Pipe Bursting Keeps Cambridge, Mass., City Hall Running

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When it became necessary to replace an existing 8-in. diameter sewer under a 12-in. diameter drain in the front sidewalk of Cambridge City Hall, disruption was not an option.

In August, the Cambridge, Mass., Department of Public Works completed a sewer and drain renewal project that successfully utilized pipebursting technology. The project was located in the sidewalk directly in front of Cambridge City Hall. For many years, the location has been the focal point of surface and landscaping improvements that enhance the access and historic beauty of the City's center of government. When it became necessary to replace a collapsing 8-in. diameter sewer located beneath this sidewalk, long-term disruption was not an option. The project demonstrated the benefits of pipebursting technology in a sensitive urban environment and the need for thorough investigation of existing facilities and utilities prior to construction.

Project Background

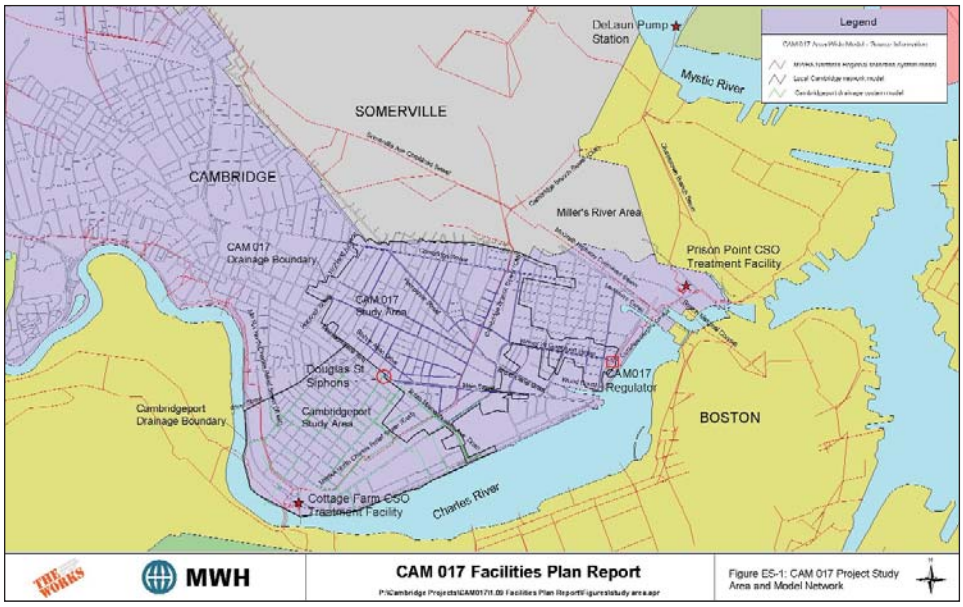
The City of Cambridge is located on the Charles River on the opposite side of Boston. Over the last 10 years, the City has been investing heavily in stormwater management and sewer separation projects to reduce stormwater from entering the sewer system, reduce backup of sewage onto streets and into basements, prevent sewage from entering the storm drain system and improve the quality of stormwater discharged to the Charles River. The "CAM 017 Facilities Plan" is an area-wide strategy to achieve those objectives in the eastern part of the City. In the course of the field investigation for this plan, a collapsed sewer was identified in front of Cambridge City Hall.

In developing a plan, the first priority was to find a way to repair the sewer as quickly as possible and without affecting the everyday functions at City Hall, including an upcoming City Council meeting, a planned street festival over Labor Day weekend, and the active pedestrian and vehicular traffic in the Central Square section of the City.

The original collection system in front of City Hall consisted of 240 ft of 12-in. diameter clay storm drain constructed above an 8-in. diameter clay sanitary sewer with only 7 in. separation between the two pipes. Record plans for the construction were dated at 1910. Common manholes were constructed at the upper end of the reach on Bigelow Street and at the lower end on Inman Street, which provided access to both pipes for maintenance. They were designed with steel separation plates to prevent cross connections between stormwater and sanitary waste, but these plates have not been functional for many years.

Condition Assessment

Internal inspections with a remote camera revealed that 30 percent of the sanitary sewer was severely fractured with two sections of pipe collapsed to 50 percent of the



cross sectional area, yet the drain above it was in good condition. There were no surface indications or nearby surface settlements to provide reasons for the fractured sewer. There were no recent trench repairs to indicate nearby utility disturbances. As a result, there was a concern for renewing the sewer without understanding the reasons for its severely deteriorated condition. For this reason, the recommendation was made and accepted to renew the storm drain as well.

Extensive dye testing and building inspection confirmed that all sanitary lateral connections from City Hall had been diverted to the sewers on the side streets of either Bigelow Street or Inman Street and that all existing service connections on the sewer in front of City Hall could be abandoned. Internal inspection of the storm drain identified two storm drain lateral connections and one illicit connection from an electrical transformer vault located in the sidewalk about 1 ft away from the drain.

Review of plans from public utility companies identified a major concentration of gas mains and electrical and telephone conduits in proximity to the common manhole on Inman Street.

Design of Common Manhole Eliminations

The area wide sewer separation plan required that the common manholes be eliminated. At both Bigelow and Inman Streets, separation was achieved by construction of new sanitary manholes and deflecting sanitary flows from the sewers on each of the two side streets into the main sewer along Massachusetts Avenue.

At Bigelow Street, the deflection was made by a gradual bend in the sanitary sewer, while at Inman Street it was made by a Y-shaped PVC sewer fitting cast in the base of the existing common manhole and then encased in concrete to complete the separation. This configuration complicates future maintenance operations to some degree but was necessary because two high-pressure, large-diameter gas transmission mains were located immediately next to the common manhole.

Evaluation of Pipe Repair Alternatives

The City reviewed options of open-cut excavation, pipe jacking, pipe bursting and cured-in-place pipe (CIPP) lining. Issues of concern included the size of the access pit needed for jacking and bursting operations, the potential impact of these two no-dig operations on the stability of adjacent pipes and structures, the ease of reconnecting service laterals, availability of materials, schedule requirements and costs.

Of the total 240 ft of sewer, there was about 35 ft of severely collapsed pipe and another 35 ft of pipe with minor cracks. Because the sewer is directly below the drain, it would be necessary to replace both pipes. In addition, the pipes are about 100 years old and there was concern as to the strength of the pipe once it was disturbed by the repair work. This method would be most disruptive to City Hall operations and pedestrian and vehicular traffic and for a longer period of time than either of the no-dig operations.

The method of pipe jacking investigated would have used hydraulic jacks located in an access pit to push an expander cone through the existing sewer to break it up, followed by 4-ft replacement sections of rubber gasketed, extra strength, smooth bell ductile iron pipe. This process requires a special type of ductile iron pipe, which added to the potential delays in the project. There was also no known contractor in the area that could demonstrate experience with this type of operation. Because of this, the quotations received were higher than typical for pipe bursting operations.

The method of pipe bursting investigated used both a pneumatic bursting tool pulled through the existing sewer by a steel cable and a power winch located in a downstream manhole. The replacement pipe is a continuous reach of HDPE pipe pulled behind the bursting tool as it breaks down the existing clay pipe. This pipe has the advantage of being joint-less and would minimize infiltration sources into the sewer system.

The idea of strengthening the 12-in. clay drain with a CIPP liner followed by pipe bursting of the sanitary sewer was considered. There was no known experience of a successful pipe bursting operation within 7 in. of a cured-in-place pipe. While the advantage of being able to conduct no-dig reactivation of the two drain service later-

als would have reduced the need for open-cut excavations, the cost of having to conduct a second repair of the storm drain made the CIPP option unacceptable.

The size of the access pit was a concern during the design phase of the project. The recommended length of the pit is at least twice the depth of the pipe to be installed. Discussions with the pipe bursting contractor prior to construction gave assurances that a smaller access pit could be obtained by lifting and bending the pipe to increase the curvature of the pipe without causing any damage.

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Project Implementation

After all the field investigations, coordination with utility companies, test pits to confirm clearances for critical utilities and final design, there was only one month before Labor Day. The City wanted to expedite the repair of the collapsed sewer and added the requirement that the work had to be completed by the holiday because of the upcoming City Council meeting and a community festival in front of City Hall. The City authorized immediate repairs under an existing emergency services contract that it had with D'Allessandro Corp. of Avon, Mass.

D'Allessandro had prior experience with the pipe bursting process and was able to mobilize for the project within a week. By Wednesday of the second week, excavation had started on the common manhole separation at Inman Street, an access pit for its bursting operation was installed at Bigelow Street, 480 ft of HDPE pipe were on site and butt fusing of pipe segments had begun. On Thursday of the second week, 240 ft of failing 8-in. clay sewer was successfully replaced with 8-in. HDPE pipe. Bursting and replacement required only 20 minutes.

On Friday of the second week, 240 ft of 12-in. clay drain pipe was replaced with 12-in. HDPE pipe. Again the bursting and replacement operation required only 20 minutes. On Saturday, the contractor installed a new sanitary service connection for the transformer vault and reconnected the two drain service laterals to the new HDPE drain through open-cut excavations. By the end of the third week, the contractor completed construction of two new manholes that eliminated the cross connections at the common manholes and restored the site with temporary pavement in time for the upcoming Labor Day weekend and City Hall activities.

Project Summary

The goals of repairing the collapsed sewer, replacing two common manholes to separate storm and sanitary flows, and minimizing the extent and duration of disruption to the community during construction were achieved. A large inventory of standard sized HDPE pipe was found to be readily available and this allowed for rapid mobilization for the project.

The speed at which pipebursting can be accomplished reduces the duration of disturbances from construction performed in busy urban area. With adequate planning, even the long reaches of butt-fused pipelines can be managed to minimize the traffic disruption. A post-construction video inspection of the new 8-in. HDPE provided no evidence of damage to the new sewer as a result of the bursting of the 12-in. drain located only 7 in. above the sewer. ***UC***