



Don River Watershed Plan

Surface Water Hydrology/Hydraulics and Stormwater Management – Report on Current Conditions

2009

Prepared by: Toronto and Region Conservation

TORONTO AND REGION Conservation for The Living City

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1.0 Introduction

The Toronto and Region Conservation Authority (TRCA), in consultation with the multi-stakeholder Don Watershed Regeneration Council and watershed municipalities, is developing a watershed plan for the Don River. This watershed planning process has been initiated in response to a number of recent policy and planning developments, including the need to fulfill York Region's watershed planning requirements under the *Oak Ridges Moraine Conservation Plan* (ORMCP, Ontario Regulation 140/02) and to update the original management strategy outlined in *Forty Steps to a New Don* (Metropolitan Toronto and Region Conservation Authority [MTRCA], 1994).

The goal of the watershed planning study is to recommend updated management strategies that will guide land and water use decisions, such that the overall ecological health of the Don River watershed is protected and improved. The aim is to build on the *Forty Steps'* principles to protect what is healthy, regenerate what is degraded, and take responsibility for the Don. Recognizing the significant watershed planning work that has already been completed, and given that there are limited undeveloped lands remaining on the ORM within the watershed boundary, the watershed plan will focus mainly on filling information gaps, guiding land use planning and approval decisions, and providing direction to advance implementation of regeneration priorities.

This report has been prepared as part of the scoping and characterization phase of the watershed planning process, in which current watershed conditions are presented in the form of technical reports covering a range of subject areas, including groundwater quality and quantity, surface water quantity, low flows and water use, surface water quality, fluvial geomorphology, aquatic systems, terrestrial systems, nature-based experiences, cultural heritage, land and resource use, and air quality.

This report lays out the current conditions relating to flooding and stormwater management in the Don River watershed. Also included in the report are the findings from the most up-to-date modeling of the Don River hydrology and peak flow rates. Section 2 provides an introduction to surface water flows in rural and urban landscapes. Section 3 outlines data sources and methods. Section 4 presents current watershed conditions relating to stream flow, stormwater management, and flooding and hydraulics, and outlines management objectives, indicators, targets and ratings. Sections 5 and 6 address opportunities for improving stormwater controls and management considerations for the *Don River Watershed Plan*.

2.0 Surface Water in the Rural and Urban Landscape

Extreme variations in surface water flow in undeveloped watersheds occur less frequently and are less severe than those in settled landscapes. Similar to the historical settlement patterns of southern Ontario, land use changes were initially made in the Don to allow for agricultural activities in the late 18th Century. Flow stabilizing features, such as forested lands, were cleared, wetlands were drained and small streams were channelized with their riparian zones removed or altered. These activities altered the hydrologic cycle by reducing interception, evapotranspiration and infiltration, which in turn generated increased surface runoff and higher, more frequent flows in rivers and streams.

Urban land form changes have imposed the most significant stress on the hydrologic system. Urbanization typically creates an increased area of impervious surfaces, such as paved roads, driveways and roof tops that reduce infiltration and generate greater runoff. Past engineering practices prior to the early 1980s focused on conveying the increased volumes of surface runoff as quickly as possible off the land through storm sewers and often channelized watercourses.

The removal of wetlands and small surface drainage systems and encroachment upon floodplains tend to reduce or eliminate the natural flood storage capacity. As a result of these urban impacts, seasonal variations in stream flow are less defined. Runoff response from a rainfall or snow melt event, regardless of the season, is more rapid compared to rural watercourses. The urban watercourse generally receives a greater total volume of flow in a shorter time frame, thereby resulting in much higher flood flows. The more rapid hydrologic response rate and higher peak flows, combined with historical encroachment on the floodplain, result in a greater hazard from flooding in urban areas.

Reduced infiltration can lower local groundwater levels, which can in turn reduce groundwater discharges to baseflow. This impact is of most concern in headwater streams, where streams can be seasonally dry. Aquatic species dependent on natural patterns of flow are impacted by the increased amounts and frequency of runoff events as well as decreased baseflows. Alterations in stream flow can also aggravate natural rates of erosion, degrading stream water quality and aquatic habitat.

A discussion of surface water responses to land use cannot entirely be separated from an understanding of the policies which have also guided activities and influenced flow conditions. Beginning in the early 1970s, the Province of Ontario developed floodplain planning policies aimed at minimizing the risk to life and property damage due to flooding. Land use planning tools were used to limit new development in delineated floodplains. Stormwater management policies were introduced in the 1980s to mitigate the impacts of increased runoff on peak flow rates (MTRCA, 1980). Since then, stormwater management policies have evolved to address erosion control, water quality and most recently groundwater concerns (e.g., MTRCA, 1990; Ontario Ministry of the Environment (OMOE), 1991, 2003; Aquafor Beech Limited, 2008). In response to these policies, approximately 140 stormwater management ponds have been constructed or proposed in the Don River watershed, as well as numerous other stormwater management facilities such as oil and grit separators, swales, and infiltration facilities. These facilities mitigate the impacts of urban runoff and also continue to influence watershed hydrology.

2.1 Valley and Stream Corridor Management Program

TRCA's Valley and Stream Corridor Management Program (VSCMP) is the Authority's guiding policy document which provides direction for the protection and restoration of valley and stream corridors. The VSCMP sets out development guidelines for properties influenced by valleys and stream corridors. The objectives of the VSCMP policies are to:

- prevent development from occurring within areas that may introduce risk to life and property associated with flooding, erosion, and slope stability, or that is not compatible with the protection of these areas in their natural state;
- prohibit new development within the Regulatory Flood Plain; and

- regulate existing development activities within the Regulatory Flood Plain (e.g., one zone and SPAs).

The VSCMP policies promote conservation of the features and functions of valley lands, including conveyance and storage of flood waters, provision of groundwater recharge and discharge areas, nutrient and sediment transport, provision of fish and wildlife habitat, and corridor linkages between significant natural areas. VSCMP policies also provide direction for the accommodation of development adjacent to valley and stream corridors, while managing the risks associated with development adjacent to flood-prone areas or unstable slopes by promoting the protection of buffers between significant features or areas and proposed development.

Through the development process, TRCA seeks to have significant natural areas, flood-prone areas and lands subject to erosion and slope instability identified within open space or hazard land zoning categories, and to have those lands conveyed into public ownership for long term conservation, restoration and enhancement.

Pursuant to Section 28 of the *Conservation Authorities Act*, TRCA has enacted Ontario Regulation 166/06 (Development, Interference with Wetlands and Alterations to Shorelines and Watercourses) in order to define a permitting process for the regulation of development within and adjacent to valley and stream corridors.

3.0 Data Sources and Methods

3.1 Flow Gauging in the Don Watershed

Measurement of flow volume within the river is accomplished by establishing a relationship between the river level (stage) and the corresponding rate of flow at specific locations within the watershed. Stream gauges are then installed at these locations to allow for the measurement of flow volume at any given time. At gauge sites where continuous flow measurement is made, the total annual flow can be computed and provide important insight into trends over time. These trends may warn of future threats to the watershed both relating to hydrologic issues such as flooding and erosion, and to the aquatic species that depend upon the watercourse. Monthly and daily measurements are also needed to identify more detailed variations in flow for further analysis. Baseflow can be defined from measured gauge data to obtain information regarding interactions between the surface and groundwater systems.

Stream flow gauge data can provide detailed flow information for a specific site within the watershed, and allow for hydrologic computer models to be calibrated and to represent a higher flood flow regime within the watershed. These modeled flows are critical in developing the flood plain mapping used in flood risk management.

Within the Don River watershed, flow is currently measured continuously at 10 stream gauges, and one water level gauge operating at G. Ross Lord Dam (Figure 1). Of the current active gauges, 4 are operated as a part of the Federal/Provincial flow network and operated and maintained by the Water Survey section of Meteorological Services of Canada (WSC), which is part of Environment Canada (Environment Canada, 2006). Two stations are the property of the Town of Richmond Hill, and the remaining gauges belong to the TRCA and are maintained and operated either by TRCA staff or a private contractor. Data is collected and maintained to the

WSC standards. The length of time for which data has been collected at the active gauges makes trend analysis difficult. The majority of the gauges were installed in 2000 or later, and two WSC gauges were shut down during the mid 1990s, and not reopened until recently. This leaves only one gauge, in the Lower Don River at Todmorden, which has both historic and current data.

Additional information on surface and ground water resources, erosion and the aquatic system in the Don watershed can be found in the following current conditions reports:

- *Fluvial Geomorphology – Report on Current Conditions* (TRCA, 2009a)
- *Geology and Groundwater Resources – Report on Current Conditions* (TRCA, 2009b)
- Baseflow and Water Use Assessment *– Report on Current Conditions* (TRCA, 2009c)
- *Surface Water Quality – Report on Current Conditions* (TRCA, 2009d)
- *Aquatic System – Report on Current Conditions* (TRCA, 2009e)

3.1.1 Real Time Gauging Network

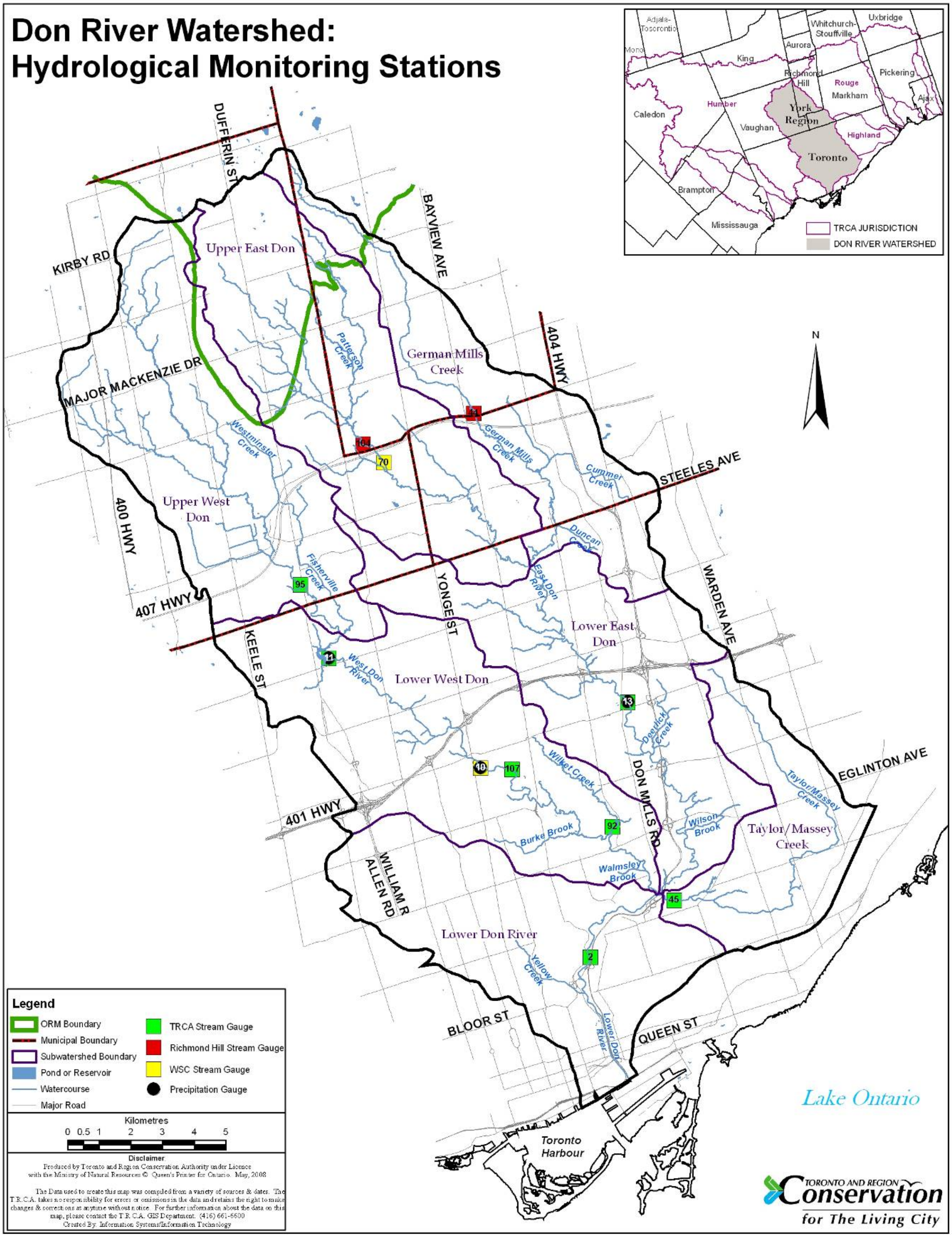
Communication with existing stream gauges has historically occurred through analogue modems, which is time and labour intensive. In response to a major flood event in 2005, the TRCA made significant improvements to its Flood Monitoring and Warning Network with the installation of 5 'real time' flow measurement stations in the Don watershed. Using cellular Internet Protocol (IP) communication, data recording, processing and storage is fully automated. Stations may be remote, standalone set-ups with wireless communications and solar power sources. Data are measured and collected at all the real time stations every 15 minutes. Stations with precipitation gauges measure total rainfall in 5 minute intervals. The data is then stored and posted to the internet through a hierarchical access web page for TRCA staff and stakeholders. Real time gauging locations are listed in Table 1 and displayed in Figure 1.

In addition to live data access, enhancements to the Flood Monitoring and Warning Network include automated alarms, where Flood Duty Officers are alerted via email if stream or dam water levels meet or exceed pre-determined triggers. Currently, the TRCA is developing a secondary alarming feature which will also automatically phone on-call staff based on the same set of triggers.

Table 1: Real time gauging locations in the Don River watershed.

Station Number	Location
2	Lower Don River at Todmorden Mills
11	G. Ross Lord Dam
13	East Don River at York Mills Rd.
95	West Don River at Glen Shields Ave.
107	West Don River at Knightswood Ave.

Figure 1: Hydrological monitoring stations in the Don River watershed.



3.2 Surface Water Modeling

TRCA has been using hydrologic and hydraulic models in the Don River watershed since 1979 (McLaren, 1979) to aid in enforcing policies and regulations intended to ensure that new developments are located outside of the flood risk area and that existing condition peak flows are maintained through the implementation of stormwater management practices. Regular updates, which typically incorporate technological advancements and additional climate and stream flow monitoring data, ensure that the models are kept current.

With updates to the hydrology models which use new computer modeling software, new flow data and updated land use, flood flows for the design (i.e., 2 to 100 year) and regional storms can be computed at multiple locations within the watershed. These flows are used as inputs to the hydraulic models, which then re-assess and re-produce updated flood line mapping.

3.2.1 Don Hydrology Model Update

In 2004, TRCA retained Marshall Macklin Monaghan Limited. to update the hydrologic model for the Don River watershed. Original modeling of the Don River was formulated in the late 1970s, and subsequently updated in the early 1990s (MMM, 1992). The 1992 model was based on the HYMO computer program, which is outdated at present, and seldom used in today's watershed modeling. This earlier model was updated to Visual OTTHYMO (Version 2.0) otherwise referred to as VO2, which is the latest transformation of the HYMO model.

There has been additional development in the Don watershed since *Forty Steps to a New Don*, the original watershed strategy, was published in 1994 (MMM, 2004). It was necessary to update the model to reflect the current development conditions in the watershed. Current land use data and hydrologic parameters were collected from Don watershed municipalities (Toronto, Markham, Richmond Hill and Vaughan) and used to update the hydrologic model. Similarly, the catchment delineations were more finely discretized to better agree with the City of Toronto's *Wet Weather Flow Management Master Plan* (WWFMMP) (MMM, 2003). Originally, the area south of Steeles Avenue was subdivided into 24 catchments, this finer discretization now has 40 catchments for the same area.

Stormwater management ponds in the Don watershed were identified and included in the model update following a "lumped" pond approach; a more detailed discussion of this approach is available in the MMM *Don River Hydrology Update* report (MMM, 2004).

In May of 2000, there was a significant storm event which resulted in a flood that ranged from a 5 year to 25 year event depending on the location within the Don watershed. This storm event was selected as the main calibration event for the updated model calibration. The calibrated Don watershed model was further validated against additional rainstorm events.

4.0 Existing Conditions in the Don River Watershed

The Don River watershed drains an area of approximately 360 km^2, which is about 80% urbanized. The watershed is comprised of two principle tributaries and is somewhat dendritic in nature, with an average stream density of 0.0031 meters per acre. The system's headwaters are generated within the south slope of the Oak Ridges Moraine, some 35 km upstream of the confluence of the Don's two main branches. The west branch, known as the West Don River, has its headwaters in the City of Vaughan, north of the village of Maple. The east branch, known as the East Don River or Little Don River, has its headwaters northeast of Maple in the northwest corner of the Town of Richmond Hill. Slopes along the east branch are similar to the west. The principle tributaries of the east branch are German Mills Creek, which drains a major portion of Richmond Hill, joining the east branch just south of Steeles Avenue, west of Leslie Street; and Taylor/Massey Creek, which drains much of East York (in the City of Toronto) and enters the east branch just upstream of its confluence with the west branch at Don Mills Road and the Don Valley Parkway (DVP).

4.1 Stream Flow

Mean total discharge for the entire Don River is 3.9 m3 / second, or approximately 124 Million m3 / year. The mean annual and modeled peak flows for the Don River watershed are shown in Figure 2. Linear regression of mean annual discharge shows that flows in the Don River have been increasing on average by 0.44 % per year for the entire gauging record (1962-2005) (Figure 3). This is a typical trend for urban and urbanizing watersheds, although this annual average increase is well below what is experienced in similarly urbanized watersheds. For example, mean annual discharge in the Highland Creek was shown to be increasing by as much as 3.25 % per year (TRCA, 2007).

Figure 2: Comparison of mean annual and modeled peak flows for the Don River at Todmorden.

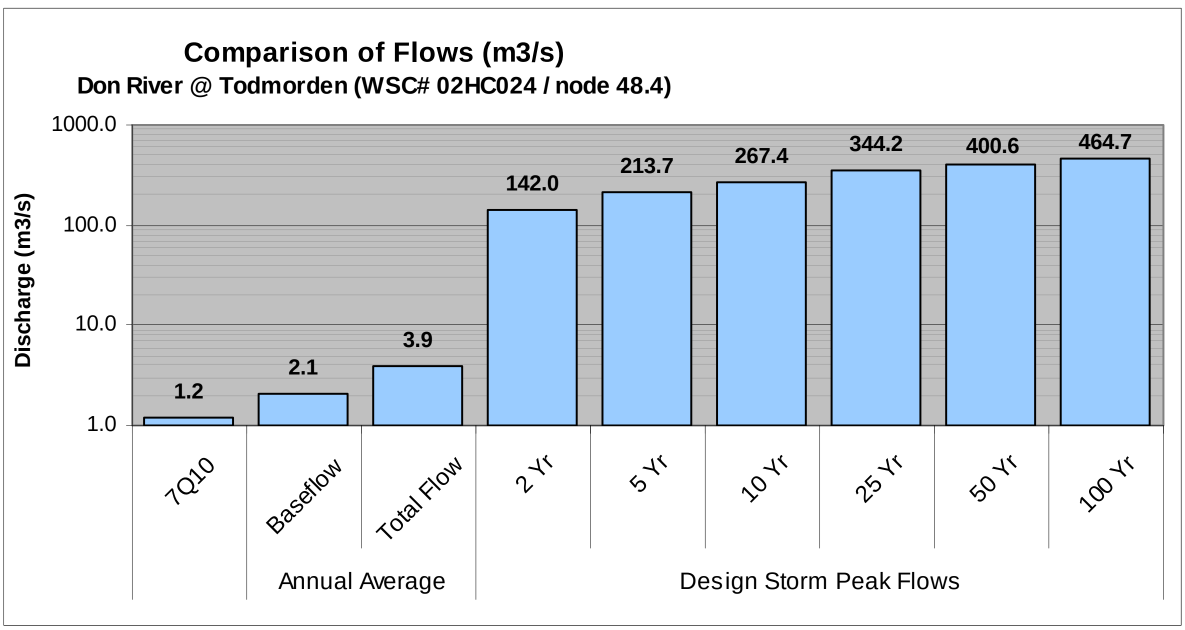
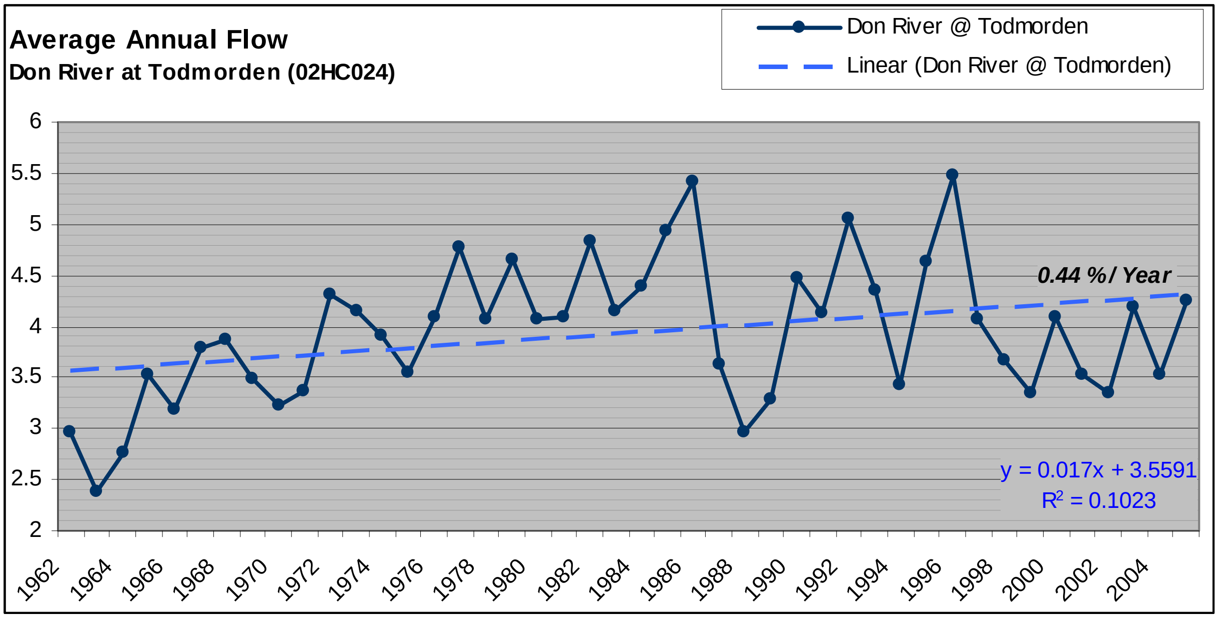


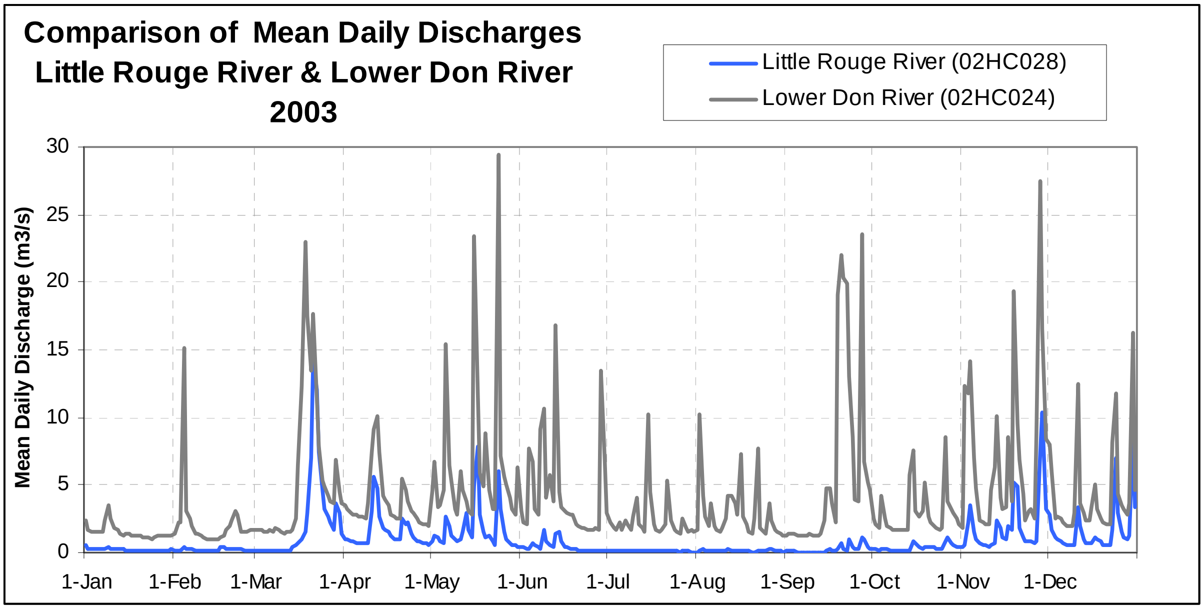
Figure 3: Average annual flow trend for the Don River (Period of Record).



There is currently one active sewage treatment facility within the Don River watershed, located in the Lower Don near Millwood Rd. The North Toronto Wastewater Treatment Plant treats wastewater for approximately 55,000 people, and discharges treated water directly into the Don River. Discharges of the plant are reported to contribute 11% of the river's total flow (CH2M Hill and MacViro, 2003).

The Don River currently is about 80% urbanized (2002 conditions) with approximately 35% of the watershed having impervious cover. This level of imperviousness is reflected in the flashy response of streamflow in the Don River. Surface runoff from rain events differs depending on the degree of urbanization and impervious cover within a watershed. Watersheds with rural or natural cover have a significantly slower response to rain events, as much of the runoff is ponded in low lying areas, or infiltrated into the soils. With the high level of impervious cover in the Don River watershed, (ranging from 19 % in the Upper East Don subwatershed to 43 % in the Taylor/Massey Creek subwatershed, based on 2002 land use), even small amounts of precipitation can have a large impact on surface flows. Figure 4 shows the daily discharge values of both the Little Rouge River (rural setting) and the Lower Don River (urban setting). As can be seen in the graph, flow response in the Don River is exaggerated as compared to more natural Little Rouge River.

Figure 4: Comparison of mean daily flows for the Don River and the Little Rouge River.



The data displayed in Figure 4 for the Don River was taken from a stream gauge in the lower part of the watershed; the response shown includes the cumulative effects from the entire watershed. A similar comparison was made, specifically looking at the May 13, 2000 storm when approximately 50 - 55 mm of rain fell. The Don River was much faster to respond to the rainfall, and began to peak approximately four to five hours following the rain. In the Little Rouge River, the times to peak were more than double those of the Don River (TRCA, 2007).

On August 19th, 2005 an extremely intense storm system moved through the Greater Toronto Area which produced high rainfall amounts and resulted in significant amounts of flooding (Figure 5). In the Don River watershed the most intense part of the storm was in the southern part of Vaughan and Richmond Hill and the northern part of Toronto - roughly between Steeles Avenue and Rutherford Road and from Highway 400 to Highway 404. Using data from several rain gauges it was determined that on August 19, 2005 the average rainfall amount in the Don River watershed was 88 mm although it ranged from over 100 mm in the headwaters to less than 30 mm near the lake. The peak rainfall amount occurred at around 3:30 PM and flooding on the Lower Don started at around 5 PM which demonstrates the extremely "flashy" nature of this highly urbanized watershed.

Figure 5: Flood damage to Don River due to August 19th 2005 rain event (Edwards Gardens).

New urban developments implement stormwater management practices in an attempt to mitigate their impacts by maintaining pre-development peak flows. However, the impacts associated with the timing of peak flows and volume of stormwater runoff remains a challenge for the surface water resource management within the Don River.

Flow nodes within the Don River watershed show general increases in average peak flows across the 2, 5, 10, 25, 50 and 100 year returns, averaging at 28%. Reductions to peak flows were observed at less than 3% of the flow nodes (Table 2 and Figure 6).

Based on the new hydrology model, the 2004 peak flows show a minor increase over the peak flows simulated during the previous 1992 update at flow nodes affected by recent urban development. The peak flows near the mouth of the Don have increased by approximately 3-6% for the 2 to 100 year design storms, although a more significant increase in peak flows was observed in some upper regions of the watershed. Modeled regional storm flows however have shown a more significant increase in various areas due to urbanization and changes in the modeling approach.

Figure 6: Map of hydrology model flow node locations (2004) in the Don River watershed.

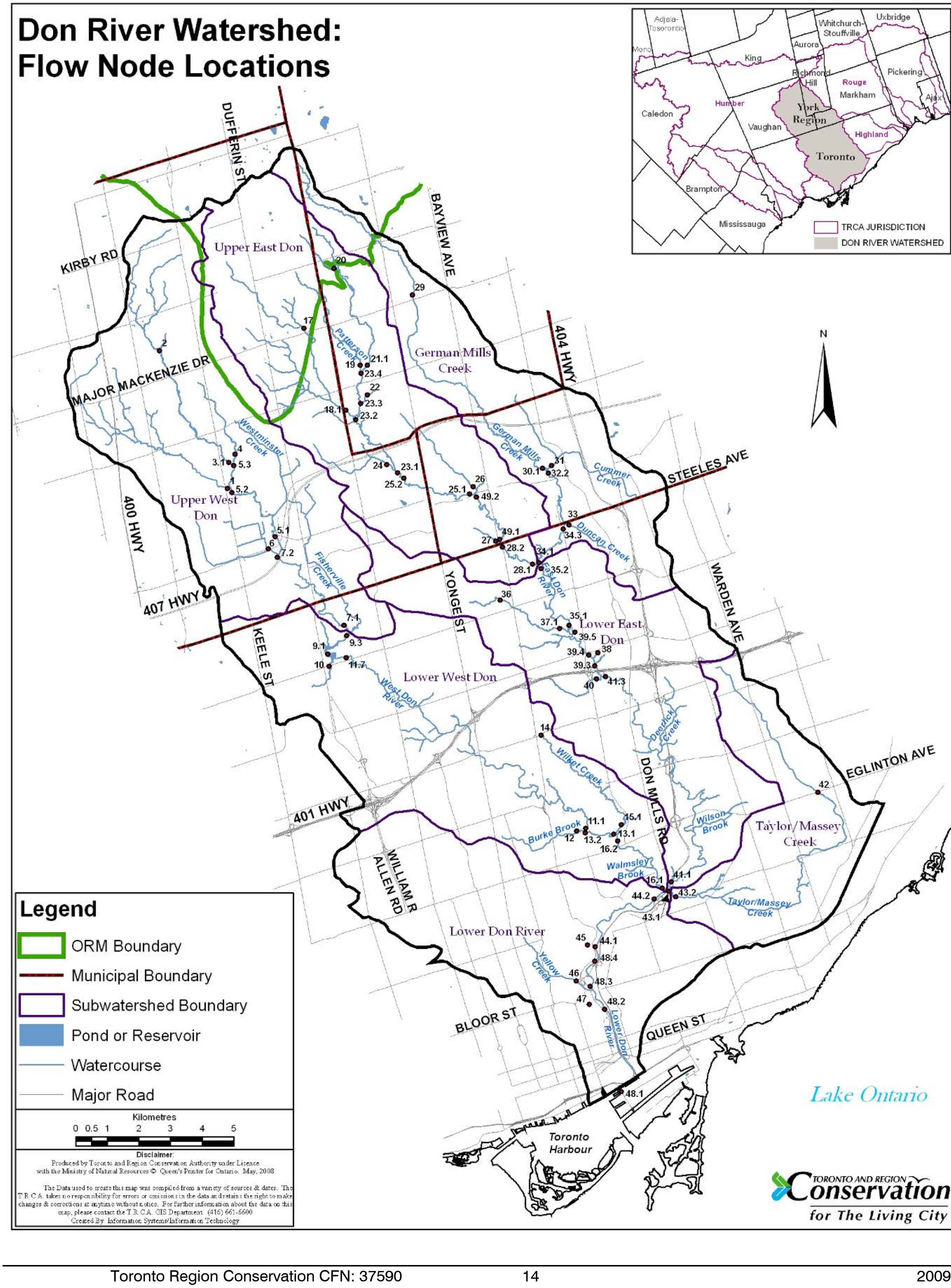


Table 2: Modeled design storm peak flows (cms) for the previous hydrologic model update (1992) and current conditions (2004).

Flow Nodes*	Drainage Area (sq. km.)	Modeled Peak Flows (CMS)												
		2-year Storm		5-year Storm		10-year Storm		25-year Storm		50-year Storm		100-year Storm		Regional Storm
		Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Future Conditions (2004 Modelling)
1	13.7	1.1	3.1	2.6	4.9	4.1	6.0	6.1	7.2	7.8	9.6	9.7	11.4	146.7
2	9.17	1.1	1.4	2.4	2.3	3.5	3.3	5.1	6.1	6.3	8.0	7.7	9.7	46.7
3.1	12.67	3.4	2.4	5.8	3.9	7.7	6.3	10.3	11.7	12.3	16.0	14.4	19.7	65.0
4	4.27	2.4	7.8	4.5	11.2	6.1	13.7	8.3	17.2	10.0	21.9	11.8	26.2	51.5
5.1	38.07	10.2	16.9	16.2	24.6	21.1	31.4	28.8	40.5	34.7	53.5	41.2	75.5	313.1
5.2	30.64	6.2	12.2	11.7	17.0	16.1	22.5	22.4	33.2	27.3	42.2	32.5	50.3	252.4
5.3	16.94	5.8	9.5	10.3	13.9	13.8	17.8	18.6	28.5	22.3	36.7	26.2	44.3	110.9
6	8.18	10.4	5.7	16.6	6.9	21.0	8.3	26.9	23.2	31.4	34.7	36.0	48.2	97.9
7.1	50.05	14.3	20.0	24.2	28.1	31.7	34.7	41.9	46.7	49.0	56.4	56.8	67.8	378.0
7.2	46.26	19.0	22.6	31.4	31.5	40.9	39.5	53.9	62.6	63.7	82.3	74.1	123.7	402.3
9.1	64.42	20.8	29.8	33.9	42.8	44.0	53.3	57.5	68.5	67.7	82.9	78.4	100.6	479.7
9.3	56.57	21.1	25.7	35.0	36.3	45.3	45.4	59.1	62.9	69.3	79.3	80.0	98.0	437.0
10	5.68	16.5	19.3	24.4	28.4	30.0	34.5	37.1	42.3	42.4	48.5	47.8	54.8	69.7
11.1	92.38	29.7	27.9	50.3	40.8	65.5	49.8	86.7	62.4	102.2	72.6	118.8	84.0	527.2
11.2	87.13	N/A	32.0	N/A	48.6	N/A	63.6	N/A	82.0	N/A	103.3	N/A	120.1	561.1
11.3	76.12	N/A	28.1	N/A	39.4	N/A	47.1	N/A	59.4	N/A	69.7	N/A	80.8	615.2
11.7	70.1	35.4	41.2	55.0	62.1	69.3	77.3	88.5	97.8	103.1	116.1	118.5	134.7	543.0
12	7.81	8.9	22.7	14.4	32.1	18.4	42.9	23.8	53.6	27.8	62.1	31.9	68.4	92.9
13.1	102.26	32.7	33.3	55.1	50.4	71.8	65.5	95.0	84.2	112.0	100.8	130.3	112.2	595.5
13.2	100.18	32.4	37.4	54.6	54.4	71.1	73.6	93.9	91.2	110.8	107.9	128.9	118.0	591.8
14	8.44	8.0	14.4	13.4	21.8	17.4	28.4	22.8	36.2	26.8	42.3	31.0	48.4	88.0
15.1	13.41	9.9	20.6	16.7	32.1	21.6	39.3	28.4	51.9	33.5	61.1	38.9	71.8	137.3
16.1	120.41	39.2	53.6	65.9	80.0	86.1	101.4	113.6	131.1	134.3	155.1	156.3	178.1	620.2
16.2	115.67	40.5	54.0	68.5	81.1	89.3	103.9	118.1	135.6	139.4	160.7	162.2	183.3	671.4
17	6.73	0.5	1.6	1.2	2.8	1.8	3.8	2.8	5.2	3.6	6.2	4.5	7.3	39.3

Flow Nodes*	Drainage Area (sq. km.)	2-year Storm		5-year Storm		10-year Storm		25-year Storm		50-year Storm		100-year Storm		Regional Storm
		Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Future Conditions (2004 Modelling)
19	5.26	0.5	1.0	1.2	2.2	1.9	3.2	2.9	4.5	3.7	5.8	4.7	7.2	58.4
20	4.2	1.4	2.0	2.4	3.4	3.3	4.4	4.5	5.9	5.4	7.0	6.3	8.2	29.6
21.1	8.55	4.6	3.9	8.3	6.3	11.2	8.0	15.3	25.7	18.4	25.9	21.7	31.4	62.3
22	2.95	6.8	8.4	10.7	12.8	13.6	15.6	17.3	19.4	20.1	22.3	22.9	25.4	35.4
23.1	36.49	9.7	13.3	17.6	19.6	23.9	24.5	32.9	32.0	39.9	39.5	47.4	47.2	277.0
23.2	31.86	12.0	10.2	20.8	16.9	27.6	22.2	36.9	43.9	44.3	50.8	52.0	60.1	271.8
23.3	16.76	10.8	9.6	18.4	14.2	24.2	17.7	32.1	38.2	38.3	45.2	44.8	53.4	153.7
23.4	13.8	4.8	4.8	9.2	8.3	12.6	11.0	17.5	26.7	21.3	26.8	25.4	32.3	119.0
24	3.13	1.2	1.7	2.2	2.8	2.9	3.6	3.9	4.7	4.6	5.6	5.4	6.5	24.2
25.1	41.88	9.7	12.9	17.0	19.1	22.3	23.7	29.9	30.7	35.8	35.8	42.2	41.5	266.5
25.2	39.62	10.9	14.1	19.7	21.5	26.8	27.2	36.8	35.5	44.5	43.7	52.8	52.2	296.2
26	6.99	6.8	16.5	11.2	24.2	14.4	34.5	18.8	43.9	22.1	45.7	25.5	52.2	82.6
27	7.33	10.6	25.1	18.0	27.5	23.5	33.3	30.8	44.0	36.3	53.0	42.1	60.5	86.2
28.1	61.07	18.0	44.3	30.8	58.1	40.2	76.7	53.4	100.4	63.4	115.9	74.3	128.7	391.6
28.2	58.35	18.4	39.5	31.5	51.0	41.2	67.8	54.8	88.7	65.3	102.2	76.5	111.5	388.8
29	7.36	4.7	7.2	8.1	34.0	10.7	37.7	14.1	44.2	16.7	51.9	19.5	53.4	86.1
30.1	19.04	10.7	26.4	18.5	45.6	24.4	60.9	32.2	87.1	38.1	106.9	44.4	132.5	126.4
31	13.8	21.8	34.8	34.4	55.2	43.3	63.9	55.1	94.9	63.9	105.8	72.9	118.0	155.0
32.2	32.84	30.4	61.2	49.4	95.8	63.4	121.6	82.2	179.0	96.3	202.6	111.1	242.3	282.5
33	6.32	16.2	12.6	25.7	19.0	32.8	28.3	41.8	36.5	48.6	38.8	55.5	44.9	75.3
34.1	45.79	32.3	44.0	52.4	75.3	66.7	98.3	85.9	136.2	101.1	162.4	117.0	193.7	380.2
34.3	0.57	30.5	46.2	50.7	86.9	65.4	113.4	85.2	161.1	100.8	191.9	117.0	228.8	352.7
35.1	110.2	44.8	63.1	74.9	99.5	97.0	127.8	127.5	170.5	150.1	203.9	175.3	242.0	719.7
35.2	106.86	50.2	75.3	83.0	117.7	106.9	154.4	139.4	212.0	164.4	251.2	191.3	291.8	782.7
36	8.23	13.3	18.2	20.6	27.6	25.8	34.8	32.7	43.8	37.8	51.1	43.0	58.5	92.2
37.1	10.59	14.6	19.8	22.8	30.9	28.8	38.8	36.5	49.2	42.2	57.4	47.8	63.5	110.8
38	3.03	4.6	7.8	8.1	12.2	10.7	15.0	14.2	18.7	16.8	21.6	19.5	24.6	36.0
39.3	128.44	54.4	75.6	89.7	117.2	115.3	150.9	151.4	202.2	178.7	243.0	208.6	287.2	856.5
39.4	125.4	53.3	73.8	87.9	114.7	113.2	147.6	148.4	198.1	175.3	237.8	204.8	281.3	835.7
39.5	120.8	52.0	72.2	85.7	113.2	110.8	146.6	145.2	197.6	171.7	237.7	200.7	281.4	811.3
40	3.15	4.6	7.9	8.0	12.3	10.7	15.2	14.4	18.9	17.2	21.9	20.2	25.0	37.3

Flow Nodes*	Drainage Area (sq. km.)	2-year Storm		5-year Storm		10-year Storm		25-year Storm		50-year Storm		100-year Storm		Regional Storm
		Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Previous Update (1992)	Existing Conditions	Future Conditions (2004 Modelling)
41.1	158.69	56.3	79.6	92.9	122.3	119.8	155.6	156.7	204.2	184.5	241.2	214.7	283.3	861.9
41.3	131.59	55.9	77.5	92.0	119.9	118.4	154.4	155.5	206.9	183.4	248.4	214.4	294.2	878.6
42	8.65	13.8	15.7	22.2	23.0	28.5	28.8	36.8	36.5	43.0	42.5	49.5	48.8	88.5
43.1	190.76	87.2	98.5	144.6	151.1	186.5	190.5	242.7	250.5	284.9	292.3	329.4	344.1	1146.0
43.2	32.07	33.1	48.1	54.2	72.5	69.0	89.6	89.0	111.7	103.9	144.4	119.3	165.2	293.3
44.1	317.67	117.1	139.8	195.6	210.4	252.8	263.7	329.1	339.7	386.6	395.4	448.5	458.7	2043.8
44.2	311.17	117.5	141.6	196.3	216.7	254.8	275.5	335.0	356.8	395.4	418.1	460.6	486.3	1860.1
45	6.08	13.9	16.5	23.1	25.7	29.9	32.9	39.0	40.7	45.8	49.7	52.8	56.6	71.2
46	10.25	16.9	31.3	26.8	48.7	33.8	55.4	43.2	72.7	50.1	83.4	57.4	94.6	121.5
47	14.81	26.0	42.0	40.6	58.0	51.2	71.3	64.8	97.0	75.0	112.6	85.4	128.4	167.0
48.1	360.81	127.1	160.3	210.2	235.5	270.7	291.2	352.2	368.7	412.8	426.5	477.7	492.5	1694.3
48.2	348.8	132.8	166.8	220.5	248.2	284.1	306.9	367.0	389.4	428.8	457.2	496.1	525.0	1807.0
48.3	334	125.8	146.7	209.8	220.2	270.5	274.2	350.9	352.4	410.9	409.7	476.0	476.2	1728.3
48.4	323.75	121.1	142.0	202.4	213.7	261.1	267.4	339.7	344.2	398.6	400.6	462.1	464.7	1681.5
49.1	51.02	14.0	19.3	24.2	29.0	31.2	37.7	41.4	48.4	49.1	48.4	57.9	65.0	326.3
49.2	48.87	14.4	25.2	24.7	38.2	32.0	52.7	42.0	67.0	49.7	73.3	58.4	85.5	331.6

* Locations of flow nodes are shown on Figure 6.

4.2 Stormwater Management

Increasingly, the focus of stormwater management is on maintenance of the natural hydrologic cycle, as a means of mitigating the effects of urbanization on the ecological integrity of a watershed (Aquafor Beech Limited, 2008). The most significant effects occur in response to the conversion of natural, pervious surfaces to impervious surfaces which prevent water from infiltrating into the soil. Impervious surfaces include roads, sidewalks, driveways, rooftops and parking lots. Schueler (1995) notes that channel instability and habitat degradation begin to occur when the percentage of impervious cover in a watershed reaches 10 to 15 per cent. As of 2006, much of the Don River watershed is in excess of 25% imperviousness, excluding the uppermost areas of the watershed, which are still being urbanized. Associated with an increase in impervious cover are an increase in runoff volume and velocity and a decline in infiltration potential (Arnold and Gibbons, 1996).

Changes to the hydrologic regime ultimately impact the physical state of the watercourse. As the energy within the system increases, given higher velocities and volumes of flow, the natural rates of erosion and sedimentation also increase, resulting in a loss of riparian vegetation and in-stream habitat, an increase in water temperature and a change in channel morphology. *Fluvial Geomorphology – Report on Current Conditions* (TRCA, 2009a) reports on an evaluation of fluvial geomorphology conditions in the Don River watershed.

In addition to the water quantity impacts, water quality is also affected as natural landscapes are modified for urban development. A number of non-point source pollutants exist in an urban environment, including heavy metals (e.g., zinc, cadmium, copper), pesticides, nutrients (e.g., phosphorus), toxic contaminants, pathogens (e.g., bacteria) and debris. Vegetation plays an important role in naturally filtering sediments and removing pollutants from overland flow. With increases in urbanization, this form of natural protection is lost, and an increase in sources of non point source pollution occurs.

A 1991-1992 study of water quality in six local tributaries to Lake Ontario, including the Don River, found that, under wet weather conditions, all indicator parameters consistently exceeded Provincial Water Quality Objectives (excluding suspended solids, for which there is no PWQO). It was also found in the 1994 report, *Forty Steps to a New Don,* that as much as 70% of the total flow in the Don River is comprised of stormwater, entering the system from 1,185 outfalls, and is the greatest source of pollution in the Don (MTRCA, 1994). This affirms the 1991-1992 study's conclusions that stormwater management remains the single most important means of improving water quality in Toronto tributaries, as well as the harbour and localized areas of Lake Ontario (Boyd, 1999). Additional information can be found in the current conditions report on surface water quality (TRCA, 2009d).

Because of the high degree of urbanization in the Don watershed, stormwater management needs to not only look at the application of such controls in new development, but retrofitting existing under-achieving controls, and areas developed prior to stormwater management practices and policies. The creation of end-of-pipe facilities (i.e., stormwater ponds) within the existing urban area of the Don watershed is difficult due to space constraints. To overcome these constraints, more innovative approaches to stormwater management require consideration, such as infiltration systems, establishment of roof top gardens and green roofs, bioretention and other innovative storm water management practices.

4.2.1 Existing Stormwater Control

An assessment was carried out to determine the existing status of stormwater control within the watershed. Figure 7 illustrates the existing and proposed level of control and the location of the stormwater management facilities within the watershed. The Don watershed is currently 80% urbanized; current stormwater quantity control exists for 20% of this urban area. The controlled area is comprised of 13% which has both quantity and quality control, and the remaining 7 % which only has quantity controls in place (Figure 8). These numbers are an increase from previous reporting, where quality and quantity control facilities have increased by approximately 6% since 1997. These changes in the percent level of control are indicative of the age of development within the watershed and also reflect the change in management approaches that has occurred to date.

In 2003, there were approximately 112 existing or proposed stormwater management facilities in the Don River watershed. This number will increase by more 20% over the next few years with the addition of 25 new facilities. These facilities are all located in blocks 11, 12 and 18 in the City of Vaughan, which is the area generally bordered by Teston Road and Rutherford Road to the north and south, and from Keele Street, east to Bathurst Avenue. This is the area where much of the recent development in the watershed is occurring.

Many of the existing facilities which fail to meet current standards have been evaluated as part of municipal stormwater retrofit studies to assess their potential for re-design and enhancement (Towns of Markham, Richmond Hill and Vaughan retrofit studies). These municipal retrofit studies also evaluated the potential to incorporate stormwater management measures in already urbanized areas where no stormwater control currently exists. The resulting retrofit plans provide the basis for a long term capital works program aimed at improving overall watershed health. Details regarding retrofit opportunities and the results of these studies are discussed in Section 5.

4.2.2 Stormwater Management Criteria

The control of stormwater runoff is achieved through implementation of management criteria and/or the determination of performance targets. These criteria and targets are quantitative expressions of stormwater management goals, which set out specific requirements for the design of stormwater management systems in new developments. The criteria are implemented through incorporation into municipal plans and plan amendments, and subsequently through enforcement by municipalities, conservation authorities, and the MOE in the development approvals and permitting processes.

Figure 7: Existing and proposed stormwater controls in the Don River watershed (2006).

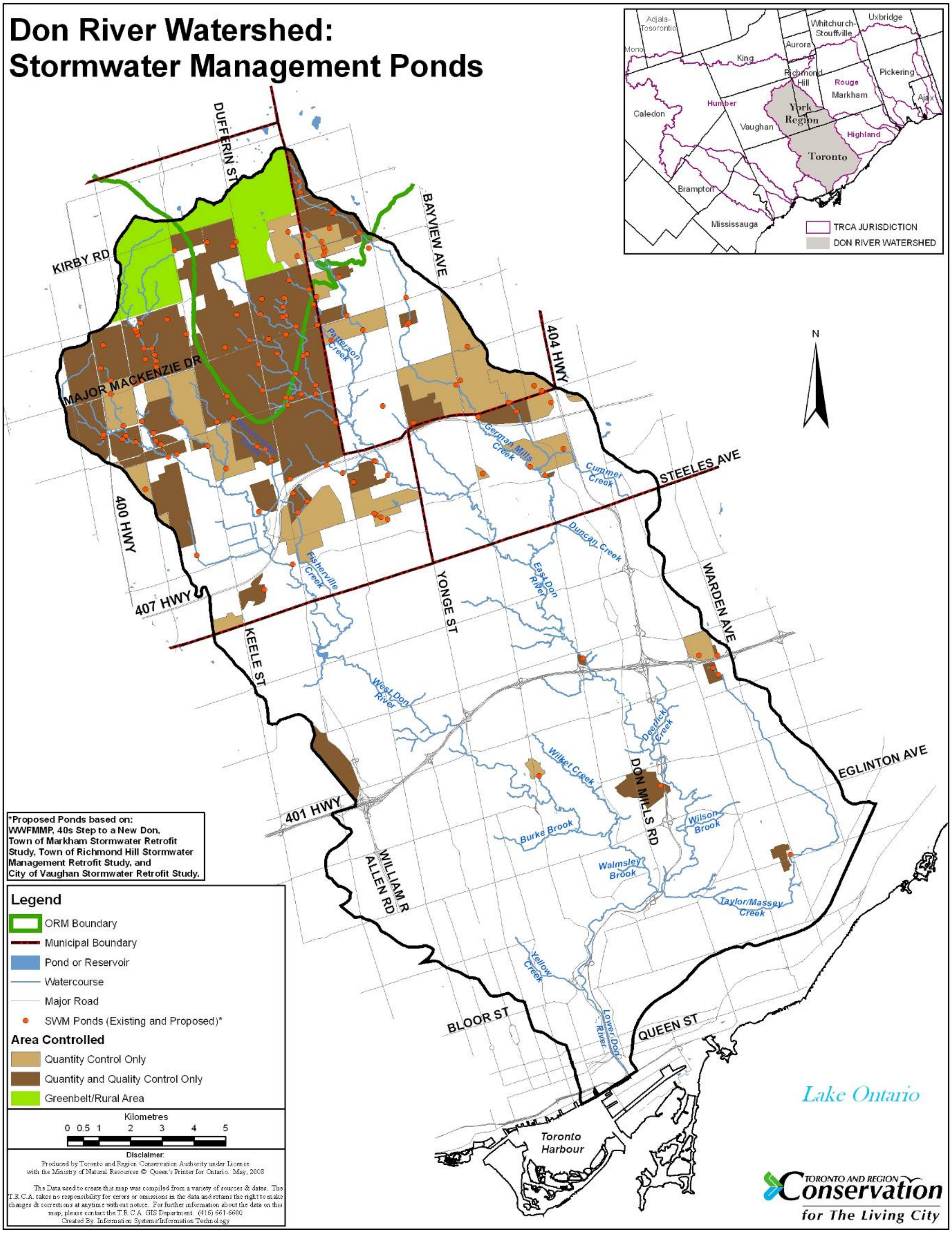
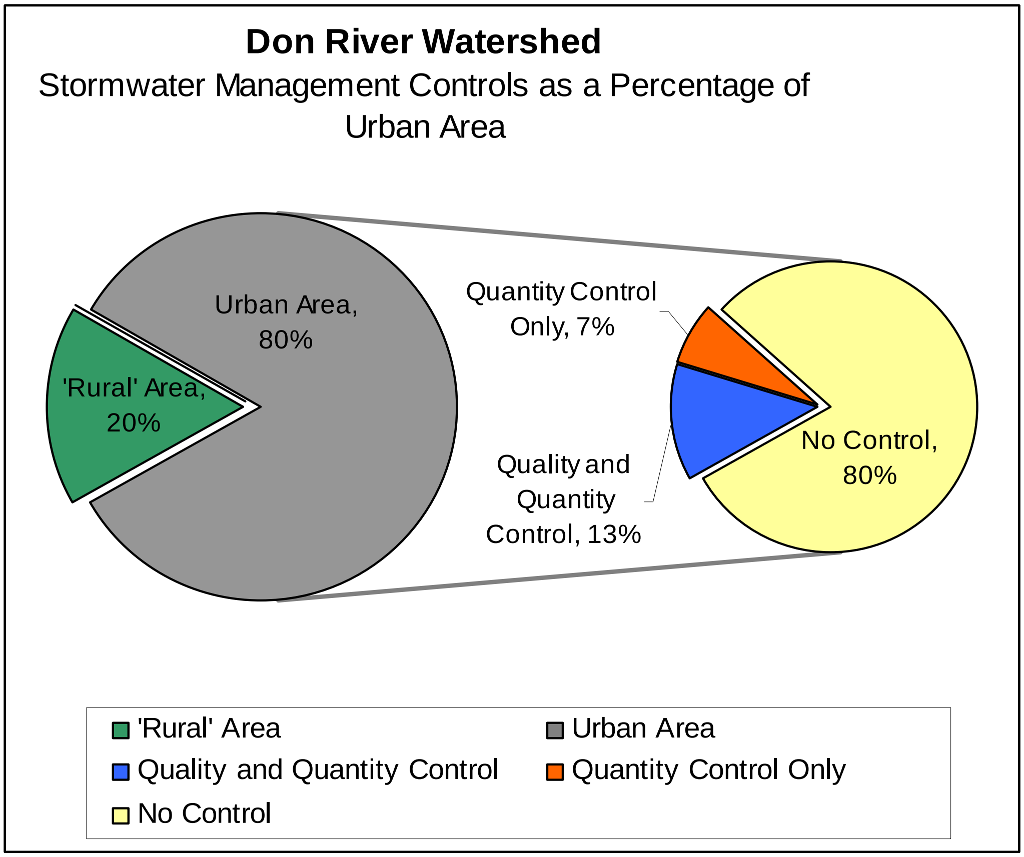


Figure 8: Stormwater management controlled areas.



Stormwater criteria are usually prescribed through watershed or subwatershed level studies, based on comprehensive hydrologic modeling and consideration of specific environmental and social factors within the watershed. Examples of factors affecting stormwater management control criteria include land-use designations, flood-vulnerable areas, erosion sites, stream baseflow, groundwater resources, and terrestrial and aquatic habitat. The criteria are expressed in straightforward, numeric terms so that they are simple for municipalities and development proponents to implement in management plans.

Regular updates are important to ensure that watershed criteria reflect existing conditions within the watershed. Changes to the hydrologic regime will have impacts not only to flood related concerns, but should be assessed in terms of management implications watershed-wide (i.e., fisheries, erosion, terrestrial systems).

Flood Flow Criteria

The intent of the flood flow criteria is to identify where in the watershed stormwater controls are required to prevent an increase in the occurrence of downstream flooding, to reduce the potential for increased erosion, and to address local fisheries concerns.

The current (2008) flood flow criteria for any development in the Don River watershed is to control post development peak flows to pre-development levels for all storms up to and including the 100 year storm (i.e., 2, 5, 10, 25, 50 and 100 year storms). The flood flow criteria for the Don River watershed was determined based on the watershed response through the *Don River Hydrology Update* (MMM, 2004). Unit flow rates have been established for the Don River watershed, north of Steeles Ave., from which pre-development runoff rates have been established. Table 3 shows current (2008) flood flow criteria for the Don River watershed.

Table 3: Environmental design criteria for a water balance approach to stormwater management.

Flood Control	Water Quality Control	Erosion Control	Infiltration and Natural Features
Control post-development peak flows to pre-development levels for all storms up to and including the 100 year storm (i.e. 2, 5, 10, 25, 50, and 100 year storms). Unit flow rates have been developed north of Steeles Avenue.	Enhanced (Level 1) protection is required as per OMOE 2003 Stormwater Management Planning and Design Manual. Contact Authority staff to determine specific requirements.	Erosion storage requirements are based on the size of site, degree of source control, soils type, and sensitivity of receiving waters. Contact Authority and Municipal staff to determine specific requirements.	Site water balance following new development shall resemble pre-development conditions to the extent possible. The pre-development rate of infiltration should be maintained through one or a combination of on-site measures to the extent possible. For significant ecological features (wetlands and woodlots), maintain flow regime (surface and groundwater contributions) and distribution.

Water Quality Control Criteria

Criteria for water quality control are typically expressed in terms of the percentage of suspended solids which must be removed from stormwater to protect aquatic life. Suspended solids are the primary pollutant of concern for water quality treatment because of their direct physical effect on aquatic ecosystems and because other stormwater contaminants, such as metals, pesticides and some nutrients, are attached to suspended solids. Water quality concerns associated with thermal impacts are emerging and are not fully addressed by these criteria.

Current provincial requirements for stormwater quality control are outlined in the Ontario Ministry of the Environment (OMOE) *Stormwater Management Planning and Design Manual* (OMOE, 2003). The manual identifies three levels of volumetric storage requirements for end-of pipe-facilities, which correspond with three levels of total suspended solids (TSS) removal. 'Enhanced' control accounts for 80 percent TSS removal; 'normal' control accounts for 70 percent TSS removal; and 'basic' control accounts for 60 percent TSS removal. The level of control provided is related to the water quality component of the overall stormwater management strategy for a particular area, with the intent being to maintain or enhance the existing aquatic habitat within the receiving watercourse. The determination of habitat sensitivity is made by a qualified aquatic biologist who is familiar with local stream conditions such as flow regime, temperature, community structure, and habitat conditions.

Within the Don River watershed, the TRCA requires that all new developments utilizing end-of-pipe facilities for water quality control adhere to the OMOE 'enhanced' criterion, or 80 percent TSS removal (Table 3). OMOE guidelines stipulate that the 'enhanced' criterion should be applied when receiving waters have aquatic communities that are sensitive to suspended solids, such as coldwater streams. However, the TRCA requirement for 'enhanced' protection throughout the Don River watershed reflects both the sensitivity of the existing aquatic habitat and a desire to minimize additional impacts to watercourses that are already disturbed. Lesser criteria are acceptable in the case of stormwater retrofits, where any significant improvement in stormwater management can be considered.

Erosion Control Criteria

Erosion is an inherent aspect of watercourse behavior, which occurs while rivers and streams function to transport water and sediment to larger water bodies. A potential impact of increased runoff from urbanized areas is an increase in the amount and magnitude of in-stream erosion and destabilization of the watercourse channel, which can destroy aquatic and riparian habitat and threaten infrastructure and public safety. Erosion control objectives for stormwater management are not intended to eliminate erosion entirely, but to maintain a level of in-stream erosion such that watercourses can fulfill their normal function.

Traditional stormwater management criteria for erosion control, including those advocated by the OMOE (OMOE, 1991, 2003; OMOEE, 1994), consisted of the detention and gradual release of a volume of water resulting from a particular depth of rainfall in an end-of-pipe facility. For example, a common erosion control criterion is for the detention of the volume of runoff from a 25 mm four hour rainfall event for a period of 24 hours. The intent of this approach was to release the runoff from frequent rainfall events over a long period of time at a rate which would not cause erosion in the receiving watercourse. However, it has been shown that this type of criterion is often too general to account for the individual characteristics of receiving streams. In some cases it is ineffective in preventing increased in-stream erosion, while in others erosion potential is drastically reduced causing excess sedimentation. Current approaches to erosion control, including the approach advocated by the OMOE, require a characterization of the receiving watercourse and a detailed hydrologic erosion analysis to determine a level of control that will maintain a functional level of in-stream erosion potential.

Until recently, the standard minimum erosion control criterion applied in the Don River watershed was for detention of the runoff from a 25 mm rainfall event in an end-of-pipe facility with a release from that facility over a minimum of 24 to 72 hours. However, studies initiated by the TRCA and by Rouge watershed municipalities indicated that the use of this blanket erosion control criterion was not effective in preventing increased erosion in watercourses downstream of new developments.

In response to these findings, TRCA requires a site-specific erosion analysis to determine if the blanket minimum criterion is sufficient (Table 3), or if more stringent requirements are needed (i.e. larger volume of runoff detention or longer duration detention time). Erosion analyses require a geomorphic investigation of the watercourse to determine the critical threshold discharge at which erosion commences, followed by continuous hydrologic simulation to determine the frequency at which the threshold is exceeded under existing (pre-development) conditions. Various stormwater control options (generally end-of-pipe controls) are then simulated in the post- development model, to determine the required level of flow control required to match the flow regime under pre-development conditions. Results of the erosion analysis can also be used in retrofit situations to determine the nature of design modifications to existing stormwater management facilities.

The development of criteria based on site-specific erosion analyses is a relatively new approach, with little long-term verification of the performance of stormwater management facilities that are constructed to meet these criteria. Preliminary results of a study being undertaken by the Town of Markham suggest that the detention of runoff in end-of-pipe facilities alone is insufficient to maintain pre-development levels of in-stream erosion potential, regardless of the volume or detention time. The study indicates that the overall increase in runoff volume from urbanization may increase in-stream erosion potential regardless of any extended detention that takes place in end-of-pipe facilities. It is recommended that, in addition to end-of-pipe facilities, control of in-stream erosion will require a certain depth of rainfall to be maintained on site through infiltration, evaporation or reuse, to reduce the overall volume of runoff to the watercourse.

Infiltration Criteria

Overall water balance in a watershed refers to the inputs, outputs and changes in storage. Inputs generally include precipitation, groundwater / surface water inflows, and human influenced inputs such as sewage treatment facilities. The outputs are commonly surface or groundwater outflows, evapotranspiration, water abstractions as well as changes in storage. For a balanced system, the inflows should equal that of the outflows. Groundwater recharge plays an important function in the overall water balance, as it can be the limiter of natural inflows.

Groundwater recharge is an important water management parameter since it replenishes the groundwater reservoir and is the main source of baseflow in streams. The annual recharge capacity of an undeveloped area depends on the climate and the soil infiltration characteristics in the area. Urbanization results in more impervious areas (such as buildings, roads, etc.), which leads to more storm runoff, and reduction in the natural recharge capacities of the area. Conventional stormwater controls aim to reduce peak storm flows, but do not necessarily enhance the post-development infiltration in the area. However, long-term reduction in recharge capacities can potentially lead to depletion of the groundwater reservoir, reduced baseflows in streams, etc. and consequently have an adverse impact on the natural hydrologic cycle. Hence, preserving pre-development recharge capacities has now been recognized as a key aspect of stormwater management. Table 3 shows current (2008) water balance management criteria for the Don River watershed.

There are currently a number of models which have been used to develop recharge estimates in the Don watershed including:

- HSP-F Models (Hydrological Simulation Program – Fortran);
- MODFLOW, a three-dimensional numerical groundwater flow model (see Geology and Groundwater Resources – Report on Current Conditions for further description; Earthfx, 2004).
- PRMS (Precipitation–Runoff Modelling System)

The City of Toronto has developed hydrological and water quality models within Toronto area watersheds to predict stormwater runoff and water quality in local streams and the Toronto

Harbourfront. This study, known as the Toronto *Wet Weather Flow Management Master Plan* (WWFMMP), uses the U.S. EPA supported HSP-F watershed modelling program. This tool has been used to assess the potential benefits of implementing stormwater management practices across the City of Toronto (e.g., Marshall Macklin Monaghan Limited, 2003). These models were calibrated to streamflow, surface water quality and sewer discharge data.

Through Source Water Protection water budget studies, recharge estimates have been finalized consistently across the TRCA watersheds utilizing the PRMS (Precipitation–Runoff Modelling System) model. The information will be used to implement TRCA stormwater management policies designed to maintain the existing recharge rates in future developments and areas of land use intensification.

As these PRMS recharge estimates were developed for Source Water Protection, they were validated and calibrated at a large scale, due to the size of the study area. For this reason, and improved water quality representation, additional modeling using the QUALHYMO model, specific to the 905 portion of the Don watershed, will be completed as part of the larger watershed plan process.

4.3 Flooding and Hydraulics

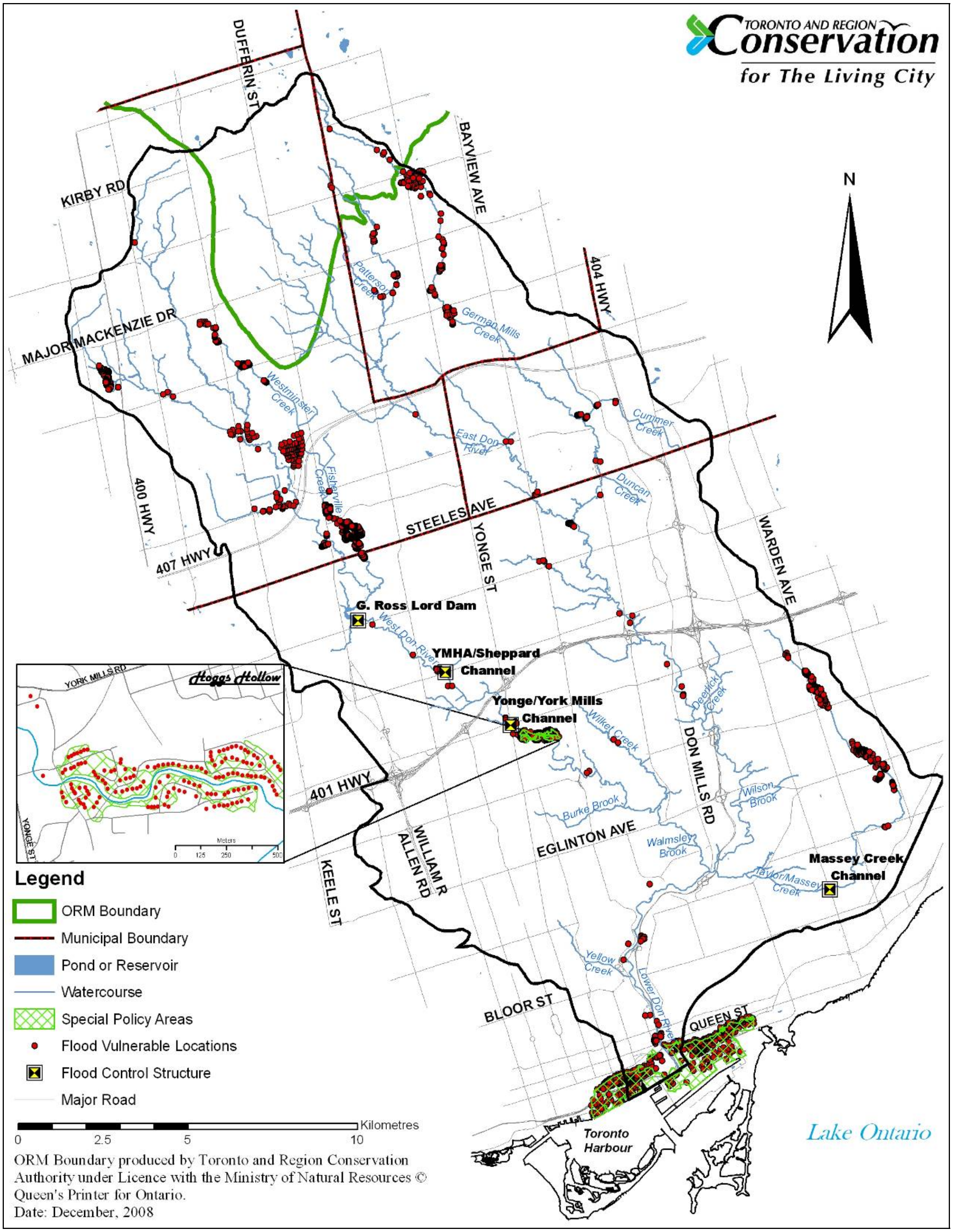
A key tool in managing flood risks is the Don River hydrology. The hydrology, along with mapping and hydraulics, allow for the location and vulnerability of flood sites to be identified within the watershed. The current location of flood vulnerable areas and roads within the Don River watershed is illustrated in Figure 9. Maintaining or reducing flood risks at these sites through effective stormwater management is the current method of controlling the impacts of increased flows caused by urbanization.

The Don River is a “flashy” watershed, responding quickly to even moderate rainfalls. Times to peak range from under one hour on the tributaries of Taylor/Massey Creek, German Mills Creek, and Wilket Creek, to 6-10 hours on the main Don River. Due to its urban nature, flooding peaks have been known to occur at lesser times when storms occur only within the southern portions of the basin.

There are a number of flood vulnerable areas located throughout the watershed including Hoggs Hollow on the West Don. Flooding in this area is controlled by the G. Ross Lord Reservoir at Finch on the West Don and conveyed through an engineered flood control channel. The lower reaches of the watercourse from the confluence at the forks of the Don for approximately 10 km down to the Keating Channel contains the most flood susceptible series of transportation systems within our area of jurisdiction.

A complete list of flood prone areas in the Don watershed is provided in Appendix A.

Figure 9: Flood vulnerable locations within the Don River watershed (2008).



There are two Special Policy Areas (SPAs) for flooding in the Don watershed: Hoggs Hollow (Figure 9: Inset) and the Lower Don at the mouth. SPAs policies provide for development in flood vulnerable areas, subject to planning considerations and flood protection measures. Hoggs Hollow is a residential SPA at Yonge and York Mills set in a low lying area, and the industrial and high density residential areas of Lower Don SPA includes the mouth and spill areas along the lakeshore, from York St. in the west, to just east of Leslie St.

Excess flows in the Don River are not the only source of flooding concerns within the Don watershed, and urban flooding is also a concern. Undersized water crossings and conveyance systems and the historic development in low lying areas increase the risk and susceptibility of flooding. Reporting of basement flooding following large rain events is also common in the Don watershed. The City of Toronto's *Wet Weather Flow Management Master Plan* (WWFMMP), which aims to restore the natural conditions of rivers and streams in the City of Toronto, is investigating areas of chronic basement flooding. Clusters of flooding basements have been identified across the City of Toronto portion of the Don River watershed, but are particularly a problem within the former City of North York (MMM, 2003). According to these investigations, the typical causes of such flooding are:

- Overloaded storm and/or sanitary sewer systems
- Overloaded surface drainage systems
- Low lying areas
- Reversed sloped driveways.

Both source controls and structural controls are being recommended as solutions to this problem. The WWFMMP is further discussed in Section 5.

4.3.1 Flood Vulnerable Areas

A database of flood vulnerable structures was updated in 2006 to include individual flood susceptible transportation routes and structures. Flood vulnerable roads and structures are plotted against the design storms (2, 5, 10, 25, 50 and 100 year returns) and the regional storm flow, and assigned a stage level based on the elevation of the structure. This allows for a breakdown of structures which are at risk of flooding depending on the severity of the storm event.

Current information within the TRCA database shows that under a Stage 5 flood (100 year return / Regional Storm) there are some 2,868 known flood vulnerable structures and road areas in Don River watershed (Figure 9). The locations of the flood vulnerable structures and roads which are included in the above values are displayed in Figure 9.

4.3.2 Flood Protection in the Lower Don

As mentioned above, the lower reach of the Don River contain some of the most flood susceptible lands as well as transportation systems within our area of jurisdiction. Since the early 1980s, this area of the Don River has been identified as the highest priority flood prone area within the TRCA jurisdiction due to the number of structures and extensive infrastructure currently at risk to flooding.

In March 2001, the Toronto Waterfront Revitalization Corporation (TWRC) identified four priority projects to enhance City of Toronto Waterfront. One of these projects identified that an environmental assessment would be conducted to develop the best option to re-naturalize the mouth of the Don River and to provide flood protection for the city's downtown core. The TRCA is carrying out this project on behalf of the TWRC to meet the objectives of the Don River priority project. The project was split into two separate components, the Lower Don River West Remedial Flood Protection Project and the Don Mouth Naturalization and Port Lands Flood Protection Project.

A Class Environmental Assessment for the Lower Don River West Remedial Flood Protection Project was completed (Dillon Consulting, 2005) and construction is underway. The objective for this project is to protect human life and infrastructure from flooding by permanently removing approximately 210 hectares of Toronto from the Regulatory Floodplain, west and north of the Don River mouth. To achieve this objective the project was broken down into five main components:

- A flood protection landform on the west side of the Don River,
- Interim flood protection works on the east bank of the Don River (retaining walls/dykes),
- An additional span attached to the west abutment of the existing CN Rail Bridge over the Don River,
- Continued dredging of the Keating Channel as per the Keating Channel Environmental Assessment (Acres Consulting Services, 1983), and
- Modifications to the Enbridge utility bridge that crosses the Don River.

The Don Mouth Naturalization project is the subject of an ongoing Individual Environmental Assessment. This project will develop a preferred alternative for the naturalization of the Don River mouth, including the Keating Channel, and flood protection for 230 ha of the Port Lands area. Completion of these projects will require ongoing political, social, and financial support from all levels of government and the public.

4.4 Ratings for the Stream Flow, Flooding and Stormwater Management Indicators

In evaluating current conditions in the Don River watershed, a rating system was adopted based on standard letter grades. Each of these categories corresponds with “poor”, “fair”, “good” and “excellent” levels of condition as shown in the table below. Where the measures and targets were quantitative and data permitted, ratings were assigned, in part, to reflect the percent satisfaction of the target. Comparisons to conditions in other watersheds under TRCA jurisdiction were made and informed evaluations where data were available, to reflect relative conditions. Where measures and targets were qualitative, or data were lacking, evaluations were based on professional judgment.

Grade	Rank	Percent of Target Achieved
A	Excellent	Better than 80
B	Good	Between 70 and 79
C	Fair	Between 60 and 69
D	Poor	Between 50 and 59
F	Fail	Below 50
TBD	To be determined	Further study required; baseline data not available

The management objectives, indicators, measures, targets, and current conditions ratings for stream flow, flooding, and stormwater management are presented below. Current conditions have been compared to previous assessments of condition undertaken as part of report cards prepared after *Forty Steps*, where detailed assessments were available (Don Watershed Regeneration Council (DWRC) and MTRCA, 1997; TRCA, 2000, 2003).

4.4.1 Stream Flow

Objective: Protect and restore the natural variability of annual and seasonal stream flow		Overall Rating
		C
Indicator	Measure	Target
Stream flow	Average annual and seasonal stream flow volume at stream gauge locations	No positive trend (i.e., increase) in average annual and seasonal stream flow volumes. maintain flow volumes at 1997 levels, even with new development.

In the 1997 report card for the Don River, a target to maintain flow volumes at 1997 levels, even with new development was set (DWRC and MTRCA, 1997). As of the 2000 report card, annual flows volumes had not shown an increase or decrease of any significance over 1997 levels (TRCA, 2000). When looking at the mean annual flows from 1997 to present, a subtle reduction in mean annual flows is observed (Figure 10). However, this change is within one standard deviation and is not considered significant. Despite the small change, this may mean that the increasing trend experienced in the last 30 years is starting to move in the right direction. With stable flows observed in the previous report card, and a small reduction in annual flow volumes occurring in the last 8 years, an improvement in the system is starting to take shape. The rating for the stream flow indicator is C or “Fair”.

4.4.2 Flooding

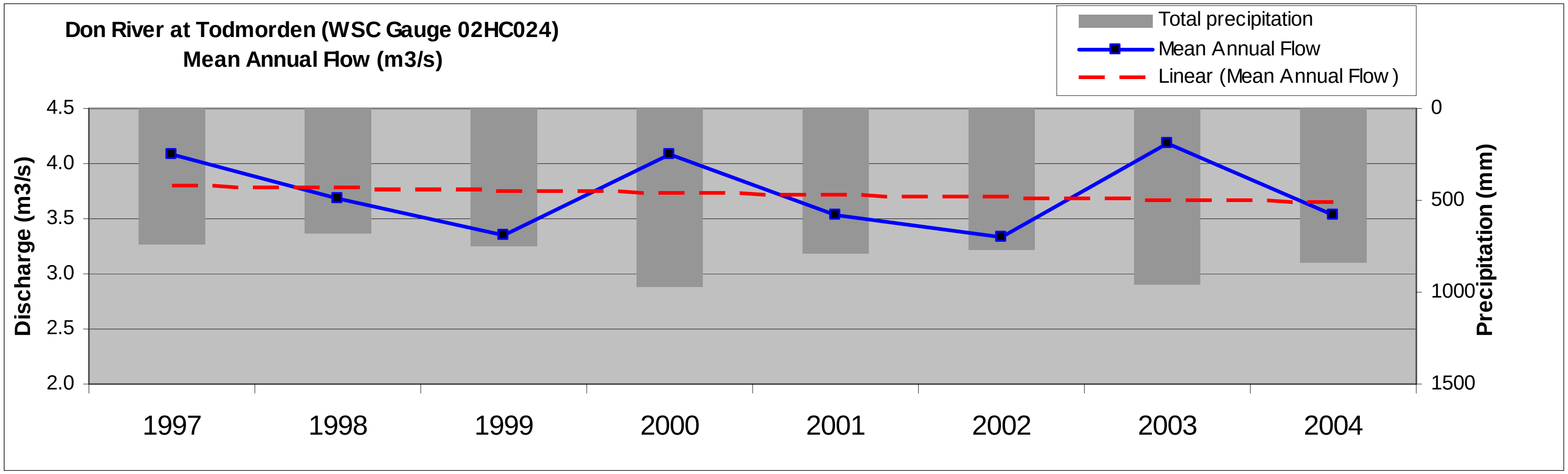
Objective: Eliminate or minimize risks to human life and property due to flooding		Overall Rating
		D
Indicator	Measure	Target
Flooding	Peak stream flow rate for 2 to 100 year return period storm events (m^3/s, at stream gauge locations)	Maintain baseline peak stream flow rates for 2 to 100 year return period storm events
	Number of Flood Vulnerable Areas and Roads (by flood stage)	Reduce or maintain the number of existing Flood Vulnerable Areas and Roads

Overall, despite the best efforts to mitigate the hydrological impacts of development, peak flows in the Don watershed have increased since the last modeling completed in 1993. At the majority of flow nodes within the Don watershed, average peak flows across the 2, 5, 10, 25, 50 and 100 year returns showed increased peak flows. Reductions to peak flows were observed at 10 – 18% of flow nodes, depending on the severity of the rain event. Cumulatively, new modelling suggests in increase of 3 – 6% at the outflow of the Don River across the 2 – 100 year design storms.

Digital flood line mapping based on the 2004 Don watershed hydrology has recently been completed. While a total number of flood vulnerable areas and roads is available, and discussed in Section 4.3, this is difficult to compare to pre-existing inventories. The TRCA has made significant changes to the maintenance and scale of this data, with each structure individually counted. Previously ‘cluster’ areas were defined, and not recorded as individual structures. In total, there are currently more than 2,800 known flood vulnerable structures and road areas in the Don watershed.

The overall rating for the flooding indicator is D or “Poor”.

Figure 10: Mean annual flows in the Don River watershed (1997 to present).



4.4.3 Stormwater Management

Objective: Manage stormwater to protect people and the health of streams and rivers		Overall Rating
		D
Indicator	Measure	Target
Stormwater management	% of urban areas with stormwater controls (quantity, quality, and erosion controls)	Increase % of urban area equipped with Level 1 stormwater controls (for improved water quantity, quality and erosion control)

As discussed, the Don watershed is currently 80% urbanized; current stormwater quantity control exists for 20% of this urban area. Of the 20% controlled area, 13% has both quantity and quality control, and the remaining 7 % only has quantity controls in place (Figure 8). This is an improvement over the condition reported in the 1997 report card. The area treated by quality and quantity control facilities has increased by approximately 6% since 1997.

All development in the Don watershed since the last report card has met current MOE and TRCA stormwater management criteria of quality and quantity controls. In 2003, there were approximately 112 existing or proposed stormwater management facilities in the Don River watershed. This number should increase by more 20% by 2010, with the addition of 25 new facilities.

The older facilities which historically only provided water quantity controls are being converted to mitigate both quality and quantity concerns. These numbers show an improvement in the way stormwater is managed in the Don River, it is clear that stormwater control facilities put in place since the 1992 modeling have functioned as designed. Recognizing that the planning and construction process of retrofits can be lengthy, there is a significant urban area that still exists with little or no stormwater controls. Even with the implementation of the discussed retrofit opportunities, the uncontrolled area of the Don would be sizeable. For this reason the rating for the stormwater management indicator is D or “Poor”.

5.0 Improving Stormwater Management

Stormwater retrofit studies within the Don River watershed were initiated to provide a framework for a long term strategy to implement stormwater quality and quantity controls within existing urbanized areas. These studies were broadly-based, planning level studies which addressed the issue of stormwater management on a municipal basis, using an ecosystem approach.

Studies have been initiated by TRCA on behalf of the towns of Richmond Hill and Markham and the City of Vaughan, in a 3 phase process. These individual phases involved an inventory of existing stormwater management facilities, a preliminary evaluation of the potential to retrofit the existing quantity control facilities to include water quality and erosion measures, and lastly to identify uncontrolled outfalls with retrofit potential (TRCA, 1999, 2001; Aquafor Beech, 2002).

The City of Toronto assessed stormwater management options in its *Wet Weather Flow Management Master Plan* study (CH2M Hill and MacViro, 2003; MMM, 2003).

5.1 Stormwater Management Retrofit Opportunities

Cumulatively, through the three municipal retrofit studies completed in the 905 portion of the Don River watershed, a total of 79 ponds and 19 uncontrolled outfalls were investigated for retrofit opportunities. Based on the existing control, the environmental benefit and the cost factors, a total of 6 ponds were identified which would benefit from a retrofit. Added to this, 13 uncontrolled outfalls were identified as potential new pond locations. The breakdown of these retrofit opportunities are displayed in Table 4 and Table 5. Figure 11 shows the locations of both the retrofit opportunities and the potential new ponds in the 905 region.

Retrofit opportunities were prioritized in Phase 3 of these studies based on Environmental benefits and Cost. Phase 3 of the Vaughan Retrofit Study is currently underway, and prioritization information is not yet available. The retrofit opportunities which were determined as a relatively high priority are Doncrest Pond (27-1) and the Leitchcroft Farm Pond (80.0). Of these, the Leitchcroft Farm Pond has already been constructed. The remaining ponds fell within the lower 50 percentile of the total scores.

The prioritization of retrofit opportunities could be further investigated based on specific recommendations in the *Forty Steps to a New Don* report. The locations of these controls are listed by management reach number, as defined in the *Forty Steps* report.

With the implementation of these proposed stormwater facilities, a total of 287 hectares of additional area will have water quality control in the 905 region of the Don watershed. Of this total area, almost 60% lies within the Upper West Don River subwatershed, and the remaining 40% is split evenly between the Upper East Don River and German Mills Creek subwatersheds.

Figure 11: Stormwater retrofit opportunities in the 905 region of the Don River watershed.

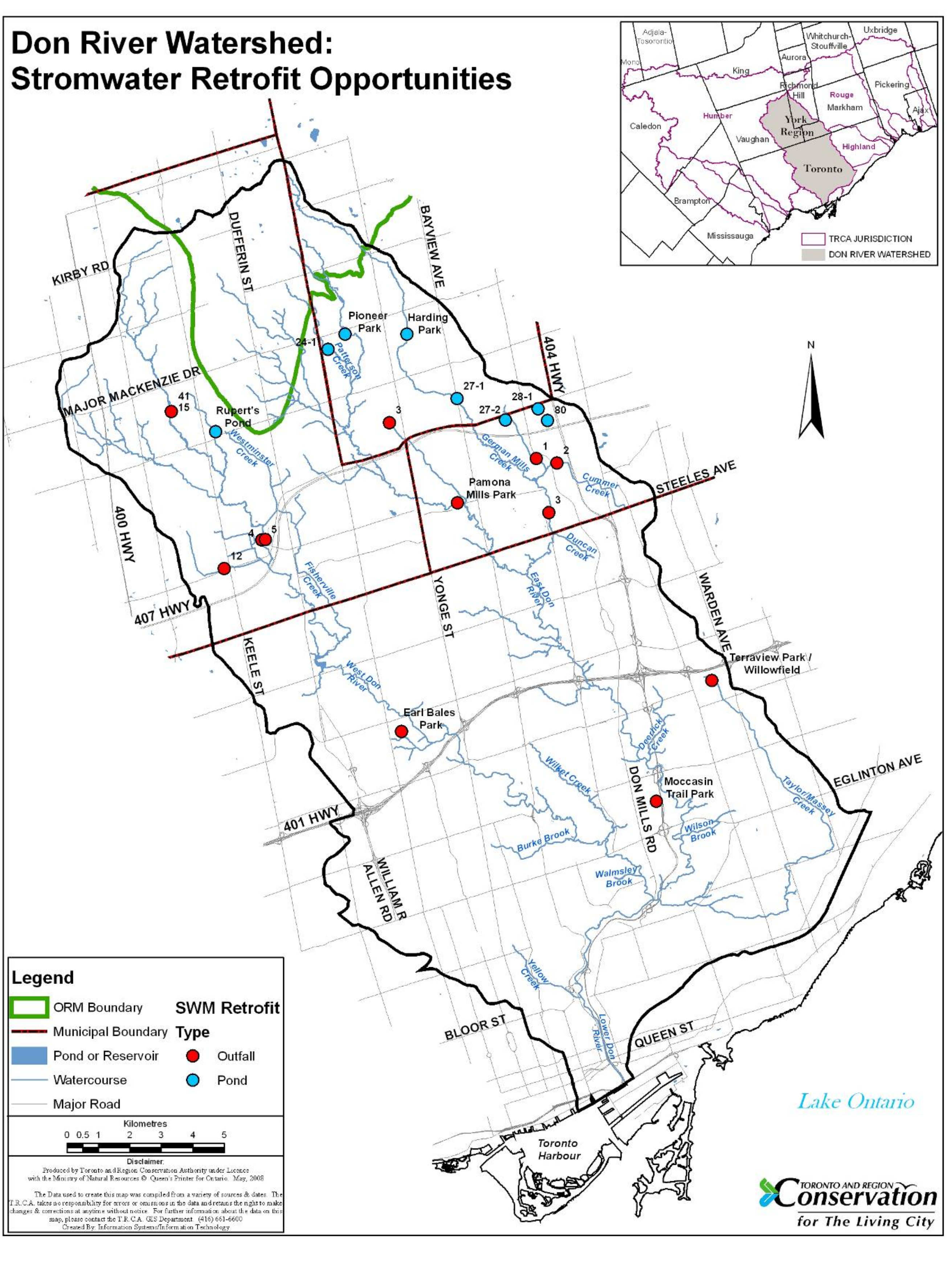


Table 4: Retrofit opportunities based on stormwater retrofit studies by 905 area municipalities.

Municipality	Pond Number	Pond Name	Drainage Area (ha)	Priority Rank*
Richmond Hill	17-2	Pioneer Park	26	4/12
Richmond Hill	24-1	Don Head West	48	7/12
Richmond Hill	27-1	Doncrest	83	8/12
Richmond Hill	28-1	Beaver Cr. Pond B	85	6/12
Richmond Hill	27-2	Beaver Cr. Pond A	80	5/12
Markham	80	Leitchcroft Fram Pond 2	46	4/10

* Priority ranks are as listed in the reports identified in Section 5.0, and were not normalized across the reports.

Table 5: New potential pond locations based on stormwater retrofit studies by 905 area municipalities.

Municipality	Outfall Number	Outfall Location	Drainage Area (ha)	Priority Rank*
Richmond Hill	3	Pearson Ave	46.7	12/12
Markham	1	Green Lane and Leslie St.	18	Not Ranked
Markham	2	Summerdale Dr. and 14th Lane	10.3	Not Ranked
Markham	3	Bercy (Wycliffe) Park	31	Not Ranked
Vaughan	12	Hwy. 7 and Keele St.	24	10/20
Vaughan	15	Lancer Dr.	7	11/20
Vaughan	4	Ortona Cres.	7	13/20
Vaughan	41	Greenock Dr.	7	15/20
Vaughan	5	Hwy. 7 and North Rivermede Rd.	10	20/20

* Priority ranks are as listed in final reports identified in Section 5.0, and were not normalized across the reports.

Stormwater retrofit studies in the Don watershed are not limited to these municipal studies however, and specific retrofit opportunities were presented in the 1994 *Forty Steps to a New Don* report, and are also a component of the City of Toronto's *Wet Weather Flow Management Master Plan*.

Forty Steps to a New Don identified a number of facilities which would benefit from retrofits (Table 6) throughout the 416 and 905 regions of the watershed.

Table 6: Completed and in-progress stormwater pond retrofits.

Location	Subwatershed	Municipality
Earl Bales Park	Lower West Don River	Toronto
Harding Park	German Mills Creek	Richmond Hill
Moccasin Trail Park	Lower East Don River	Toronto
Pamona Mills Park	Upper East Don River	Markham
Pioneer Park	Upper East Don River	Richmond Hill
Rupert's Pond	Upper West Don River	Vaughan
Terraview Park / Willowfield Park	Taylor/Massey Creek	Toronto

Earl Bales Park

TRCA studies had identified Earl Bales Park as a retrofit opportunity, which was ultimately included the City of Toronto's WWFMMP. Currently in its design stage, Earl Bales will incorporate natural channel rehabilitation into an endof pipe retrofit (Figure 12). There are three stormwater sewer outfalls located in the Earl Bales Park drainage area, which is approximately 550 ha. These discharges have created extensive erosion, putting municipal infrastructure at risk. The EA and Preliminary Design are in final stages of completion, with various options evaluated and public information sessions held. The final design will Improve water quality in the Don River by treating storm runoff from Storm sewer discharges, and stabilize ravines negatively Impacted by storm sewer discharges in the Earl Bales Park area.

Figure 12: Earl Bales Park Retrofit (Example, Option 4).

Harding Park

Identified in *Forty Steps*, the Harding Park retrofit is now complete. There were two existing ponds in Harding Park, which provided quantity controls only. As well as both aquatic and terrestrial planting, these ponds were enhanced to provide water quality control.

Moccasin Trail Park

Identified in *Forty Steps*, the Moccasin Trail Park retrofit is now complete.

Pamona Mills Park

The objectives of the Pamona Park retrofit are to identify, prioritize, and implement specific regeneration projects that will result in measurable improvements in the Don River. The stormwater improvements include water quality and quantity treatment enhancements, and on-site detention to reduce streambank erosion (**Error! Reference source not found.**). In addition to the stormwater management improvements, barrier removal (**Error! Reference source not found.**) and recreational trail extensions will also be implemented.

Figure 13: Pamona Mills existing fish barrier

Figure 14: Pamona Mills existing erosion scar.

Pioneer Park

Pioneer Park, which is now in its final stages of design, will be implemented at Bathurst and Major Mackenzie Ave. Originally constructed in 1985, which pre-dates water quality requirements, the Pioneer Park on-line stormwater pond had become silted, reducing its capacity and design volumes by as much as 51% (Town of Richmond Hill, 2006). This silting had also caused lower outlet control structure of the pond to be obstructed with silt and debris, rendering it useless. Through a lengthy 10 year process and Class EA, this facility has been retrofitted to have quality control, and increased quantity and erosion control, adding an additional 725 ha of controlled area to the watershed. As well as retrofitting the SWM facility itself, this project brings about additional rehabilitation and naturalization in part of the East Don River, including the removal of a fish barrier.

Rupert's Pond

Identified in *Forty Steps*, the Rupert's Pond retrofit is now complete. This project involved stream naturalization and water quality improvements to the existing detention facility.

Terraview Park / Willowfield Park

Terraview Park was a concept site presented in *Forty Steps*, the first phase of which has been constructed. A headwater park located in heavily urbanized Scarborough, originally had concrete channels lining the watercourse, and was subject to flooding. The retrofit includes downspout disconnection, construction of a sediment basin and naturalization of the stream, with the removal of the concrete lining.

5.2 Wet Weather Flow Management Master Plan for the City of Toronto

In order to restore the natural conditions of rivers and streams in the City of Toronto the development of the City's *Wet Weather Flow Master Management Plan* (WWFMMP), otherwise referred to as 'Toronto's Solution to Pollution' was initiated in 1999. The Master Plan was developed to be implemented with 13 key objectives, under four general categories:

- water quality,
- water quantity,
- natural areas, and
- wildlife and sewer systems.

These objectives provide a framework for overall wet weather flow management, ranging from the reduction or elimination of Combined Sewer Overflows (CSO), to individual downspout disconnection initiatives.

The project is split up into two study areas within the Don River watershed (Figure 15): the Combined Sewer Overflow (CSO) area, largely south of Eglinton Avenue (CH2M Hill and MacViro, 2003); and the separated sewer area (north of Eglinton) (MMM, 2003). This discretization is primarily due to the difference in management objectives and approaches.

In the initial stages of the WWFMMP, a variety of management techniques and stormwater technologies were explored which may be applied in various circumstances in the control of wet weather flows. These can generally be categorized as source controls, conveyance controls, and end-of-pipe controls. More than 100 techniques and technologies were standardized and documented into a "Blue Book" (City of Toronto, 2003a). The Blue Book allows for comparisons of technologies and also to evaluate equivalencies.

Within the WWFMMP targets were developed to assess the impacts of these technologies at 20 locations in the Don River within the City of Toronto from Steeles Avenue down to Lake Ontario. Three levels of targets were established which represent maintaining the status quo in the watershed, achieving moderate levels of enhancement, and achieving significant levels of enhancement (i.e., meet PWQO at all times).

To evaluate the effects of alternative strategies, a watershed based hydrologic model was used (HSPF), which allows for evaluation of both water quality and quantity parameters. To address the spatial distribution of runoff controls, a "unit response function" (URF) method was developed. The URF method established a set of representative test catchments covering the range of land uses found within the watershed. These test catchments were then assigned "unit response functions" which represented the hydrologic response and water quality response of the area to a predetermined set of meteorological inputs.

5.2.1 The Preferred Strategy and Implementation Plan

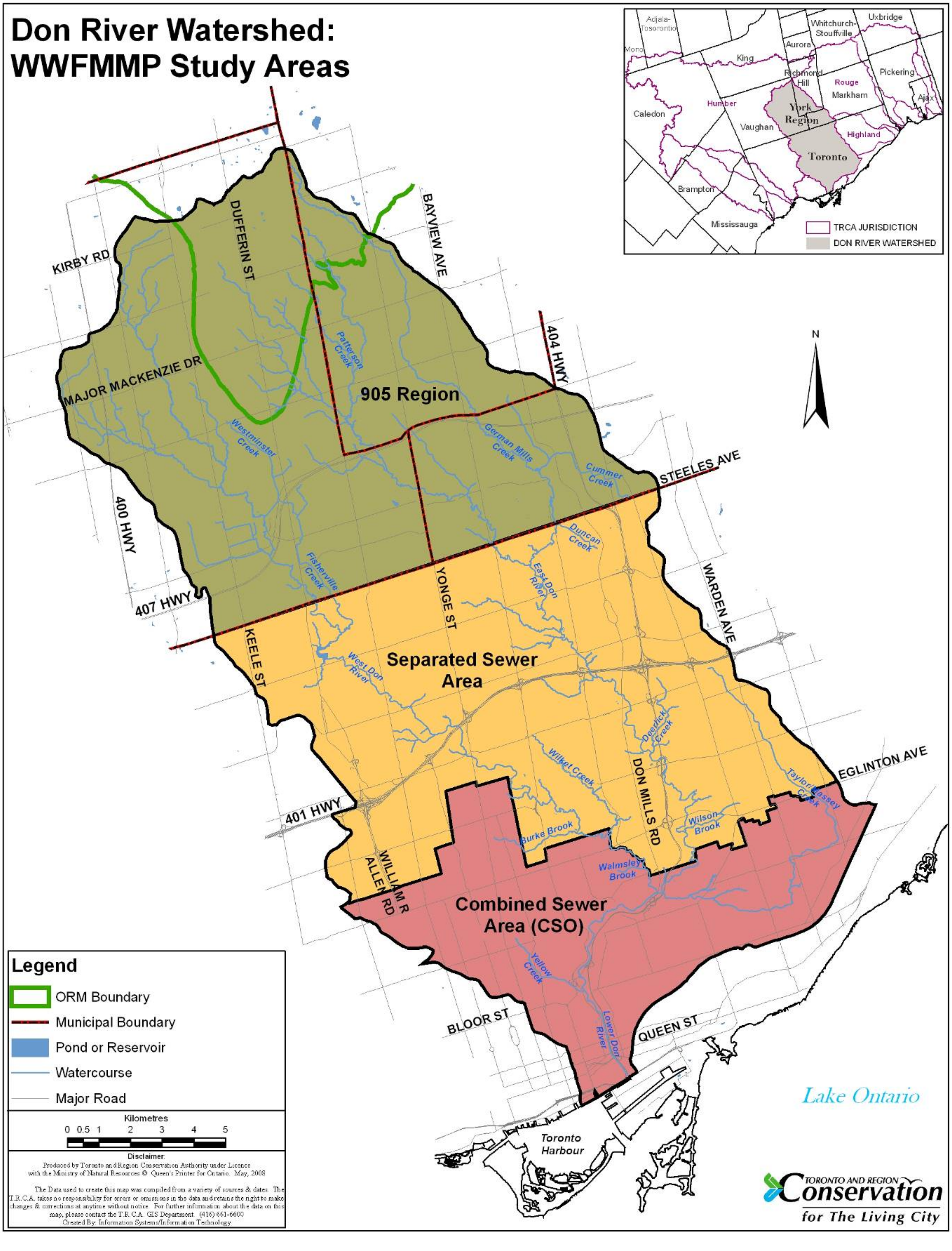
It was concluded that the Preferred Strategy should consist of a long term plan to achieve significant levels of environmental enhancement. A Long Term Preferred Strategy plan (100 year) and a 25 year implementation plan were developed based on the City of Toronto's budget and corporate priority expectations. The 25 year plan (City of Toronto, 2003b), which is the first phase of the Long Term Preferred Strategy, includes the following stormwater components:

- 108,000 downspouts to be disconnected,
- 27,000 rain barrels to be installed,
- 120 km of exfiltration systems to be installed under public roadways as road and sewer infrastructure is replaced,
- 43 stormwater management facilities to be constructed, and
- Inline storage and weir adjustments to reduce or eliminate CSOs.

Added to these specific components, enhanced municipal operations will be undertaken; and public education / outreach programs and an environmental monitoring program will be initiated.

From the initial phases of this study, it was concluded that implementation of the 25 year plan would result in incremental improvements in water quality, stream flows and geomorphology. It is expected to result in significant reductions in basement flooding and aesthetic problems, as well as significantly improved stream and riparian habitats.

Figure 15: Wet Weather Flow Management Master Plan study areas in the Don River watershed.



The 25 Year Implementation Plan

Currently, in the City of Toronto area of the Don River watershed, a little more than 6% of the area has stormwater control facilities. The long term objective of the WWFMMP is to significantly enhance the amount of controlled areas. To achieve this objective, the implementation components were prioritized from a wide range of variables (Table 7).

Table 7: Implementation of the City of Toronto's Wet Weather Flow Management Master Plan.

Implementation Period	Control Measures (Separated Sewer Area)
Year 1 – 25	Source Controls, Public Education and Community Outreach, Enhanced Municipal Operations and Environmental Monitoring.
Year 1 – 5	Basement Flood Remediation
Year 2 – 15	Construction and Implementation of Stream Restoration Works
Year 3 – 25	Construction of Conveyance Control Measures and End-of-Pipe Facilities

Source: MMM, 2003.

There are currently two implementation strategies proposed for the CSO area of the Don watershed. Although there are specific differences between the two, the major undertakings are the same. One of the key actions of the WWFMMP in the CSO area is the creation of inline storage and weir adjustments in order to eliminate CSOs. By providing additional inline storage within the sewer infrastructure excess stormwater, which would usually mix with sanitary and be flushed to the surface water system, can instead be stored and piped to a treatment facility. This initiative would dramatically reduce the amount of sanitary effluent entering the watercourse.

In addition to the management and mitigation of CSOs, the WWFMMP has determined a priority list of stormwater management facility retrofit opportunities, similar to those discussed in Section 5.0. Included in these retrofits is the upgrade of a large SWM facility in Earl Bales Park. This existing quantity control facility is in the final design stages, expected to increase water quality controlled areas in the Don watershed by approximately 570 ha.

6.0 Management Issues and Considerations

Management recommendations to achieve surface water quantity management objectives include:

- Design review should continue to ensure pre-development recharge / infiltration is maintained in new construction projects. It is especially important in high recharge areas to protect natural cover, use low impact development design and implement state of the art stormwater management that infiltrates clean runoff. See Aquafor Beech (2008) for approaches for achieving pre-development water balance.
- Recharge should be protected and, where possible, enhanced, throughout the watershed during redevelopment and infill development where soil conditions allow and where enhanced recharge will not exacerbate basement flooding.

- Continue the evaluation and development of new stormwater management techniques (e.g., green roofs, bioretention, etc.).
- A key aspect in enhancing the hydrology of the Don watershed is the implementation of stormwater retrofits on existing ponds and facilities. Since such a large portion of the watershed was developed prior to stormwater management, retrofits and upgrades is the best way to reduce flooding, erosion and water quality issues in the Don watershed.
- The TRCA should support and encourage the activities and recommendations made in the WWFMMP for the City of Toronto.
- The effects of climate change should be of concern for new and existing stormwater pond designs. Climate change models predict a higher proportion of precipitation being attributed to severe weather events. These factors can significantly reduce the effectiveness of some stormwater ponds.
- Continue to implement Flood Mitigation Projects.
- Examine urban flooding within the Don watershed, addressing urban flooding issues, such as major/minor system drainage (i.e., outside of the floodplain)

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Appendix A: Known Flood Prone Locations in the Don River Watershed

Upper West Don River Subwatershed		
Flood Vulnerable Site	**Issue**	**Remediation / Action Required**
New Westminster Creek Steeles Ave. to Centre St	Undersized water crossings and conveyance system throughout reach	Comprehensive flood remediation plan including detailed hydraulic analysis and analysis of potential storm water management facilities for upstream areas. Implementation of flood remediation plan.
Vaughan Industrial Area, north of Hwy 7 Keel St. to Hwy 7 bridge over West Don River	Undersized water crossings	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to Keele St., Hwy 7, and CNR crossings. Implementation of study results.
Keele/Langstaff Industrial Area	Undersized water crossings, development in low lying area	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to CNR and Langstaff crossings. Implementation of study results.
CN McMillan Yard	Undersized water crossings, development in low lying area	CN has previously completed flood remediation study for the area which identified preferred options to reduce flood risk on site. Currently a berm has been constructed to ensure site is flood proofed to the 100 year event. For complete Regional protection an additional diversion pipe will be required at the cost of CN and the City of Vaughan.
North Rivermede Industrial Area	Undersized crossing at Connie Crescent, undersized diversion pipe at Hwy 7 resulting in multiple spills	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to Connie Crescent. Implementation of study results.
Barrhill Rd. Residential Area	Undersized Rutherford Rd. crossing in conjunction with on-line pond outlet (Rupert's pond) create enough backwater to spill onto adjacent residential development.	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to Rutherford Rd. crossing in addition to modifications to on-line pond outlet structure. Implementation of study results.
Block 32 Residential Development	Undersized Hwy 400 culvert	Comprehensive flood remediation plan including detailed hydraulic analysis and analysis of potential storm water management facilities for upstream areas. Implementation of flood remediation plan.

Upper East Don River Subwatershed		
Flood Vulnerable Site	**Issue**	**Remediation / Action Required**
Thornridge Area	Low lying area with outdated storm water management upstream. Undersized crossings and conveyance system throughout area.	City of Vaughan currently conducting Thornhill Environmental Assessment for drainage options for entire area. TRCA to continue working with Vaughan for favorable flood remediation plan. Implementation of flood remediation plan.
Walmer Rd from Pemberton Rd. to Weldrick Rd	Undersized crossings at Walmer Rd, Pemberton Rd., and Weldrick Rd.	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to Walmer Rd.,Pemberton Rd., and Weldrick Rd. Implementation of study results.
East Don Mill St. to Kerrybrook Drive	Historical development in low lying areas.	Continue to apply TRCA flood plain management policies in area.

German Mills Creek Subwatershed		
Flood Vulnerable Site	**Issue**	**Remediation / Action Required**
Wycliffe Park	Private recreational development in flood plain.	Continue to apply TRCA flood plain management policies in area.
Don Mills Ditch (Cummer Creek)	Multiple spill area with no upstream storm water management controls, where undersized crossings and conveyance systems pose significant constraints to drainage.	Town of Markham currently conducting Don Mills Ditch Drainage Assessment for drainage options for entire area, including crossing/conveyance options as well a implementation of storm water management controls through out area. TRCA to continue working with Markham for favorable flood remediation plan. Implementation of flood remediation plan.
Red Maple Industrial Area	Historical development in low lying areas.	Continue to apply TRCA flood plain management policies in area.
Observatory Lane	Undersized crossing at Observatory Lane.	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to Observatory Lane. Implementation of study results.
German Mills Creek Weldrick Rd to Church St.	Undersized crossing at Weldrick Rd, Pedestrian Crossing, and Church St.	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to Weldrick Rd, pedestrian crossing, and Church St. Implementation of study results.
German Mills Creek Major Mackenzie Dr. to Palmer Ave.	Undersized crossing at Palmer Ave., in addition to development is low lying areas.	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to Palmer Ave. Implementation of study results, and continue to apply TRCA flood plain management policies in area.
German Mills Creek Spill	Large spill starting at the Elgin Mills / Yonge St intersection, continuing downstream to Crosby St. where undersized crossings and conveyance systems pose significant constraints to drainage.	Town of Richmond Hill completed drainage study in 2005 which outlined recommendations of how to alleviate flooding issues across the area. Recommendations including upgrades to existing crossings and conveyance systems. TRCA to continue working with Town to ensure flood remediation measures are completed.

Lower West Don River Subwatershed		
Flood Vulnerable Site	**Issue**	**Remediation / Action Required**
York University Glendon Campus	Historical development in low lying areas.	Continue to apply TRCA flood plain management policies in area.
Hogg's Hollow Special Policy Area	Historical development in low lying areas.	Continued monitoring through flood warning system, maintenance of flood control channel through site, and apply TRCA flood plain management policies for Special Policy Areas in the area.
Don River Blvd.	Historical development in low lying areas.	Continue to apply TRCA flood plain management policies in area.
Bathurst Jewish Community Centre	Historical development in low lying areas.	Continue to apply TRCA flood plain management policies in area.

Lower East Don River Subwatershed		
Flood Vulnerable Site	**Issue**	**Remediation / Action Required**
North York General Hospital	Development in low lying areas.	Continue to apply TRCA flood plain management policies in area.

Taylor/Massey Creek Subwatershed		
Flood Vulnerable Site	**Issue**	**Remediation / Action Required**
Taylor Massy Spill 1	Undersized CNR crossing, causing extensive backwater spilling onto adjacent residential area.	Flood remediation plan including a detailed hydraulic assessment/feasibility study for crossing improvements to CNR crossing. Implementation of study results.
Taylor Massy Spill 2	Undersized diversion pipe, which causes extensive backwater. Water over topping the diversion pipe continues to flow south, through a residential area to downstream of Lawrence Ave.	Comprehensive flood remediation plan including detailed hydraulic analysis and analysis of potential storm water management facilities for upstream areas. Implementation of flood remediation plan.

Lower Don River Subwatershed		
Flood Vulnerable Site	**Issue**	**Remediation / Action Required**
Port Lands	During Regional event water over tops Keating Channel and floods port lands, in addition to flooding to the east of Don Blvd. from the East Don Lands Spill through Eastern Ave underpass.	TRCA and TWRC (Toronto Waterfront Revitalization Corporation) are currently conducting Don Mouth Naturalization and Port Lands Flood Protection Project Environmental Assessment. Once environment assessment is completed implementation of Preferred Alternative should be conducted.
West Don Lands	Undersized CNR crossing, in conjunction with low lying areas adjacent to the river cause extensive flooding on the west side of the Don from Queen St. south to Lake Ontario.	Implementation of the Lower Don West Remedial Flood Protection Project is ongoing and should be completed late 2008. Currently the proposed additional opening of the CNR crossing has been completed, with the land form under construction.
East Don Lands	Undersized CNR crossing, in conjunction with low lying areas adjacent to the river cause extensive flooding on the east side of the Don from Queen St. south to Lake Ontario.	Implementation of the Lower Don West Remedial Flood Protection Project is ongoing and should be completed late 2008, which will help reduce the amount of flooding in the East Don Lands. Additional flood relief will be provided in once the implementation of the Don Mouth Naturalization and Port Lands Flood Protection Project. Where flooding remains, the Authority will continue to apply TRCA flood plain management policies for Special Policy Area in the area.
Don Narrows	Historical development adjacent to the Don, within the floodplain	Continue to apply TRCA flood plain management policies in area.
Brickworks	Historical development/redevelopment in a low lying area.	Continued monitoring through flood warning system.
North Toronto Sewage Treatment Plant	Historical development in a low lying area.	Continued monitoring through flood warning system.