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Title: Sewer Rehabilitation with Sprayed Geopolymer Mortar Lining – A Successful Case Study in Markham

Theme: Trenchless Design and Construction,Emerging Technologies

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Abstract: This paper presents the experience gained during a sewer rehabilitation pilot study conducted using a sprayed geopolymer, mortar lining for the approximately 3.0-km long 16th Avenue Sanitary Trunk Sewer in Markham, Ontario. The sewer was constructed in 2002-2003 and consists of a 2,642mm-diameter, 35m- to 47m-deep tunnel, which was installed with a tunnel boring machine (TBM) and included an initial support comprising steel ribs and wood lagging, and a final lining comprising unreinforced cast-in-place concrete.

Surveys including CCTV, Multi Sensor Instrumentation, and man-entry inspections were performed in 2006 and 2007 and in ensuing years. Survey results revealed that several locations exhibited deficiencies only a few years after construction. These included defective construction joints, longitudinal fractures (generally located at or adjacent to pinch points or areas where the tunnel section was reduced due to difficulties encountered during tunnel construction), and radial fractures (commonly located immediately adjacent to construction joints). These defects mainly manifested as excessive groundwater infiltration and washout of soil fines, which sometimes compounded as generalized pipe deterioration. Rehabilitation using trenchless technology was recommended to minimize surface disruption, reduce construction risks and costs, and preserve the sewer hydraulic capacity. A preliminary rehabilitation design had recommended sliplining and annular grouting using four new construction access shafts. However, subsequent Peer Review and Value Engineering efforts demonstrated that other rehabilitation techniques, including the application of a sprayed geopolymer lining, would result in significant savings while meeting the project objectives of providing the lowest-risk, technically most sound, and best-value solution.

The paper will discuss how the combination of full-length geopolymer lining and point rehabilitation methods was considered the most suitable approach for the challenging subsurface, groundwater and hydrogeological conditions of the project. In addition, information regarding how the lining application matched the existing geometry restrictions of the pipeline and access shafts, including their diameter, shape, configuration, and alignment curvature. The point rehabilitation consisted in applying a quick-set and high-strength chemical grout. Results of extensive material testing will also be provided to: a) illustrate the material

performance in terms of various types of strength and related engineering properties; b) show if the geopolymer material could provide structural stability; and c) demonstrate whether the applied liner could firmly bond to the host pipe. Difficulties experienced during the pilot test, including the partial collapse of a small, deteriorated existing pipe section and successful repairs, will be provided. Overall, the pilot test helped establish the suitability of procedures that could be used at this sewer segment and may also serve as a system-wide sewer rehabilitation method.