The flume with a 6-by-12-ft trough is part of the Truckee Meadows Water Authority (TMWA) raw water supply system and is the main source of drinking water for the area’s 330,000 residents. Water is gravity fed via the Highland Canal from the Truckee River at a rate of 55 million gal per day (mgd) to the TMWA’s primary surface water treatment plant, Chalk Bluff.

The ‘physicians’ on this case were from the emergency rooms at P&F Distributors, Brisbane, Calif.; Q&D Construction, Sparks, Nev.; engineering firm Wood Rogers, Sacramento, Calif.; and Performance Pipe, Plano, Texas. The group of consultants and engineers was led by TMWA.

“The earthquake hit on April 25 at around 11 in the evening,” said Juan Esparza, principal engineer for TMWA. “This seismic event caused some rock to loosen up and tumble down the hillside, knocking out a number of supports from underneath the elevated flume, causing it to collapse and thereby cutting short our water supply.”

“More than half of the plant’s raw water supply was lost. We had to immediately come up with solutions for making up that 55-mgd loss very quickly,” Esparza said.

Addressing Water Loss

In order to overcome the sudden shortfall, temporary diversion pumps were rented and installed at the Orr Ditch diversion off of the Truckee River. A 10-pump package was rented from Rain for Rent. It was estimated that these 10 pumps could provide 40 mgd to Chalk Bluff. Each of the pumps consumed diesel fuel at the rate of 9 gal per minute at a design point rated to provide 40 mgd.

Just like surgeons doing a coronary bypass operation, engineers and construction crews saved a patient using high-density polyethylene pipe (HDPE) pipe as the replacement pathway. In this case, the patient was a 100-year-old wooden flume that was the main source of potable water for the Reno, Nev., community. The catastrophic event was a 4.7-magnitude earthquake that led to the failure of a 200-ft run of the elevated flume that followed along a steep hillside slope located immediately above a residential subdivision.
At the time, when oil was well over $100 a barrel, we negotiated a price of $4.25 per gal for the fuel,” Esparza said. “With a potential fuel demand of 90 gal per hour, there was an opportunity to incur substantial costs just for the fuel. Then there was also the cost to rent the pumps, provide maintenance and make frequent oil changes.

“Typically, when you have a problem with a pump or a leak, you have to get the pumps up and running, and it usually takes a couple of hours to get it back up to speed, and then you have to spend time maintaining it, and it’s a continuous process,” he continued.

“Given that, we knew it was going to be a big job of moving it up steep slopes and putting together 800 ft of heavy, durable HDPE pipe provided by P&F.”

“With the pressure and the conditions we were facing, we knew we had to respond quickly and efficiently,” said Chris Lyne, project manager for P&F Distributors. “Our primary objective is to accommodate our customers’ needs while providing the highest quality products and service in a safe and efficient manner,” said David Morgan, president of Performance Pipe. “Typically, 36-, 48- and 54-in.-diameter pipe is made to order. We knew the severity of the problem and the time-critical need the residents faced. We were able to adjust our manufacturing schedule to get the pipe delivery expedited.”

The TMWA formulated a plan of action and received bids from four separate contractors, each with a different solution for the problem.

“Rather than do a formal design-bid-and-then-build type of construction process, we decided to try an information design-build type of approach,” Lyne said. “We got together with the contractors, talked about the project, and then we let them propose on the project.”

“Each of the four contractors submitted bids and essentially four different alternatives,” he continued. “The plan from Q&D Construction using HDPE pipe was selected. It bypassed the entire damaged section of the flume, while the other three alternatives would use those portions of the flume that were intact.”

The HDPE pipe alternative was more expensive up front due to capital costs,” Esparza said. “But from a business standpoint, it was the most conservative play. It would allow us to eliminate the necessity for the continued use of the old flume so that if we ever had another seismic event, the probability that this repair would fail was fairly minimal. It was more probable that with the other alternatives we could suffer another catastrophic failure and the potential for a complete outage again would be higher.”

Two of the other submissions would use steel pipe, and the other called for building a concrete ditch on an embankment.

The HDPE pipe was at Performance Pipe’s Reno plant. DriscoPlex 4100, SDR 32.5 solid-wall pipe carries a pressure rating of 50 psi. It meets both ASTM F 714 and AWWA C906 specifications. The pipe is made from engineered polyethylene materials that provide a balance of properties for strength, toughness, flexibility, wear resistance, chemical resistance and durability. Performance Pipe products for this type of application have excellent hydraulic qualities to fluid flows, even at high-flow velocities.

Knowing what the job required regarding pressure and performance and what was needed to be accomplished, this DriscoPlex pipe fit the exact need, plus met the engineering specifications,” said Jeff Sevario, the Performance Pipe representative for the area. It was because of both the proximity of the Performance Pipe plant to the job site and the availability of the pipe that the repairs could be made quickly. Producing pressure-rated pipe that is more than 4 ft in diameter is not a “make-and-stock” item. The company was able, however, to shift its manufacturing timetable.

“The HDPE pipe has the ability to conform to the contours of the hills and can move along with any changes brought on by an earthquake,” he said.

“Two of the other submissions would use steel pipe, and the other called for building a concrete ditch on an embankment.”

Once the pipe was on site, the Q&D Construction crew undertook the big and tough job of moving it up steep slopes and putting together 800 ft of heavy, durable HDPE pipe. Sections of the 54-in.-diameter pipe were joined using the heat fusion method that

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provides a strong, lifetime leak-tight joint.

“It’s hard to look at a site plan on paper and realize just how tough a job it’s going to be,” said Mike Douglas, chief estimator for Q&D Construction and the Truckee project manager. “We faced how to move 100,000 lb of pipe up a slope with virtually no roads. But our main concern was with the movement of the water: Will the pipe provide the flow rate needed? And will it stand up to an earthquake?”

“That’s why Truckee Meadows Water selected us,” Douglas said. “We had a unique solution for the problem. Originally, they wanted to recreate what existed or put in an earthen berm. Steve Strickland of Wood Rogers, our design partner for this project, provided the initial idea of a bypass. We selected Performance Pipe and the HDPE material because we were sure the pipe would work with the existing alignment and the contours of the terrain. Plus, it would meet the criteria for the required flow, and the repair could be done in the shortest amount of time, which was about two weeks once we were on the job site. It would also be a bit more secure, as the flume would be left in place, which could offer further protection for the pipe in the event of another earthquake.”

Weighing some 120 lb per running foot, the 54-in.-diameter pipe needed more than a little coaxing to get it into place, especially after 50-ft sections of pipe were heat fused together to form a 600-ft monolithic line. First, the Q&D Construction team cut a road into the mountainside. “You have to imagine that road not being there,” Douglas said, “and the flume supported just by wooden legs. It is not an easy locale.”

But there was still another hurdle to get the 100,000-lb pipe in place, so Douglas and his crew got even more inventive.

“We took a flange coupling adaptor that acted like a slip-collar on the pipeline, attached the lines and dragged the entire piece up the slope—about 100 ft,” he said.

The line was then tied into the existing concrete channels at the inlet, where the transition is made into the flume on the upstream side. On the outlet side, transition is from the elevated flume to an earth-and-concrete channel and to the HDPE pipe. Douglas had some advice for others. “A job like this is a work in progress,” he said. “You can’t go into any of these jobs thinking this is exactly what we’re doing to do. It’s an ever-changing problem. You go back and forth to make sure everyone is comfortable with what you’ve got, even if it is temporary because you have people’s lives at stake. So you take very seriously what people have to say and their concerns.”

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For more information, write in 1109 on this issue’s Reader Service Card.

After a strong earthquake, 200 ft of an elevated wooden flume that ran along this steep slope failed.

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