the data used in exploration survey and other works for groundwater, providing fast processing, storage and modification of large amounts of multidimensional information and its processing with subsequent output and use;
- draw proposals relating to the requirements (standards) for accepted hydrogeological materials to the state authorities that meet the parameters to use this data in the General geographic information system and make it easy and efficient to enter information into the common database;
- to define the principle of implementation and algorithm to use GIS created in the current structure of state authorities of the Republic of Kazakhstan.

Scientific and practical novelty. For the first time in Kazakhstan, a geographic information system has been developed for the reasonable planning and setting hydrogeological exploration survey on the example of Talgar undergraoun water deposits. The principle of implementation and algorithm to use the GIS by state authorities of the Republic of Kazakhstan taking into account the current laws is described.

Practical relevance of the work. GIS:

- will reduce the time of operation for several times;
- will ensure the completeness of the information received and improve the reliability and correctness of the studied data;

- will provide accumulation of information about the region in the form of digital maps, plans, diagrams and their visualization;

- will provide maximum accuracy in selection of the region of exploration wells, construction of their sections and forecast of the expected results;

- will reduce the actual time and financial costs in collection, systematization and analysis of hydrogeological information;

- will allow to keep records of the submitted materials, improve their quality, provide the ability to monitor compliance with subsoil users and water users of the current laws of the Republic of Kazakhstan;

- it will serve as an information basis for solving any practical or scientific problem of hydro-geology when performing it within the boundaries of the created geoinformation model of Talgar undergraound water deposits.

Field of application – hydrogeology, forecast and management of groundwater resource database.

Publications. As a result of research work, we have published 7 articles. They are 1 article in the international magazine included in the database Scopus, 3 articles in the national specialized publications recommended by the Committee for control in education and science of the Ministry of Education and Science of the Republic of Kazakhstan, as well as materials and abstracts of 3 reports at national and international conferences.