



## **Problematic rock complexes on the planned FinEst tunnel route**

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The planned rail tunnel route between the cities of Helsinki and Tallinn (FinEst) runs to a great extent (more than 90% of its length) in the hard Paleoproterozoic crystalline basement metamorphic and intrusive rocks (such as various gneisses, amphibolites, or granites). In the Estonian end, the crystalline basement is covered by a 150–180 m thick sequence of sedimentary rocks. These rocks comprise Quaternary deposits and Neoproterozoic (Ediacaran) and Palaeozoic (Cambrian, Ordovician) sedimentary rocks, containing a few layers of problematic deposits and rocks, which may assert a serious challenge to tunnel constructors. The sequence of sedimentary rocks includes (from top to bottom): Ordovician limestones – up to 20 m; Ordovician and Cambrian sandstones and alum shale – ca 20 m; Lower Cambrian blue clays – ca 90 m; and Ediacaran sandstones – ca 60 m.

The most problematic layers for constructors are weakly lithified and water-saturated Ediacaran fine-grained quartzose sandstones, which also form the main groundwater aquifer for the eastern part of the Tallinn region. Their lithological, physical, hydrogeological and geotechnical properties are poorly studied, and additional investigation is required. The output of the existing drill cores of Ediacaran sandstones is very low (ca 10%). Therefore, additional drilling of cores is essential in the Viimsi region. Geophysical well logging has been carried out in existing drill holes in Viimsi peninsula for aiding in determination of the well logs that were compiled during the drilling. United results from a combination of drilling logs and geophysical logs of the same borehole provide a more detailed picture on lithological changes within the subsurface. In Ediacaran rocks, geophysical logs can primarily be used to differentiate sandstone, silty sand and clay layers from each other. Changes in bedrock types can be determined, as well. The methods used for borehole geophysical logging are natural gamma (API), calliper, formation resistivity (16“, SPR and 64“), density (g/cm<sup>3</sup>) and seismic/acoustic logging.

Another problematic set of sequences is connected with buried valleys running under the Bay of Tallinn, cutting the sedimentary rock sequence. In the Merivälja region, there is a ca 145 m deep buried valley, filled with water-saturated Quaternary deposits (silt, sand, gravel and till). For the purposes of constructing the tunnel, there is lack of data on the buried valleys under the Bay of Tallinn. Thus, additional marine geophysical investigations are essential.