Drill, Don't Dig

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Horizontal directional drilling and fusible pipe provide a new discharge system while minimizing impact on a busy campus. The new system was not only less intrusive but more cost-effective in the long run.

The Scripps Institution of Oceanography at the University of California – San Diego has maintained a seawater system to support its research and teaching mission since 1910. The system currently draws 1 MGD of seawater from an intake pipe at the end of Scripps Pier. After filtration, the seawater is stored in holding tanks until used in experiments or aquarium life-support systems. Until recently, the water would then be commingled with stormwater before it was discharged back into the Pacific Ocean. State regulators began issuing discharge permit requirements for the institution's effluent in 1969. The permit was reissued in 1979, 1984, 1994 and 1999. Meanwhile, the State Water Resources Board designated the waters off the institute's coastline – the San Diego Marine Life Refuge – as an Area of Special Biological Significance, specifically ASBS 31.

Although the California Ocean Plan prohibits waste discharges into ASBSs, the State Water Board adopted a resolution that grants the institution an exception if it complies with all of its National Pollutant Discharge Elimination System (NPDES) permit requirements. The goal was to ensure that the seawater system's effluent would not alter ASBS 31's natural water quality. Separating seawater and stormwater flows was deemed essential, but reconfiguring the 80-year-old system was an arduous engineering task. Also, proposed modifications to the open-flow system had to be carefully evaluated to ensure that they would not jeopardize the marine life used in research and public exhibits.

Evaluation of possible solutions

The institution had six months to submit a report to the regional board. The report included an evaluation of the costs and feasibility of potential solutions, as well as partial or complete diversion of flows to the municipal sewer system, alternate treatment techniques, and pollutant minimization and source control.

The project team considered four alternatives:

- Separating the seawater and stormwater discharge systems,
- Diverting flow to the municipal sewer system,
- Extending the pier (and discharge pipe) beyond ASBS 31, and
- Constructing an ocean outfall.

Team members determined that only sewer separation was feasible. The other options proved to be impractical, were more expensive or would take too long to complete. Sewer separation would meet the board's requirements by:

- Segregating seawater flows from stormwater flows,
- Minimizing the use of chemical additives, and
- Eliminating the discharge of copper and other treatment chemicals by diverting them to the municipal sewer system.

The specially made PVC pipe is fastened into place along the Scripps Pier as one long piece.

Project design

The original system discharged commingled seawater and stormwater via two outfalls. The project team decided to reserve the existing piping for stormwater and install a new pipeline to handle seawater from existing aquarium and research tank sites. The conceptual plan called for 2,500 feet of 8-inch, inside-diameter pipe to be installed near the existing storm drain lines.

The planned construction area had steep hillsides and tight site constraints, and was heavily populated during the day with about 50,000 university staff and students. Also, a site survey and a review of existing infrastructure drawings indicated that the area was crowded with utilities. Moreover, its soils consisted of sedimentary rock, including pockets of large cobblestones, cemented sandstone and moist sandstone.

The bid documents allowed pipe installation with or without trenches, and for the trenchless option to provide glued PVC pipe installed by micro-tunneling. The contracting team proposed installing the pipes via horizontal directional drilling (HDD), which was less expensive than micro-tunneling.

In the HDD method, a directional drill bores a path for the pipe, which is pulled through afterward. Typically, the bore path originates at the surface and has little impact on the surrounding area. This method often is used when trenching or excavating is impractical, or when minimal environmental disruption is preferred. The method also recommended the use of fused high-density polyethylene (HDPE) pipe.

Upon review, the institute became concerned that the 8-inch pipe would only have an inner diameter of 6.6 inches, which would not be able to handle the required flow rate. The contractor, Newest Construction Co. Inc., with Inland Valley Engineering Inc. as a drilling subcontractor, suggested that the institute consider fusible PVC pipes instead. This pipe had the same 8-inch inner diameter as the original specified PVC pipe, thereby meeting design flows, but was stronger than HDPE, resulting in a reduced outside diameter and a smaller bore hole. The institute also had a long history with the installation of PVC pipe and was most comfortable with this material.

After inspecting the shop drawings to confirm that this approach was feasible, institute staff accepted this team's proposal. Although slightly more expensive than the traditional trench-based installation method, the HDD/PVC was deemed likely to be less intrusive at the campus.

Project construction

Construction began in August 2006. In addition to the contracting team, project staff included an archeologist, who monitored the soils for native artifacts, and a biologist, who ensured that the pits and staging areas remained within previously established boundaries to minimize environmental effects.

The contractor first constructed pits at strategic locations next to roads or in parking lots. Due to the depths of the lines (20 to 25 feet), they used a custom pit-launched directional drill to bore paths below the surface for the new pipeline. Each time, the contractors set the drill to a pre-established pipe grade (angle) and directionally drilled a pilot hole from entry pit to exit pit. They then step-reamed each hole with aggregate hole openers to facilitate a smooth pull.

The restricted workspace was a challenge. The project team initially underestimated the staging and space required to fuse 40-foot pipe lengths together and pull them through each hole, as well as the space requirements for the associated equipment needed to excavate and shore up each pit. However, after determination of the requirements for the initial pull, the team became adept at determining the construction areas required. The installation method proved so beneficial that the team was able to expand the project so telecommunications lines could also be installed for a small additional cost.

The pipe was surprisingly flexible – although not as flexible as HDPE – so that the contractors did not need as large a trench as

The project involved the fusing and installation of 3,000 feet of 8-inch Fusible C-900 pipe for the new seawater return system.

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originally designed to maneuver the pipe so deep underground. This flexibility was useful when the pipe had to be threaded through existing utilities at some sites.

Overall, the installation went very well. There were two cases where the drill rod connecting bolts on the swivel were sheared due to difficult pull-back conditions in high-cobble areas and the resultant forces required. The pipe was not damaged and simply pulled back through the entrance hole (with a backhoe), and new swivel bolts were installed and reconnected. The contractors installed more than 4,000 feet of 6- and 8-inch inside diameter, fusible-PVC C-900 pipe in about eight months. The project involved 12 pulls and was completed in early May 2007.

The new pipe is expected to handle seawater with fewer maintenance requirements than the concrete pipe that formerly housed such flows. Seawater is highly corrosive and contains living organisms, such as algae, crabs, and mussels that tend to inhabit concrete pipes.

Of the $8 million the institute budgeted to address 13 discharge issues, this project cost $2.5 million. Material costs were lower than originally planned, because the pipe was about 30-percent less expensive than a comparable HDPE pipe for the project, and resulted in a smaller bore hole. However, total projects costs were somewhat higher because the drilling went so well that the institute added more work (telecommunications line installations) via change orders. ***PE***

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