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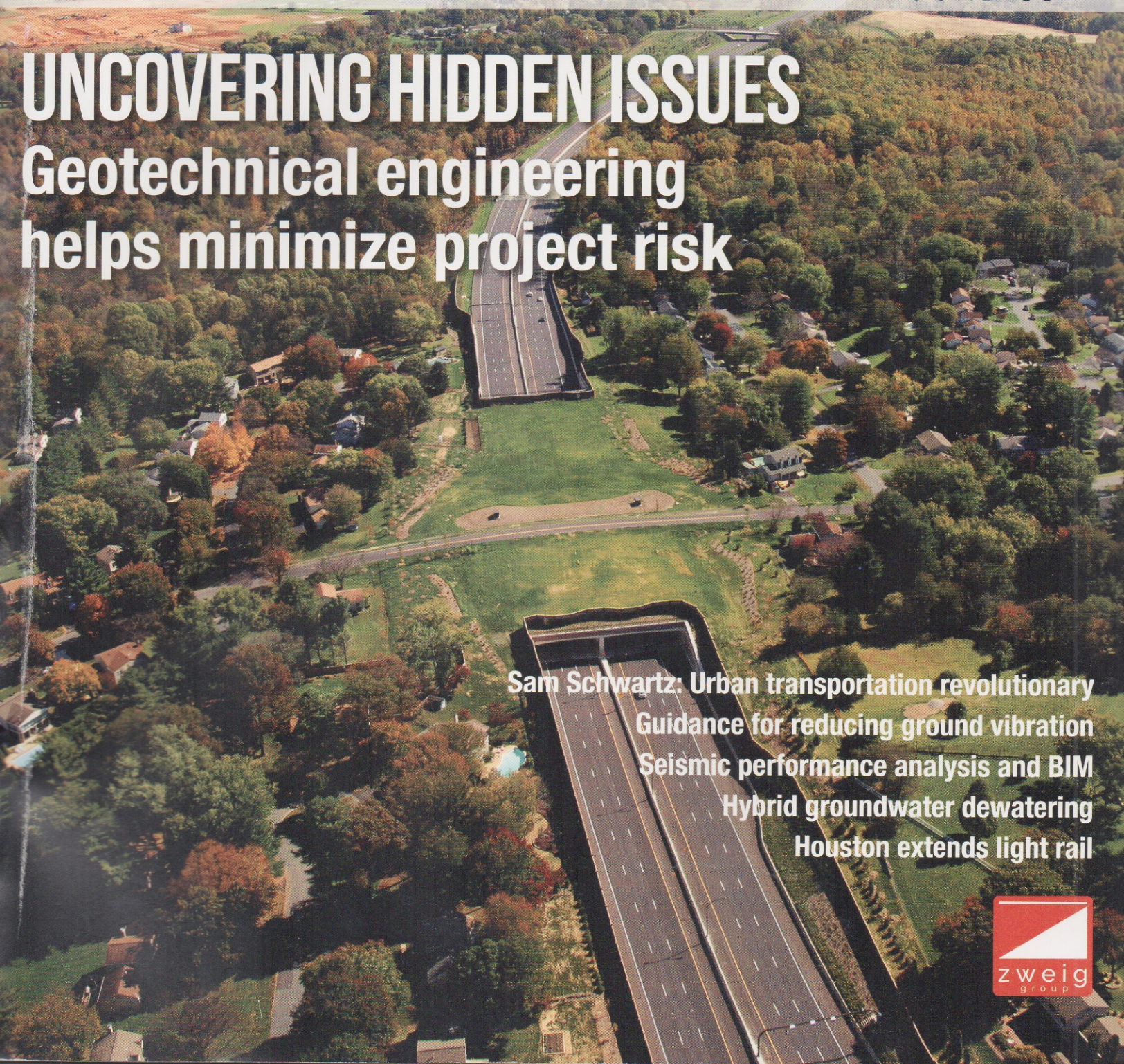
# civil + structural ENGINEER

CELEBRATING THE DESIGNERS OF THE WORLD AROUND US



## UNCOVERING HIDDEN ISSUES

## Geotechnical engineering helps minimize project risk

Sam Schwartz: Urban transportation revolutionary

Guidance for reducing ground vibration

Seismic performance analysis and BIM

Hybrid groundwater dewatering

Houston extends light rail

zweig group

TerraFirma's well modification in progress. Wells must be lowered as excavation advances.

# HYBRID GROUNDWATER DEWATERING

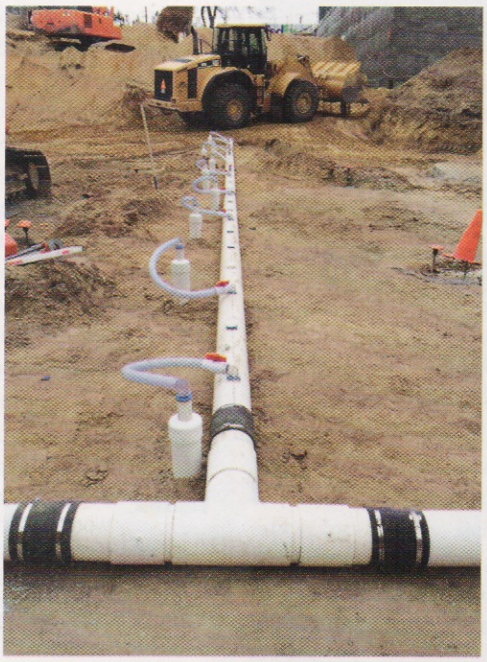
## DEEP DEWATERING WELLS COMBINED WITH MINI-VACUUM WELLS REDUCE THE RISK OF CONTAMINANT MIGRATION.

**WHEN AN OFFICE** and retail development in the heavily travelled Cherry Creek business district of Denver broke ground in February 2014, neither general contractor GE Johnson, owner 100 Saint Paul, LLC, nor geotechnical consultant Terracon could predict unforeseen conditions that would require on-the-spot installation of more dewatering features than originally designed. Dewatering experts from TerraFirma Earth Technologies worked with the owner, general contractor, and design consultants to come up with a supplemental dewatering system that averted delays and minimized costs.

The original design included widely spaced, deep dewatering wells meant to maximize drawdown, while minimizing the rate of groundwater flow, in an effort to prevent migration of potentially contaminated groundwater from adjacent properties. The modified system meant adding mini-vacuum wells directly adjacent to the building's elevator pits and a permanent dewatering sump pit that TerraFirma was able to custom design on the job, making for unique hybrid dewatering methods to better suit the actual soil and jobsite conditions.

TerraFirma's President David Giles explained, "Usually when we pump water from the ground, we pipe it directly to a storm sewer drain. However,

TerraFirma utilizes Holland's Rotary Lobe wellpoint pump for its mini-vacuum well-dewatering system. Traditional deep well dewatering wells are visible in the background.



A PVC mini-vacuum well assembly was installed following drilling of the borehole using a track-mounted Geoprobe hollow stem drilling rig.

Groundwater collection lines allowed clean groundwater to be directed to the city storm sewer drain; contaminated, treatable groundwater to an onsite groundwater treatment system; and contaminated, untreatable groundwater to be re-injected into the ground, to its original source.

there was concern that this groundwater was contaminated from three sources: chemicals from a dry cleaning business, hydrocarbons from a previously demolished fuel station, and dissolved metals, which occur naturally in the earth.

"By isolating the supplemental dewatering to just those few areas needing it, we saved precious time and reduced costs," Giles said. "Also, by limiting supplemental dewatering efforts to just those few areas, we reduced the required amount of groundwater to be pumped, thereby reducing the risk of pulling in contaminants identified on adjacent properties during the investigative phase of the project."

Brian Lawrenson, GE Johnson's superintendent, said, "The project is situated in the heart of Cherry Creek, with very little or no laydown. TerraFirma worked with us during the logistical challenges we faced daily. Due to the complexity of the site excavation and ever-changing conditions, GE Johnson had TerraFirma install two areas of vacuum-well assemblies to provide additional localized dewatering. TerraFirma reacted quickly to these unforeseen conditions and was able to minimize the impact to the construction schedule."

The final dewatering system included 11 extraction wells, one injection well, 42 mini-vacuum wells, three perimeter high-density polyethylene groundwater discharge manifold lines, and a groundwater treatment system.

"It was the first time I have seen such a unique groundwater collection and treatment system design in my 28 years in this business," Giles said. "It was much easier and less expensive to design and install this at the outset, just to cover the possibility that it would be needed. Had we not planned in advance for the three possible discharge routes and needed them, it would have been expensive to do so later. Terracon deserves credit for a really unique design."

According to Giles, in the end Terracon's samplings were all within limits, and the water didn't have to be redirected away from the sewer. The injection wells will remain in place after completion of construction and incorporated into a separate, permanent dewatering system.

David Cross of 100 Saint Paul, LLC, said, "TerraFirma brought a high level of expertise and extensive knowledge base to the table when we hit the bottom of the hole. They were instrumental in bringing about a speedy resolution to unforeseen subsurface conditions to the benefit of the general contractor and the project owner."

100 Saint Paul, a Class A office and retail development, is scheduled for tenant occupancy in the summer of 2015. As of Nov. 18, 2014, the steel structure rises to eight levels above grade over three below-grade parking levels.

Giles and partners Josh Peltier and Mike Giles founded TerraFirma in 2004 with the mandate of elevating the quality and professionalism of the dewatering industry. Headquartered in Houston, TerraFirma helps owners and contractors throughout the U.S. maintain acceptable groundwater levels for both temporary projects and permanent installations. Past deep excavation projects include athletic stadiums, hospitals, high-rise facilities, transportation facilities, airports, tunnels, power plants, dams, waterways, petro-chemical plants, and municipal infrastructure sites such as pumping stations, treatment plants, as well as sewer and gas pipelines.

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Information provided by TerraFirma Earth Technologies, Ltd. (www.tfearth.com).