РОССИЙСКИЙ НАЦИОНАЛЬНЫЙ КОНКУРС ВОДНЫХ ПРОЕКТОВ СТАРШЕКЛАССНИКОВ

с 2003 года

RUSSIAN NATIONAL JUNIOR WATER PRIZE

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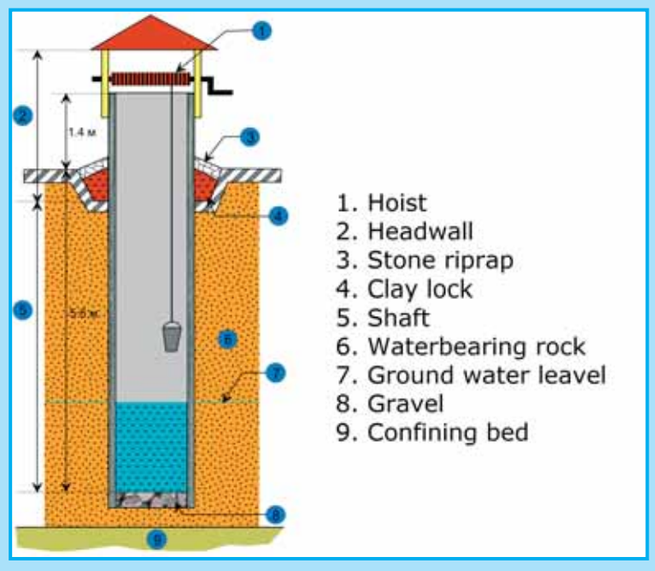
Geophysical Metods of

Water: designing the future

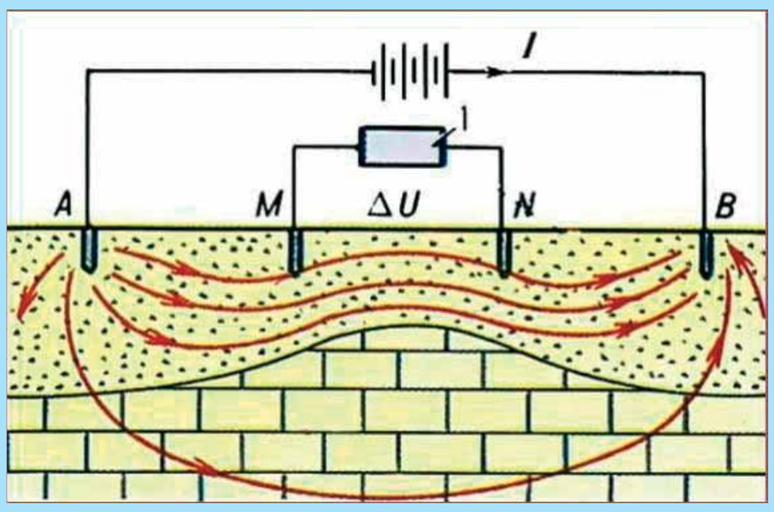
INTRODUCTION

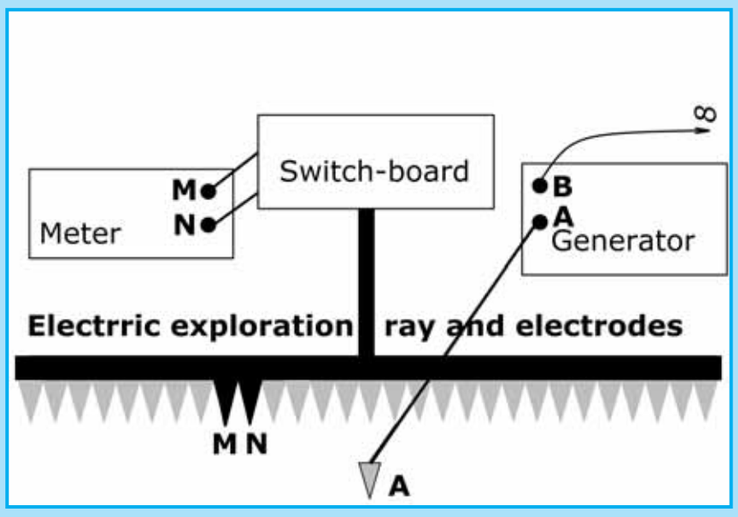
About 80,000 rural settlements in Russia with total population of 16 million people currently use local (decentralized) sources of potable water. About 9 million people drink water which does not meet drinking water quality standards. Consumption of this water contributes to unfavorable sanitary-epidemiologic situation in many rural settlements.

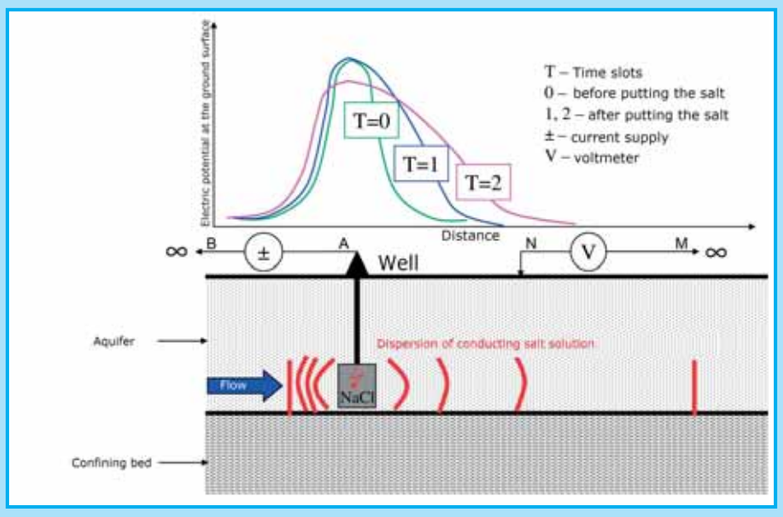


OBJECT OF THE STUDY was the main water well in Kireevka village of Rostov region. The study was conducted in July-September of 2012. This water well is used as the primary source of drinking water by most residents. The new gas station was constructed within 48 meters from the well early in 2012. Despite the claims of the gas station owner about environmental safety of this property, local residents expressed concerns about potential contamination of their source of drinking water with oil products.

PROJECT GOAL was to assess the potential for contamination of the source of drinking water in Kireevka village by using modern noninvasive methods.







STEPS OF THE PROJECT:

1. Conduct geophysical measurements and elucidate information on geological structure of the area around the water well;
2. Determine the direction of laminar groundwater flow which supplies the well;
3. Conduct sanitary-topographic survey of the well and determine potential sources of water contamination;
4. Inform Kireevka residents about the project findings.

METHODS AND INSTRUMENTS

Monitoring was carried out by methods of an electrotomography and an electric charge. Devices and equipment: three electrode installation, ERA-MAX equipment, multichannel reception line, programs for data processing (ZondRes2D, Golden Sofware).

First stage of my project involved sanitary-topographic survey of the water supply source. I studied the condition and structure of the well, drew its scheme, detected potential sources of ground water pollution by visual examination of the adjacent area.

Second stage consisted of preparations to geophysical measurements. Tape-line and flaggings were used for topographic positioning of the profiles. After positioning the profiles were picketed and marked on the chart with the bearing circle.

Third stage included processing of field measurements.

ИНСТИТУТ КОНСАЛТИНГА ЭКОЛОГИЧЕСКИХ ПРОЕКТОВ

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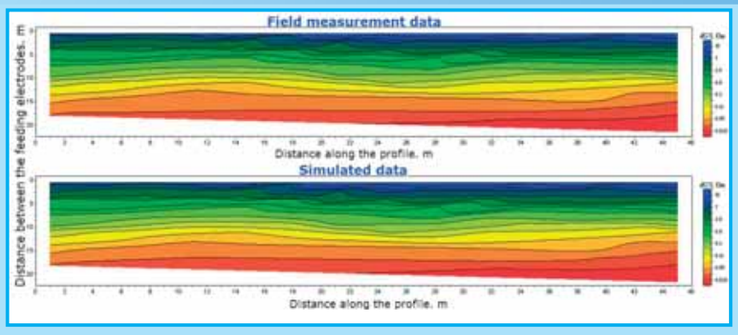
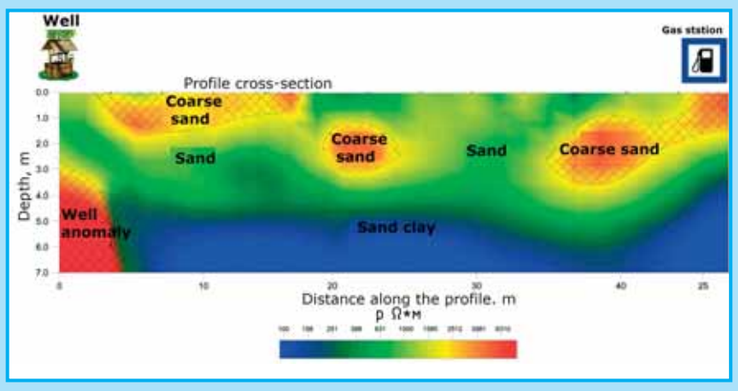
FEDERATION

Ground Water Monitoring

by Vadim Tereletsky



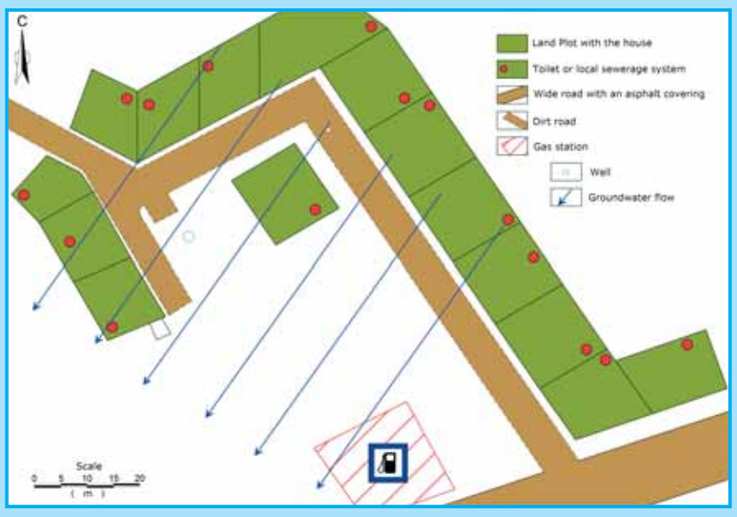


RESULTS AND DISCUSSION

The novelty of my approach stemmed from the combined application of two methods of electric exploration, which produced high-confidence characteristics of the study area. Sanitary-topographic survey of the well was used to detect potential sources of water pollution. I identified and mapped the nearby toilets, local sewerage tanks and the gas station as potential sources of water pollution. Infiltration of hazardous substances from these sources in the groundwater may contaminate the well.

Geologic and environmental forecast considered the following aspects:

1. Hazardous substances are dispersed in the environment and transported by groundwater over long distances.
2. The direction of groundwater flow does not necessarily follow the relief of the area, because this direction is determined by geometry of the confining bed and its cross-sectional heterogeneities.
3. The direction of groundwater flow and filtration coefficient (water conductivity) of the rock are the key parameters in the forecast of potential water contamination.

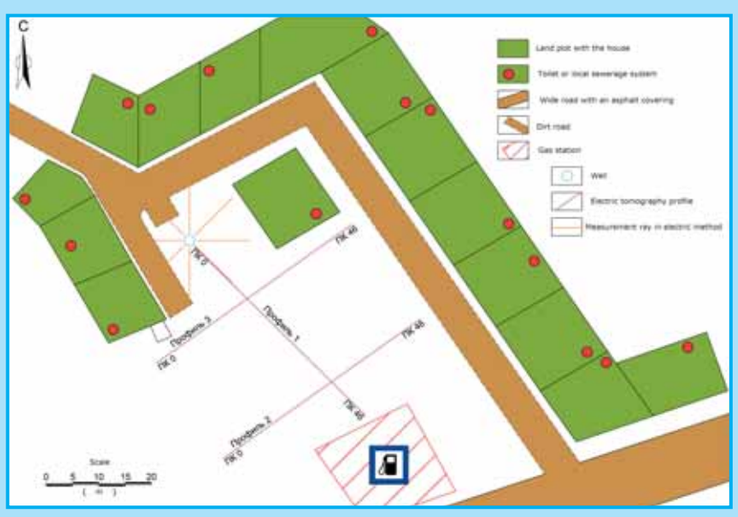


Electric tomography was used to reconstruct geometry and chemical composition of quaternary sediments in the section of the aquifer. I used archive data on geologic composition of the area and a geologic manual to determine the composition of sediments.

My findings may be summarized as follows:

1. The upper layer of the section (down to the depths of 5-6.5 m) is composed by wet sands, presumably fine-grained, with specific electric resistance 75-160 Ohm×m. The sands usually have very high water conductivity.
2. Along the breached boundary, the sands are confined by underclay with specific electric resistance 25-70 Ohm×m.

The results of geologic survey confirmed that geological structure of waterbearing sands was rather complex and non-uniform. Nevertheless, the absence of patches with low water conductivity indicated linear character of ground water flow.

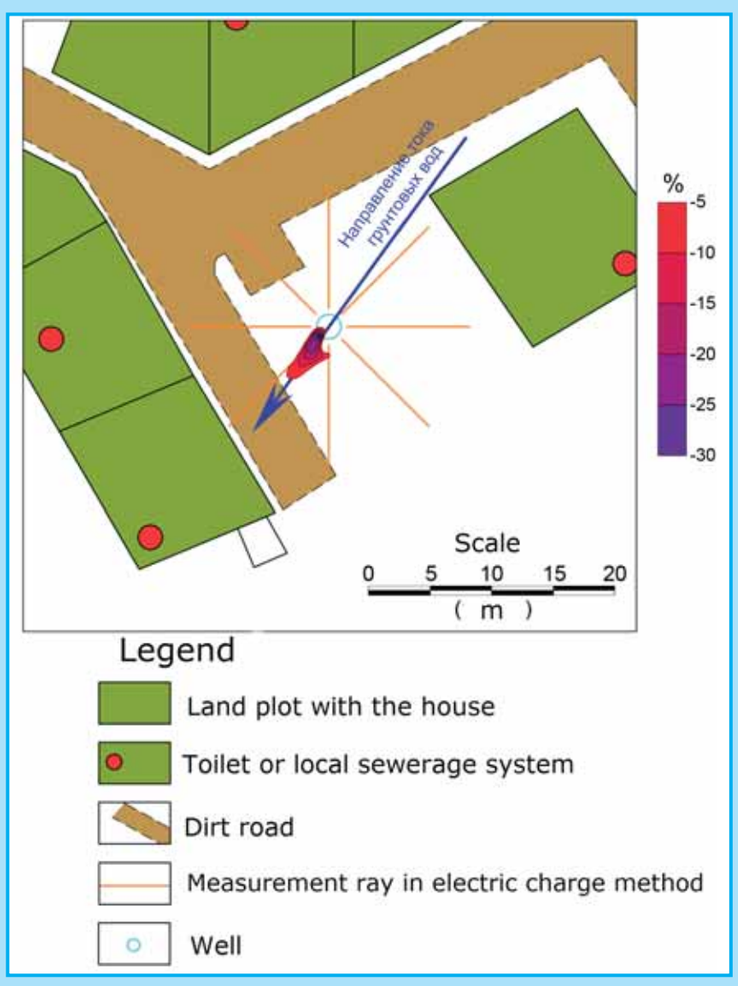


CONCLUSIONS

This study was the first one to implement a combination of electric tomography and electric charge methods with the aim to detect the direction of ground water flow within the study area. The results of the study indicated that the gas station could not pose risks of contamination of drinking water in the well. At the same time, project results indicated several previously unknown potential sources of contamination: local sewerage to the north-east from the well. The owners of household sewerage systems have been informed about these risks and the need to use these systems in a responsible manner. The concerns of Kireevka residents have been duly answered.

RECOMMENDATION

A combination of electric tomography and electric charge methods should be used in environmental risks assessment during land use planning and design of new infrastructure objects: gas stations, warehouses, etc. The proposed methodology can provide the basis for communication of information about potential risks of contamination of open reservoirs to local residents who drink water from these reservoirs.



При реализации проекта используются средства государственной поддержки, выделенные в качестве гранта Фондом подготовки кадрового резерва «Государственный клуб» по итогам конкурса, проведенного в соответствии с распоряжением Президента Российской Федерации № 216-рп от 03.05.2012 года «Об обеспечении в 2012 году государственной поддержки некоммерческих неправительственных организаций, участвующих в развитии институтов гражданского общества».