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Memo

From: Andrew Garland
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To:	Township of North Huron Attn: Sean McGhee, Director of Public Works
Re:	Update for Technical Memo No. 1: Reserve Capacity Analysis for the North Huron Major Water and Wastewater Facilities
File #:	17181
Date:	June 27, 2019

Sean:

1.0 Purpose of Memo

The purpose of this memo is to summarize our analysis of the reserve capacities of the following water and wastewater system components for Wingham and Blyth:

- Water Treatment Systems
- Water Storage Facilities
- Wastewater Treatment Plant (WWTP)

The information provides the basis for existing system capacities, both total and reserve, which is used in evaluation of projected expansion timing requirements as part of the Water and Wastewater Master Plan (WWWMP). The information can be used when considering proposals for new development, and planning for infrastructure expansions.

2.0 Existing Customers and Development Information

2.1 Existing Customers

As of December 2018:

- Water system
  - Wingham = 1,557[1]
  - Blyth = 512[2]
- Wastewater system
  - Wingham = 1,559[3]
  - Blyth = 493[4]

[1] 1,275 water bills are issued. The value of 1,557 accounts for multi units with only one meter.
[2] 446 water bills are issued. The value of 512 accounts for multi units with only one meter.
[3] 1,254 sewage bills are issued. The value of 1,559 accounts for multi units with only one bill.
[4] 428 sewage bills are issued. The value of 493 accounts for multi units with only one bill.

2.2 Development Commitments

The following is based on plans and draft plans of development that are “approved”, or for which approval is pending. In some cases assumptions have been made about the number of potential units in multi-unit parcels.

Table 2.1A
Development Commitments - Wingham

Development Name	Single Units	Multi Units	Total
A2A	454	-	454
Hutton Heights	100	-	100
Infill allowance	25	-	25
Total Commitments	579	-	579

Table 2.1B
Development Commitments - Blyth

Development Name	Single Units	Multi Units[1]	Total
GJAJ Holdings	35	70	105
Infill allowance	25	-	25
Total Commitments	60	70	130

Notes: 1. Including apartments.

The above commitments are considered to be applicable to both water and wastewater servicing.

2.3 Other Commitments

The Township is party to a Cross-Border Servicing Agreement (CBSA) with the Municipality of Morris-Turnberry. The CBSA relates to water and wastewater (sanitary sewer) servicing, for specific Morris-Turnberry properties, from Wingham infrastructure. The total combined commitment for all properties, for each utility is:

- Water – 682.5 m^3/day
- Wastewater – 247.7 m^3/day

Though the CBSA expresses capacity commitments in terms of m^3/day, actual usage per day is unavailable. From the annual metered volumes provided for water, it is estimated that, as a daily average, less than 50 m^3/day of water is being used. Wastewater flows are not metered.

For the purposes of the reserve capacity analysis, it is assumed that the entire CBSA values are unused commitments for the Wingham water and wastewater systems. This does not account for actual usages that are contained within historical water demand and

sewage flow data provided below, but provides a somewhat conservative approach to the analysis.

3.0 Definition of an ERU

For the purposes of quantifying servicing requirements for current development commitments and future growth, water demands and wastewater flows are described in terms of Equivalent Residential Units (ERUs). An ERU is defined as the unit flow design value for an individual residential unit, including single detached, semi-detached, apartments, condominiums, etc. Water demands and wastewater flows per ERU are calculated in Sections 4.0 and 6.0, respectively.

Where available, large non-residential water and wastewater flow data has been subtracted from total flows, and the associated number of non-residential customers subtracted from the total number of customers, in order to better represent actual residential unit demands. This methodology applies to Wingham water and wastewater, with wastewater non-residential contribution taken as equivalent flow to water demand.

Where non-residential flow data is not available, the total flows and total number of customers is used for the analysis. This will generally result in a slight overestimation of each residential unit servicing requirements, providing an underestimation of reserve capacity for ERUs, assuming non-residential customers have greater demands per connection than residential customers do. This methodology applies to Blyth water and wastewater.

4.0 Water Treatment Plant Reserve

4.1.1 Wingham Water Treatment Capacity

The rated treatment capacity of the Wingham system is established by Schedule C, Table 1 of Municipal Drinking Water License (MDWL) No. 090-102 Issue No. 4, dated June 20, 2017.

- Well No. 3 Capacity = 6,537 m^3/day
- Well No. 4 Capacity = 5,270 m^3/day

The firm capacity of the system, which is defined as the capacity with the largest well out of service, is **5,270 m^3/day**.

4.1.2 Wingham Current Water Demands

Table 4.1
Maximum Day Demand 2013 to 2017 - Wingham

Year	Maximum Day (m^3/d)
2013	2,195
2014	2,426
2015	2,174
2016	2,277[1]
2017	2,241
2018	2,195

Notes: 1. Ignoring August 9 value of 5,664 m^3 which was due to control malfunction.

Because maximum water demands vary from year to year depending on environmental conditions the existing demand, for reserve capacity calculations purposes, is generally considered to be the maximum day in the previous three years.

Current Maximum Demand = **2,277 m^3/d**

4.1.3 Wingham Total Reserve Capacity

Total Reserve = 5,270 – 2,277
= **2,993 m^3/d**

4.1.4 Wingham Per Customer Usage

The 10 largest non-residential water users account for 374 m^3/day, as an average, for 2015 and 2016. Data is not available on a maximum day basis, therefore it is not possible to determine if demands for these customers change significantly from day to day. For the purposes of this analysis, average day is assumed to be equal to maximum day, which may provide an overestimation of residential water use and a factor of safety in establishing reserve capacity.

$$\text{Per Customer Demand} = \frac{2{,}277 - 374\ m^3/d}{1{,}557 - 10\ \text{ERU}}$$

= 1.23 m^3/d per ERU

4.1.5 Wingham Uncommitted Reserve Capacity

Total Reserve = 2,993 m^3/d

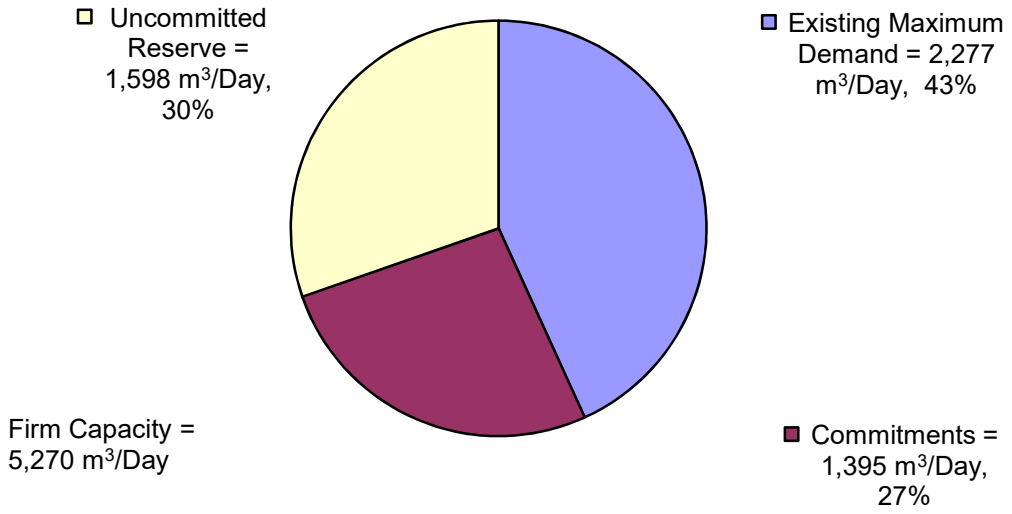
Commitments:
CBSA = 682.5 m^3/d
579 units x 1.23 = 712.2 m^3/d

Uncommitted Reserve = **1,598 m^3/d**

At 1.23 m^3/d per ERU the uncommitted reserve would be adequate for approximately **1,299** additional ERUs.

Figure 4.1 provides a graphical illustration of the Wingham water treatment existing usage, commitments, and uncommitted reserve in relation to system firm capacity.

Figure 4.1 - Water Treatment Capacity - Wingham



4.2.1 Blyth Water Treatment Capacity

The rated treatment capacity of the Blyth system is established by Schedule C, Table 1 of Municipal Drinking Water License (MDWL) No. 090-101 Issue No. 3, dated June 20, 2017.

- Well No. 1 & 2 Capacity = 1,149 m^3/day
- Well No. 5 Capacity = 1,728 m^3/day

The firm capacity of the system is **1,149 m^3/day**.

4.2.2 Blyth Current Water Demands

Table 4.2
Maximum Day Demand 2013 to 2017 - Blyth

Year	Maximum Day (m^3/d)
2013	622
2014	745
2015	810
2016	1,010[1]
2017	762
2018	1,019[2]

Notes: 1. This value due to hydrant flushing.
2. This value was excluded as an anomaly

Per Section 4.1.2, maximum demand is generally considered to be the maximum day in the previous three years. The 2016 value is disregarded because it is due to hydrant flushing, which could be limited as necessary to reduce daily demand. The 2018 value was considered to be an anomaly and the 2015 value was chosen as a conservative maximum for the purpose of this calculation.

Current Maximum Demand = **810 m^3/d**

4.2.3 Blyth Total Reserve Capacity

Total Reserve = 1,149 – 810
= **339 m^3/d**

4.2.4 Blyth Per Customer Usage

$$\text{Per Customer Demand} = \frac{810\ m^3/d}{500\ \text{ERU}}$$

= 1.62 m^3/d per ERU

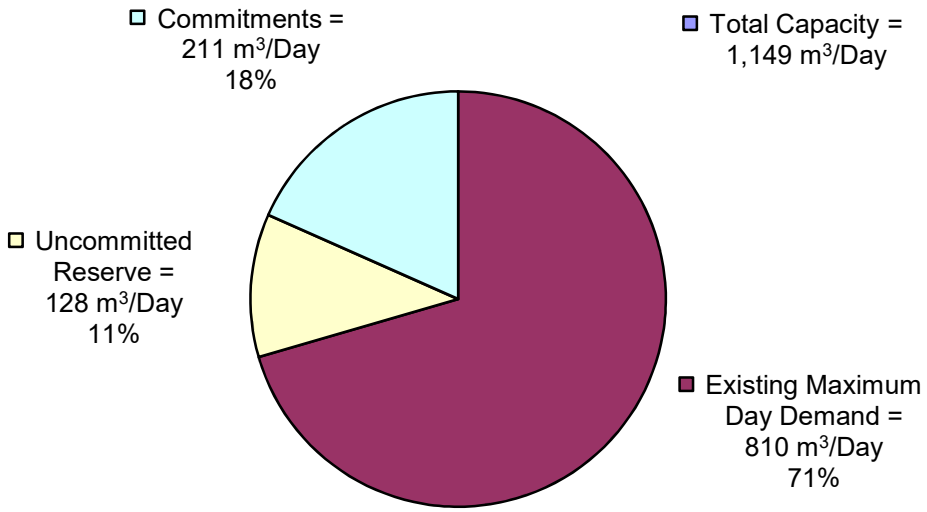
4.2.5 Blyth Uncommitted Reserve Capacity

Total Reserve	=	339 m^3/d
Commitments (130 units x 1.62)	=	211 m^3/d
Uncommitted Reserve	=	**128 m^3/d**

At 1.62 m^3/d per ERU the uncommitted reserve would be adequate for approximately **79** additional ERUs.

Figure 4.2 provides a graphical illustration of the Blyth water treatment existing usage, commitments, and uncommitted reserve in relation to system firm capacity.

Figure 4.2 - Water Treatment Capacity - Blyth



5.0 Water Storage Reserve

5.1 Existing Facilities

Table 5.1 identifies the existing storage facilities and their volumes.

Table 5.1
Water Storage Facilities – Wingham and Blyth

Facility	Total Volume (m^3)	Effective Volume (m^3)
Wingham Standpipe	1,680	232[1]
Blyth Reservoir	379	379

Notes:

1. Currently only the top 4 m of the standpipe is available by gravity.

5.2 Required Volumes

(a) General

Water storage is used to provide:

- Peak flow equalization
- Water supply for fire protection
- Water supply for emergencies

The above requirements are listed in order of priority and discussed in more detail in the following sections.

(b) Storage for Peak Flow Equalization

Normally, the water supply and treatment facilities are designed to provide supply for the "maximum day" demand. If there is insufficient storage (e.g. standpipe, reservoir) to satisfy the peak flow equalization requirements (typically taken as 25% of the maximum day demand) then peak demands must be met from other storage (e.g. chlorine contact reservoir) or from surplus in the treatment facilities (i.e. water provided directly from treatment system rather than from storage).

Tables 5.2A and B provide the peak flow equalization required for the existing and committed serviced scenarios, for Wingham and Blyth, respectively.

Table 5.2A
Storage Requirements for Peak Flow Equalization - Wingham

Scenario	Volume Required (m^3)
Existing	569
Existing + Commitments	918

Table 5.2B
Storage Requirements for Peak Flow Equalization - Blyth

Scenario	Volume Required (m^3)
Existing	203
Existing + Commitments	255

While the total storage volume in each community is greater than the required volume for peak flow equalization, limitations in effective volume in Wingham result in a deficit of 655 m^3 in uncommitted volume.

(c) Storage for Fire Protection

The MOECC Guidelines (2008) recommend the following volumes for fire protection purposes:

Table 5.3A
Storage Requirements for Fire Protection - Wingham

Scenario	Criteria[1]	Volume Required (m^3)
Existing	109 L/s x 2 hours	785
Existing + Commitments	148 L/s x 2.3 hours	1,225

Table 5.3B
Storage Requirements for Fire Protection - Blyth

Scenario	Criteria[1]	Volume Required (m^3)
Existing	63 L/s x 2 hours	454
Existing + Commitments	72 L/s x 2 hours	518

Notes:
1. Volumes are based on formulas in MOECC Guidelines (2008). Assume 2.1 persons per customer in Wingham and calculated number of ERUs equivalent to CBSA flows. Assume 2.2 persons per customer in Blyth.

In each community, the fire flow requirement exceeds the uncommitted reserve volume. Some of this deficit is currently made up with surplus treatment capacity.

(d) Storage for Emergencies

As per the MOECC Guidelines (2008), emergency storage is typically taken as 25% of the of the total volume of peak flow equalization plus fire storage. Given that neither community has sufficient storage to meet peak flow equalization plus fire storage design volumes, neither community has emergency storage that meets design values. Tables 5.4A and 5.4B summarize the design storage values for Wingham and Blyth, respectively.

Table 5.4A
Storage Requirements for Emergencies - Wingham

Scenario	Volume Required (m^3)
Existing	339
Existing + Commitments	536

Table 5.4B
Storage Requirements for Emergencies - Blyth

Scenario	Volume Required (m^3)
Existing	164
Existing + Commitments	193

(d) Storage Summary

The Wingham standpipe has a total volume of approximately 1,680 m^3, of which 232 m^3 is the effective volume. The Blyth reservoir has a total and effective volume of 379 m^3. Tables 5.5A and 5.5B summarize the individual component and total design storage volumes for Wingham and Blyth, respectively, based on MOECC Design Guidelines (2008).

Table 5.5A
Storage Summary - Wingham

Scenario	Volume Required (m^3)			
	For Equalization	For Fire Protection	For Emergency	Total
Existing	569	785	339	1,693
Existing + Commitments	887	1,225	536	2,679

Table 5.5B
Storage Summary - Blyth

Scenario	Volume Required (m^3)			
	For Equalization	For Fire Protection	For Emergency	Total
Existing	203	454	164	821
Existing + Commitments	255	518	193	966

6.0 Wastewater Treatment Plant Reserve

6.1.1 Wingham WWTP Capacity

The hydraulic or volumetric capacity of the existing wastewater treatment plant is established by Environmental Compliance Approval (ECA) No. 1040-9HAN94, dated May 30, 2014, as **3,400 m^3/day** on an annual average basis.

The ECA also sets limits on organic, solids, phosphorus, and ammonia loadings (i.e. concentration x volume) on a monthly basis.

6.1.2 Wingham Current Wastewater Flows

Table 6.1 identifies the annual average and maximum day flows for the previous three years.

Table 6.1
Wastewater Flows 2015 -2017 - Wingham

Year	Annual Average (m^3/day)	Maximum Day (m^3/day)
2015	1,917	11,096
2016	2,311	13,626
2017	2,385	10,337
2018	2,246	14,359
3 Year Average	2,314	-
3 Year Maximum	-	14,359

6.1.3 Wingham Total Reserve Based on Annual Average Flow

Total Reserve = 3,400 – 2,314
= **1,086 m^3/d**

6.1.4 Wingham Total Reserve Based on Maximum Monthly Average Loading

As noted, the ECA stipulates limits for effluent loading (kg/day) on a monthly basis. The maximum monthly average flow for the previous three years was 5,530 m^3/d in April of 2016, the second highest volume was 4,584 m^3/d in March of 2016 and the third greatest was 4,013 m^3/d in April 2016. Table 6.2 compares requirements to historical performance.

Table 6.2
Effluent Loading Experience - Wingham

Parameter	Non-Compliance Limit (kg/day)	Actual[1] at 5,530 m^3/d (kg/day)	Actual[1] at 4,584 m^3/d (kg/day)	Actual[1] at 4,013 m^3/d (kg/day)
$CBOD_5$	51.0	16.6	9.2	8.0
TSS	51.0	22.1	22.9	8.0
TP	1.7	1.05	0.93	0.58
TAN	See Note 2	1.84	0.61	0.40

Notes:
1. Based on average concentration for the month.
2. 10.2 kg/day for “freezing period”, normally taken as December 15 to April 15. 2.7 kg/day for “non-freezing period”.

Based on the estimated loadings for the three greatest monthly flows during the previous three years, actual loadings have been well under non-compliance limits. A review of annual reports for 2012 to 2018 has also confirmed that the loading criteria have consistently been met. Although it is not possible to accurately establish reserve capacity

based on effluent loading, it is our observation that use of the hydraulic annual average flow is the best and most reasonable approximation of reserve capacity.

6.1.5 Wingham Per Customer Flows

Refer to Section 4.1.4 for a discussion related to non-residential flows. The same methodology is used here, assuming that non-residential water demand is equivalent to non-residential wastewater flow.

$$\text{Per Customer Flow} = \frac{2{,}314 - 374\ m^3/d}{1{,}559 - 10\ ERU}$$

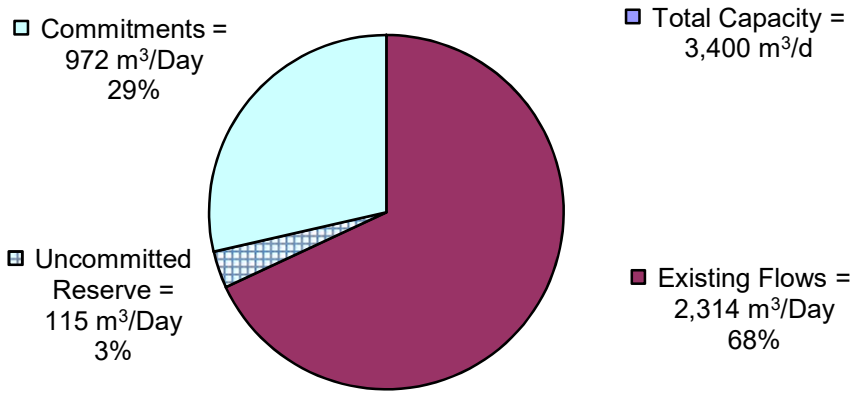
$$= 1.25\ m^3/d/ERU$$

6.1.6 Wingham Uncommitted Reserve Capacity

Total Reserve	=	1,086 m^3/d
Commitments:		
CBSA	=	247.7 m^3/d
579 units x 1.25	=	723.8 m^3/d
Uncommitted reserve	=	**114.5 m^3/d**

At 1.25 m^3/d per ERU the uncommitted reserve would be adequate for approximately **92** additional ERUs.

Figure 6.1 - Wastewater Treatment Plant Capacity - Wingham



6.2.1 Blyth WWTP Capacity

The hydraulic or volumetric capacity of the existing wastewater treatment plant is established by ECA No. 8687-826L6Z, dated February 9, 2010, as **730 m^3/day** on an annual average basis and a peak flow rate of 2,730 m^3/day.

The ECA also sets limits on organic, solids, and phosphorus loadings on a monthly basis.

6.2.2 Blyth Current Wastewater Flows

Table 6.3 identifies the annual average and maximum day flows for the previous three years.

Table 6.3
Wastewater Flows 2015 -2017 - Blyth

Year	Annual Average (m^3/day)	Maximum Day (m^3/day)
2015	382	1,671
2016	393	2,186
2017	412	1,892
2018	413	2,854
3 Year Average	406	-
3 Year Maximum	-	2,854

6.2.3 Blyth Total Reserve Based on Annual Average Flow

We caution, calculating reserve capacity based on peak flows may provide different results than on an average basis, although maximum day values are below the ECA peak flow rate. The calculation below is provided on the basis of average daily flow rates. The reason it is difficult to calculate reserve on peak basis relates to varying infiltration & inflow (I&I) assumptions for existing versus new development (e.g. “old” areas expected to have greater I&I per development area as compared to “new” development).

Total Reserve = 730 – 406
= **324 m^3/d**

6.2.4 Blyth Total Reserve Based on Maximum Monthly Average Loading

As noted, the ECA stipulates limits for effluent loading (kg/day) on a monthly basis. The maximum monthly average flow for the previous three years was 874 m^3/d in April of 2016, the second highest volume was 680 m^3/d in March of 2016 and the third greatest was 671 m^3/d in January of 2017. Table 6.4 compares requirements to historical performance.

Table 6.4
Effluent Loading Experience - Blyth

Parameter	Non-Compliance Limit[1] (kg/day)	Actual[2] at 874 m^3/d (kg/day)	Actual[2] at 680 m^3/d (kg/day)	Actual[2] at 671 m^3/d (kg/day)
$CBOD_5$	11.0	1.75	1.36	1.34
TSS	11.0	2.04	1.36	1.34
TP	0.7	0.08	0.11	0.16

Notes:
1. Values shown are for Nov. 1 to April 30. For May 1 to Oct. 31, values of 3.7, 3.7, and 0.2 (CBOD5, TSS, TP) would apply.
2. Based on average concentration for the month.

Based on the estimated loadings for the three greatest monthly flows during the previous three years, actual loadings have been well under non-compliance limits. A review of annual reports for 2012 to 2017 has also confirmed that the loading criteria have generally been met, with the exception of single monthly exceedances for E. Coli, TP, and TSS.

6.2.5 Blyth Per Customer Flows

$$\text{Per Customer Flow} = \frac{406\ m^3/d}{482\ \text{ERU}}$$

$$= 0.84\ m^3/d/\text{ERU}$$

6.2.6 Blyth Uncommitted Reserve Capacity

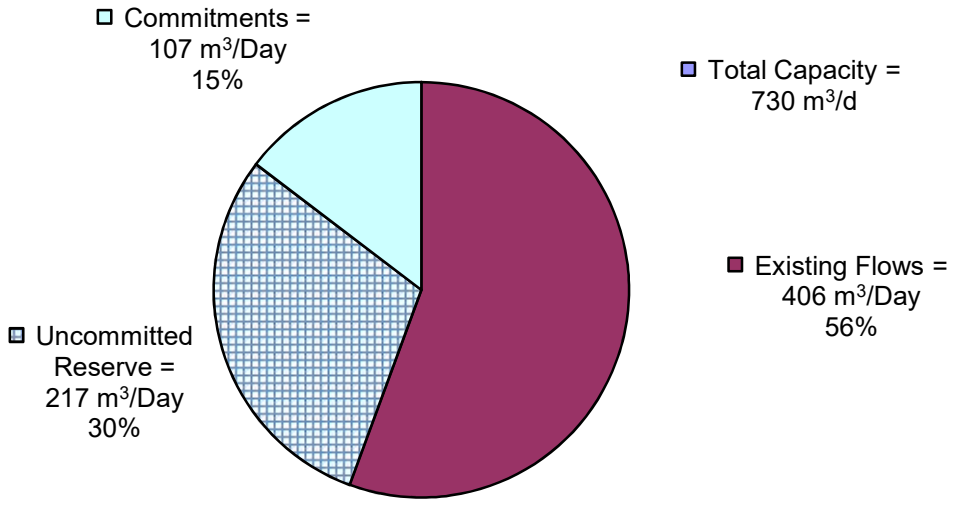
Total Reserve = 324 m^3/d

Commitments (130 units x 0.84 m^3/d) = 107 m^3/d

Uncommitted reserve = **217 m^3/d**

At 0.84 m^3/d per ERU the uncommitted reserve would be adequate for approximately **259** additional ERUs.

Figure 6.2 - Wastewater Treatment Plant Capacity - Blyth



7.0 Summary

This assessment looked at the capacities of the following major water and wastewater facilities servicing the communities of Wingham and Blyth:

- Water Treatment Systems
- Water Storage Facilities
- Wastewater Treatment Plants

Reserve capacities for the treatment plants are as follows:

Table 7.1A
Treatment Plant Capacities - Wingham

Facility	Rated Capacity (m^3/d)	Total Reserve (m^3/ d)	Uncommitted Reserve		
			(m^3/d)	(% of Total)	(Approx. Units)
Water Treatment	5,270	2,993	1,598	30	1,299
WWTP	3,400	1,086	115	3	92

Table 7.1B
Treatment Plant Capacities - Blyth

Facility	Rated Capacity (m^3/d)	Total Reserve (m^3/ d)	Uncommitted Reserve		
			(m^3/d)	(% of Total)	(Approx. Units)
Water Treatment	1,149	339	119	10	79
WWTP	730	324	217	30	259

Analysis of the capacity of the water storage facilities established that there is adequate storage for peak flow equalization in Blyth, but insufficient effective storage in Wingham. Neither community has storage to satisfy MOECC Design Guideline values for fire protection, and at least a portion of the water required for fire protection must come from surplus treatment capacity.

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Andrew Garland, P. Eng.