Regional Municipality of York

UPDATE Water and Wastewater Master Plan

Servicing... for a safe and healthy environment

Unit Rates
Water and Wastewater
Master Plan Update

May 2008

GENIVAR XCG

5830-14

May 6, 2008

Dr. H. Hatami, Ph.D, P.Eng, PMP
Project Manager
The Regional Municipality of York
17250 Yonge Street
Newmarket, ON L3Y 6Z1

Re: Water & Wastewater Master Plan
Unit Rates

Dear Dr. Hatami:

We are pleased to submit our report on the Unit Rates for the Water and Wastewater Master Plan Update. The report summarizes various historical YWS and YDSS reports and data. It also recommends the unit rates to be utilized in the community models of the water and sanitary systems.

Please review the report and we can arrange to discuss your comments.

Yours truly,

GENIVAR Ontario Inc.

Stan C. Holden, P.Eng.
Project Manager

/cl

cc: Mr. George Zukovs, XCG Consultants Ltd.

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Table of Contents

List of Tables

List of Figures

Appendices

1. Introduction

The intent of this working paper is to document the water and wastewater unit rates that will be used for the Master Plan update. The sources of information included previous Region documents and Regional water data collected through SCADA plus data from some of the local municipalities.

The rates for water and wastewater systems will be applied in the assessment of the existing systems and the planning of the future system requirements. Water and wastewater unit rates determination is an important step in the Master Planning process. These rates are applied to the planning forecasts to establish the demands on the water supply and wastewater collection systems. The unit rates have a significant impact on the determination of the infrastructure requirements for the system. Oversizing could result in construction of infrastructure that is not required or operational issues that may result in water quality concerns. Infrastructure that is undersized may cause additional projects to be required soon after a projects completion.

2. Water

2.1 Background

2.1.1 General

The objective of this section is to present a summary of unit water consumption rates that have been presented in previous studies of the larger York Water System (YWS) and the Small Urban System (SUS). Also a brief comparison of rates locally, nationally and internationally are provided for comparison.

2.1.2 Long Term Water Project – July 1997

The Master Plan for Water Supply in 1997 was the first comprehensive water system study for York Region. The study assessed unit water consumption rates, peaking factors and water efficiency measurements to provide a demand forecast from 1997 to 2031.

Unit water consumption rates were developed using the IWR-MAIN software. IWR-MAIN was designed to project municipal and industrial water demands and analyze potential water savings. Using historical data the software could analyse the inputs and forecast the unit rates based on different types of development and estimate the various peaks in water usage.

Maximum day factors were based on historical consumption trends measured in the system. A summary of the rates used in the 1997 study is summarized in Table 2-1.

Table 2-1 1997 Master Plan Unit Rates

Municipality	Unit Consumption Rate (L/ca/d)			Maximum Day Factor
	1995 Actual	2011	2031	
Aurora	332	325	306	1.78
East Gwillimbury	295	278	278	2.5
Georgina	371	331	313	2.42
King	508	493	497	2.79
Markham	371	348	331	1.8
Newmarket	337	320	317	1.58
Richmond Hill	419	409	430	1.8
Vaughan	504	460	457	1.8
Stouffville	415	400	386	1.77

2.1.3 York Long Term Water Project Modelling and Optimization – February 1998

This study was conducted following the 1997 Master Plan to optimize the proposed infrastructure in the York Water System (YWS). The study did not consider the municipalities that were not connected or proposed to be connected to the YWS.

Unit water consumption rates were based on the work completed for the 1997 Master Plan. The previous study determined unit rates based on residential populations whereas the 1998 update proposed separate residential and employment unit consumption rates based on:

- field demand data
- population/employment values
- residential demand is 65% of total; employment 35%
- existing users account for 41% of total demand; growth 59%

Consumption rates of 277 L/ca/d (residential) and 285 L/e/d (employment) were calculated for the 1997 rates. Weighted overall Regional rates for 2031 were estimated using IWR MAIN software. The overall Regional projected rates for residential and employment were 252 L/ca/d and 225 L/e/d, respectively.

2.1.4 Toronto/York Joint Optimization Study – 2004

The City of Toronto and York Region conducted a joint study of the water supply from Toronto to York Region. The 2004 study was originally conducted to consider transmission requirements for the YWS. The original 2004 study was updated in 2005 to consider revised demands and supply alternatives. The unit rates were developed using IWR-Main software and the peaking factors were estimated based on operations data.

For the 2004 study and the 2005 update, the demand criteria were as follows for the 2011 and 2031 scenarios:

- Unit rates for Toronto: residential 246–302 L/ca/d; employment 239-320 L/e/d; York: residential 211–268 L/ca/d; employment 187-262 L/e/d;
- Peaking factors for Toronto: 1.64; York: 1.9.

2.1.5 Long Term Water Project Master Plan Update – April 2004

In this update report, historical consumption rates were determined for each service area for the years 1996 to 2001. The historical rates were initially determined as a combined residential/ employment rate that were used to estimate future separate residential and employment rates using IWR MAIN software and are presented in Table 2-2.

Table 2-2 Water Consumption Unit Rates (L/ca/d) Residential and Employment – 2004 Master Plan Update

Water System	Service Area	Rate Type	2006	2011	2016	2021	2026	2031	2036	Maximum Day Factor
York Water System	Aurora	Res	260	258	252	250	247	244	241	1.8
		Emp	218	214	213	212	211	210	209	
	Holland Landing	Res	193	190	187	185	184	182	181	2.16
		Emp	183	179	177	176	175	174	173	
	Queensville/ Sharon	Res	197	194	191	189	188	186	185	2.16
		Emp	190	186	184	182	182	181	180	
	Markham	Res	285	282	278	274	273	270	270	1.8
		Emp	173	170	169	167	167	166	166	
	Newmarket	Res	212	208	207	206	205	204	203	1.8
		Emp	173	170	169	168	167	166	165	
	Richmond Hill	Res	300	295	291	288	287	284	282	1.8
		Emp	232	228	227	226	225	223	222	
	Vaughan	Res	307	298	291	286	282	278	275	1.8
		Emp	269	267	265	264	263	263	261	
Georgina Water System	Keswick	Res	323	324	321	315	312	299	295	2.3
		Emp	309	309	308	302	300	289	285	
	Lakeshore	Res	276	280	282	283	284	287	283	2.3
		Emp	269	273	276	277	279	282	278	
	Sutton	Res	351	338	300	245	234	226	223	2.3
		Emp	319	306	273	223	214	207	204	
Small Urban System	Ballantrae	Res	123	121	119	118	118	117	116	3.28
		Emp	122	120	119	118	117	117	116	
	King City	Res	283	279	275	272	270	268	266	2.42
		Emp	273	268	265	263	262	260	259	
	Kleinburg	Res	275	270	266	264	262	260	257	2.42
		Emp	253	248	246	244	2443	241	240	
	Mount Albert	Res	259	255	251	249	247	245	243	2.72
		Emp	251	246	244	241	240	239	238	
	Nobleton	Res	242	238	235	232	231	229	227	2.52
		Emp	222	218	216	214	213	212	210	
	Schomberg	Res	178	175	173	171	170	169	167	2.54
		Emp	96	94	94	93	92	92	91	
	Stouffville	Res	274	270	266	264	262	260	257	1.68
		Emp	238	234	231	229	228	227	226	

2.1.6 Servicing Studies

Since the completion of the 2004 Master Plan, a number of servicing studies have been completed for communities as follows:

2.1.6.1 Water Supply for the Community of Stouffville, 2003 and 2006

In 2003, York Region conducted a water supply study for the Community of Stouffville. The Stouffville Master Water Servicing Study reviewed the future needs of the community as the community was expecting significant growth and needed to identify sources for water supply and alternative methods for distribution. This study was used as the basis for the proposed infrastructure examined by the Stouffville Water Supply "Schedule B" Class EA in March 2006.

Demand rates for the Community were based on historical data from 1996 to 2001. The design flow rates were based on the 85 percentile of the historical rates. The year 1999 was used as a base year for assessment as planning information and aerial mapping could be used to assess the extent of development. Residential and non-residential rates were developed, however, institutional demand was considered as residential.

The average day water consumption rates used in this study and the Class EA were 315 L/ca/d for residential and 281 L/ca/d for industrial/commercial lands, with a maximum day peaking factor of 1.71.

2.1.6.2 Water Supply and Storage and Wastewater Servicing Capacity for the Community of Kleinburg-Nashville

In May 2007, York Region completed a Water Supply and Storage Class Environmental Study "Schedule C" for the Community of Kleinburg-Nashville. The Class EA identified the preferred approach to provide water supply and storage capacity to meet the growth needs of the Kleinburg-Nashville community to 2021, as identified in the Kleinburg-Nashville Community Plan (Amendment 601 to the Official Plan of the Vaughan Planning Area).

Historical data for the years 2001-2005 was analyzed to develop the average day demand. This resulted in a combined residential/non-residential rate of 457 L/ca/d. The potential savings from the Water Efficiency program were considered by reducing the consumption rate by 10%. A rate of 412 L/ca/d was used for the projected demands with a maximum day peaking factor of 2.21.

2.1.6.3 Class Environmental Assessment and Water Resource Exploration for Water Supply and Storage in King City

In September 2007, York Region completed a Water Supply and Storage Class Environmental Study "Schedule C" for the Community of King City. The Class EA identified the preferred approach to provide water supply and storage capacity to meet the growth projection needs of King City to 2021, as identified in the 2004 Master Plan Update and the King City Community Plan (Official Plan Amendment 54, January 2000).

The King City Class EA utilized the 2021 water consumption unit rates of 272 L/ca/d for residential and 263 L/ca/d for non-residential, as identified in the 2004 Master Plan Update. The maximum day factor used was 2.4. Population numbers were adjusted to suit the King City Community Plan.

2.1.6.4 Water Resource Exploration for Water Supply to the Community of Mount Albert

In 2007, York Region completed a Water Supply Class Environmental Assessment "Schedule B" for the Community of Mount Albert. The Class EA identified the preferred approach for delivery of additional water supply to service approved planned growth in the Community of Mount Albert.

The Mount Albert Class EA utilized water consumption rates identified in the 2004 Master Plan of 259 to 243 L/ca/d residential and 251 to 238 L/e/d for employment. The unit rates were reduced over the time covered in the Master Plan, higher rates used in earlier years.

2.1.6.5 Class Environmental Assessment for Water Supply for the Community of Schomberg

In March 2006, York Region completed a Water Supply and Storage Class Environmental Study "Schedule B" for the Community of Schomberg. The Class EA was undertaken to confirm water supply and storage capacity needed to support the approved Schomberg Community Plan (OPA#47, 1996; Office Consolidation, 1998). The Class EA identified and provided preliminary detailing for the preferred water servicing alternative.

The Schomberg Class EA report analysed the historical data to develop a future consumption rate. In the analysis of the historical data and the future development types, the report suggested that the York Region average value of 265 L/ca/d was more appropriate than the historical average of 210 L/ca/d as it was considered too low. For the industrial/commercial lands, the rate was based on land area as there are no water limits for employment lands. Demand rates for employment lands – 28 m^3/ha/d for commercial and 25 m^3/ha/d for industrial lands. The maximum day factor applied to the average rates was 2.17.

2.1.6.6 Resource Exploration for Water Supply and Storage to the Community of Nobleton

In 2006, York Region completed a Water Supply and Storage Class Environmental Assessment "Schedule B" for the Community of Nobleton. The Class EA was undertaken to confirm water supply and storage capacity needed to support the approved planned growth of the Community of Nobleton, as identified in the Nobleton Community Plan (OPA 57 to the Official Plan for the Township of King Planning Area). The Class EA identified and provided a design concept for the preferred servicing alternative.

The Nobleton Class EA utilized water consumption rates between 242 to 227 L/ca/d for residential and 222 to 210 L/ca/d for non-residential, as identified in the 2004 Master Plan Update. The unit rates were reduced over the time covered in the Master Plan, higher rates were used in earlier years.

2.1.7 Water Efficiency Master Plan Update

The Water Efficiency Master Plan Update was completed in April 2007. The study was intended to provide a plan for the implementation of water efficiency for the next ten years to maintain the success of the previous study. One of the major outcomes of The 1997 Water Supply Master Plan Study was the recommendation to implement Region-wide water efficiency measures. A savings of 19 million litres per day was forecast at the time. The program consisted of:

- Residential/Commercial Retrofit Program;

- Industrial/Institutional Audit and Capacity Buyback Program;
- Distribution Leakage Reduction Program;
- Broad-scale Public Education; and
- Youth Education.

These measures actually resulted in a sustained water savings of 20.33 million litres per day proving the importance and viability of the Water Efficiency Program.

2.1.8 Other Jurisdictions

Local Municipalities

The Municipalities within York Region have their own consumption criteria. The design rates vary as shown in Table 2-3.

Table 2-3 Local Municipal Design Rates

Municipality	Residential Demand Average Day (L/ca/d)	Employment Demand Average Day (L/m^2)	Maximum Day Factor
Aurora	390	2.56-5.48	1.8
East Gwillimbury	278	N/A	Res 2.2 Emp 1.5
Georgina	454	4-5.5	1.2
King	450	MOE Guidelines	MOE Guidelines
Markham	365	2.56-5.48	Res 2.0 Emp 1.4
Newmarket	300	25-50	2.0
Richmond Hill	365	4-5	1.5
Stouffville	315	281 L/e/day	1.71
Vaughan	450	15	2.0

Some of the rates are based on historical data that may now be out of date. Others are based on the Ontario Ministry of the Environment (MOE) Design Guidelines. It is recommended that York Region discuss the consumption rates with local municipalities to standardize the criteria. The municipalities should not be designing their system beyond the servicing capabilities of the Regional system. While demands within a future development may have higher peaking factor than the community as a whole, the average day demands should be similar to the Region standard.

Regions

The unit rates utilized by some of the neighbouring Regions are shown in Table 2-4.

Table 2-4 Regional Rates

Region	Residential Demand Average Day (L/ca/d)	Employment Demand Average Day
Halton	275	3.4 L/m^2
Peel	300	4-5.5 L/m^2
MOE	450	28 m^3/ha/d
Hamilton	300	260 L/e/d
Toronto	300 – 360	MOE Guidelines

Canada

Residential combined unit rates (2004) for the Canadian provinces and territories from Environment Canada are shown in Table 2-5, see Appendix A.

Table 2-5 Rates Across Canada

Province/Territory	Combined (Res/NonRes) Demand Average Day (L/ca/d)	Residential Demand Average Day (L/ca/d)
Newfoundland	780	501
PEI	569	238
Nova Scotia	546	321
New Brunswick	1384	438
Quebec	848	424
Ontario	481	260
Manitoba	466	219
Saskatchewan	516	303
Alberta	488	271
British Columbia	649	426
Yukon	932	645
Northwest Territories	437	257
Nunavut	134	113
Canada Average	609	329

2.1.9 Summary

York Region conducted two master plans for water supply and one for a water efficiency program. Over the past decade water consumption rates have reduced significantly from 300 - 500 L/ca/d (combined residential and employment) range to the current range around 250 - 450 L/ca/d. The reduction in rates is a result of the water efficiency program, changes to the building code and changes to the type of developments constructed. Depending on the area considered this represents a 10 to 35% reduction in unit consumption.

The comparison of rates locally and nationally indicates that York Region is consistent with the City of Toronto and other regional municipalities. However, York Region has a much lower rate than most areas across Canada.

2.2 Water Consumption Analysis

2.2.1 Approach

The approach in projecting water consumption for this update of the Master Plan was carried as follows:

- provide an understanding of how unit consumption rates have been determined previously;

- provide an understanding of why or what water is consumed in York Region for both residents and businesses (employees);
- assess the historical consumption and understanding how the consumption has changed;
- describe the factors (environment, water restrictions) that may have impacted the historical water consumption data;
- establish a 'base' or starting unit rate for residential and employment for each community/service area and explain the basis of the value;
- predict how the unit consumption will change over the next 30 years and the factors affecting the rate.

Section 2.1 of this report summarizes the reports that have been prepared by York Region to assess water consumption. The background information provides an understanding of how rates have been determined in the past and the current projected rates are for comparison purposes. In previous reports, the software IWR-Main is mentioned as the means of calculating the existing and future unit rates. The Region has not been able to obtain the supporting electronic files used for the rate calculations. The current version of the software requires detailed existing data to more accurately forecast future values. The Region does not currently monitor the type of data required. It is suggested that the Region investigate the software requirements further and initiate programs to record the required data for future Master Plan reports. Water consumption in York Region has generally been defined by 'residential' and employment categories. Residential is defined as domestic use around a dwelling which includes the following housing types: single family, semi detached, row house and apartments. While water consumption across these residential categories can vary dramatically, the consumption is categorized as shown in Figure 2.1.

Figure 2.1 York Region, Residential End Use 2006 (Water Efficiency Master Plan Update)

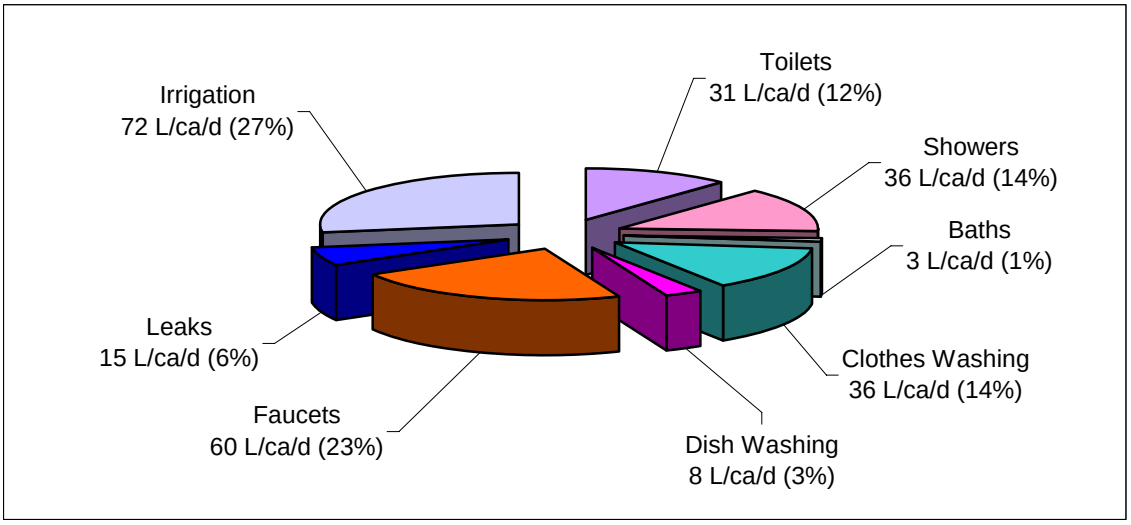

Figure 2.1 indicates that about 70% of the consumption is directly related to domestic use such as toilets, showers and faucets with the remaining largely related to lawn watering.

Employment consumption is further defined as institution (schools), commercial (stores) and industrial (manufacturers). Historically, the industry type in York Region has been defined as 'dry' with limited water consumption for the industrial process. Therefore, employment consumption generally reflects the domestic use consumption occurring within the institution/commercial/industrial facilities.

2.2.2 Historical Consumption Data

Table 2-6 presents historical water consumption data based on historical flow data and population data for the period of 1996 to 2006, as provided by York Region. For most of the communities, the historical average day and maximum day flows were identified by York Region. In the areas of the Region supplied by the City of Toronto, York Region was not able to provide a maximum day value. This means the maximum day peaking factor in Markham, Vaughan and Richmond Hill could not be determined.

Municipal water consumption data categorized by residential and employment was available for the communities of Markham, Vaughan, Richmond Hill, Newmarket, Georgina and Aurora.

Historical unit consumption rates were calculated from the data (flow and population) provided for 2001 to 2006. The data sheets and calculations are provided in Appendix B. Combined residential/employment unit rates were calculated, along with maximum day peaking factors.

The breakdown between residential and employment unit rates was estimated by starting with either the average rate calculated from the municipal billing information, if available, or a 55/45 split of the combined rate as a starting point based on the averages from the billing information. Billing information was received from the communities of Aurora, East Gwillimbury, Georgina, Markham, Newmarket, Richmond Hill, Vaughan and Stouffville. In some cases, the employment rate is higher than the residential. The two rates were adjusted up or down by 2-3 L per attempt until the resultant unit rates multiplied by population and employment numbers equalled the yearly average flow for that community. The rates from years 2001 to 2006 were averaged and the resulting average rate was considered as the 2006 or 'Base' unit rate, see Table 2-7. In some cases, the 'Base' rate was adjusted. The details of these adjustments are discussed in Section 2.3.

Table 2-6 Historical Water Consumption Unit Rates (L/ca/d) (combined rate based on residential population only)

Water System	Service Area	Rate Type	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
York Water System	Aurora	Com	343	345	352	364	336	334	331	323	316	308	323
	Holland Landing	Com	289	289	278	296	267	282	279	278	267	296	287
	Queensville	Com	-	-	-	-	-	212	202	202	202	202	202
	Sharon	Com	311	329	349	326	283	290	286	289	300	286	236
	Markham	Com	375	366	398	388	382	380	379	358	332	348	327
	Newmarket	Com	330	340	343	343	320	328	333	332	331	333	326
	Richmond Hill	Com	381	384	390	420	372	374	384	357	342	358	344
	Vaughan	Com	486	510	508	578	502	500	469	440	435	441	438

Table 2-6 Historical Water Consumption Unit Rates (L/ca/d) (combined rate based on residential population only)

Water System	Service Area	Rate Type	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Georgina Water System	Keswick	Com	357	338	302	306	294	296	295	288	274	283	284
	Sutton	Com	405	395	393	406	396	348	365	380	396	406	296
Smaller Urban System	Ballantrae	Com	-	74	147	182	191	238	243	247	245	296	227
	King City	Com	379	406	405	428	355	364	361	351	328	366	327
	Kleinburg	Com	324	346	361	405	367	440	454	486	458	485	491
	Mount Albert	Com	248	272	298	300	277	290	277	284	299	303	269
	Nobleton	Com	308	319	342	378	324	341	366	297	339	312	303
	Schomberg	Com	253	271	317	306	340	322	372	376	422	419	362
	Stouffville	Com	375	364	382	373	327	330	336	331	335	350	366

Com – Combined Residential/Employment rate

Table 2-7 Adjusted Historical Water Consumption Unit Rates (L/ca/day) Residential and Employment

Water System	Service Area	Rate Type	2001	2002	2003	2004	2005	2006	Average
York Water System	Aurora	Res	239	239	237	243	250	237	241
		Emp	249	254	254	252	253	247	252
	Holland Landing	Res	230	230	230	230	230	230	230
		Emp	230	230	230	230	230	230	230
	Queensville	Res	155	150	143	140	135	132	143
		Emp	120	114	113	108	105	98	110
	Sharon	Res	239	238	241	228	235	192	229
		Emp	225	222	224	215	220	178	214
	Markham	Res	255	256	240	225	240	223	240
		Emp	228	227	219	204	206	202	214
	Newmarket	Res	233	233	221	225	232	228	229
		Emp	197	201	197	196	198	197	198
	Richmond Hill	Res	267	273	253	242	253	245	256
		Emp	257	268	254	239	233	225	246
	Vaughan	Res	284	284	276	269	282	274	278
		Emp	307	289	278	277	279	268	283
Georgina Water System	Keswick	Res	319	305	294	271	280	271	290
		Emp	277	265	255	235	243	235	252
	Sutton	Res	259	244	251	257	266	256	256
		Emp	279	264	272	278	288	276	276
Smaller Urban System	Ballantrae	Res	225	215	222	209	243	223	223
		Emp	220	206	218	188	227	189	208
	King City	Res	267	273	253	242	253	245	256
		Emp	257	268	254	239	233	225	246
	Kleinburg	Res	343	348	371	341	343	366	352
		Emp	316	321	344	317	313	323	322
	Mount Albert	Res	242	215	214	206	214	193	214

Table 2-7 Adjusted Historical Water Consumption Unit Rates (L/ca/day) Residential and Employment

Water System	Service Area	Rate Type	2001	2002	2003	2004	2005	2006	Average
		Emp	220	202	199	191	196	180	198
	Nobleton	Res	273	289	265	259	248	249	264
		Emp	228	238	221	214	207	213	220
	Schomberg	Res	190	185	203	221	240	215	208
		Emp	170	165	175	196	212	191	184
	Stouffville	Res	262	262	254	254	271	290	266
		Emp	229	229	222	220	237	253	232

2.2.3 Projected Rate Changes

Changes to the unit water consumption rates can be expected but are sometimes difficult to assess. The significant change in rates in York Region has been due to cost (water rate increases), metering, plumbing code and the Water Efficiency Program. Going forward some of the previous changes will continue to affect consumption but likely to a lesser extent. However, changes due to the Water Efficiency Program are expected. The Region is committed to mitigating the impact of climate change through demand and capacity planning and the design and operation of water and wastewater services.

The Water Efficiency Master Plan was briefly discussed in Section 2.1.7 in terms of the history of the program in York Region. The Master Plan also provided an ongoing program for York Region to implement identified water saving that could be realized.

An overall future savings of 23.4 million litres per day has been estimated using the 2006 average day demand of 320 million litres as a starting point. The savings are projected to occur between 2009 to 2018 and are conservatively estimated to be 7% of total consumption for the period. Additional potential savings have not been included in the calculation, although AWWA estimates up to 4 to 5% reduction in usage could be recognized due to public education about water use reduction.

The savings are to be monitored to ensure the savings are maintained. The Water Efficiency Master Plan recommended audits in years 3, 6, and 10 to observe if installed devices are still in use and operating properly.

On the basis of the findings of the Water Efficiency Master Plan a 7% reduction was applied to the base rate over the 10-year period to 2016. Since this reduction is not expected on new growth, it was not applied in the East Gwillimbury communities of Holland Landing, Sharon and Queensville where significant growth is expected.

Climate change may impact water consumption. There is no firm consensus on how climate change may influence water consumption rates, however, climate change can be expected to produce extremes in weather from heavy rainfall to dry or drought like conditions. These conditions would impact the need for irrigation (lawn watering) which as mentioned can amount to about 27% of the unit consumption rate. It is recommended that York Region mitigate the impact of climate change through demand and capacity planning and the design and operation of water and wastewater services.

2.3 Projected Water Consumption

2.3.1 Consumption Rates

The Projected Water Consumption Rates have been determined for each service area/community and presented in Table 2-8.

The maximum day peaking factors for each community/service area were based on the historical data. Where the data was unreliable due to water restrictions or major changes proposed in the community population, the peaking factor was chosen based on similar communities. Separate unit rates for residential and employment have been determined for all communities based on actual data available from Markham, Vaughan, Newmarket, Georgina and Aurora.

The maximum day factors for each community are shown in Table 2-8 and discussed in Section 2.3.1.

The projected rates are lower than shown in the 1997 and 2004 water master plans, considering a decrease in water consumption due to implementing water use reduction programs, such as Water for Tomorrow, which are assumed to be continued in the future
The presented data will be used for planning of the proposed and new infrastructure facilities. They are not used for allocation purposes as the allocation is a function of the capacity of the existing infrastructure facilities. Please note that the reduction in water consumption reduction is contingent upon the implementation of Water Efficiency program.

Table 2-8 Projected Water Consumption Unit Rates (L/ca/d)

Water System	Service Area	Rate Type	Base	2031	2036	Maximum Day Factor
York Water System	Aurora	Res	241	224	224	1.8
		Emp	252	234	234	
	Holland Landing	Res	229	229	229	1.8
		Emp	198	198	198	
	Queensville	Res	229	229	229	1.8
		Emp	198	198	198	
	Sharon	Res	229	229	229	1.8
		Emp	198	198	198	
	Markham	Res	240	223	223	1.8
		Emp	214	199	199	
	Newmarket	Res	229	213	213	1.8
		Emp	198	184	184	
	Richmond Hill	Res	256	238	238	1.8
		Emp	246	229	229	
	Vaughan	Res	278	259	259	1.8
		Emp	283	263	263	
Georgina Water System	Keswick	Res	290	270	270	2.1
		Emp	252	234	234	
	Sutton	Res	256	238	238	2.1
		Emp	276	257	257	

Table 2-8 Projected Water Consumption Unit Rates (L/ca/d)

Water System	Service Area	Rate Type	Base	2031	2036	Maximum Day Factor
Smaller Urban System	Ballantrae	Res	223	207	207	2.9
		Emp	208	193	193	
	King City	Res	256	238	238	2.4
		Emp	246	229	229	
	Kleinburg	Res	352	327	327	2.5
		Emp	322	300	300	
	Mount Albert	Res	214	199	199	2.8
		Emp	198	184	184	
	Nobleton	Res	264	245	245	2.5
		Emp	220	205	205	
	Schomberg	Res	276	257	257	2.1
		Emp	401	373	373	
	Stouffville	Res	266	235	235	2.0
		Emp	232	205	205	

A discussion of each community follows.

2.3.1.1 Aurora

The 'Base' rates for Aurora are 241 and 252 L/ca/d for residential and employment, respectively. These values represent the average value for the past five years during which there has not been a significant deviation. The maximum day peaking factor has ranged from 1.4 to 1.7. It is recognized that Aurora has been subject to water restrictions (Stage 1) and water bans (Stage 2) at times throughout the summers of 2001 to 2006. It is believed the maximum day factor has been impacted by the water restriction in Aurora as in Newmarket. A maximum day factor of 1.8, which would be consistent with larger urban areas like Markham and Vaughan, is recommended. Also, it is recognized that in 2008 there will be additional water supply available in Aurora and York Region may not need to impose water restrictions. Without the restrictions the question remains whether the unit rates and/or the maximum day factor would increase.

2.3.1.2 Holland Landing / Queensville / Sharon

These three communities are planned to grow into a large urban area, larger than Newmarket to the south. Current water consumption rates are, therefore, not considered to be representative of the future. The 'Base' rates are recommended as 229 L/ca/d and 198 L/ca/d for residential and employment, respectively. These rates are generally representative of the large urban areas like Newmarket and Markham. Reduction of these rates is not recommended as noted in Section 2.2.3.

2.3.1.3 Markham / Richmond Hill / Vaughan

The 'Base' rates for residential and employment for these three large service areas have been based on the average rates of 2001 to 2006. While the maximum day factor was not available for these areas, information from previous master plan studies confirms a rate of 1.8.

2.3.1.4 Newmarket

The 'Base' rates for Newmarket have been based on the average rates for 2001 to 2006. The maximum day factor over this period was an average of 1.4 (range of 1.2 to 1.5). Similar to the reasons for Aurora, the recommended maximum day factor is 1.8.

2.3.1.5 Keswick

The 'Base' rates for Keswick have been based on the average rate for 2001 to 2006. The average maximum day factor is 1.9 but was increased to 2.1 to be consistent with the nearby communities (i.e. Sutton).

2.3.1.6 Sutton

The 'Base' rates for Sutton are based on the average rates for 2001 to 2006. The maximum day rate is 2.2 but was reduced slightly to be more inline with the lower rate of Keswick.

2.3.1.7 Ballantrae-Musselmans Lake

The 'Base' rates for Ballantrae-Musselmans Lake are based on the average rates for 2001 to 2006 with population numbers based on serviced homes not total population. The water supply system in these communities was developed in the mid 1990s and put in service in 1997. The data indicates a gradual increase in the unit consumption rate. The community was originally serviced by private wells then changed to the municipal system. New developments that have occurred since 1997 are on the municipal system but some prior houses may be still using the private wells (irrigation or irrigation and domestic) which affect the assessment of the historical data. The 'Base' rates are consistent with Markham since most of the new development is estate type of residential. The maximum day factor is 2.9 which is consistent with smaller communities like Kleinburg, Mount Albert and King City.

2.3.1.8 King City

The 'Base' rates for King City have been is based on the average for 2001 to 2006. The maximum day factor is 2.4.

2.3.1.9 Kleinburg

The community of Kleinburg has experienced steadily increasing unit consumption. York Region has assessed the rapid increase and identified irrigation (lawn sprinklers) as the primary reason for the increase. Efforts have been made to control the increase in unit consumption. It is recommended 'Base' rates for the community be slightly greater than the average with a maximum day factor of 2.5. In setting these values, the following has been considered:

- The average is less than the actual value for the last three years.
- New development in the community is expected to be higher density than the existing estate residential.
- The Kleinburg system is proposed to be connected to the YWS which in the interim will be more forgiving of the rate.

- Setting a too high unit rate with a high maximum day peaking factor can result in oversizing facilities (i.e. storage) which could lead to water quality concerns.

2.3.1.10 Mount Albert

The 'Base' rates in Mount Albert have been based on the average rates for 2001 to 2006. The maximum day factor is 2.8 which is consistent with the values calculated in other smaller communities.

2.3.1.11 Nobleton

The 'Base' rates in Nobleton have been based on the average rates for 2001 to 2006. The maximum day factor of 2.5 is the highest experienced over the same period.

2.3.1.12 Schomberg

Schomberg has experienced a steady increase in the unit consumption rate over the last 10 years. Using the calculation based on the average historical resulted in a unit rate lower than anticipated by the recent EA. The recommended 'Base' rate was calculated using the findings from the recent EA. The average day demand was split approximately 40/60 res/emp. Residential population based on the community growth plan, employment based on existing employment planning numbers plus 50 employees/ha for the future employment lands. The calculated rates are 276 L/ca/d and 401 L/ca/d for residential and employment, respectively. The employment rate is higher than the other communities as the existing and proposed industries in Schomberg are more 'wet' than the typical industries within the Region. The maximum day factor is 2.1 which is consistent with similar communities.

2.3.1.13 Stouffville

The 'Base' rates in Stouffville are based on the average rates for 2001 to 2006. The maximum day factor is set at the maximum value of 2.0 which has been experienced in the same period.

2.3.2 Diurnal Demand Pattern

Each community has its own unique daily usage pattern. Normally for residential areas, there is relatively low usage at night, increased usage during the early morning hours, decreased usage during the middle of the day, and finally, increased usage again in the early evening as people return home. Commercial and industrial areas can have patterns unique to their type of business. Some industries can have constant usage for the entire day if the factory runs on shifts and never closes or they may have a process that only runs for a few hours resulting in a pattern that is constant for most of the day and a very large peak during the process time. Diurnal demand curves in the InfoWater model for each pressure district were developed for the 1997 Master Plan and updated in the 2004 JOS report. The diurnal curves are presented in Appendix C.

2.4 Summary

Based on the analysis presented in this Working Paper, the following conclusions and recommendations are made with regard to the water system unit consumption rates:

1. Water unit consumption rates for residential and employment populations for each community have been determined based on historical rates over the last six years. For some communities the starting or 'Base' rate for this study has been adjusted for reason particular to the community.
2. Separate unit rates for residential and employment have been determined for all communities based on actual data available from Markham, Vaughan, Newmarket, Georgina and Aurora.
3. The unit rates vary over time in recognition of the impact of Water Efficiency Program which will be continued by York Region.
4. The maximum day factors for the water rates have been based on the historical data for each community. Some adjustments to the factors were made where insufficient or erroneous data existed.
5. For the York Water System, diurnal patterns currently available for the InfoWater model will continue to be applied.

3. Wastewater

3.1 Background

3.1.1 General

The objective of this section is to present information on unit wastewater generation rates that have been used in previous studies. Over time, York Region and local municipalities have adopted different approaches for the design of the YDSS (including the Duffin Creek WPCP) and small urban systems (collection and treatment). Differing approaches have been adopted to recognize the different nature of the YDSS and the small urban systems. The following sections summarize the unit rates used previously in the design of the YDSS and small urban systems.

3.1.2 YDSS and Duffin Creek WPCP

Unit wastewater generation rates used in previous studies of the YDSS and Duffin Creek WPCP are summarized in the following sections.

3.1.2.1 Original YDSS

The YDSS was first constructed by the Province of Ontario in the late 1970s and early 1980s to eliminate the environmental impacts associated with several sewage treatment plants discharging to local rivers and to address the needs of proposed development in York and Durham Regions. The York Region communities originally serviced by the YDSS included the local municipalities of Newmarket, Aurora, Richmond Hill, Vaughan and Markham. Table 3-1 presents the original unit wastewater generation rates used to size the YDSS. This information was documented in the 1997 YDSS Master Plan.

Table 3-1 YDSS Original Unit Wastewater Generation Rates

Parameter	Unit Wastewater Generation Rate
Average Residential Sanitary Flow (excluding dry weather infiltration)	368 L/ca/d (81 gpcd)
Average Non-Residential Sanitary Flow (including dry weather infiltration)	42,690 L/ha/d (8,100 gpad)
Residential Areas I/I Allowance for Vaughan, Markham and part of Richmond Hill added to average flows	0.05 L/s/ha (400 gpad)
Residential Areas I/I Allowance for Newmarket, Aurora, and part of Richmond Hill added to average flows	0.08 L/s/ha (600 gpad)
Residential Areas I/I Allowance for Vaughan, Markham and part of Richmond Hill added to peak flow	0.24 L/s/ha (1,800 gpad)
Residential Areas I/I Allowance for Newmarket, Aurora, and part of Richmond Hill add to peak flow	0.33 L/s/ha (2,500 gpad)
Average Non-Residential Sanitary Flow (excluding dry weather infiltration)	42,690 L/ha/d
Non-Residential Areas Peak Flow including wet weather I/I	1.05 L/s/ha (8,100 gpad)
Dry Weather Peaking Factor	Harmon

The values presented in Table 3-1 were used to calculate expected average and peak flows into the YDSS in the original design.

3.1.2.2 1997 Master Plan

In 1997, York Region completed the York-Durham Trunk Sewer System Master Plan Class Environmental Assessment. As part of the study, a comprehensive analysis of flow data collected at York Region's permanent metering sites was completed to develop unit wastewater generation rates. Table 3-2 summarizes the rates developed.

Table 3-2 1997 Master Plan Unit Wastewater Generation Rates

Parameter	Unit Wastewater Generation Rate
Residential Wastewater Flow	265 L/ca/d
Non-Residential Wastewater Flow	160 L/e/d
Dry Weather Peaking Factor	Harmon
Dry Weather Extraneous Flow	0.02 L/s/ha (1,800 L/ha/d)
Peak Extraneous Flow Factor	$(1+120A^{-0.162})$ where A is the area (ha)

The comprehensive data analysis included a statistical analysis. The statistical analysis developed a formula to estimate the peak extraneous flow. The flow formula linked tributary area to peak extraneous flow rate which, was assumed to correspond to a rainfall return frequency of approximately 10 to 25 years depending on the location in the system. The analysis of flow data was completed with approximately 5 years of flow data collected at permanent metering stations in the system. This approach for the peak extraneous flow estimation was revisited and modified in 2003.

3.1.2.3 2003 Master Plan Update

In 2003, York Region completed the YDSS Master Plan Update Study. For the 2003 Update, more effort was dedicated to determine how each area of the YDSS performed. The study

involved greater use of available flow records and modelling to more accurately define infiltration and inflows into the system. It was recognized that peak infiltration and inflow periods corresponded to the highest flow periods in the YDSS. The analysis completed included the development, calibration and validation of a model to predict conditions in the YDSS. The model was calibrated and validated with flow data collected between 2000 and 2002 in the YDSS. Unit rates for infiltration and inflow were derived from calibrated model results using a 25 year design storm as input into the model. Table 3-3 presents the 2003 Master Plan Update unit wastewater generation rates.

Table 3-3 2003 Master Plan Update Unit Wastewater Generation Rates

Parameter	Value
Residential Wastewater Flow	265 L/ca/d
Non-Residential Wastewater Flow	160 L/e/d
Dry Weather Peaking Factor	Harmon
Extraneous Dry Weather Flow	0.01 L/s/ha (900 L/ha/d)
Peak Infiltration / Inflow Value – Vaughan	0.29 L/s/ha
Peak Infiltration/ Inflow Value – Richmond Hill	0.50 L/s/ha
Peak Infiltration / Inflow Value – Markham	0.29 L/s/ha
Peak Infiltration/ Inflow Value – Aurora	0.31 L/s/ha
Peak Infiltration / Inflow Value – Newmarket	0.50 L/s/ha
Peak Infiltration / Inflow Value – Boundary Meter	0.29 L/s/ha

These values were used to evaluate the performance of the YDSS system in 2003 and to plan system requirements.

3.1.2.4 Duffin Creek WPCP

Expansion needs at the Duffin Creek WPCP have been assessed as part of the Duffin Creek WPCP Class Environmental Assessment (EA) (2006). The EA study recognized that water use had dropped in both York and Durham Regions from values greater than 400 L/ca/d to (in the 1990s) to a value of 365 L/ca/d (in 2004). The EA developed wastewater flow projections for the Duffin Creek WPCP for three scenarios including a high flow scenario, a moderate flow scenario and a water efficiency scenario. The EA study selected the moderate flow scenario for the purposes of developing flow projections. A value of 409 L/ca/d was used to develop future flow projections. This value includes an allowance for dry weather infiltration.

3.1.3 Small Urban Systems

Since 2003, York Region has completed several Class EA and servicing studies to support facility expansions within the small urban systems. Table 3-4 summarizes the values used for unit wastewater generation rates for both existing and future conditions. In general, wastewater collection systems within the systems are the responsibility of the local municipalities. Wastewater generation rates used by the local municipalities to size wastewater collection systems are presented in Section 3.1.4.

Table 3-4 Existing and Projected Unit Wastewater Flow Generation Rates Used in Class EA and Servicing Studies

Study Area	Residential Unit Flow Rate (L/ca/d)	Non-Residential Unit Flow Rates (L/ca/d)	Peaking Factor	Infiltration Allowance
Existing Service Area				
Schomberg[1]	300	Industrial Specific	1.84 (from existing data)	Included in Residential Unit Flow Rate
Keswick[2]	329[9]	329[9]	1.90 (from existing data)	50-85 L/ca/d
Sutton[3,8]	455[9]	455[9]	1.33 (from existing data)	N/A
Mount Albert[4]	245[9]	245[9]	N/A	N/A
Kleinburg[6]	411[9]	411[9]	2.18 (from existing data)	N/A
Holland Landing[7]	304[9]	304[9]	N/A	N/A
Future Service Area				
Schomberg[1]	365	22.6 m^3/ha/d (Ind.) 28 m^3/ha/d (Com.)	Harmon	Included in Residential and Non- Residential Unit Flow Rates
Keswick[2]	265[9]	265[9]	1.8 (from existing data)	100 L/ca/d
Sutton[3]	455[9]	455[9]	N/A	Included in Per capita Wastewater Flow
Mount Albert[4]	340[9]	340[9]	N/A	Included in Per capita Wastewater Flow
Nobleton[5]	450[9]	450[9]	Harmon	Included in Per capita Wastewater Flow
Kleinburg[6]	383[9]	383[9]	N/A	Included in Per capita Wastewater Flow

Notes:

1. Schomberg WWTP Class EA Study, KMK Consultants, 2004.
2. Keswick WPCP Performance and Capacity Re-evaluation, XCG Consultants, 2004.
3. Addendum to Environmental Study Report for Expansion of Municipal Sewage Treatment Capacity in the Community of Sutton, Azurix, 2001
4. Addendum to Mount Albert WPCP Environmental Study Report, MMM, 2003.
5. Nobleton Sewage Servicing Environmental Study Report, TSH, 2003.
6. Class Environmental Assessment Wastewater Servicing Capacity of Kleinburg- Nashville, KMK Consultants, 2007.
7. Holland Landing Sanitary Sewage Treatment Study, Phase 2 Report, May 1996.
8. Feasibility Study for the Expansion of Municipal Sewage Treatment Capacity in the Community of Sutton, MacViro Consultants Inc., 1991.
9. Combined residential and non-residential per capita wastewater generation rate.

In addition to the above, an EA has recently been initiated for an expansion of the Sutton WPCP. No information is available at this time for this recently initiated EA.

A review of the information provided in Table 3-4 indicates that residential wastewater generation rates used for the planning of the facilities in the smaller urban systems has varied from 365 L/ca/d for Keswick WPCP (includes a 100 L/ca/d allowance for infiltration) and Schomberg WPCP to 450 L/ca/d for Nobleton. In general, rates have been selected based on a

review of historical data at each facility except in Nobleton where a new facility was recommended.

3.1.4 Other Jurisdictions

This section presents information on the unit wastewater generation rates used by local municipalities for the design of wastewater collection systems, as well as unit wastewater generation rates used by other Regional municipalities for the design of wastewater treatment facilities.

3.1.4.1 Local Municipalities

Each local municipality in York Region has defined unit wastewater generation rates for the design of new infrastructure within their systems. Table 3-5 presents a comparison of these rates.

Table 3-5 Local Municipalities – Unit Wastewater Generation Rates

Local Municipality	Residential Land Use	Infiltration Allowance (L/s/ha)	Commercial Land Use	Institutional Land Use (L/s/ha)	Industrial Land Use (L/s/ha)
King Township	450 L/ca/d	0.2	0.75 L/s/ha	0.75 L/s/ha	Light – 0.41 L/s/ha Heavy -0.64 L/s/ha
City of Vaughan	450 L/ca/d	0.23	0.40 L/s/ha	0.26 L/s/ha	0.50 L/s/ha
City of Richmond Hill	365 L/ca/d	0.26	2.08 L/s/ha	2.08 L/s/ha	2.08 L/s/ha
Town of Markham	340 L/ca/d	0.26	0.13 L/s/ha	1.08 L/s/ha	1.05 L/s/ha
Town of Aurora	400 L/ca/d	0.26	160 L/ca/d	160 L/ca/d	160 L/ca/d
Town of Newmarket	0.0011 m^3/s/ha	0.30	0.58 L/s/ha	2.5 L/s/ha	1.7 L/s/ha
Town of Whitchurch-Stouffville	450 L/ca/d	0.23	0.26 L/s/ha	0.26 L/s/ha	0.26 L/s/ha
Town of Georgina	454 L/ca/d	0.21	2.08 L/s/ha	2.08 L/s/ha	2.08 L/s/ha

In general, the unit wastewater rates selected by the local municipalities reflect the specific nature of each municipality. Residential wastewater generation rates ranged from 340 L/ca/d (Markham) to 454 L/ca/d (Georgina). Values for commercial, industrial and institutional land uses varied significantly as these rates are based on the specific nature of commercial, industrial and institutional development within each local municipality. Peak infiltration allowances ranged from 0.20 L/s/ha (King) to 0.30 L/s/ha (Newmarket). It is important to note that these rates are typically applied for the design of local sanitary sewer systems.

3.1.4.2 Other Regions and MOE

Across Ontario, municipalities have developed and utilized design criteria for wastewater collection systems. In addition, the MOE has provided guidance on design criteria as part of their Design Guidelines. Table 3-6 presents design criteria used by other regional municipalities as well as the MOE Design Guidelines criteria.

Table 3-6 Other Regions Unit Wastewater Generation Rates

Local Municipality	Residential Land Use (L/ca/d)	Infiltration Allowance	Commercial Land Use	Institutional Land Use	Industrial Land Use
Durham Region	364	22.5 m^3/gross floor area 45.0 m^3/gross floor area[1]	180 m^3/ gross floor area	112 m^3/gross floor area	180 m^3/ gross flow area (local sewers) 90 m^3/gross floor area (trunk sewers)
Halton Region	275	0.286 L/s/ha	24.75 m^3/s/ha	11.0 m^3/s/ha	34.375 m^3/s/ha
City of Hamilton	360	(included in per capita flows)	260 L/ca/d	260 L/ca/d	260 L/ca/d
Niagara Region	275	0.286 L/s/ha	24.75 m^3/s/ha	11.0 m^3/s/ha	Special Study required
MOE Design Guidelines	225-450	0.10-0.286 L/s/ha	0.32 L/s/ha	70-140 L/ca/d	0.41 L/s/ha (Light) 0.64 L/s/ha (Heavy)

Note:
1. Higher infiltration allowance for areas with foundation drain connected.

In general, wastewater generation rates for other regional municipalities range from 275 L/ca/d for Niagara Region to 364 L/ca/d for the Region of Durham (not including infiltration). Unit wastewater generation rates used historically in York Region for the design and assessment of treatment facilities and collection systems are within the range of values used by other regional municipalities and the range of values recommended by the MOE Design Guidelines.

3.2 Wastewater Unit Rate Development

Section 3.1 presented a discussion of historical wastewater generation rates used to size the YDSS, Duffin Creek WPCP and the smaller urban system facilities. The historical rates provide an important linkage to understand how wastewater infrastructure sizing has been completed in the past. For this Master Plan Update, it was decided to modify these rates to reflect actual water usage on a community basis. This approach allowed the linkage between water use and wastewater generation to be recognized and also allows the specific nature of each local municipality or system to be considered. For collection systems, unit wastewater generation rates are recommended to generate peak flows as wastewater collection systems are designed to convey peak flows. For treatment facilities, unit wastewater generation rates are selected to generate average day flows as wastewater treatment plants are generally designed to treat average flows although some unit processes within each facility are designed for peak flow conditions.

Notionally, the derivation of wastewater generation rates should recognize the water used, water lost in the system due to leakage and outdoor water use and the water entering the wastewater system from infiltration and inflow. The Water Efficiency Master Plan Update identified that 27% of water demand resulted from irrigation while a further 6% of water demand resulted from leakage. The American Water Works Association (AWWA) completed a comprehensive study of indoor and outdoor water use and concluded that 81.5% of the total water demand was used

for indoor uses in Cities of Waterloo and Cambridge. To define the ratio of water demand to wastewater generated, monthly average 2005 water billing data was compared against wastewater volumes measured at the Region's wastewater treatment facilities. Table 3-7 presents the results of the comparison.

Table 3-7 Comparison of Calculated Water Demands and Observed Wastewater Flows

Month	Average Day Water Used (m3/d)[1]	Average Day Measured Wastewater Flows (m3/d)	Water Demand/ Wastewater Generation Ratio
January	261,720	267,730	1.05
February	273,829	363,762	0.75
March	248,445	325,307	0.76
April	308,300	378,204	0.82
May	287,660	390,824	0.74
June	383,025	263,994	1.06
July	375,844	315,311	1.19
August	400,401	291,465	1.37
September	318,188	309,552	1.03
October	307,530	330,361	0.93
November	262,174	395,367	0.66
December	276,776	306,282	0.90
Yearly Average	310,316	336,439	0.92

Notes: Average Day Water Use from communities with private wastewater servicing excluded.

The results shown in Table 3-7 show that on average water demand accounts for only 92% of the wastewater generated. However, this percentage varies monthly. In the spring months when high infiltration is expected, water demand accounts for between 76% to 82% of wastewater generated. In the summer months when outdoor water use is high, the water demand exceeds the wastewater generated by 106% to 137%. These results are consistent with the findings of the Water Efficiency Master Plan Update

On this basis, it was decided to utilize 100% of the average water demand as the average wastewater generation rate for each system along with an allowance to account for average infiltration. This is a conservative approach when considering the entire year but is reasonable to account for variations in water use and infiltration over the course of a year.

Additional detail on the selection of wastewater system rates for the YDSS and the smaller urban systems is presented in the following sections.

3.3 YDSS and Duffin Creek WPCP Projected Rates

The following sections present the recommended average flow, peak dry weather and infiltration and inflow unit rates for the YDSS and Duffin Creek WPCP.

3.3.1 Average Dry Weather Flow

In keeping with the findings presented in Table 3-7, wastewater generation rates were adopted from the YDSS community based water demand rates presented in Table 2-8. To represent dry weather infiltration and inflow (groundwater infiltration or GWI) into the system, an additional 90 L/ca/d was added for both residential and employment land use. This value is recommended

for treatment plant and major pumping station design in the MOE Design Guidelines. As was noted in the water unit rate discussion in Section 2.2.3, these proposed wastewater generation rates recognize the impact of the York Region's Water for Tomorrow program over time. Table 3-8 presents the recommended wastewater generation rates by community for the period up to 2036 for the YDSS and Duffin Creek WPCP. Note that the presented rates include a dry weather inflow and infiltration allowance of 90 L/ca/d.

Table 3-8 YDSS and Duffin Creek WPCP Future Wastewater Generation Unit Rates (L/ca/d) (Including dry weather infiltration allowance 90 L/ca/d)

Wastewater System	Service Area	Rate Type	2001-2005 Average	2031	2036
YDSS	Aurora	Res	331	314	314
		Emp	342	324	324
	East Gwillimbury	Res	319	319	319
		Emp	288	288	288
	Markham	Res	330	313	313
		Emp	304	289	289
	Newmarket	Res	319	303	303
		Emp	288	274	274
	Richmond Hill	Res	346	328	328
		Emp	336	319	319
	Vaughan	Res	368	349	349
		Emp	373	353	353
	King City	Res	346	328	328
		Emp	336	319	319
	Stouffville	Res	356	325	325
		Emp	322	295	295

Average residential wastewater generation rates for the YDSS and Duffin Creek WPCP system by 2036 range from 303 L/ca/d for Newmarket to 349 L/ca/d for Vaughan. Average employment wastewater generation rates for the YDSS and Duffin Creek WPCP system range from 274 L/ca/d for Newmarket to 353 L/ca/d for Vaughan. It is important to note that these rates include an allowance for average infiltration. The previous 2003 Master Plan utilized a residential wastewater generation rate of 265 L/ca/d and an employment wastewater generation rate of 160 L/e/d along with an infiltration allowance of 1,000 L/ha/d. The wastewater generation rates recommended for this Master Plan Update are higher for some communities than those utilized in the 2003 Master Plan. However, the recommended rates recognize the specific nature of these communities.

3.3.2 Peak Dry Weather Flows

Peak dry weather flows in the YDSS will be calculated based on the average flow and calculated peaking factors. For the YDSS, the InfoWorks model is populated with diurnal patterns that allow the model to replicate the actual diurnal flow patterns observed within the YDSS. These patterns were derived based on the actual measured flows. For future growth scenarios, it is

recommended that the existing diurnal patterns found in the InfoWorks model be applied to the future growth.

3.3.3 Peak Inflow/infiltration Allowance

Inflow and infiltration have been identified as important component of the flow within the YDSS system. York Region has invested significant effort into developing modelling tools to achieve a better understanding of how existing inflow and infiltration contributes to the performance of the YDSS.

It is important to note that inflow and infiltration into existing wastewater conveyance systems within York Region occurs due to the age, condition and nature of existing infrastructure. Any new infrastructure will be designed and constructed in accordance with current municipal standards.

An average infiltration and inflow allowance has been included in the average wastewater generation rates presented in Table 3-8. However, these rates do not account for peak infiltration and inflow that can enter the YDSS.

For the YDSS, it is recommended that the InfoWorks model continue to be used to generate existing peak infiltration and inflows. Details of wet weather flows generated within existing developed areas will be documented within the InfoWorks Model Development Technical Memorandum. For new development areas, it is recommended that the YDSS target infiltration and inflow allowance of 0.26 L/s/ha be adopted. This rate of 0.26 L/s/ha has been adopted as part of the South East Collector IEA and is representative of an achievable target rate for infiltration and inflow for new development areas.

York Region has recently initiated an Inflow and Infiltration Reduction Program, in coordination with the South East Collector IEA, that will focus on understanding, communication, cooperation and investment to ensure that inflow and infiltration is managed to a level currently achievable through industry best practices.

3.4 Smaller Urban System Facilities

The following sections present the recommended average flow and average infiltration and inflow unit rates for the smaller urban system facilities.

3.4.1 Average Day Flow

Similar to the YDSS, average unit wastewater generation rates for the smaller urban systems were calculated on a community basis. For residential development, an average infiltration and inflow allowance of 90 L/ca/d was added to the community based residential water demand rates to calculate the wastewater generation rates. The community based water demand rates, shown in Table 2-8, consider the impact of the York Region's Water for Tomorrow program over time. Table 3-9 presents the proposed wastewater generation rates for the smaller urban system facilities by community for the period up to 2036.

Table 3-9 Smaller Urban System Facilities – Future Wastewater Generation Unit Rates (includes dry weather infiltration allowance 90 L/ca/d) (L/ca/d)

Wastewater System	Service Area	Rate Type	Base	2031	2036
Keswick WWTP	Keswick	Res	380	360	360
		Emp	342	324	324
Sutton WWTP	Sutton	Res	346	328	328
		Emp	366	347	347
Kleinburg WWTP	Kleinburg	Res	442	417	417
		Emp	412	390	390
Mount Albert WWTP	Mount Albert	Res	304	289	289
		Emp	288	274	274
Nobleton WWTP	Nobleton	Res	354	335	335
		Emp	310	295	295
Schomberg WWTP	Schomberg	Res	366	347	347
		Emp	491	463	463

Average residential wastewater generation rates for the smaller urban systems in 2036 range from 289 L/ca/d for Mount Albert to 417 L/ca/d for Kleinburg. Average employment wastewater generation rates for the smaller urban systems range from 274 L/ca/d for Mount Albert to 390 L/ca/d for Kleinburg. For Schomberg, the Region has previously utilized industry specific unit rates to generate average flows from employment lands to reflect high water use industries. Unit rates shown in Table 3-9 should not be used alone without consideration of specific industry types and land areas.

3.4.2 Inflow/infiltration

For the calculation of average day treatment requirements at treatment facilities, it is customary to adopt an infiltration allowance that represents average flow conditions. The MOE recommends that an infiltration allowance of 90 L/ca/d be utilized to develop average flow projections. This infiltration and inflow allowance has been included in the unit wastewater generation rates presented in Table 3-9.

For peak wet weather infiltration and inflows, the local municipality infiltration and inflow rates were adopted. Table 3-10 presents the recommended peak infiltration and inflow rates. These rates will be used for any new regional trunk sewer infrastructure located within these communities. These rates have been selected to ensure that adequate downstream trunk sewer capacity is provided.

Table 3-10 Smaller Urban Systems Peak Infiltration and Inflow Rates

Smaller Urban System	Peak Infiltration and Inflow Rate (L/s/ha)
Keswick WWTP Sewershed Area	0.21
Sutton WWTP Sewershed Area	0.21
Kleinburg WWTP Sewershed Area	0.23
Mount Albert WWTP Sewershed Area	0.26
Nobleton WWTP Sewershed Area	0.20
Schomberg WWTP Sewershed Area	0.20

Peak infiltration and inflow rates for the smaller urban systems range from 0.20 L/s/ha for Schomberg and Nobleton, located in King Township, to 0.26 L/s/ha for Mount Albert. In general, these rates are marginally higher than the recommended target rate for the YDSS of 0.26 L/s/ha.

3.5 Summary Wastewater Generation Rates

Based on the analysis presented in this Working Paper, the following recommendations are made with regard to wastewater system unit generation rates:

1. Wastewater generation unit rates for residential and employment populations in each community be calculated based on the water consumption rates. These rates vary over time and recognize the impact of the Water for Tomorrow Program.

2. Average wastewater generation rates equal to the average water consumption rates plus 90 L/ca/d for dry weather infiltration for residential and employment populations be adopted for the YDSS and for the smaller urban system treatment facilities. A comparison of average historical water consumed and measured wastewater flows shows that historically annual average wastewater volumes have been higher than average water demand. However, during the spring months, wastewater volumes exceeded water demands by as much as 37%. The adoption of this approach is conservative and recognizes the specific nature of water use and wastewater generation in each community. The adoption of the 90 L/ca/d allowance for dry weather infiltration is considered suitable for the design of wastewater treatment systems.

3. For the YDSS, diurnal patterns currently utilized in the InfoWorks model and developed based on observed data continue to be applied to new growth areas to represent peak dry weather flow conditions.

4. For the YDSS, peak infiltration and inflow rates generated by the calibrated InfoWorks model continue to be used for existing residential and employment development areas.

5. For the YDSS, a peak infiltration and inflow allowance of 0.26 L/s/ha be adopted for use for new development areas. This rate is the target rate for the YDSS. York Region is currently moving forward with a comprehensive Inflow and Infiltration Reduction Program to meet this target rate. The program is focused on understanding, communication, cooperation and investment to ensure that inflow and infiltration is managed to a level currently achievable through industry best practices.

6. For the smaller urban systems, peak infiltration and inflow allowances equal to the local municipality design allowances be adopted for use. These rates range from 0.2 L/s/ha to 0.26 L/s/ha and will be used by the local municipalities to size sanitary sewer infrastructure. These rates will be applied to any regional trunk sewer infrastructure located within these systems.

4. Recommendations

The following recommendations should be considered by the Region for implementation before the next update of the Master Plan:

1. A program should be set up with the Local Municipalities to collect more discrete data on consumption types such as:
    - Residential Low (single family)
    - Residential Medium (townhouses)
    - Residential High (apartments, condominiums)
    - Institutional
    - Commercial Retail (stores)
    - Commercial Office (office buildings)
    - Industrial

    The identification of these individual rates will improve the water consumption understanding and projection.

2. Flow meters should be installed at the storage facilities to aid in the calculation of water usage and peaking factors.
3. A wastewater monitoring program should be set up to establish wastewater generation rates and diurnal patterns for various land use types such as:
    - Residential
    - Commercial
    - Industrial