Mosul Dam is one of the largest multi-purpose dams in the Middle-East, providing drinking water, irrigation, flood risk management, hydropower generation, recreation and environmental benefits. The 3.4 km long earth fill dam is located on a karstic foundation that presents safety concerns related to solutioning of the foundation leading to collapse of the foundation or erosion of the embankment into voids in the foundation below. The dam is estimated to pose extremely high risk to the population, economy and water resources of Iraq. The foundation of the dam consists of multiple layers of gypsum/anhydrite and calcareous formations at various depths below the embankment up to 300 meters in depth. Gypsum is known for its high solubility and the dissolution of these layers could result in voids and collapses leading to stoping of the embankment material into the foundation. Shallow blanket grouting and a deeper grout curtain were installed during original construction and maintenance grouting has been performed since commissioning from a 3-meter wide grouting gallery located along the centerline of the dam at the dam/bedrock interface. The portion of the gallery referred to as the “Lower Gallery” is located in the historic alignment of the Tigris River prior to the construction of the dam and is therefore the lowest elevation of the gallery. It also comprises the most challenging and problematic geology across the dam. In this area the Tigris River is well incised into the foundation bedrock and some sections in the lower gallery were constructed directly above the gypsum/anhydrite layers. Due to the elevation, location and geology in the area, the lower gallery experiences high artesian pressures (upto 11 bar) and outflows (upto 1100 l/sec). During recent grouting activities the reservoir pool was at its highest level since 2006, resulting in significant challenges to grouting. This paper focuses on the challenges to grouting with high artesian conditions and the solutions devised to overcome them in order to complete grouting.