

ALL BOXED IN

Precast box culvert proves to be the perfect product to overcome multiple challenges while fixing a historic storm drainage line.

By Shari Held

Photos courtesy of
Tim Smith,
construction
inspector of City of
Bangor, Maine



On Nov. 16, 2016, in Bangor, Maine, a huge sinkhole swallowed a lamp pole and a portion of a recreational trail. Its sudden appearance could seem supernatural to some. After all, Bangor is Stephen King territory – the horror fiction writer based his fictional town of Derry, Maine, on the city of Bangor.

But there's nothing mysterious about this sinkhole. A portion of the city's storm drainage line collapsed, creating a sinkhole about 8 feet wide and about 20 feet deep.

The original lines constructed in the 1870s, consists of 5-foot-by-7-foot granite culvert. Later, 60 feet of timber box culvert was added, which feeds directly into the Penobscot River. The line failed at the juncture where timber met granite due to rotting timber sections.

The line provided storm drainage for a large portion of the city and served as an emergency sewer overflow. It needed to be reopened quickly to prevent potential flooding. Precast proved to be the best solution for replacing the old timber sections.

CHALLENGES GALORE

Unfortunately for the city, the Davis Brook Outfall project was anything but simple. In fact, it was uncommonly complex for numerous reasons.

The failure site is near many other structures:

- A combined sewer overflow building
- The Davis Brook Storage Facility, a long series of 8 foot-by-9-foot box culvert used for sanitary storage
- The 42-inch Penobscot Interceptor sewer pipe, part of the main sewer along the river
- The Bangor Landing Coal Tar Remediation project of 2010. The remediation project used 6-foot-by-7-foot precast box culvert to extend the culvert to attain the desired back-slope grade.

"We had to be careful during the excavation that we didn't disturb any of these older projects," said John Theriault, city engineer.

In addition, the site was also once part of the Maine Central Railroad.

"Soils on this site have been deemed impacted and contain contaminants related to railroad use," said Tim Smith, construction inspector with the city. "Any excavated material had to remain on-site and be capped with a minimum of six inches of cover soil material."

As if that weren't enough, workers had to contend with the depth of the excavation, frigid temperatures, ice and up to 14-foot-tall tides from the Penobscot River. At high tide, the entire area is underwater.

"Each one by itself wasn't necessarily a game stopper, but there were many different things that impacted the project," said Barney Silver, owner of Lou Silver Inc., the contractor for the project. "I think the challenges are what made the project highly interesting."



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PRECAST UP TO THE CHALLENGE

“Our first inclination was to use box culverts to take care of the problem,” Theriault said. “But we had to weigh all the other alternatives such as using a slip lining, 5-foot-diameter HDPE pipe or heavy-duty polyethylene pipe. In the end, what it came down to was we knew from previous experience that 6-foot-by-7-foot precast box culverts would do the job.”

Weather and tidal considerations also favored the installation of precast culvert sections.

“They could be installed fairly efficiently in the short increments of time allowed by 12-foot tides,” Smith said. “We also felt they could best be joined with the existing granite and provide the best long-term structural support.”

The ready availability of the precast culvert was another positive

factor. The project needed 10 sections.

“We had the pieces in stock, on the ground and available for delivery whenever they were ready to start working,” said Will Esworth, project manager for American Concrete Industries in Veazie, Maine.

According to Esworth, these precast sections are used as commercial tanks for fire suppression, cisterns or septic holding tanks as well as box culvert. Each section weighs about 10 tons and measures 6 feet tall by 7.5 feet long, with a 7-foot inside span. The inside features two bolt pockets placed in the floor. Two additional bolt pockets are positioned on the top of the outside of each section.

“As you tighten the bolt, it pulls the pieces together and holds them together,” Esworth said. “Obviously, the dirt around them will hold them together as well, but it’s an added precaution.”



“We were virtually running around with 5-gallon buckets trying to throw enough sand on areas where people were walking so people didn’t slip and get hurt.”

– Barney Silver, Lou Silver Inc.

Preparation is Key

Before excavation could begin, the sinkhole needed to be stabilized. The contractor removed the lamp pole and electrical conduits as well as the rotted timber and debris from the box culvert to open it up. Dealing with the 42-inch Penobscot Interceptor sewer pipe, which ran almost directly over the failure point, was one of the project’s biggest challenges.

“This was an important piece of our infrastructure and it was being compromised by the sinkhole,” Theriault said.

Workers initially secured it with steel I-beams and chain binders. Later, the sewage line was bypassed to an existing box culvert and the line was temporarily isolated.

Excavation began in January 2017. Before workers could lay new culvert at the new elevation, three sections of precast box culvert from the 2010 project also had to be removed. Workers broke the sections into pieces to remove them. The final grade was also unknown until excavation began.

“It could go one direction, or after digging for a couple days, it could go in another direction,” Silver said. “We had to be flexible.”

In all, 2,000 cubic yards of material was excavated. Next, the contractor had to determine what equipment could place the 20,000-pound sections, given the conditions. A crane could do it, but the amount of river ice on the ground – up to four feet at times – meant it had to be large. Silver asked American Concrete Industries for a single section to test using a Model 349 Cat Excavator.

“We discovered we could set the 20,000-pound concrete box culvert 35 feet from the center of the machine, which would be 25 feet from the tracks,” Silver said. “Using the Cat Excavator became a much easier, cleaner and quicker way to get those boxes down in the ground, because we only had between two or three hours of working time on each tide.”

Tough Conditions

Another issue was finding how to connect the precast sections to the

original granite sections. The granite was far from smooth and even.

“In some areas they touched, and in other areas there was as much as a foot or 18 inches between the concrete and the granite,” Silver said. “That was as close as we could get them.”

In the end, workers drilled into the granite and the adjoining precast component, inserted dowel rods and poured a concrete connecting piece between them. On Jan. 31, workers set the first three box culvert sections. They could only work when the tide was at its lowest point.

“Each time they set box sections they had about three hours of stone grading and setting time before the tide would get too high to efficiently do either,” Smith said. “The boxes were set at 0.5% slope from the existing granite to the final location of the outfall.”

Workers constantly battled the weather. Temperatures dropped to as low as 3 degrees Fahrenheit and it was a challenge to break up the ice along the riverbank.

“We were virtually running around with 5-gallon buckets trying to throw enough sand on areas where people were walking so people didn’t slip and get hurt,” Silver said.

Installation occurred during four early morning low tides and four late morning low tides. The biggest portion of the project was completed in February. The city of Bangor now has a functioning storm line that will likely last for another century or two.

A Job Well Done

Despite the many challenges, the project was completed quickly, efficiently and safely. The CSO building and the Davis Brook Storage Facility were undisturbed. The 42-inch Penobscot Interceptor sewer line wasn’t damaged by the sinkhole and the bentonite cap on the Bangor Landing Coal Tar Remediation project wasn’t compromised.

“I think the project came out well for everybody,” Silver said. **PI**

Shari Held is an Indianapolis, Ind.-based freelance writer who has covered the construction industry for more than 10 years.