Hespeler Trunk Sanitary Sewer Rehabilitation

2019 ACEC CCE Engineering Excellence Awards | Category G | Project Management

Project site map

Project summary

GHD Ltd. designed and implemented an innovative trenchless technology solution to rehabilitate the Hespeler Trunk Sanitary Sewer (HTSS) for the City of Cambridge (City). The project was successfully executed by using the Cured-In-Place Pipe (CIPP) rehabilitation of the sewer through exceptional project management, innovative solutions, and careful adherence to project milestones. The project team planned the HTSS rehabilitation in a concise manner, ensuring that time-consuming items such as agency approvals and coordination with property owners were initiated early to mitigate potential project delays.

The sewer is located in the northeast corner of the City along the Speed River tributary, where it services a population of approximately 35,000 people primarily located in the residential community of Silver Heights. Bound by Highway 24 to the west and northwest, Blackbridge Road to the north, and the Speed River to the south and east, the sewer is approximately 1,710 metres (m) long with a 600-millimetre (mm) to 675-mm diameter.

Constructed in the 1970s of vitrified clay that connects 16 maintenance holes, with the furthest downstream maintenance hole out letting into the Region of Waterloo (Region) Hespeler Wastewater Treatment Plant (WWTP), the sewer was annually inspected by the City as part of a proactive approach to sewer maintenance. By identifying the need for sewer rehabilitation prior to any catastrophic system failures, the City could reduce overall sewer rehabilitation costs. Since constructing the sewer over 45 years ago, the City has continually monitored its condition through annual inspections. A recent inspection confirmed that the sewer was approaching its end-of-life. GHD was selected through a competitive Request for Proposal (RFP) process to design and implement an innovative trenchless technology solution to rehabilitate the sewer.

Complexity

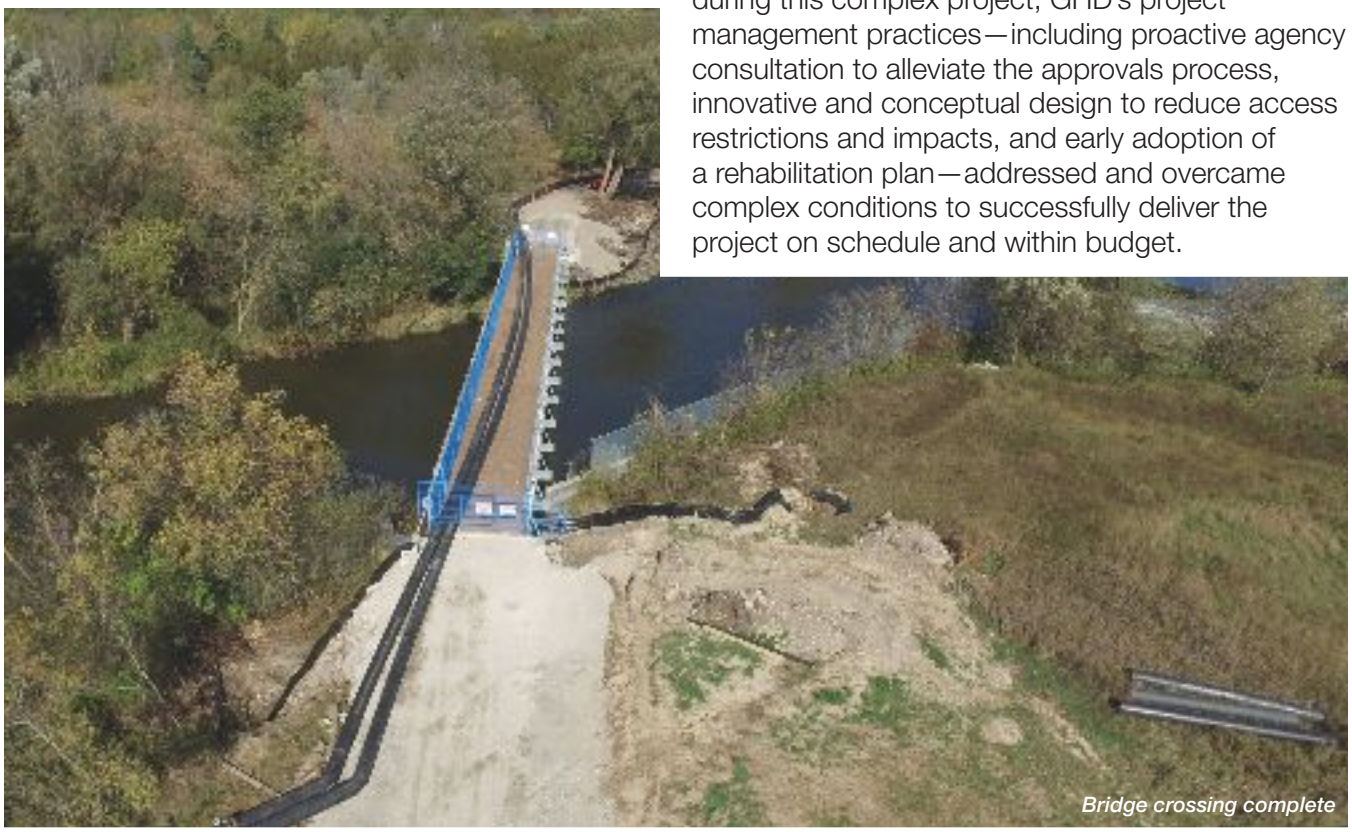
This rehabilitation project presented several challenges, including site constraints due to sewer location and alignment. The project site is located within a Grand River Conservation Authority (GRCA) regulated wetland area and crosses the Speed River. By reviewing background information during initial coordination with regional, provincial, and federal agencies, GHD determined that any in-water works would require approval from the Ministry of Natural Resources (MNR) and Fisheries and Oceans Canada (DFO). To keep MNR and DFO informed, avoid future conflicts, and establish an open line of communication, GHD reached out to both agencies early in the project.

During the initial background review, the project team determined that the cracks and infiltration along the sewer did not yet require extensive repairs, enabling the use of trenchless methodologies to rehabilitate the sewer. Additionally, the chosen method of installation reduced the number of approvals needed and the corresponding potential for schedule delays.

The sewer is located in a naturally sensitive environmental area. A unique feature of this project included the rehabilitation of one maintenance hole located on a small island in the middle of the Speed River. Because of this adjacent land uses and environmentally sensitive lands, accessing presented a challenge. Due to the limited access, the lining inversion lengths for the rehabilitation exceeded 200 metres (650 feet [ft]). Furthermore, to facilitate lining installation and rehabilitation, the sewer flow required bypassing across the Speed River.

GHD developed a conceptual bypass design early to mitigate the approval process with federal regulatory agencies and address any other project limitations. The bypass design included suspending two fused high-density polyethylene (HDPE) pipes over the Speed River, reducing environmental impacts and unnecessary property access requirements.

Although the team encountered many challenges during this complex project, GHD's project management practices—including proactive agency consultation to alleviate the approvals process, innovative and conceptual design to reduce access restrictions and impacts, and early adoption of a rehabilitation plan—addressed and overcame complex conditions to successfully deliver the project on schedule and within budget.



Bridge crossing complete

Project initiation

GHD began the project with a preliminary background investigation, including detailed review of closed-circuit television (CCTV) inspections, the City's as-built drawings, and sewer flow monitoring (depth and velocity) readings. Results indicated that the existing sewer was installed using an open-cut method, including a concrete-encased crossing under the Speed River.

The project team discovered many defects throughout the sewer, including surface spalling, cracks, fractures, encrustation, infiltration, and separated and/or offset joints. Immediately, the project team determined that the cracks and infiltration along the sewer did not yet require extensive repairs, enabling the use of trenchless methodologies to rehabilitate the sewer.

Subsequently, the project team conducted a feasibility study to determine the most suitable trenchless rehabilitation method for the sewer. Many possibilities were considered to ensure the implementation of the best methodology, with a focus on trenchless rehabilitation due to limited environmental impacts to the habitat and wetland area, improved structural integrity of the sewer, reduced overall capital construction costs, shortened construction schedule, sufficient access within the limited easement area of the existing sewer, and minimized overall risks. The project team narrowed the options to GRP sliplining and CIPP, conducting an in-depth review and comprehensive selection process to identify CIPP as the preferred trenchless rehabilitation method.

CIPP rehabilitation

The preferred rehabilitation method entailed lining the entire 1,710-m sewer with CIPP. Typical CIPP liner launch pit locations (existing sanitary maintenance holes) were selected based on maximum lengths that could be lined, access restrictions to launch pits, and bends in the sewer alignment at maintenance holes.

Using CIPP provided many advantages for this rehabilitation, since the project team, City, and several local contractors were all experienced with CIPP projects and had increased confidence in the technology and process. CIPP rehabilitation would not hamper the installation by access restrictions and it would reduce the amount of excavation required to complete the rehabilitation. Once the bypass flow control system was in place, the lining process was completed quickly to optimize the project schedule and budget and reduce costs for the City.

The use of CIPP rehabilitation allowed the project to take place outside of MNR's fish protection windows, as in-water works were no longer required. While CIPP rehabilitation minimally reduced the inside diameter of the trunk sewer, it improved the friction coefficient of the trunk sewer and therefore increased its hydraulic capabilities.

Pre- and post-lining view of pipe with longitudinal cracking and running infiltration

Meeting client's needs

Through sound planning, comprehensive design, early involvement of approval agencies, and implementation of an innovative rehabilitation plan, GHD exceeded the City's budgetary and schedule goals, creating an open line of communication to ensure client satisfaction. The implementation of a full-system bypass design was instrumental in reducing project costs and risks. Additionally, GHD's use of a City-supported, technically scored RFP, as opposed to the traditional Request for Tender, allowed for greater flexibility in the work plan.

Contractors were able to demonstrate creativity in their approaches by planning and pricing work plans based on their own methods, ultimately providing the best solution. Throughout the construction process, GHD worked closely with the City and contractor to implement the most viable solution to ultimately satisfy and exceed project goals.

Overall success of the project

GHD's exceptional project management, innovative solutions, and adherence to project milestones led to City satisfaction regarding budget, schedule, and quality of services in increasing the useful service life of this key piece of infrastructure.

Following project completion, GHD, the City, and the contractor won the 2017 Centre of Advancement of Trenchless Technologies (CATT) Outstanding Project Award of Excellence.

> GHD's innovative solutions and project management led to overall client satisfaction and reduced overall project impact.

Environmental benefits

Throughout this project, the project team constantly considered the environmental benefits and impacts of this project. Every interaction in society impacts the environment in some way, GHD is passionate about reducing that impact in any way possible. GHD holds a responsibility to ourselves, our clients, and present and future communities to embed sustainable practice in how GHD operates and executes projects.

Immediately following the background review for this project, GHD conducted a feasibility study to determine the potential trenchless rehabilitation methods for the sewer. Through a comprehensive selection process, GHD considered many trenchless rehabilitation methods to limit environmental impacts to the habitat and wetland area, address site constraints, and implement the best methodology. GHD determined that CIPP rehabilitation was the preferred method of installation because it complied with access restrictions and reduced the amount of excavation required, reducing environmental impacts.

CIPP installation eliminated the need for in-water works and allowed the project to take place outside of MNR's fish protection windows, reducing fish habitat impact and easing the approval process. Final inspections of the sewer confirmed the successful installation of the CIPP liner and verified that the structure was reinforced for at least another 50 years. Increasing the life of this valuable piece of infrastructure reduces overall maintenance and rehabilitation impacts in the future.

Furthermore, the North American Society for Trenchless Technology (NASTT) carbon calculator indicates that this construction method reduced the amount of greenhouse gases emitted by approximately 700 to 900 tonnes. Note that the NASTT carbon calculator only accounts for soil moved through open-cut rehabilitation and does not consider the associated dewatering required, which would have tripled carbon emissions.

Speed River

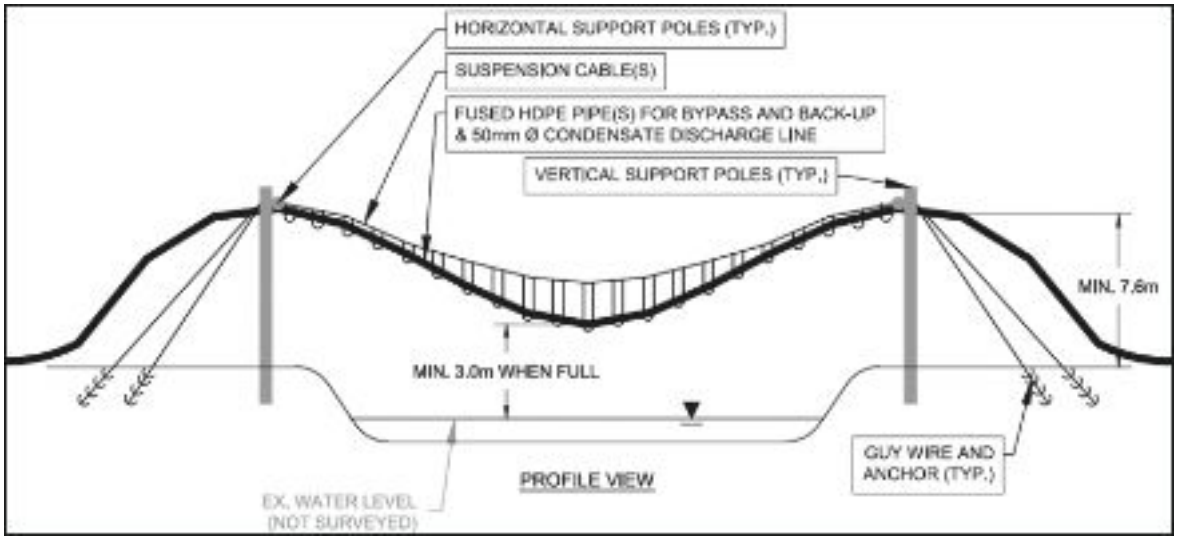
Innovation

GHD understood that the installation of a full bypass system was necessary to rehabilitate the sewer via CIPP lining and recognized that the bypass system would ultimately reduce the construction phase and overall project budget. Additionally, a full-length bypass system would give the contractor unparalleled access to the sewer for cleaning, measurement, and liner installation. However, the full bypass system required crossing the Speed River and its regular unpredictable flows.

GHD worked closely with the contractor to evaluate a suspension bridge and finally install a temporary Bailey bridge across the Speed River, supporting the bypass system in crossing the Speed River as well. Installing this bridge near the existing sanitary easement also reduced permitting requirements from regulatory agencies, as it was minimally invasive to the surrounding environment.

Additionally, to permit the bypass of the entire system, GHD proposed that the contractor install a temporary sump chamber at the upstream end of the system to divert flows from the two mainline sewers that feed into the trunk sewer into the sump, before pulling the flows into the bypass system-by-system pumps.

Temporary Bailey bridge crossing construction



Construction contractor selection process

The project team looked for a contractor who would be proactive about the bypass design system and implement the most viable solution. The City and the design team wanted to provide the contractor with the opportunity to highlight their own ingenuity, resulting in bidding this work through a Request for Proposal (RFP) instead of the traditional request for tender. This process allowed contractors to demonstrate creativity in their approaches by planning and pricing work plans based on their own team's methods, ultimately providing the best solution.

GRCA's main concern was the location and construction of the temporary Bailey bridge used to elevate the bypass piping over the Speed River. Once the location was finalized, the contractor confirmed that the bridge elevation would remain above the Region's floodplain limit and provided details of the bridge construction, including footing designs, to receive full approval from GRCA to commence works within the regulated area.

In October 2017, the pumps were turned on and the bypass flow system brought online. Over the next few days, the contractor's preparation team inspected the trunk sewer and prepared for the CIPP lining. In total, almost 5,600 feet (1,710 m) of trunk sewer was inspected, cleaned, prepared, and re-inspected within 4 days. The contractor designed the liners to be completed in 11 inversions, each ranging in length from 141 feet (43 m) to 686 feet (209 m), instead of the conceptually designed 5 inversions ranging from 246 feet (75 m) to 1,466 feet (447 m).

The CIPP lining of the trunk sewer commenced 2 days after pipe preparations began, and was completed in 12 days. The final inspections verified that each liner was successfully installed with minimal issue and that the structure of the trunk sewer has been reinforced for at least another 50+ years.

Bypass system

Bypass system

Social benefits

GHD's proactive planning and design of this project shortened the project schedule, which reduced negative social impacts on residents, it also lengthened the life of the sewer by over 50 years, which reduces overall future maintenance and rehabilitation costs to the City.

GHD's selection of CIPP rehabilitation as the preferred method allowed local sewer rehabilitation contractors to bid and execute the work. Since many local contractors were familiar with CIPP installation, this further controlled costs and ensured that local businesses benefitted from this project. Hiring a local contractor benefitted the local economy by keeping the City's tax dollars within the Province.

Additionally, GHD's full-length deployment of bypass pumping greatly reduced the implementation schedule and cost in comparison to section-by-section rehabilitation. The CIPP lining commenced 2 days after pipe preparations began and took 12 days to complete, limiting project impacts on the local community such as the closure of the high-volume, multi-use Speed River Trail along the north bank of the river. A different rehabilitation method would have closed the trail for longer and resulted in other ramifications for local residents, who already have to cope with several multi-year large-scale construction projects for the nearby TransCanada Highway.

Bridge crossing complete

Contact

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