Application of concrete pipes for underground stormwater detention storage

In a recent commercial development in Vaughan, Ontario, concrete pipe was used to help satisfy the stormwater management objectives for the development by providing underground (in-pipe) storage to attenuate post-development runoff rates to the City's standard target release rate of 180 L/s/ha for storm events ranging up to the 1:100 year return period.

The 1.4 ha site, located at the southeast corner of Highway #7 and Woodstream Boulevard, is to be occupied by Shoppers Drug Mart and a Tim Hortons/Wendy's combination. It falls significantly in a northeasterly direction and is constrained topographically on the north, south and west property limits, especially due to the access points to Highway #7 and Woodstream Boulevard. This condition does not easily lend itself to surface storage in a flat parking lot which is generally the preferred method of dealing with stormwater detention.

Several alternative designs were analyzed with respect to functionality, aesthetics and, most importantly, cost. As the proposed buildings are to have flat roofs, then rooftop storage was a common element of each alternative and, therefore, did not factor into the decision-making process. In addition to rooftop storage, providing surface storage alone resulted in a generally unpleasant combination of steep slopes and retaining walls (ranging up to two metres in height). This scenario was poor from an aesthetic and marketing point of view for the users, who obviously want to maximize the exposure to the passing traffic on Highway #7. Also, the cost of the retaining walls was very high.

The final design employed a combination of rooftop storage (23%), parking lot surface storage (13%) and underground, or in-pipe, storage (64%). A conceptual design of the detention system is provided in **Figure 1**. The final design helped to reduce overall project costs by balancing the cost of retaining walls with that of increased pipe sizes. Furthermore, the final appearance of the site is more attractive in that it blends in well with the surrounding topography and has mild parking lot slopes. Also, the buildings on the site will be set sufficiently high which results in good visibility for passing traffic.

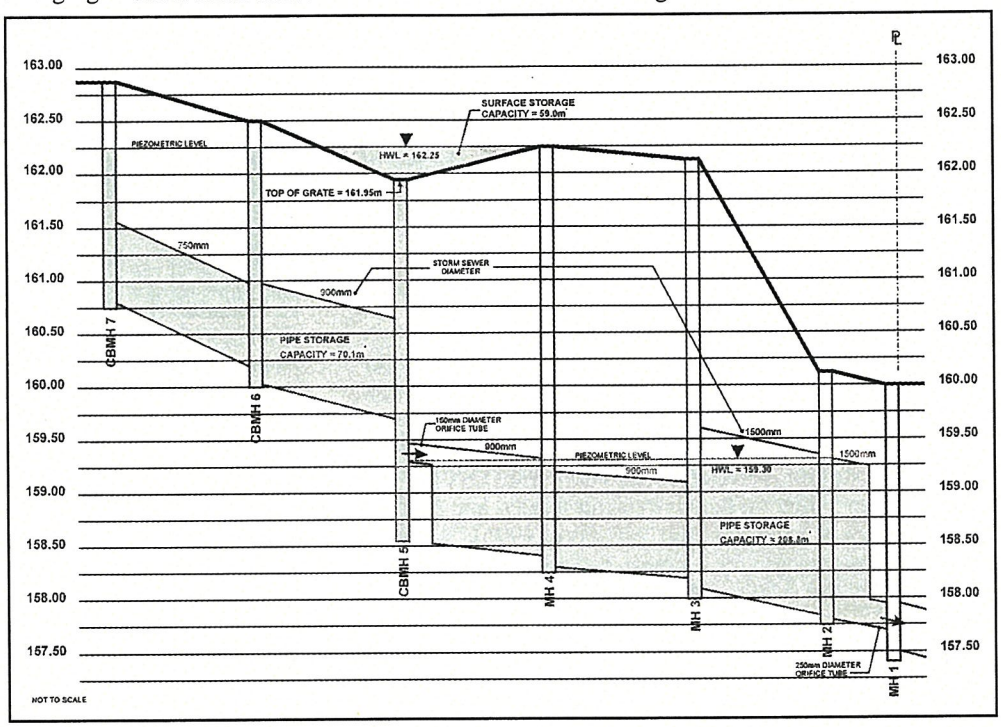

Figure 1. *Conceptual design and operation of stormwater detention storage system.*

As can be seen in the figure, the underground storage system was divided into two separate storage zones, based on topography. This enabled the upper lengths of the storm sewer system to be installed at shallower depths, thus reducing construction costs. The division of the zones was accomplished with a 150 mm diameter orifice tube in addition to the 250 mm diameter orifice tube at the downstream end of the site. Normally, the City of Vaughan requires that only a single control in the storm sewer system be installed at the most downstream point in the system; however, City staff accepted the proposal, given the site specific conditions and the technical merits of the design. Additionally, the City endorsed the use of concrete pipe for this application over other materials.

In addition to the financial and aesthetic benefits that accrued as a result of the final design, the use of the underground concrete pipes for storage also minimizes the amount of "nuisance" flooding on the surface.

The site servicing contractor for this project was Torcon Construction of Woodbridge, Ontario, who completed the installation of the underground storage tanks in three days. Material quantities for the construction of the stormwater holding tanks consisted of 55m - 750mm, 115m - 900mm and 90m - 1,500mm reinforced concrete pipe. All the concrete pipes supplied to this project were complete with Super Seal self-lubricating gaskets.

The reinforced concrete pipe and maintenance holes were supplied by Hanson Pipe & Products Canada Inc. (formerly Centennial Concrete Pipe & Products Inc.).

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