APPENDIX J
WATER AND WASTEWATER ANALYSIS
FOR ALL OPTIONS

MEMO

To: Niagara 2031 – Infrastructure Review

From: Darrell Smith, P. Eng.

Date: 14 July 08

Subject: Technical Memorandum 1 – Gap Analysis for Water/Wastewater

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The purpose of this memorandum is to explain the assumptions and calculations used for the gap analysis for water and wastewater facilities.

1 Water Analysis

1.1 Rated Capacity

The rated capacity for each facility was supplied by the Region from the Ministry of Environment **(MOE)** Certificate of Approval.

1.2 Peaking Factor

The peaking factor was taken from the Region's 2006 Annual Water Report for each facility.

1.3 Average Day Capacity

The average day capacity for each facility is determined by dividing the rated capacity by the peaking factor for each facility.

1.4 Reserve Capacity

The reserve capacity for each facility was calculated using actual flows. Using Regional flow data, the greater of the 5 year average daily flow demand or the 2006 average daily flow demand was deducted from the rated capacity to determine the remaining capacity for each facility.

Table 1: Summary of Capacities by Water Treatment Facility

Facility	Rated Capacity ML/d	Peaking Factor (supplied by RMN)	Average Day Capacity ML/d	Average 2006 Daily Flows ML/d	5 Year Average Daily Flow ML/d	Reserve Capacity* ML/d
Decew	227.3	1.56	145.71	71.15	76.99	68.72
Rosehill	50	1.66	30.12	13.81	14.51	17.72
Grimsby	44	1.76	25.00	13.3	14.45	10.55
Niagara Falls	145.58	1.61	90.42	46.12	47.06	43.36
Welland	102.3	1.8	56.83	27.22	33.14	23.69
Port Colborne	36	1.34	26.87	10.1	11.29	15.58

Reserve Capacity is based on 2006 Average or 5 Year Average whichever is higher

1.5 Flow Rates

The original calculations were completed utilizing MOE design flow rates. This was determined to be conservative and did not reflect historical usage within the Region. It was imperative to determine flow rates that were a realistic picture of the historical demand as well as allow for unexpected or non – historical growth within the various sewer sheds.

Using actual flow data, the 2003 Master Servicing Plan developed flow rates for each municipality. The study team used the most conservative number for residential flows among those flow rates as our composite flow rate, Region wide. This is a reasonable and defensible approach for developing a realistic future demand and the associated facility upgrades.

Similarly, the Industrial, Commercial and Institutional flow rates were adjusted.

Table 2: Summary of Flow Rates by Water Treatment Facility

WATER					
Criteria	Municipality	Residential L/cap/da	Industrial L/ha/da	Commercial L/ha/da	Institutional L/ha/da*
MOE	Uniform	450	55,000	28,000	70,560
MSP WORKING PAPERS	Fort Erie	260	10,000	10,000	10,000
	Grimsby	315	14,700	6,300	6,300
	Lincoln (from Decew)	224	20,000	20,000	20,000
	Lincoln (from Grimsby)	315	14,700	6,300	6,300
	Niagara Falls	378	20,000	20,000	20,000
	Niagara-on-the-Lake	242	15,000	15,000	15,000
	Pelham	385	20,000	10,000	10,000
	Port Colborne	230	12,000	12,000	12,000
	Welland	400	24,000	12,000	12,000
	West Lincoln	265	12,600	5,400	5,400
	St. Catharines	224	20,000	20,000	20,000
	Wainfleet				
	Thorold (from Niag. Falls)	378	20,000	20,000	20,000
	Thorold (from Decew)	224	20,000	20,000	20,000
COMPOSITE	Uniform	400	35,000	25,000	35,000

* MOE value listed is actually from Municipal Works Design Manual.

1.6 Flow Allocation per Municipality (Present and Future)

Flow rates for each municipality (related back to the various facilities) were based on historical demand. Using the composite rates developed, future demand for the 5, 10 and 25 year options were developed for each of the three options of growth. The future flow was combined with the historical allocation to produce future demand for each facility.

1.7 Facility Upgrade Costs

Using Regional budgeting numbers, a unit cost to upgrade in $/Ml/day was determined. This allowed the development of a budget for the long term facility upgrades.

Table 3: Summary of Estimated Costs by Water Treatment Facility

Facility	Rated Capacity ML/d	Peaking Factor (supplied by RMN)	Average Day Capacity ML/d	2006 Replacement Cost*	Unit Cost to Expand (based on rated capacity) $/ML/da
Decew	227.3	1.56	145.71	$209,135,279	$920,085
Rosehill	50	1.66	30.12	$54,620,368	$1,092,407
Grimsby	44	1.76	25.00	$42,800,184	$972,731
Niagara Falls	145.58	1.61	90.42	$127,647,546	$876,821
Welland	102.3	1.8	56.83	$118,273,288	$1,156,142
Port Colborne	36	1.34	26.87	$45,087,612	$1,252,434

1.8 Projected Flow and Upgrade Budget

Using the projected future demand, a spreadsheet was developed to show future demand and upgrade costs for each facility and for each option.

Table 4: Summary of Water Treatment Facilities

Water Summary Sheet

Facility	PERIOD	RESERVE CAPACITY ML/da			COST TO EXPAND (WHERE APPLICABLE)		
		OPTION A	OPTION B	OPTION C	OPTION A	OPTION B	OPTION C
DECEW	5 YEARS	64.5	64.1	64.6			
	10 YEARS	59.1	58.5	59.3			
	25 YEARS	44.2	43.3	44.7			
ROSEHILL	5 YEARS	14.4	13.1	14.3			
	10 YEARS	12.6	9.8	12.5			
	25 YEARS	8.4	3.1	8.0			
GRIMSBY	5 YEARS	7.8	10.2	8.3			
	10 YEARS	4.9	9.6	5.8			
	25 YEARS	-1.8	6.8	0.6	$1,733,760		
NIAGARA FALLS	5 YEARS	41.0	41.5	40.6			
	10 YEARS	37.8	39.0	37.3			
	25 YEARS	28.9	31.2	27.5			
WELLAND	5 YEARS	21.4	20.5	21.3			
	10 YEARS	18.7	16.7	18.4			
	25 YEARS	11.5	8.1	10.9			
PORT COLBORNE	5 YEARS	15.1	14.6	14.9			
	10 YEARS	14.5	13.5	14.1			
	25 YEARS	12.9	11.1	12.1			

1.9 Water Summary

Based on this brief analysis, the water facilities within the Region are capable of meeting all the future growth options with minimal investment. Only the facility located in Grimsby requires an upgrade of less than $2M and that is in the 25 year time frame.

2 Wastewater Analysis

2.1 Wet Weather Flows

The wastewater analysis was completed for dry weather flow only. Currently, there are existing problems with the sanitary systems throughout the Region when large rainfall events occur; however, these impacts are not quantifiable at this time.

In addition, there are many options to mitigate wet weather flows. These include sewer separation, sewage storage tanks, roof leader and weeping tile disconnect programs, inflow & infiltration (I&I) reduction programs and sewer relining.

2.2 Rated Capacity

The rated capacity for each facility was supplied by the Region from the Ministry of Environment **(MOE)** Certificates of Approval.

2.3 Reserve Capacity

The reserve capacity for each facility was calculated using actual flows. Using Regional flow data, the greater of the 5 year average daily flow demand or the 2006 average daily flow demand was deducted from the rated capacity to determine the remaining capacity for each facility.

Table 5: Summary of Capacities by Wastewater Treatment Facility

Facility	Rated Capacity ML/da	Average 2006 Daily Flows ML/da	5 Year Average Daily Flow ML/da	Reserve Capacity in ML/da
Anger Avenue	24.5	14.5	14.6	8.9
Baker Road*	31.3	22.6	21.8	16.7
Crystal Beach	9.1	5.8	5.2	3.3
Niagara Falls	68.2	50.2	53.1	15.2
Niagara on the Lake	5.7	4.8	4.8	0.9
Port Dalhousie	61.4	40.3	42.9	18.5
Port Weller	56.2	40.4	42.1	14.1
Queenston	0.5	Not Available	0.3	0.2
Seaway	15.1	13.6	13.1	1.5
Stevensville	2.3	Not Available	1.0	1.3
Welland	54.6	45.6	46.8	7.8

*Baker Road Capacity reflects imminent upgrade

2.4 Flow Rates

The original calculations were completed utilizing MOE design flow rates. This was determined to be conservative and did not reflect historical usage within the Region. It was imperative to determine flow rates that were a realistic picture of the historical demand as well as allow for unexpected or non – historical growth within the various sewer sheds.

Using actual flow data, the 2003 Master Servicing Plan developed flow rates for each municipality. The study team used the most conservative number for residential flows among those flow rates as our composite flow rate, Region wide. This is a reasonable and defensible best approach for developing a realistic future demand and the associated facility upgrades.

Similarly, the Industrial, Commercial and Institutional rates were adjusted.

Table 6: Summary of Flow Rates by Wastewater Treatment Facility

WASTEWATER						
Criteria	**Municipality**	**Residential L/cap/da**	**Industrial L/ha/da**	**Commercial L/ha/da**	**Institutional L/ha/da***	**Infiltration L/ha/da**
MOE	Uniform	450	55,000	28,000	70,560	864
MSP WORKING PAPERS	Fort Erie	270	12,000	6,000	6,000	2,000
	Grimsby	270	8,000	4,000	4,000	1,700
	Lincoln	270	8,000	4,000	4,000	1,700
	Niagara Falls	280	15,000	20,000	10,000	7,000
	Niagara-on-the-Lake	350	25,000	15,000	7,500	1,100
	Pelham	290	20,000	5,000	5,000	9,500
	Port Colborne	235	20,000	10,000	10,000	4,000
	Welland	350	10,000	5,000	5,000	6,700
	West Lincoln	270	8,000	4,000	4,000	1,700
	St. Cath. (Port Dal.)	320	20,000	20,000	10,000	8,000
	St. Cath. (Port Wel.)	270	20,000	20,000	10,000	5,000
	Wainfleet					
	Thorold (Port Dalhousie)	320	20,000	20,000	10,000	8,000
	Thorold (Port Weller)	270	20,000	20,000	10,000	5,000
COMPOSITE	Uniform	350	35,000	25,000	35,000	4,800

2.5 Flow Allocation per Municipality (Present and Future)

Flow rates for each municipality (related back to the various facilities) were based on historical demand. Using the composite rates developed, future demand for the 5, 10 and 25 year options were developed for each of the three options of growth. The future flow was combined with the historical allocation to produce future demand for each facility.

2.6 Facility Upgrade Costs

Using Regional budgeting numbers, a unit cost to upgrade in $/Ml/day, was developed. This allowed the development of a budget for the long term facility upgrades.

Table 7: Summary of Estimated Costs by Wastewater Treatment Facility

Facility	Rated Capacity ML/da	2006 Replacement Cost	Unit Cost of Plant Expansion $/ML/da
Anger Avenue	24.5	$77,503,331	$3,163,401
Baker Road	22.8	$55,082,094	$2,421,191
Crystal Beach	9.1	$19,187,546	$2,108,522
Niagara Falls	68.2	$209,461,735	$3,071,286
Niagara on the Lake	5.7	$31,758,266	$5,561,868
Port Dalhousie	61.4	$178,049,744	$2,902,196
Port Weller	56.2	$141,598,653	$2,520,446
Queenston	0.5	$2,922,505	$5,845,010
Seaway	15.1	$53,612,623	$3,545,808
Stevensville	2.3	Not Available	Not Available
Welland	54.6	$130,504,042	$2,392,375

2.7 Projected Flow and Upgrade Budget

Using the projected future demand, a spreadsheet was developed to show future demand and upgrade costs for each facility and for each option.

Table 8: Summary of Wastewater Treatment Facilities

Wastewater Summary Sheet

Facility	PERIOD	RESERVE CAPACITY ML/da			COST TO EXPAND (WHERE APPLICABLE)		
		OPTION A	OPTION B	OPTION C	OPTION A	OPTION B	OPTION C
Anger Avenue	5 YEARS	9.01	8.15	8.97			
	10 YEARS	7.76	5.92	7.66			
	25 YEARS	4.78	1.58	4.55			
Baker Road	5 YEARS	5.45	8.20	6.02			
	10 YEARS	2.02	7.48	3.01			
	25 YEARS	-6.08	3.44	-3.44	$14,721,253		$8,337,389
Crystal Beach	5 YEARS	2.93	2.56	2.92			
	10 YEARS	2.39	1.59	2.35			
	25 YEARS	1.10	-0.29	1.00		$604,562	
Niagara Falls	5 YEARS	12.73	13.28	12.44			
	10 YEARS	9.67	11.03	9.26			
	25 YEARS	1.19	3.69	-0.02			$56,238
Niagara on the Lake	5 YEARS	-0.12	0.52	0.07	$692,970		
	10 YEARS	-1.29	0.07	-0.86	$7,154,194		$4,774,532
	25 YEARS	-4.41	-1.91	-3.38	$24,546,785	$10,615,187	$18,803,100
Port Dalhousie	5 YEARS	17.04	16.32	16.95			
	10 YEARS	15.11	13.72	14.92			
	25 YEARS	9.95	7.45	9.47			
Port Weller	5 YEARS	12.63	11.91	12.53			
	10 YEARS	10.71	9.32	10.51			
	25 YEARS	5.57	3.07	5.09			
Queenston	5 YEARS	0.21	0.21	0.21			
	10 YEARS	0.21	0.21	0.21			
	25 YEARS	0.21	0.21	0.21			
Seaway	5 YEARS	1.04	0.59	0.88			
	10 YEARS	0.43	-0.56	0.07		$1,994,040	
	25 YEARS	-1.11	-2.88	-1.97	$3,935,147	$10,207,198	$6,986,133
Stevensville	5 YEARS	1.20	1.13	1.18			
	10 YEARS	1.10	0.97	1.09			
	25 YEARS	0.89	0.66	0.87			
Welland	5 YEARS	5.42	4.50	5.30			
	10 YEARS	2.68	0.66	2.43			
	25 YEARS	-4.39	-7.79	-5.01	$10,493,146	$18,625,061	$11,997,655

2.8 Wastewater Summary

Based on this brief analysis, whichever growth option is chosen, upgrades in the long term are required to the wastewater facilities. In addition, all options require some upgrades in the ten year forecast, with only Option A requiring upgrades in the short term.

3 Water Trunk Mains

Review of the water trunk system was not undertaken as part of this exercise.

4 Sanitary Trunk Sewers

At present, the Region is establishing wastewater models with flow data; therefore, validated flow data is not available for the sewer trunk system. Due to that limitation, the investigation of the trunk system will be more qualitative than quantitative. Once the model is complete, a full investigation of the trunk sewer system should be completed for both dry weather and wet weather flows.

4.1 Methodology

Key sewer segments were identified using the GIS layer supplied by the region. For those segments, maximum gravity flow was calculated and compared to the expected flow due to growth.

Welland was not analyzed due to the construction of the OAW Tunnel Trunk Sewer which is seen to address their needs.

Any segment greater than 60% capacity is considered to have wet weather flow capacity issues, and any segment greater than 80% capacity is considered to have dry weather issues.

Table 9: Summary of Trunk Analysis

5 Year Flow

Facility	Municipality Served	Key Trunk Capacity l/s	Total Flow Option A l/s	Percentage of Trunk Capacity Used	Total Flow Option B l/s	Percentage of Trunk Capacity Used	Total Flow Option C l/s	Percentage of Trunk Capacity Used
Anger Avenue	Fort Erie	1178.24	179.23	15.21	189.23	16.06	179.83	15.26
Baker Road	Grimsby	544.80	135.14	24.81	120.94	22.20	132.84	24.38
	Lincoln	717.70	111.26	15.50	101.46	14.14	109.46	15.25
	West Lincoln	124.00	43.40	35.00	35.50	28.63	41.00	33.06
Crystal Beach	Fort Erie	430.60	64.57	14.99	68.84	15.99	64.84	15.06
Niagara Falls	Niagara Falls		642.05		635.65		645.45	
Niagara on the Lake	NOTL		67.56		60.06		65.26	
Port Dalhousie	St. Catharines	2578.00	430.32	16.69	430.22	16.69	430.32	16.69
	Thorold	609.00	82.49	13.55	90.99	14.94	83.59	13.73
Port Weller	St. Catharines	3239.40	402.47	12.42	402.37	12.42	402.47	12.42
	Thorold	166.2	101.62	61.15	110.02	66.20	102.72	61.81
Queenston	NOTL							
Seaway	Port Colborne	1848.9	157.95	8.54	163.25	8.83	159.85	8.65
Stevensville	Fort Erie		12.63		13.43		12.83	
Welland	Welland		524.66		543.06		528.36	
	Pelham		43.93		36.23		41.63	

10 Year Flow

Facility	Municipality Served	Key Trunk Capacity l/s	Total Flow Option A l/s	Percentage of Trunk Capacity Used	Total Flow Option B l/s	Percentage of Trunk Capacity Used	Total Flow Option C l/s	Percentage of Trunk Capacity Used
Anger Avenue	Fort Erie	1178.24	193.73	16.44	215.03	18.25	194.83	16.54
Baker Road	Grimsby	544.80	147.14	27.01	124.24	22.81	144.94	26.61
	Lincoln	717.70	126.86	17.68	105.06	14.64	122.76	17.10
	West Lincoln	124.00	55.60	44.84	37.00	29.84	50.40	40.64
Crystal Beach	Fort Erie	430.60	70.84	16.45	80.04	18.59	71.34	16.57
Stamford	Niagara Falls**		677.45		661.65		682.15	
Niagara on the Lake	NOTL		80.96		65.26		76.06	
Port Dalhousie	St. Catharines	2578.00	446.62	17.32	445.12	17.27	446.72	17.33
	Thorold	609.00	88.49	14.53	106.09	17.42	90.69	14.89
Port Weller	St. Catharines	3239.40	418.07	12.91	417.17	12.88	418.77	12.93
	Thorold	166.2	107.52	64.70	125.22	75.35	109.82	66.08
Queenston	NOTL							
Seaway	Port Colborne	1848.9	165.05	8.93	176.55	9.55	169.25	9.15
Stevensville	Fort Erie		13.73		15.23		13.83	
Welland	Welland		545.36		584.86		553.26	
	Pelham		55.03		38.83		50.03	

25 Year Flow

Facility	Municipality Served	Key Trunk Capacity l/s	Total Flow Option A l/s	Percentage of Trunk Capacity Used	Total Flow Option B l/s	Percentage of Trunk Capacity Used	Total Flow Option C l/s	Percentage of Trunk Capacity Used
Anger Avenue	Fort Erie	1178.24	228.23	19.37	265.33	22.52	230.93	19.60
Baker Road	Grimsby	544.80	155.74	28.59	137.54	25.25	148.54	27.27
	Lincoln	717.70	165.96	23.12	124.46	17.34	156.26	21.77
	West Lincoln	124.00	101.50	81.85	51.10	41.21	88.00	70.96
Crystal Beach	Fort Erie	430.60	85.84	19.93	101.84	23.65	86.94	20.19
Stamford	Niagara Falls**		775.55		746.65		789.55	
Niagara on the Lake	NOTL		117.16		88.16		105.26	
Port Dalhousie	St. Catharines	2578.00	491.22	19.05	489.02	18.97	491.42	19.06
	Thorold	609.00	103.69	17.03	134.79	22.13	108.99	17.90
Port Weller	St. Catharines	3239.40	462.87	14.29	460.67	14.22	463.17	14.30
	Thorold	166.2	122.82	73.90	153.92	92.61	128.12	77.09
Queenston	NOTL							
Seaway	Port Colborne	1848.9	182.85		203.35		192.85	10.43
Stevensville	Fort Erie		16.13		18.83		16.33	
Welland	Welland		598.16		667.76		617.26	
	Pelham		83.93		53.63		72.13	

4.2 Findings

This method of analysis has its limitations and should only be considered as an early warning sign and not a definitive picture of the state of the Regional collection system. There are systems which already exhibit problems in both dry and wet weather that cannot be determined from this approach.

This analysis has identified two trunk systems that require further study; the connection of West Lincoln to Baker Road and Thorold connection to Port Weller.

4.2.1 Thorold South

The Thorold connection to the Port Weller System requires attention in the short term; regardless of the development growth scenario. This potentially may limit development in the future.

4.2.2 West Lincoln

The West Lincoln trunk system requires attention only if growth option A or C is chosen and only in the long term. Since the sewage is pumped from Smithville to a gravity system at Parker and Ridge Road, there are options to control the flow which are not available in a pure gravity system. Options such as limiting peak discharge of the pump or increasing storage may be considered rather than replacement of the trunk system.

4.3 Summary

For dry weather flow, the Regional collection system appears to be adequate to meet the growth requirements except for the exceptions noted above. Once again, we strongly recommend that a full investigation of the trunk sewer system should be completed for both dry weather and wet weather flows once the Regional Sanitary Trunk Model is completed and calibrated.

Further, we recommend that the Region and Area Municipalities continue to purse options to reduce wet weather flow. Any reduction in wet weather flow will increase the service life of the existing system and reduce both long – term capital and operational costs.

MEMO

To: Niagara 2031 – Infrastructure Review

From: Darrell Smith, P. Eng.

Date: 21 July 08

Subject: Technical Memorandum 2 – Downtown Intensification

The purpose of this memorandum is to discuss, in general, the issues facing downtown intensification from a municipal servicing perspective.

Intensification means increasing the density of urban development. Intensification can be an increase per unit of land area in the number of people, buildings, jobs or any other urban function. A municipality can encourage or provide incentives to intensification in cases where it wishes to jump start the process at selected locations or, more generally, as part of an overall growth management strategy that seeks to maximize the use of public investment in infrastructure and people services.

Infrastructure Challenges

Traditionally, the water/wastewater infrastructure within the downtown core is among the oldest in any municipality. As such, condition may be more critical than size in its ability to meet changing demands for intensification. Whatever the issue, size or condition, the rehabilitation of infrastructure within the downtown core presents unique challenges as discussed below.

- Property tends to be at a premium within the existing core area with buildings built up to and often encroaching into the existing right of way (ROW). There is no easy opportunity to secure additional property for infrastructure expansion if required.

- The existing ROW tends to be "crowded" with infrastructure (cable, phone, etc.) that has been placed haphazardly as the need has arisen. In some instances this crowding has been compounded by the decorative reconstruction of main streets which had placed overhead hydro underground. The ability to meet separation requirements for new sewers or watermains will be difficult.

- Construction work within the downtown core presents contractors with unique challenges of their own and is often reflected in the price municipalities pay for this work. Traffic and crowd control are the obvious expense, however, contractors often charge a premium due to the large amount of utilities within proximity of the new infrastructure. Contractors are aware that they will have to avoid, protect, bridge and replace utilities within the ROW and municipal contracts make the contractor 100% responsible for utilities no matter what the cause of damage.

Moving Forward

When the existing water and sewer is not capable of supporting intensification, how does a municipality address these infrastructure challenges? There is obviously a cost associated with this work and the key is to minimize it to help intensification be economically feasible. Following is a brief discussion on several suggestions to minimize cost.

- New Technologies/Materials – Municipalities tend to be cautious in the acceptance of new technologies in providing public services. Part of this is the need to make sure the public is not at risk, but in many cases there is a hesitancy of operational staff to move out of their comfort area and accept change. As the expense of infrastructure reconstruction rises, new technologies may provide for lower cost solutions and they will have to be seriously considered.

- Trenchless Technologies – The ability of trenchless technologies has grown to meet many infrastructure needs. Once considered too expensive for most applications, the total cost has come down as more and more contractors have the ability to perform this work. Further, when the "actual" cost of traditional construction is considered, including impact to vehicular and pedestrian traffic and loss of business, the cost / benefit of using trenchless methods becomes viable.

- Realistic Expectation – In the Niagara Region, most contracts use the Niagara Peninsula Standard Contract Documents. While an excellent tool, it does not recognize the unique challenges of downtown intensification. Contract documents that reflect actual conditions and deal fairly with issues will receive fairer pricing from contractors resulting in overall cost reductions.

MEMO

To: Niagara 2031 – Infrastructure Review

From: Darrell Smith, P. Eng.

Date: 7 Oct 08

Subject: Technical Memorandum 3 – Gap Analysis for Water/Wastewater Option D

This memo should be read in conjunction with Technical Memo 1 which outlines the methodologies for evaluating the options. Using those methods, Option D was evaluated and this memo presents the findings.

1 Water Analysis

1.1 Rated Capacity

As per T.M. 1 – Section 1.1

1.2 Peaking Factor

As per T.M. 1 – Section 1.2

1.3 Average Day Capacity

As per T.M. 1 – Section 1.3

1.4 Reserve Capacity

As per T.M. 1 – Section 1.4

1.5 Flow Rates

As per T.M. 1 – Section 1.5

1.6 Flow Allocation per Municipality (Present and Future)

As per T.M. 1 – Section 1.6

1.7 Facility Upgrade Costs

As per T.M. 1 – Section 1.7

1.8 Projected Flow and Upgrade Budget

Using the projected future demand, a spreadsheet was developed to show future demand and upgrade costs for each facility for each Option D.

Table 1: Summary of Water Treatment Facilities

Water Summary Sheet

Facility	PERIOD	RESERVE CAPACITY ML/da	Unit Cost to Expand	COST TO EXPAND
		OPTION D		OPTION D
DECEW	5 YEARS	64.6	$920,085	
	10 YEARS	59.5	$920,085	
	25 YEARS	46.1	$920,085	
ROSEHILL	5 YEARS	14.2	$1,092,407	
	10 YEARS	12.3	$1,092,407	
	25 YEARS	7.6	$1,092,407	
GRIMSBY	5 YEARS	7.9	$972,731	
	10 YEARS	5.2	$972,731	
	25 YEARS	0.05	$972,731	$46,697
NIAGARA FALLS	5 YEARS	40.6	$876,821	
	10 YEARS	37.2	$876,821	
	25 YEARS	28.7	$876,821	
WELLAND	5 YEARS	21.6	$1,156,142	
	10 YEARS	18.9	$1,156,142	
	25 YEARS	9.2	$1,156,142	
PORT COLBORNE	5 YEARS	15.1	$1,252,434	
	10 YEARS	14.3	$1,252,434	
	25 YEARS	12.3	$1,252,434	

1.9 Water Summary

Based on this brief analysis, the water facilities within the Region are capable of meeting all the future growth options with minimal investment. Only the facility located in Grimsby requires a minimal upgrade in the 25 year time frame.

2 Wastewater Analysis

2.1 Wet Weather Flows

As per T.M. 1 – Section 2.1

2.2 Rated Capacity

As per T.M. 1 – Section 2.2

2.3 Reserve Capacity

As per T.M. 1 – Section 2.3

2.4 Flow Rates

As per T.M. 1 – Section 2.4

2.5 Flow Allocation per Municipality (Present and Future)

As per T.M. 1 – Section 2.5

2.6 Facility Upgrade Costs

As per T.M. 1 – Section 2.6

2.7 Projected Flow and Upgrade Budget

Using the projected future demand, a spreadsheet was developed to show future demand and upgrade costs for each facility for Option D.

Table 2: Summary of Wastewater Treatment Facilities

Wastewater Summary Sheet

Facility	PERIOD	RESERVE CAPACITY ML/da	Unit Cost to Expand	COST TO EXPAND (WHERE APPLICABLE)
		OPTION D		OPTION D
Anger Avenue	5 YEARS	8.88	$3,163,401	
	10 YEARS	7.56	$3,163,401	
	25 YEARS	4.34	$3,163,401	
Baker Road	5 YEARS	5.61	$2,421,191	
	10 YEARS	2.39	$2,421,191	
	25 YEARS	-4.19	$2,421,191	$10,137,115
Crystal Beach	5 YEARS	2.88	$2,108,522	
	10 YEARS	2.30	$2,108,522	
	25 YEARS	0.91	$2,108,522	
Stamford (Niagara Falls)	5 YEARS	12.25	$3,071,286	
	10 YEARS	8.80	$3,071,286	
	25 YEARS	0.81	$3,071,286	
Niagara on the Lake	5 YEARS	0.08	$5,561,868	
	10 YEARS	-0.94	$5,561,868	$5,247,244
	25 YEARS	-3.90	$5,561,868	$21,668,159
Port Dalhousie	5 YEARS	17.04	$2,902,196	
	10 YEARS	15.25	$2,902,196	
	25 YEARS	10.61	$2,902,196	
Port Weller	5 YEARS	12.62	$2,520,446	
	10 YEARS	10.84	$2,520,446	
	25 YEARS	6.23	$2,520,446	
Queenston	5 YEARS	0.21	$5,845,010	
	10 YEARS	0.21	$5,845,010	
	25 YEARS	0.21	$5,845,010	
Seaway	5 YEARS	1.00	$3,545,808	
	10 YEARS	0.23	$3,545,808	
	25 YEARS	-1.70	$3,545,808	$6,039,788
Stevensville	5 YEARS	1.18	Not Available	
	10 YEARS	1.09	Not Available	
	25 YEARS	0.86	Not Available	

Facility	PERIOD	RESERVE CAPACITY ML/da	Unit Cost to Expand	COST TO EXPAND (WHERE APPLICABLE)
Welland	5 YEARS	5.60	$2,392,375	
	10 YEARS	2.82	$2,392,375	
	25 YEARS	-6.63	$2,392,375	$15,851,452

2.8 Wastewater Summary

Based on this brief analysis, Option D requires long - term upgrades for the Seaway, Baker Road, Welland and Niagara - on - the - Lake Facilities. The NOTL facility requires medium term upgrades as well. It should be noted that the existing facilities (with the completion of the Baker Road upgrades already underway) can service all growth for the short-term.

3 Water Trunk Mains

As per T.M. 1 – Section 3

4 Sanitary Trunk Sewers

As per T.M 1 – Section 4

4.1 Methodology

As per T.M. 1 – Section 4.1

Table 2: Summary of Trunk Analysis

5 Year Flow

Facility	Municipality Served	Key Trunk Capacity l/s	Existing Flow l/s	Flow Increase Option D l/s	Total Flow Option D l/s	Percentage of Trunk Capacity Used
Anger Avenue	Fort Erie	1178.24	168.83	12.00	180.83	15.35
Baker Road	Grimsby	544.80	118.34	15.00	133.34	24.48
	Lincoln	717.70	98.96	12.40	111.36	15.52
	West Lincoln	124.00	34.50	8.70	43.20	34.84
Crystal Beach	Fort Erie	430.60	60.04	5.20	65.24	15.15
Niagara Falls	Niagara Falls		614.85	32.70	647.55	
Niagara on the Lake	NOTL		55.66	9.50	65.16	
Port Dalhousie	St. Catharines	2578.00	418.72	12.20	430.92	16.72
	Thorold	609.00	77.39	4.60	81.99	13.46
Port Weller	St. Catharines	3239.40	390.97	11.50	402.47	12.42
	Thorold	166.2	96.52	12.10	108.62	65.36
Queenston	NOTL		3.36		3.36	
Seaway	Port Colborne	1848.9	152.15	6.30	158.45	8.57
Stevensville	Fort Erie		12.03	0.80	12.83	
Welland	Welland		507.56	16.80	524.36	
	Pelham		34.13	8.10	42.23	

10 Year Flow

Facility	Municipality Served	Key Trunk Capacity l/s	Existing Flow l/s	Flow Increase Option D l/s	Total Flow Option D l/s	Percentage of Trunk Capacity Used
Anger Avenue	Fort Erie	1178.24	168.83	27.3	196.13	16.65
Baker Road	Grimsby	544.80	118.34	30	148.34	27.23
	Lincoln	717.70	98.96	26.5	125.46	17.48
	West Lincoln	124.00	34.50	16.8	51.30	41.37
Crystal Beach	Fort Erie	430.60	60.04	11.8	71.84	16.68
Stamford	Niagara Falls**		614.85	72.6	687.45	
Niagara on the Lake	NOTL		55.66	21.3	76.96	
Port Dalhousie	St. Catharines	2578.00	418.72	26.5	445.22	17.27
	Thorold	609.00	77.39	10.9	88.29	14.50
Port Weller	St. Catharines	3239.40	390.97	26.3	417.27	12.88
	Thorold	166.2	96.52	10.9	107.42	64.64
Queenston	NOTL		3.36		3.36	
Seaway	Port Colborne	1848.9	152.15	15.3	167.45	9.06
Stevensville	Fort Erie		12.03	1.9	13.93	
Welland	Welland		507.56	39.2	546.76	
	Pelham		34.13	17.8	51.93	

25 Year Flow

Facility	Municipality Served	Key Trunk Capacity l/s	Existing Flow l/s	Flow Increase Option D l/s	Total Flow Option D l/s	Percentage of Trunk Capacity Used
Anger Avenue	Fort Erie	1178.24	168.83	64.5	233.33	19.80
Baker Road	Grimsby	544.80	118.34	54.2	172.54	31.67
	Lincoln	717.70	98.96	56.9	155.86	21.72
	West Lincoln	124.00	34.50	38.4	72.90	58.79
Crystal Beach	Fort Erie	430.60	60.04	28	88.04	20.45
Stamford	Niagara Falls**		614.85	165.1	779.95	
Niagara on the Lake	NOTL		55.66	55.5	111.16	
Port Dalhousie	St. Catharines	2578.00	418.72	59.6	478.32	18.55
	Thorold	609.00	77.39	31.5	108.89	17.88
Port Weller	St. Catharines	3239.40	390.97	59.1	450.07	13.89
	Thorold	166.2	96.52	31.5	128.02	77.03
Queenston	NOTL		3.36		3.36	
Seaway	Port Colborne	1848.9	152.15	37.6	189.75	10.26
Stevensville	Fort Erie		12.03	4.5	16.53	
Welland	Welland		507.56	120.2	627.76	
	Pelham		34.13	46.1	80.23	

4.2 Findings

This method of analysis has its limitations and should only be considered as an early warning sign and not a definitive picture of the state of the Regional collection system. There are systems which already exhibit problems in both dry and wet weather that cannot be determined from this approach.

This analysis has identified that the Thorold trunk to the Port Weller System may have capacity issues in the short-term. This potentially may limit development in the future.

4.3 Summary

For dry weather flow, the Regional collection system appears to be adequate to meet the growth requirements except for the exception noted above. Once again, we strongly recommend that a full investigation of the trunk sewer system should be completed for both dry weather and wet weather flows once the Regional Sanitary Trunk Model is completed and calibrated.

Further, we recommend that the Region and Area Municipalities continue to purse options to reduce wet weather flow. Any reduction in wet weather flow will increase the service life of the existing system and reduce both long – term capital and operational costs.

MEMO

To: Niagara 2031 – Infrastructure Review

From: Darrell Smith, P. Eng.

Date: 27 Nov 08

Subject: Technical Memorandum 4 – Sanitary Trunk Analysis for Option D

This memo replaces the Trunk Analysis Section of Technical Memo 3.

1 Trunk Analysis

At the request of the Region, a more detailed analysis of the sanitary trunk system was undertaken for Option D.

1.1 Population Breakdown

To analyze the trunk system, population growth was assigned to each catchment area. This was completed on a macro level since location and timing of growth is controlled by the lower tier municipality. This percentage growth was used to calculate increases in sewer flow in the trunk system.

Table 1: Assumed Population Growth for each Facility

Name	Municipality	Assigned Percent of Growth	Option D: Total Urban Population Growth	Option D: Proportional Population Growth (2006-2031)
Douglastown	Fort Erie	10%	11,421	1,142
Stevensville	Fort Erie	5%	11,421	571
Fort Erie	Fort Erie	55%	11,421	6,282
Crystal Beach	Fort Erie	30%	11,421	3,426
Grimsby South	Grimsby	40%	9,248	3,699
Grimsby East	Grimsby	40%	9,248	3,699
Grimsby West	Grimsby	20%	9,248	1,850
Beamsville	Lincoln	52%	8,703	4,526
Campden	Lincoln	5%	8,703	435
Vineland	Lincoln	25%	8,703	2,176
Jordan	Lincoln	1%	8,703	87

Vineland East	Lincoln	1%	8,703	87
Jordan Station	Lincoln	1%	8,703	87
Prudommes	Lincoln	15%	8,703	1,306
Niagara Falls East	Niagara Falls	46%	28,229	12,985
Niagara Falls West	Niagara Falls	54%	28,229	15,244
NOTL Old Town	Niagara on the Lake	25%	8,223	2,056
Virgil	Niagara on the Lake	20%	8,223	1,645
St David's	Niagara on the Lake	30%	8,223	2,467
Queenston	Niagara on the Lake	1%	8,223	82
Glendale	Niagara on the Lake	24%	8,223	1,973
Fonthill	Pelham	70%	8,599	6,019
Fenwick	Pelham	30%	8,599	2,580
East of Canal	Port Colborne	50%	5,919	2,960
West of Canal	Port Colborne	50%	5,919	2,960
St. Catharines East	St Catharines	55%	20,284	11,156
St. Catharines West	St Catharines	45%	20,284	9,128
Thorold North East	Thorold	5%	10,464	523
Thorold North West	Thorold	15%	10,464	1,570
Thorold South	Thorold	40%	10,464	4,186
Port Robinson East	Thorold	10%	10,464	1,046
Port Robinson West	Thorold	30%	10,464	3,139
Welland East	Welland	0%	18,023	0
Welland Central	Welland	45%	18,023	8,110
Welland West Central	Welland	10%	18,023	1,802
Welland North	Welland	45%	18,023	8,110
Smithville	West Lincoln	100%	2,868	2,868
Region of Niagara	Niagara		131,982	131,982

1.2 Regional Model Existing Flows

The Region provided their recently completed trunk sanitary sewer model (the calibration of the model is still underway). For each trunk system within the Region, a dry weather flow scenario was completed. This provided existing reserve capacity for each trunk segment (segments are defined in the model) and identified those that are already experiencing difficulty. Due to the way the data is broken down in the model, these sections are identified below by municipality.

Niagara Falls (Stamford)

ID	Reserve Capacity (L/s)
19000089	-14.266

Grimsby, Lincoln, West Lincoln (Baker Road)

ID	Reserve Capacity (L/s)
19001264	-33.1234
1035660	-5.6103

Fort Erie (Anger)

ID	Reserve Capacity (L/s)
18000302	-83.9607
1012888	-18.0112

NOTL

ID	Reserve Capacity (L/s)
NOTL_OUTFALL	-2.788

Port Colborne (Seaway)

No capacity issues calculated.

Welland

ID	Reserve Capacity (L/s)
19000923	-100.2262
19001097	-12.2206

St. Catharines (Port Dalhousie, Port Weller)

ID	Reserve Capacity (L/s)
PEEL_ST_INFLOW	-165.957
19001267	-20.316

1.3 Regional Model Future Flows

Using the population growth shown in Table 1, the flows were increased proportionally in each segment based on the percentage growth. With plants that serve multiple municipalities a weighted percentage growth was utilized. This is a very conservative approach, but the goal of this analysis is to flag segments that require further study, not a definitive list of problem areas.

Niagara Falls (Stamford)

ID	Future Reserve Capacity (l/s)
19000374	-69.28
19000089	-42.09
19000130	-6.64
19000375	-4.59

Grimsby, Lincoln, West Lincoln (Baker Road)

ID	Future Reserve Capacity (l/s)
19001264	-212.17
1021087	-102.89
19000278	-96.69
19000471	-76.30
19000092	-61.12
19000066	-59.68
19000484	-37.74
19001126	-26.52
19000817	-24.81
1035660	-22.21
19000950	-5.93

Fort Erie (Anger)

ID	Future Reserve Capacity (l/s)
18000302	-198.16
19000722	-83.74
1012879	-81.69
1012888	-60.74
1012880	-38.76
1012985	-10.99
19000723	-8.21
1012629	-6.57

NOTL

ID	Future Reserve Capacity (l/s)
19000157	-262.85
19000158	-250.78
NOTL_OUTFALL	-80.65

Port Colborne (Seaway)

No capacity issues calculated. (This does not include an analysis of Wainfleet flows)

Welland

ID	Future Reserve Capacity (l/s)
1119416	-945.15
19001452	-903.21
19001451	-796.08
1118216	-791.97
1117588	-408.04
19000923	-317.93
19001097	-211.49
19001083	-138.56
19000030	-122.97
19000033	-112.67
1118192	-103.63
19000032	-102.36
19000968	-88.58
19000036	-57.63
19000272	-53.38
19000970	-52.67
19001080	-52.18
19001449	-50.33
19000031	-46.42
19001079	-43.76
19001081	-41.59
19000604	-40.18
19001077	-28.31
19000603	-27.10
19001123	-26.44
19000601	-24.45
19000037	-22.09
19000034	-18.31
19000271	-18.21
19000035	-13.16
19000969	-12.43
19000797	-12.12
19000599	-11.34
19000602	-8.45
10635	-5.90
19000535	-4.06

It is unknown what effect the OAW tunnel will have on this system.

St. Catharines (Port Dalhousie, Port Weller)

ID	Future Reserve Capacity (l/s)
PEEL_ST_INFLOW	-781.03
10810936	-68.58
19001267	-48.48
10812674	-22.04
19001261	-18.08
10812667	-16.99
10812680	-13.93
10815341	-3.25

1.4 Additional Analysis of Critical Systems

In addition, we analyzed systems that were identified in Technical Memo 3 as having potential issues.

Smithville (West Lincoln)
The potential issue with Smithville is related to the pump station and force main, not the gravity trunk system. According to the Philips Study prepared for West Lincoln, the pump station has a capacity of 85 l/s and that the observed flow was 54.5 l/s. This flow was measured when chicken farm (the largest single flow contributor) was shut down. Option D has an increase of base flow of 11.62 l/s for residential and 5.5 l/s for ICI in the year 2031. Depending on the contribution of chicken farm and how conservative an approach to peaking and inflow and infiltration, there is a 5 to 15 year window to deal with this pump station. That allows for the Region to complete the Master Servicing Plan prior to addressing the pump station if they choose to do so.

Thorold South
The Thorold connection to the Port Weller System requires attention in the short term. This potentially may limit development in the future.

1.5 Wet Weather Flows

An analysis of wet weather flows was not completed as part of this exercise; however, we are aware that there is a significant wet weather flow issue Region wide. This could potentially limit development, but the local can work on their systems to limit I&I and free up capacity for development.

2 Summary

Although various segments have been identified as requiring further study, overall the

majority of the Regional Trunk System has more than adequate capacity for future growth dry weather flows. Obviously some of the listed segments are true capacity issues, but there are other issues such as reverse grade which may affect the outcome.

This broad statement only addresses capacity issues and does not address other system indicators such as structural integrity and infiltration and inflow. These factors may warrant rehabilitation of replacement of trunk systems long before capacity is used.