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To cut or not to cut?

Determining the most feasible option for burying stormwater pipelines.

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Editor's note: Trenchless construction is a great way to avoid digging up environmentally sensitive areas. More contractors are bidding on jobs, increasing competition and lowering anticipated project costs almost to the level of open-cut construction.

But location isn't the only variable that influences pipe installation. Up to half the cost of trenchless construction is associated with mobilizing the equipment and excavating the entry pits. Mobilizing may require additional ramp-up time, potentially affecting project schedules.

That said, on alignments exceeding 100 feet, some techniques — such as horizontal directional drilling — actually entail less time and disruption than open-cutting.

There's also pipe length, width, and depth to consider. Substrate conditions and water levels may prohibit trenchless entirely, or require that a different pipe material be specified. Budget and politics play a role.

The following scenarios show how two public works departments determined what would work best for their unique challenge.

KNOW THE GEOTECHNICAL AND HYDROLOGICAL CONDITIONS

When the Westminster Department of Public Works & Utilities decided to place an 8-foot stormwater pipe under one of Colorado's busiest highways, a jack-and-bore system was the first choice for installation.

Preliminary designs called for 240 feet of reinforced concrete pipe (RCP) that connected to grouted, boulder-lined channels on each side of the interstate. The pipe would carry 750 cubic feet of water per second, serving as a key link in a larger, $7.5 million stormwater improvement project.

Subsurface conditions soon affected their plans.

During the preliminary feasibility study, geo-technical consultants CTL|Thompson Inc. explored conditions along the alignment and recommended one tunnel. But the subsequent analysis — consisting of 40-foot borings adjacent to and in the middle of the road — revealed that the upper part of the soils, to a depth of about 18 feet, was clay. Beneath the clay was wet, sandy, and gravelly soils and claystone bedrock.

These "split face" conditions restricted the use of a jack-and-bore system. Instead, a tunneling contractor would need to use a much more expensive "earth pressure balanced" boring system.

To eliminate split-face conditions, CTL recommended running two

66-inch pipes, each through a tunnel of its own, built 4 feet higher than originally estimated. Raising the elevation of the invert and using smaller-diameter pipes reduced the need for dewatering, which in turn reduced overall project costs.

“The conditions for the final project were ideal,” says Mike Galuzzi, lead civil engineer at WHPacific Inc., design engineering firm for the project. “But if we hadn't collected detailed geotechnical information and stayed with the original design, we would've met with increased costs, delays, and disruption to interstate traffic that would have caused public outcry.”

As Westminster learned, ground conditions such as hard bedrock, clay, sand, or shallow groundwater determine whether open-cutting is even possible. If it isn't, they determine what type of trenchless technology to use.

“Understanding subsurface conditions is the most important consideration when analyzing trenchless projects,” says Chris Knott, project manager and estimator for specialty contractor BTrenchless. “You need to know exactly what you're getting into, and at what depth, and in what location.”

Geotechnical consultants recommend performing a series of borings along the proposed alignment and, for complex projects, digging test pits at select points.

The presence of groundwater is also critical.

In wet conditions, open-cut contractors must dewater excavations before and during construction, which increases costs. That's also true for trenchless construction. If the site can't be dewatered because, say, the water is contaminated, a more advanced, and thus more expensive, trenchless method may be required.

“Dewatering issues aren't considered as thoroughly as they should be,” Knott says. “Incorporate dewatering into the project design schedule and budget, or you'll face significant project delays resulting in additional costs and change orders.”

Groundwater conditions should be identified during the geotechnical investigation along the alignment. If shallow groundwater exists, several options are available for dewatering, depending on the sub-surface conditions: sloping trenches, pumping the water from the excavation, and a series of well points or even cutoff walls.

WHEN ONLY OPEN-CUTTING WILL DO

Six times over the past 70 years, storms have ravaged the 5-square-mile area of west-central Fort Collins, Colo.

In 1997, floodwaters were deep enough for college students to kayak down the main road, causing hundreds of millions of dollars in damage and killing five people.

The city pledged in 2001 to supplement its existing stormwater control system with a $35 million system of detention ponds, conveyance canals, and pipelines. The project hit a snag, however, when the utilities department realized one 102-inch reinforced concrete pipeline would run through a residential area that already hosts numerous underground utilities.

Using an alternate product-delivery management system, the department convened a team of civil engineers, geotechnical consultants, and construction contractors to collectively evaluate detention and conveyance alternatives.

The team determined that the best route was through the neighborhood. But it was risky: Without adequately shoring the excavation, open-cutting could undermine the foundations of two multifamily structures in the pathway. Furthermore, contractors would encounter saturated soils including clays, caving sand, and gravel at a depth of 35 feet.

“We exceeded a depth that even a triple-stacked trench box couldn't handle,” says Andrea Faucett, manager of municipal engineering for Ayres Associates, the lead engineering firm.

Geotechnical consultants CTL|Thompson Inc. excavated test pits and drilled numerous borings to evaluate soil, bedrock, and groundwater conditions. Based on the results, the design team decided open-cutting was possible. Residents, however, were less than thrilled with the idea. They didn't want the area torn up for six to eight weeks and have to park half a block from home in the interim.

The other viable option was a $1.5 million micro-tunneling system. But it was more than twice the cost of open-cutting.

A resolution came with the discovery of the slide rail system, a little-used dynamic trench box that allowed the contractor to open-cut through the neighborhood for roughly $500,000.

Issues like impact on the community, parking, and traffic can halt projects. To keep from setting off a flurry of complaints, managers reached out to the residents at community meetings, discussing the project and explaining what to expect, before announcing their decision.

They'd learned the importance of public buy-in when a stormwater drain had to be placed in the city's historic downtown area. Open-cutting would have disrupted the pedestrian-heavy area, which was also adjacent to a heavily trafficked state highway. It was sure to cause an uproar. Managers specified a jack-and-bore with hand mining instead.

“Put all these factors on the table, and work it through with your design and construction team early on to avoid any complications,” says Chris Knott, project manager and estimator for specialty contractor BTrenchless.

The neighbors were comfortable with the project, which proceeded on schedule.

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Web Extra

For an overview of trenchless options, visit here.