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## **Geological hazards and the construction of new metro routes in Moscow**

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Nowadays, the metro construction has been intensified significantly in Moscow. The time span between engineering geological survey, projecting, and construction of new metro lines is very short, all works are carried out almost simultaneously. This increases considerably the risk of possible damage from the geohazard manifestation. At the same time, the geological conditions are studied very well in Moscow. To optimize the projecting and construction of major transport lines (metro, urban railway, highways) in Moscow, the engineering geological conditions should be adequately assessed beforehand. The study of digitized and GIS-arranged archive borehole data and thematic geological maps compiled for the Moscow territory permits us to analyze the engineering geological conditions at the construction site adequately, quickly and cheaply, to reveal the existing geological problems and to recommend decisions for solving them. The assessment of this kind was performed upon projecting the Kozhukhovskaya metro line in the southeast of Moscow.

Kozhukhovskaya metro line consists of 9 stations and is 20 km long in total. The main geological hazard within its construction area results from the presence of a thick layer of water-saturated Quaternary sand, prone to liquefaction and manifestation of quicksand phenomena. Probable karst and suffusion may be manifested at the surface near one of the designed metro stations. Geological cross-sections of two stations show the presence of weak and specific ground.

The analysis of available data on engineering geological conditions at the construction site as well as the use of newly obtained survey results for this metro line permitted us to reveal the possible geological problems that may arise in the course of construction and operation of metro infrastructure and to deliver recommendations on geological constraints. The degree of geoenvironment suitability was assessed proceeding from the existing geological hazards and applicability of special design projects and protection measures. As a result, the proposals have been elaborated for the engineering geological survey requirement specification, for recommendations on geohazard assessment and geofiltration tests, as well as for geotechnological monitoring, application of protective measures and special engineering designs.

The performed studies prove that the preliminary assessment of engineering geological conditions at the pre-project stage for major engineering construction allows managing geological risk by the rational planning of engineering geological investigations and choosing the optimal construction project and protective measures.

