Historic Rains in Memphis Lead to Monumental Emergency Bypass

Fast-turnaround, turnkey solution minimizes environmental impact and maintains service while ensuring regulatory compliance

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Record rainfalls in Memphis, TN eroded the soil supporting a 96-inch sanitary sewer main, causing the line to fail. With nearly 40 million gallons per day (MGD) of raw sewage escaping into Cypress Creek, less than a mile from McKellar Lake and the Mississippi River, an emergency bypass was needed fast to facilitate the repair work on the 96" sewer main. City officials immediately activated their Emergency Response Plan, gathering the management team from the Public Works Division and bringing in the experts at Xylem, to help assess the damage and to map out an action plan.

Solution

Xylem quickly organized and coordinated around-the-clock job teams to implement a turnkey solution that maintained sewer services, minimized the environmental impact and ensured regulatory compliance. More than 30 Xylem staff members managed and worked side-by-side with approximately 100 Memphis Public Works and 60 contractor personnel to complete the necessary tasks. This "all hands on deck" approach accelerated the project timeline. Bypass solutions of this magnitude typically take upwards of two to three weeks to implement. The Xylem-led teams completed the emergency task in just six days.

The bypass needed to handle 160 million gallons per day (MGD) of flow and traverse approximately 2,400 linear feet from suction point to discharge location. To execute the monumental effort in an extremely compressed timeframe, Xylem had everything onsite within 30 hours.

"Xylem was able to marshal the equipment, the pumps and whatever else was needed and get the job done – plus they had people who knew how to utilize those resources," said Paul Patterson, Environmental Engineering Administrator, City of Memphis. "Public Works had the manpower and we had equipment as well. All of that put together resulted in a very successful response."

Before pumping could begin, several "critical path" projects had to be executed, from creating a right-of-way for the bypass to shoring up 250 feet of embankment on one side of the suction pit where the pumps would be positioned.

"Critical Path" Construction Projects That Supported the Bypass:

Excavation/creation of roadway

Utilizing more than a dozen excavators and bulldozers, a 2,400-foot-long, 40-foot-wide road was created to establish a path for the bypass. In excess of 6,500 yards of recycled material was hauled in as a base for the right-of-way.

Excavation/creation of suction pit

A suction pit – 150 feet wide on each side and 40 feet deep – was created to situate the pumps. The base of the pit was built using 40,000 cubic yards of imported material.

Excavation/ installation of culvert

As a critical piece of the bypass right-of-way, two 86-inch culverts side-by-side, each 100 feet long, were installed to contain the bypass piping as it crossed Cypress Creek.

Re-route battery supply line

The 13-kilovolt (kV) battery supply line for a substation adjacent to the bypass right-of-way was moved to provide adequate clearance from bypass operations.

Erosion control

Xylem brought in a shoring contractor to minimize erosion along the suction pit. The contractor drilled pilings 70 feet deep to address 250 linear feet of shoring, and installed erosion control material along the 2,400 foot right-of-way.

Plugging - Line 1

Plugs were installed at the suction and discharge ends of the main. To reduce dependency on the plugs, City officials asked Xylem to design a redundant plugging option. A customized steel plate was designed and placed over the ends of the existing pipes.

Plugging - Line 2

While work was done on the 96-inch main, an abandoned 60-inch sewer line needed to be re-plugged. An inflatable plug was installed at the manhole downstream from the suction structure, and the abandoned 60-inch line was filled with concrete to ensure the line was completely sealed from the 96-inch main.

To handle the 160 MGD of peak flow, Xylem mobilized 14 Godwin diesel-driven Dri-Prime CD400M pumps. Each pump would push approximately 11.5 MGD of flow through 24-inch HDPE suction tubes and 18-inch discharge tubes into an eight-foot square concrete manhole structure. Six days after the break, five of the 14 Godwin pumps were operational and handling 50 MGD of flow – an average daily flow rate for the system.

To span 2,400 feet of travel distance, the bypass utilized more than 30,000 feet of piping shipped from Xylem's rental locations along the east coast. A dozen factory-trained and certified Xylem fusion techs from across the country operated fusion machines in four staging areas. Working non-stop for a week, the teams fused 50-foot pieces of pipe into 500-foot sections and moved them into place along the right-of-way.

As the piping was set, the other nine pumps were installed and all 14 pumps put in place just two weeks after the break. One additional CD400M pump stood by as a redundant backup.

In addition to the primary bypass, Xylem installed a 36-inch bypass line to handle 11 MGD of flow and protect the structure. This bypass utilized two Godwin hydraulically driven CD300M pumps and a backup pump – all run by diesel power packs located 100 feet away behind a berm to prevent flooding and environmental contamination.

Results

Once the pumps were online, Xylem switched to 24/7 bypass operating mode. Two teams of Xylem mechanics worked alternating 12-hour shifts to operate, monitor, service and adjust the pumps as flow fluctuated. The bypass system worked as planned, pumping approximately 60 to 160 MGD of raw sewage. Xylem delivered a safe, compliant, cost-effective and comprehensive turnkey bypass solution that maintained service levels for the City of Memphis, while overcoming numerous obstacles to get it done in a very compressed timeframe. Working around the clock and utilizing more than 20 pieces of heavy equipment and machinery, the Xylem-led team mobilized and installed 18 pumps, nearly six miles of 18-inch and 24-inch HDPE pipe and all accessories in just two weeks.

"One of the benefits of Xylem's turnkey solution," said Patterson, "is it allowed the City to focus our resources and our efforts entirely on design and construction and getting the pipe replaced. And that was key."

Xylem and the contractor teams worked around the clock to get the first pumps in place in six days.

A culvert was put in place along 100 feet of the bypass line where the bypass crossed Cypress Creek.

A 40-foot wide right-of-way was constructed to handle the nearly six miles of pipe mobilized for the bypass. This section shows pipes heading towards the discharge structure 2,400 feet away.

Aerial shot of the suction pit, with the discharge tubes running off into the lower right corner of the image. To the upper left of the suction pit is the retaining wall that was installed adjacent to the parking lot.

Customer

City of Memphis, TN

Project

Nonconnah 96" Sewer Interceptor Emergency Bypass

Challenge

Design, excavate, and install a turnkey comprehensive emergency bypass solution to address a failed 96-inch sanitary sewer main.

Result

Xylem delivered a turnkey emergency bypass solution to the City of Memphis that maintained sewer services, minimized the environmental impact and ensured regulatory compliance. To make it happen, over 30 Xylem personnel were directly involved and managed over 100 City of Memphis staff and over 60 personnel from different contractors handling:

- Excavation
- Confined space & plug installation
- Shoring
- Drill rigs
- Traffic control
- Waste facilities
- Fencing

It took the Xylem team and supporting contractors, working around the clock, less than 6 days to mobilize – from up and down the east coast – and install 22 Godwin pumps, over 6 miles of 18 inch and 24 inch HDPE pipe, and corresponding accessories to implement the bypass.

Xylem's expertise provided the City of Memphis with the peace-of-mind that the project was in good hands. Beyond the right pumps for the job, Xylem addressed critical emergency project requirements and customer needs over the life of the six-month project, including erosion control measures to minimize environmental impact and safety measures to ensure regulatory compliance. The bypass operation allowed the City to focus on the replacement of the 96-inch sewer main, and establishing a long-term, environmentally secure solution.

Xylem Rental Equipment For The Bypass

- 15 Godwin CD400M diesel driven pumps – 14 for the bypass, and 1 redundant back-up
- 3 Godwin CD300M Hydraulically Driven Pumps – 8,000 GPM bypass of manhole structures
- 1 Godwin CD100M diesel driven pump – dewatering for excavation activity
- 1 Godwin CD100M electric pump – for re-aerating Lake McKellar
- 14 diesel fuel cubes (550 gallons each)
- Godwin generators
- 6 miles of fused 18 and 24 inch HDPE pipe
- 4 fusion trailers
- (1) 24 inch fusion machine
- (3) 18 inch fusion machine
- (2) 96 inch sewer plugs
- (1) 60 inch sewer plug
- Pump and piping accessories

Additional Equipment List

- 1 Site Control Job Trailer
- 10 Excavators
- 4 Telehandlers (three 8,000 lbs and one 15,000 lbs)
- 5 Dozers
- 10 Light Towers

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