

Resilience in the Design and Construction of Highland Creek Valley Segment 4a

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Abstract

The 1.6 km length of Markham Branch of East Highland Creek within Valley Segment 4/4a was reconstructed between 2012 and 2015 using 'Engineered' Natural Channel System principles, to protect exposed sanitary sewer infrastructure and improve fish habitat. Design and regulatory approvals were completed between 2009 and 2011, following completion of an Environmental Assessment which was initiated shortly after the Aug 19th 2005 storm. This paper stresses the resilience aspects of design, construction and monitoring. A complete new channel liner was designed and constructed using two different bed forms, a bed level weir structure for a relatively straight channel upstream of Markham Road, based on a previous channel liner, and a riffle - pool meandering liner downstream of Markham Road to accommodate a steeper gradient. The Valley Segment approach has been adopted as a biophysical based under pinning for all Highland Creek watershed projects, to manage and to communicate habitat and geomorphic character. The construction project was built in four successive winter construction periods, which accommodated City budget pressures, permitted monitoring learning and design adaptation, and use of dormant vegetation during construction. The construction challenges and general successes of building a vegetated rock structure on outside bends are presented. In two pools, excessive local stresses required subsequent replacement of the vegetated rock structure. Due to excessive loss of bed material from riffles during the first 2012 construction period, additional design modifications were implemented which included: use of a denser rock material in riffles, rib structures in select riffles, and removal of fines from select riffles. The design emphasized the placement of riffles over sanitary sewer crossings for long - term protection of the sewer system from exposure, but with a bed elevation which improves connection to the floodplain. As such, this design is intended to create minimal bed load, which implies that a long - term monitoring period of ca 25 or more years will be needed to test the resilience of this design. The wider channel design resulted in a larger channel footprint, requiring a net loss of valley floor forest cover. Creation of three off-channel wetland areas, within former stream bends, are evolving due to the local topographical and Highland Creek's hydrograph characteristics. Channel infilling created by Mother Nature, is fine tuning the built form and will ultimately determine the resilience of the Valley Segment 4a.

Biographies

H Reinders was the lead from R and M Construction for the Valley Segment 4a Stream Restoration reconstruction. Harry will focus on the challenges of winter time construction, building the vegetated rock structure on outside bends, and the experimental design modifications implemented to address the excessive loss of bed material from riffles.

John Parish lead the Consultant team in the EA and design stages, during construction, and in post monitoring of the first construction phase.

Dr Bill Snodgrass was Toronto Water's lead on the overall project, and particularly in regulatory approvals, City budgetting, and asset management of the new channel structure.