Characterization of Particle Size Distributions of Runoff from High Impervious Urban Catchments in the Greater Toronto Area

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Final Report

Prepared for:

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Toronto and Region Conservation Authority's
Sustainable Technologies Evaluation Program

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PUBLICATION INFORMATION

Reports conducted under the Sustainable Technologies Evaluation Program (STEP) are available at www.sustainabletechnologies.ca. For more information about this study, or STEP, please contact:

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THE SUSTAINABLE TECHNOLOGIES EVALUATION PROGRAM

The Sustainable Technologies Evaluation Program (STEP) is a multi-agency program, led by the Toronto and Region Conservation Authority (TRCA). The program was developed to provide the information, data and analytical tools necessary to support broader implementation of sustainable technologies and practices within a Canadian context. The main program objectives are to:

- monitor and evaluate clean water, air and energy technologies;
- assess barriers and opportunities to implementing technologies ;
- develop supporting tools, guidelines and policies, and
- promote broader use of effective technologies through research, education and advocacy.

Technologies evaluated under STEP are not limited to physical products or devices; they may also include preventative measures, alternative urban site designs, and other innovative practices that help create more sustainable and liveable communities.

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EXECUTIVE SUMMARY

Many stormwater best management practices rely, at least in part, on sedimentation for treatment of runoff. The effectiveness of these practices is strongly influenced by the size distribution of particles because smaller particles tend to have lower settling velocities. Thus, accurate data and information on the size distribution of particles in urban runoff is important.

This study assesses the accuracy and reliability of common laboratory particle size distribution (PSD) analytical methods, and identifies a range of PSDs in stormwater runoff that is broadly representative of high impervious drainage areas in the Greater Toronto Area.

To determine the accuracy of laboratory PSD analytical methods, two to three samples of a standard solution of known PSD were submitted for analysis to five laboratories. Three of these laboratories analyzed samples using laser diffraction methods and two used digital micro-imaging. Comparison of PSD results showed good overall correlation among labs, but reported differences were as high as 80% of the standard particle size in certain size ranges.

Samples submitted for PSD analysis were also analyzed for total suspended solids (TSS) at three of the five laboratories. Comparisons revealed only one lab to provide reasonably accurate and repeatable TSS results.

Following the laboratory assessment, untreated stormwater runoff was sampled from six high impervious parking and road drainage areas over the course of six rain events. Grab samples were collected within the storm sewer system, directly from paved surfaces and at storm sewer outfalls. The PSD of samples was analyzed by the two labs that best matched the standard during testing. Comparison of PSD field test results from these two labs showed no statistically significant difference in the average PSDs. However, significant differences were found in the size ranges between 250 and 14.9 µm, and 3.73 to 0.66 µm. There was no significant difference between the reported TSS values from the two labs.

Results from the lab that best matched the standard showed a median particle size range of 4.2 to 31.1 microns across the various source areas and rain events. On average, 50% of particles were finer than 13.7 microns and 90% of particles were finer than 55 microns. Although samples were collected from different source areas and at different locations within the drainage network, the variability among samples collected at a single site was often greater than the variability among samples collected at different sites.

Comparisons to other literature showed that samples collected in the Greater Toronto Area both in the present and previous studies tend to have finer particle PSDs than those collected in many other cold climate jurisdictions. This result is particularly evident in the coarser particle size range above 200 µm, which was almost never found, even in runoff sampled directly from the pavement surface. Further testing is recommended to assess how detection of these coarse particles may be influenced by the sampling methods and laboratory techniques used to analyze samples. This testing should also address the potential discrepancy between the PSD of stormwater as reported by laboratories and the actual or ‘effective’ PSD of urban runoff draining to stormwater treatment facilities.