APPENDIX A

Population & Flow Data, Storage Calculations

Date:		By: NML		Sheet No: 1
Project No.: 184328		Project: Pelham New ET Class EA		
Description: Population & Water Storage Calcs				

1. 2016 MSP Population and Demand

From the 2016 MSP, the following is the forecasted population for the Pelham Service Area broken into Pressure Zones, and with associated average and maximum day water demands:

Location	Pressure Zone	Year	Serviced Population	Serviced Employment	Total Population	Average Day Demand (MLD)	Maximum Day Demand (MLD)
Fenwick	247	2014	1664	620	2284	0.7	1.0
		2021	1710	709	2419	0.7	1.1
		2026	1853	764	2617	0.8	1.2
		2031	2042	855	2897	0.9	1.3
		2036	2268	945	3213	0.9	1.4
		2041	2550	1061	3611	1.1	1.6
Fonthill East	248	2014	7968	2271	10239	2.2	3.4
		2021	8630	2522	11152	2.5	3.8
		2026	9824	2693	12517	2.9	4.5
		2031	11503	2964	14467	3.5	5.3
		2036	12833	3233	16066	4.0	6.1
		2041	13685	3572	17257	4.3	6.6
Ridgeville (Between Fonthill & Fenwick)	268	2014	2229	230	2459	0.3	0.4
		2021	2297	257	2554	0.3	0.4
		2026	2458	273	2731	0.3	0.5
		2031	2675	293	2968	0.4	0.6
		2036	2914	315	3229	0.5	0.8
		2041	3212	340	3552	0.6	0.9
Fonthill West	272	2014	3278	920	4198	1.2	1.9
		2021	3321	1009	4330	1.3	1.9
		2026	3337	1072	4409	1.3	2.0
		2031	3378	1170	4548	1.3	2.0
		2036	3753	1268	5021	1.5	2.2
		2041	3835	1389	5224	1.5	2.3

The following table summarizes the 2014 population, the total forecasted additional population to 2041 from the 2016 MSP, and the total forecasted population to 2041 from the MSP. Additionally the table shows the updated forecasted population to 2041 from Niagara Region's Planning and Development Services Department, and the updated total forecasted population to 2041.

	Population Based on 2016 MSP	Population Based on Niagara Region's Updates
2014 Population	19,180	19,180
Forecasted Additional Population to 2041	10,464	13,500
Forecasted Total Population in 2041	**29,644**	**32,680**

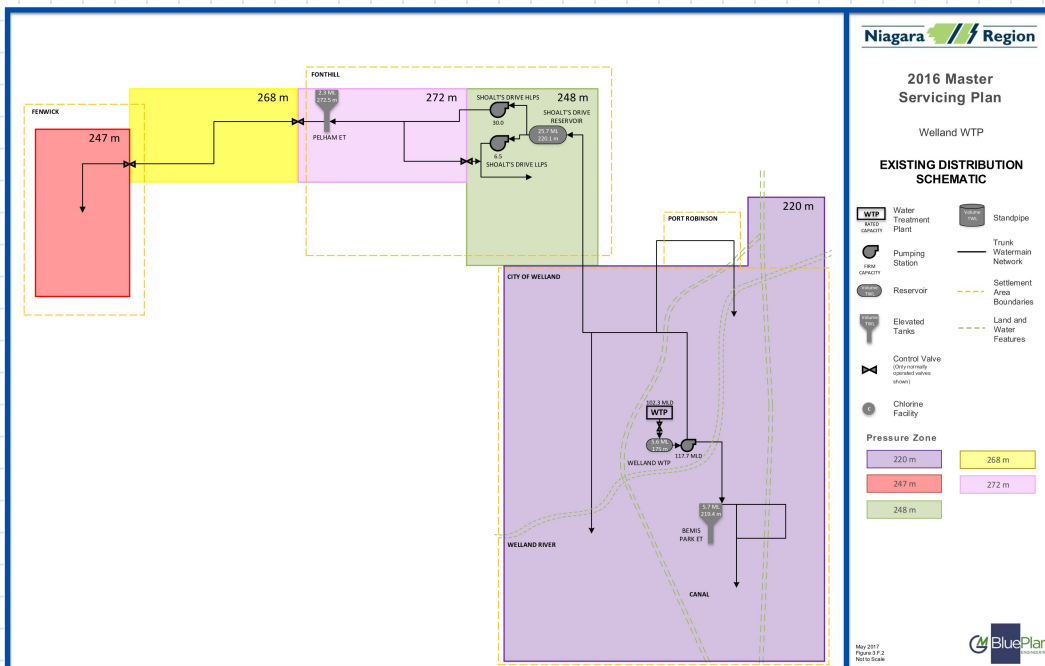| Date:		By: NML	Sheet No: 2
Project No.: 184328		Project: Pelham New ET Class EA	
Description: Population & Water Storage Calcs			

The increase in the forecasted population from the 2016 MSP and the Region's updated forecast is approximately 3,036 persons. Based on this, the total Average and Maximum Day Demands were updated to reflect the increase in population:

Location	Pressure Zone	Year	Total Population	Average Day Demand (MLD)	Maximum Day Demand (MLD)
Fenwick	247	2041	3,611	1.1	1.6
Fonthill East	248	2041	17,257	4.3	6.6
Ridgeville	268	2041	3,552	0.6	0.9
Fonthill West	272	2041	5,224	1.5	2.3
Forecasted Population Increase		2041	3,036	1.1*	1.6*

Note: The associated average day and maximum day water demands for the additional forecasted population were not provided by the Region. Since the additional forecasted population is similar to that of Fenwick (Pressure Zone 247), the same average day and maximum day water demands were used.

The new EST will service Fonthill West (Pressure Zone 272), Ridgeville (Pressure Zone 268), and Fenwick (Pressure Zone 247). As the additional forecasted population is not broken down by pressure zone, to be conservative it is assumed that the forecasted population increase of 3,036 will also be serviced by the new EST. The total forecasted population, and average day and maximum day water demands to be serviced by the new EST are as follows:

	Forecasted Population to be Serviced by New EST	Average Day Demand (MLD)	Maximum Day Demand (MLD)
Total (2041)	15,423	4.30	6.40

Excerpt from 2016 MSP showing the pressure zones in the Pelham Service Area, and which zones the existing EST services. The new EST will replace the existing EST and service the same zones.

The required storage volume of the new EST to service the forecasted 2041 population was calculated based on the Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Drinking Water Systems (last updated May 15, 2019):

Total Treated Water Storage Requirement = A + B +C

Where: A = Fire Storage

B = Equalization Storage (25% of the Maximum Day Demand)

C = Emergency Storage (25% of A + B)

(A) Fire Storage Volume Calculation:

Based on the forecasted service population of 15,423, the suggested fire flow (L/s) and duration (hours) were linearly interpolated based on Table 8-1: Fire Flow Requirements from the MECP Design Guidelines.

Excerpt of Table 8-1: Fire Flow Requirements

Equivalent Population	Suggested Fire Flow (L/s)	Duration (hrs)
13,000	220	3
17,000	250	4

Interpolated Fire Flow & Duration Based on Population of 15,243:

- Fire Flow = 237 L/s (853,200 L/hour)
- Duration = 3.6 Hours

Fire Storage Volume Required

= Fire Flow x Duration

= 853,200 (L/hour) x 3.6 hours

= 3,071,520 L

= 3.07 ML

(B) Equalization Storage Volume Calculation:

Based on the total Maximum day demand of 6.40 MLD, the equalization storage volume required is:

Equalization Storage = 0.25 x Max Day Demand

= 0.25 x 6.40 MLD

= 1.6 ML

(C) Emergency Storage Volume Calculation:

Based on the fire storage and equalization storage volumes calculated above, the emergency storage volume required is:

Emergency Storage = 0.25 x (Fire Storage + Equalization Storage)

= 0.25 x (3.07 ML + 1.6 ML)

= 1.17 ML

(D) Total Treated Water Storage Calculation:

Based on the storage volumes for fire, equalization, and emergency calculated above, the total treated water storage required for the new EST is:

Total Treated Water Storage

= A + B +C

= 3.07 ML + 1.6 ML +1.17 ML

= 5.84 ML

However, the 2016 MSP recommended a total storage volume for the new EST of 6 ML. The additional capacity would allow the new EST to feed water back to East Fonthill (Pressure Zone 248) and improve the flexibility and redundancy of the overall water system.

Date:	By: FFF	Sheet No: 4
Project No.: 184328	Project: Pelham New ET Class EA	
Description: Population & Water Storage Calcs		

1. Ongoing MSP Population and Demand

From the ongoing MSP, the following is the forecasted population for the Pelham Service Area broken into Pressure Zones, provided by the Region in November 2022. It should be noted that the Region is still in the midst of updating the MSP, the population data has not been finalized and is subject to change.

Zone	Location	Pop 2051	Emp 2051	Total
247	Fenwick	2,986	778	3,764
268	Ridgeville	1,914	445	2,359
272	Fonthill West	5,687	1,346	7,033
			Total	13,156

The Design Criteria used for the ongoing MSP was provided by the Region, and summarized below:
- Per capital consumption: 240 L/c/d for residential and 270 L/e/d for employment
- Peaking factor: for this exercise, a peaking factor of 1.5 was used, which is the average of what was used for the three service areas in 2016 MSP
- Fire flow: 30 psi residual pressure with minimum 250 L/s for 4 hours for fire storage
- Overall Storage: MECP methodology (A+B+C)

Zone	Location	Pop Flow (L/s)	Emp Flow (L/s)	Avg Day Demand (MLD)	Max Day Demand (MLD)
247	Fenwick	716640	210060	1.1	1.7
268	Ridgeville	459360	120150	0.6	0.9
272	Fonthill West	1364880	363420	1.5	2.3
				Total	4.8

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Date:	By: FFF	Sheet No: 5
Project No.: 184328	Project: Pelham New ET Class EA	
Description: Population & Water Storage Calcs		

The required storage volume of the new EST to service the forecasted 2051 population was calculated based on the Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Drinking Water Systems (last updated May 15, 2019):

Total Treated Water Storage Requirement = A + B + C

Where: A = Fire Storage
B = Equalization Storage (25% of the Maximum Day Demand)
C = Emergency Storage (25% of A + B)

(A) Fire Storage Volume Calculation:

Based on the forecasted service population of 13,156, the suggested fire flow (L/s) and duration (hours) were provided by the design criteria from the ongoing MSP.

Fire Storage Volume Required = Fire Flow x Duration
= 250 L/s x 4 hours
= 3.6 ML

(B) Equalization Storage Volume Calculation:

Based on the total Maximum day demand of 4.8 MLD, the equalization storage volume required is:

Equalization Storage = 0.25 x Max Day Demand
= 0.25 x 4.8 MLD
= 1.2 ML

(C) Emergency Storage Volume Calculation:

Based on the fire storage and equalization storage volumes calculated above, the emergency storage volume required is:

Emergency Storage = 0.25 x (Fire Storage + Equalization Storage)
= 0.25 x (3.6 ML + 1.2 ML)
= 1.2 ML

(D) Total Treated Water Storage Calculation:

Based on the storage volumes for fire, equalization, and emergency calculated above, the total treated water storage required for the new EST is:

Total Treated Water Storage = A + B + C
= 3.6 ML + 1.2 ML + 1.2 ML
= 6 ML

Both Scenarios reached the same conclusion that the overall storage requirement is 6 ML

The 2016 MSP recommended capacity of 6 ML for the new EST was therefore adopted.