

Pneumatic Fracturing and Dual Phase Extraction in Fractured Shale Bedrock

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At this former manufacturing facility in Flemington, New Jersey, a ground water pump-and-treat system has been operational since 1987 to address elevated levels of trichloroethene (TCE) and vinyl chloride in the ground water. Review of historical TCE ground water concentration trends showed a “spiking” pattern, which led site investigators to conclude that a residual source was still present in the aquifer. To address this source area, the installation of a dual phase vapor extraction (DVE) system to enhance ground water recovery and remove vapor phase TCE from the shallow bedrock zone was proposed. During the design phase of the project, a DVE pilot test was performed to collect system design parameters. However, due to the presence of low permeability shale bedrock, ground water recovery and vacuum radii of influence was minimal at the applied vacuum levels.

Pneumatic Fracturing, a process consisting of the controlled injection of air into the formation, increases the conductivity of the formation through the creation of an interconnected fracture network. At this site, fractures were initiated through the dilation and interconnection along bedding planes and joints. Some preferential direction was also observed along the bedrock strike and dip direction. Pneumatic Fracturing activities consisted of injections in two existing monitoring wells at the site targeting the 16 to 37 ft bgs interval. In fracturing the two wells, pressures ranging from 97 to 430 psig were required to initiate fractures in the formation. During the fracture events, pressure influence was observed at monitoring wells 45 feet away from the fracture injection well.

Subsequent to the fracturing and start-up of the DVE system, dissolved TCE concentrations in a key source area well decreased by 92%, signifying the increased production of the well. Ground water draw down effects and vacuum influence were also observed to increase significantly after fracturing. Several wells that previously showed little to no influence from the DVE operation were observed to respond to the applied vacuum subsequent to Pneumatic Fracturing.