

## Combined Sewer Overflow Tunnel

Providence, Rhode Island, USA

Moving groundwater and groundwater contamination can inhibit freeze closure. Keller overcame these challenges with accurate and early diagnosis of the condition and timely reaction to mitigate potential project delays.



### The project

The overall project involved the freezing of four shafts excavated by conventional methods, plus an additional two shafts which were raise bored through frozen ground. The conventionally excavated shafts varied from 45 to 34 ft in diameter and were as deep as 175 ft. The raise bored shafts were frozen solid for 12 and 6 ft diameter bores.

## The challenge

While ground freezing for the nearby shafts had been accomplished without incident, closure for the main 45 ft diameter access shaft proved to be particularly challenging due to three unanticipated factors; the presence of free-phase gasoline at the surface of the water table from a 17,000 gallon gasoline spill immediately at the location of the shaft, highly permeable openwork gravel layers and seams within the glaciofluvial deposits, and flow of groundwater from the rock. Piezometric levels in the rock were higher than in the glaciofluvial materials. Several grout holes left unabandoned from an earlier grouting contract, acted as open conduits during freezing, permitting free flow of water from the rock into the overburden.

## The solution

Probing at shallow depth near the water table indicated lack of frozen ground uniformly around the perimeter of the shaft, and presence of free product. Keller immediately installed a secondary series of shallow angled freeze pipes, splitting the centers between the original freeze pipes to provide frozen ground in the contaminated zone. Profiling of the freeze pipes also revealed warm spots (“windows”) at various locations in the frozen wall between depths of 90 and 160 ft. Clusters of TAM grout pipes were installed and cement-bentonite grout was injected outside the shaft perimeter to close the windows.

## Project facts

### Owner(s)

Confidential Client

### Keller business unit(s)

Keller

### Main contractor(s)

Keller

### Solutions

Groundwater control and dewatering

### Markets

Infrastructure  
Tunnels and shafts

### Techniques

Ground freezing  
Permeation (chemical) grouting

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