OMBI
ONTARIO MUNICIPAL CAO'S BENCHMARKING INITIATIVE
PARTNERING FOR SERVICE EXCELLENCE

OCMBP
Ontario Centre for Municipal Best Practices

ONTARIO CENTRE FOR MUNICIPAL BEST PRACTICES

200 University Ave., Suite 801, Toronto, Ontario, M5H 3C6

BEST PRACTICE SUMMARY REPORT

February, 2008

Water and Sewer

GENERAL INFLOW & INFILTRATION MANAGEMENT PRACTICES

The 2007 OMBI business question sought to answer the following questions pertaining to inflow and infiltration:

- Is there a significant difference between OMBI Municipalities in the amount of inflow and infiltration entering the wastewater collection and treatment system?
- What are the estimated annual Operating Costs associated with Inflow & Infiltration entering the wastewater collection and wastewater treatment systems?
- How can the impacts on the natural and built environment related to Inflow and Infiltration be best quantified?
- What options are available to reduce Inflow and Infiltration to wastewater systems which can economically be implemented and will result in a reduced impact on the environment and customers, while at the same time improving the efficiency and effectiveness of wastewater service operations?

Inflow and infiltration is a challenging area to address for many municipalities. Performance measurements for inflow and infiltration are not conclusive as there is little guidance on acceptable values of inflow and infiltration. In addition, inflow and infiltration problems tend to be underestimated as data that is collected and compared by various municipalities for performance measurements is municipality-wide data and is not specific to a single catchment area. Inflow and infiltration is difficult to measure and compare year after year because it is highly dependant upon rainfall; an extremely wet year followed by a dry year could mislead one to think that the municipality has made significant progress in reducing inflow and infiltration even though no actions were taken to reduce I&I.

There are numerous programs and procedures that can help reduce inflow and infiltration on both the public right of way and private property, however, often these efforts require a great deal of commitment and support as the associated costs, politics, and support for by-law enforcement and programs to implement inflow and infiltration reduction can be significant.

The OMBI Water and Wastewater 2007 business question has taken a step towards improvements; through discussions relating to the stage one survey and stage two interviews, participating municipalities identified why Inflow & Infiltration management is so challenging, sharing initiatives and practices that have or will be implemented to address inflow and infiltration. This added input by municipalities has helped the business question garner recognition and understanding of the issues faced by each municipality, obtain information on how municipalities are similar and how they differ, as well as identify the solutions that are being implemented. Included at the end of this document is a summary of Inflow and Infiltration estimates and associated costs received from the various OMBI municipalities. The data is based on best estimates using information available, but it does indicate the level of inflow and infiltration in each municipality, the impact it is having on treatment plants in terms of peak flows, and the approximate associated cost.

The estimated annual cost of treating excess flow due to inflow ranged from $121,000 and $16,000,000 across the OMBI municipalities responding to the survey as further outlined in the table at the end of this document.

Some of the challenges faced relating to inflow and infiltration include the following:

- Protecting customers from basement flooding
- Weeping tiles and downspouts connected to the sanitary system are difficult to address because of required co-operation from private property owners
- For two tier municipalities where the operation and maintenance of wastewater collection, trunk systems, treatment plants, and stormwater systems is shared, co-operation and support from regional and local municipalities is critical
- Increased flow to wastewater treatment plants and increased operating costs at the plants due to the excess volume of water requiring treatment
- Quantifying and pinpointing sources of inflow and infiltration
- Remedial actions required to reduce inflow and infiltration are often very costly
- Difficulties obtaining sufficient information for decision makers to balance cost versus tolerance.

Many municipalities in Ontario are still struggling to find solutions to the challenges listed above. They are all experiencing the negative impacts that inflow and infiltration is having on customers / system operations problems and are taking steps required to address it. Summarized below are some of the practices noted by the thirteen municipalities that participated in the stage one surveys and/or stage two interviews to address inflow and infiltration.

Wastewater collection system maintenance and operation activities

- Maintaining an inventory of the sanitary collection system and the deficiencies
- CCTV sewer inspection using WRC convention to rate sewer deficiencies and to prioritize repairs (establishing pipe condition)
- Addressing system deficiencies through complete replacement, reaming and sealing, sewer relining, maintenance chamber repairs, and spot repairs
- Preventative maintenance inspection program
- Basement flooding standard response protocol / procedure

Wastewater collection system inflow and infiltration investigations

- Master Planning to examine inflow and infiltration
- Flow monitoring
- Smoke testing of wastewater system
- Dye testing of downspouts
- Flow modeling
- Identification of areas where there are downspout connections and/or sump pumps
- Household inspections to review lot grading, lateral inspections, roof leader and weeping tile connection assessments, and a determination as to whether homes have backflow prevention devices in place and sump pumps installed.

Municipal by-laws and policies and procedures to control inflow and infiltration to wastewater collection systems

- Sewer use by-law preventing connection of foundation drains and downspouts to the wastewater collection system for new construction
- Sewer use by-law to prevent connection of sump pumps from existing development to the wastewater collection system
- Active enforcement of sewer use by-law with respect to reducing source of extraneous flow from system by actively pursuing the reduction or elimination of sources that discharge storm or uncontaminated water into the sanitary sewer system
- Downspout Disconnection Programs where customers are educated about the impact of downspout connections and are given information on how to disconnect their downspouts from the sanitary sewer system (Some municipalities are removing downspouts for customers at no charge or with a subsidy)
- Basement Flooding Protection Subsidy Programs assisting homeowners to take the necessary precautions to reduce their property's flooding risk.

OMBI Municipality	Name of WWTP	Treated Effluent Receiver	Level of Treatment Provided P=Primary S=Secondary T=Tertiary			MOE Rated WWTP Capacity	2006 Average Utilization (WWTR806)	2006 Peak Utilization (WWTR807)	2006 Total Volume of Wastewater Treated	2006 Estimated Annual Base Wastewater Flow (Refer to Note 1 below)	2006 Estimated Annual Volume of Inflow & Infiltration (Refer to Note 2 below)	2006 Variable Operation & Maintenance Costs per Megalitre Treated (Refer to Note 3 below)	2006 Estimated Annual Cost of Treating Inflow & Infiltration (Refer to Note 4 below)	Types of Collection Systems Tributary to WWTP C = Combined P1 = Partially Combined P2 = Partially Combined S = Separated (Refer to Note 5 below)			
			P	S	T	ML/Day	ML/Day	# Days > 90 %	ML	ML	ML	$ / Megalitre Treated	$ / Annum	C	P1	P2	S
Halton	Acton	Black Creek			X	4.55	4.37	274	1,595.00	391.00	7.75	$ 241.50	N/A				X
	Georgetown	Silver Creek			X	22.73	16.98	42	6,165.00	1,568.00	57.00	$ 148.00	N/A				X
	Mid-Halton	Lake Ontario		X		50.00	35.94	20	13,113.00	2,981.50	173.25	$ 120.70	N/A				X
	Milton	Sixteen Mile Creek			X	18.50	11.68		4,261.00	1,032.25	57.25	$ 210.00	N/A				X
	Oakville Southeast	Lake Ontario		X		31.80	22.20	26	8,087.00	2,409.75	100.25	$ 110.10	N/A				X
	Oakville Southwest	Lake Ontario		X		45.40	33.94	147	12.38	2,928.25	301.75	$ 102.80	N/A				X
	Burlington Skyway	Burlington Bay		X		118.00	103.93	119	37.20	8,733.75	676.75	$ 139.70	N/A				X
	Total					**290.97**	**229.04**		**33,270.58**	**20,044.50**	**1,374.00**						
Durham	ALL Duffin Creek	Lake Ontario		X		418.18	373.26	110	136,240.00	121,924.26	14,315.74	$ 50.08	$ 716,890.39				X
	Duffin Creek	Lake Ontario		X		418.18	66.98	110	24,448.95	20,433.73	4,015.22	$ 50.08	$ 201,070.43				X
	Pringle Creek	Lake Ontario		X		14.77	9.49	29	3,463.78	2,657.48	806.29	$ 82.22	$ 66,295.32				X
	Corbett Creek	Lake Ontario		X		72.73	54.06	23	19,733.52	18,026.62	1,706.90	$ 73.02	$ 124,633.90				X
	Harmony Creek	Lake Ontario		X		68.18	57.77	99	21,084.80	16,988.90	4,095.90	$ 75.53	$ 309,356.61				X
	Port Darlington	Lake Ontario		X		13.64	12.14	146	4,432.57	3,458.67	973.90	$ 102.74	$ 100,058.06				X
	Newcastle	Lake Ontario		X		4.09	2.63	14	958.42	764.30	194.12	$ 352.25	$ 68,379.26				X
	Nonquon River	Nonquon River	X			3.86	3.51	121	1,282.42	902.19	380.23	$ 939.86	$ 357,362.76				X
	Uxbridge Brook	Uxbridge Brook			X	3.64	2.91	61	1,063.75	915.76	147.99	$ 169.57	$ 25,094.71				X
	Sunderland	Beaver River	X			0.73	0.41	4	150.89	115.47	35.41	$ 169.57	$ 6,005.12				X
	Cannington	Beaver River	X			1.07	1.05	222	381.82	257.00	124.82	$ 169.57	$ 21,166.88				X
	Lake Simcoe	Lake Simcoe			X	4.55	2.05	5	747.87	442.55	305.32	$ 169.57	$ 51,774.69				X
	Total					**1,023.62**	**586.27**		**213,988.78**	**186,886.93**	**27,101.85**		**$ 2,048,088.13**				
Hamilton	Woodward	HamiltonHarbour		X		409.00	0.96	198	143,565.00	120,574.00	22,991.00	N/A	N/A				
	Dundas	Cootes Paradise			X	18.20	0.81	83	5,339.00	4,143.00	1,196.00	N/A	N/A				
	Waterdown	Grindstone Creek			X	2.70	1.02	241	1,012.00	789.00	223.00	N/A	N/A				
	Total					**429.90**	**2.79**		**149,916.00**	**125,506.00**	**24,410.00**		**-**				
Muskoka	Bracebridge	Muskoka River			X	5.23	5.23	5.23	1,025.00	863.30	162.30	$ 158.00	$ 25,643.00		X		X
	Gravenhurst	Lake Muskoka			X	5.17	2.93	0	1,070.80	86.00	209.80	$ 250.00	$ 52,450.00		X		X
	Port Carling	Indian River			X	0.55		141	203.80	105.00	98.50	$ 132.00	$ 13,002.00				X
	Golden Pheasant	Muskoka River			X	4.46	2.90	6	1,058.80	853.40	205.40	$ 232.41	$ 47,737.00		X		X
	Mountview	Muskoka River		X		3.64	2.86	9	1,044.30	768.20	276.10	$ 219.60	$ 60,643.00		X		X
	Total					**8.64**	**5.76**		**2,306.90**	**1,726.60**	**580.00**		**121,382.00**				

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			P	S	T	ML/Day	ML/Day	# Days > 90 %	ML	ML	ML	$ / Megalitre Treated	$ / Annum	C	P1	P2	S
Niagara	Niagara Falls	Queenston Power Canal		X		68.20	50.16	56	18,323.07	14,000.00	4,323.07	$ 149.78	$ 647,510.02				X
	Fort Erie	Niagara River		X		24.50	14.54	51	5,314.44	3,220.37	2,094.07	$ 221.49	$ 463,816.45				X
	Welland	Welland River			X	54.55	45.62	87	16,651.63	13,493.16	3,158.47	$ 112.05	$ 353,906.34				X
	Crystal Beach	Niagara River		X		9.10	5.77	38	2,107.48	1,413.55	693.93	$ 442.08	$ 306,772.57				X
	Port Colborne	Lake Erie		X		15.12	13.58	104	4,954.93	3,716.04	1,238.89	$ 296.40	$ 367,207.00				X
	Port Dalhousie	Lake Ontario		X		61.35	40.39	40	14,742.60	11,300.69	3,441.91	$ 163.42	$ 562,476.93				X
	Port Weller	Lake Ontario		X		56.18	40.45	60	14,762.73	10,345.17	4,417.56	$ 156.53	$ 691,480.65				X
	Baker Road	Lake Ontario		X		22.75	22.57	192	8,236.54	5,996.73	2,239.81	$ 193.29	$ 432,933.65				X
	Niagara-on-the-lake	Lake Ontario	X			5.71	4.80	107	1,750.25	1,398.07	352.18	$ 249.48	$ 87,862.86				X
	Queenston	Niagara River		X		0.50	0.29	28	106.93	74.68	32.25	$ 453.88	$ 14,639.17				X
	Stevensville	Niagara River	X			2.29	1.09		398.11	287.91	110.20	$ 158.55	$ 17,472.21				X
	Total					**320.25**	**239.25**		**87,348.73**	**65,246.37**	**22,102.36**		**3,946,077.86**				
Peel	Lakeview	Lake Ontario		X		406.00	7.30	29	127,332.43	106,698.00	20,634.43	$ 90.10	$ 1,859,263.71				X
	Clarkson	Lake Ontario		X		172.30	32.00	76	62,311.52	57,147.00	5,164.52	$ 27.51	$ 142,093.19				X
	Total					**578.30**	**39.30**		**189,643.95**	**163,845.00**	**25,798.95**		**2,001,356.90**				
Sudbury	Sudbury	Junction Creek		X		79.63	56.98	56	20,797.60	14,436.50	6,061.10	$ 79.97	$ 484,677.00			X	
	Azilda	Pilon Creek		X		2.84	2.95	164	1,078.40	628.50	449.90	$ 112.17	$ 50,465.00			X	
	Chelmsford	Whitson River		X		7.10	4.87	86	1,775.70	1,151.90	623.80	$ 125.94	$ 78,558.00			X	
	Coniston	Coniston Creek		X		3.00	1.38	33	504.90	290.90	214.00	$ 160.99	$ 34,452.00			X	
	Dowling	Vermillion River		X		3.20	2.15	49	784.00	613.20	170.80	$ 115.22	$ 19,680.00			X	
	Falconbridge	Coniston Creek	X			0.91	0.55	14	200.01	95.30	104.70	$ 71.27	$ 7,462.00			X	
	Levack	Vermillion River		X		2.27	0.98	2	358.12	259.50	98.60	$ 324.85	$ 32,029.00			X	
	Lively	Meatbird Creek		X		1.60	0.96	25	349.53	238.00	111.50	$ 360.37	$ 40,181.00			X	
	Valley East	Vermillion River		X		11.40	6.33	21	23,087.40	1,801.60	507.10	$ 155.72	$ 78,967.00			X	
	Walden	Junction Creek		X		4.50	2.71	37	989.81	685.80	304.00	$ 172.47	$ 52,430.00			X	
	Total					**116.44**	**79.85**		**49,925.47**	**20,201.20**	**8,645.50**		**878,901.00**				
Thunder Bay	WPCP	Kaministiquia River		X		84.50	62.94	62	22,972.92	18,706.25	4,266.67	$ 113.72	$ 485,199.35	X	X	X	X
Toronto	Humber	Lake Ontario		X		473.00	301.18	21	109,932.00	69,715.00	40,217.00	$ 64.71	$ 2,602,287.79			X	
									109,932.00	69,715.00	20,914.50	$ 64.71	$ 1,353,297.06				
	North Toronto	Lake Ontario		X		40.00	34.84	108	12,715.00	12,300.50	414.50	$ 41.36	$ 17,145.70				X
									12,715.00	12,300.50	3,690.15	$ 41.36	$ 152,642.19				
	Ashbridge's Bay	Lake Ontario		X		818.00	700.87	106	255,817.00	211,408.00	44,409.00	$ 87.51	$ 3,886,387.88			X	
									255,817.00	211,408.00	63,422.40	$ 87.51	$ 5,550,317.43				
	Highland Creek	Lake Ontario		X		219.00	167.85	17	61,266.00	59,203.00	2,063.00	$ 132.73	$ 273,817.64			X	
									61,266.00	59,203.00	17,760.90	$ 132.73	$ 2,357,366.81				
	Total					**1,550.00**	**1,204.74**		**879,460.00**	**705,253.00**	**192,891.45**		**16,193,262.51**				

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Waterloo	Alt Heidelberg	Heidelberg Creek			X	0.13	0.05	1	18.47	14.60	3.87	$ 3,491.96	$ 13,510.39				X
	Ayr	Nith River		X		1.50	1.26	94	460.63	402.23	58.40	$ 153.44	$ 8,959.84				X
	Conestoga	Grand River			X	0.15	0.05	28	18.33	14.97	3.37	$ 2,974.03	$ 10,007.62				X
	Elmira	Canagagigue Creek			X	7.80	4.24	27	1,546.00	959.22	586.78	$ 231.93	$ 136,094.63		X		
	Foxboro	Subsurface		X		0.15	0.12	53	43.07	37.96	5.11	$ 1,455.98	$ 7,440.05				X
	Galt WWTP	Grand River			X	56.80	31.49	1	11,493.00	10,056.48	1,436.52	$ 56.30	$ 80,878.46				X
	Hespeler	Speed River		X		9.32	8.01	103	2,925.00	2,451.34	473.66	$ 77.18	$ 36,556.67				X
	Kitchener	Grand River		X		122.75	74.35	6	27,133.00	23,995.83	3,137.17	$ 27.30	$ 85,638.62				X
	New Hamburg	Nith River			X	5.20	3.62	38	1,321.00	972.00	349.01	$ 150.09	$ 52,380.60				X
	Preston	Grand River		X		16.86	12.23	15	4,465.00	3,981.42	483.58	$ 78.49	$ 37,953.94				X
	Total					**220.65**	**135.42**		**49,423.49**	**42,886.04**	**6,537.45**		**469,420.82**				
Windsor	L.R.W.R.P.	Detroit River	X			159.11	157.59	62	57,519.40	40,880.00	16,639.40	$ 143.57	$ 2,388,918.60				X
	L.R.P.C.P.	Little River		X		63.70	47.60	74	17,392.00	14,734.00	2,658.00	$ 101.46	$ 269,691.00				X
	Total					**222.81**	**205.19**		**74,911.40**	**55,614.00**	**19,297.40**		**2,658,609.60**				
York	Holland Landing	Holland River	X			1.36	1.46	281	534.00	393.00	141.00	$ 119.00	$ 16,779.00				X
	Schomberg	Holland River	X			0.68	0.66	112	243.00	187.00	56.00	$ 251.00	$ 14,056.00				X
	Kleinburg	Humber River			X	1.20	1.07	118	389.00	338.00	51.00	$ 381.00	$ 19,431.00				X
	Mount Albert	Mount Albert Creek			X	2.04	0.66	0	297.00	259.00	38.00						X
	Sutton	Lake Simcoe			X	3.40	1.47	13	536.00	344.00	192.00						X
	Keswick	Cook's Bay			X	12.07	9.59	7	3,500.00	2,934.00	566.00	$ 261.00	$ 147,726.00				X
	Total					**20.75**	**14.91**		**5,499.00**	**4,455.00**	**1,044.00**		**197,992.00**				

Note 1	*The methodology employed to calculate "Base Wastewater Flow" is calculated utilizing both the average daily sewage flow from the residential and ICI sectors and nominal infiltration to the system during non wet weather events for each municipalities wastewater treatment plants*	
Note 2	*Estimated Annual Volume of Inflow and Infiltration is calculated by subtracting the Estimated Annual Base Wastewater Flow from the Total Volume of Wastewater Treated*	
Note 3	*Variable Operating and Maintenance Costs are those which are dependent of flow volumes treated such as energy costs and treatment chemicals. Fixed costs for manpower and charge backs for other services which should not vary with flow volumes are not included.*	
Note 4	*Estimated Annual Cost of Treating Inflow and Infiltration is calculated by multiplying the Estimated Annual Volume of Inflow and Infiltration by the Variable Operations and Maintenance Costs per Megalitre Treated*	
Note 5	*Combined Wastewater Collection System 1*	*A one pipe system initially designed to accommodate both storm sewer drainage and sanitary sewer system drainage on a daily basis.*
	Combined Wastewater Collection System 2	*A two pipe system initially designed to including both a storm sewer and sanitary sewer Flows in excess of storm sewer capacity or sanitary sewer capacity overflow into either the sanitary sewer or storm sewer depending on the nature of the event.*
	Partially Combined Wastewater Collection 1	*Sewage system initially designed to accommodate sanitary sewage and flows from foundation drainage connected to sanitary sewage system. Downspouts discharged to grade or connected to storm sewer system.*
	Partially Combined Wastewater Collection 2	*Sewage system initially designed to accommodate sanitary sewage, flows from foundation drainage and downspouts connected to sanitary sewage system.*
	Separated Wastewater Collection System	*Sewage system initially designed to accommodate sanitary sewage flows only. Flows from foundation drainage are handled by sump pumps with discharge to grade or by gravity connection to a separate storm sewer system. Flows from downspouts are directed to grade or connected by to a separate storm sewer system.*