S.BURNETT & ASSOCIATES LIMITED
ENGINEERING & ENVIRONMENTAL

TOWNSHIP OF EAST GARAFRAXA

MARSVILLE WATER SYSTEM ASSESSMENT

TOWNSHIP OF EAST GARAFRAXA

SEPTEMBER 2025

SBA File No.: M24019

REPORT PREPARED BY:

S. BURNETT & ASSOCIATES LIMITED

www.sbaengineering.com |
Tel (519) 941-2949 | Fax (519) 941-2036 | info@sbaengineering.com
210 Broadway, Unit 203 Orangeville, ON L9W 5G4

September 26, 2025

Township of East Garafraxa
065371 Dufferin County Road 3, Unit 2
East Garafraxa, ON L9W 7J8

Attn: Peter Avgoustis, Chief Administrative Officer
pavgoustis@eastgarafraxa.ca

Re: Township of East Garafraxa, Marsville Water System Conditions Assessment Study
Conditions Assessment Report
SBA File No: M24019

Dear Peter,

S. Burnett & Associates Limited (SBA) is pleased to provide this Conditions Assessment Report for the Marsville, Ontario Drinking Water System. This report includes findings from the site visit that SBA completed, a summary of the current conditions of the water system's existing assets, necessary repairs and cost estimates, a desktop review of the pumphouse's capacity and its ability to treat current and expected future demands. Also included in the Appendix are the results of hydraulic modelling of the existing distribution system. This report will allow the Township of East Garafraxa to update its Township Asset Management Plan and meet the requirements of Ontario Regulation 588/17.

Thank you for the opportunity to work together on this important project. Should you have any questions please do not hesitate to contact us.

Yours truly,

Daymar Creary, P.Eng.
Senior Civil/Environmental Engineer
S. Burnett & Associates Limited

Stephen Burnett, P.Eng.
Principal
S. Burnett & Associates Limited

cc: Matthew Wick, Manager, Capital Delivery and Environmental Services, Township of East Garafraxa, mwick@eastgarafraxa.ca

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1. Introduction

Marsville is a small community in southwestern Ontario within the Township of East Garafraxa (the “Township”). The Township itself is a predominantly rural community west of the Town of Orangeville in Dufferin County. It is also within commuting distance of several urban centers including Toronto, Brampton, Guelph and Kitchener. The location of Marsville, Ontario is shown in **Figure 1**.

The Marsville Subdivision Drinking Water System (DWS) is owned by the Township and is operated by the Dufferin Water Company Ltd. The distribution system provides water to 33 houses or approximately 106 people (R.J. Burnside & Associates Limited, 2023).

S. Burnett & Associates Limited (SBA) was retained by the Township to provide Engineering Services for a Condition Assessment Study for the DWS in Marsville, Ontario. The scope of the project is to assess the current conditions of the existing components in the DWS. As discussed with the Township, this report focuses on the conditions of the existing assets and necessary re-capitalization required to extend the life of the current asset, rather than on planned future system expansion. Also, the capacity of the pumphouse (PH) to meet current and future demands, raw water quality conditions, and treatment effectiveness are evaluated. As an added scope item agreed with the Township, SBA also completed a hydraulic model and assessment of the existing distribution system. It is understood that this assessment is required so that the Township can update the Township Asset Management Plan and meet the requirements of Ontario Regulation 588/17.

Figure 1: Site Location Map

MAP REFERENCE: MTO – OFFICIAL ROAD MAP OF ONTARIO

FIGURE 1
MARSVILLE, TOWNSHIP OF
EAST GARAFRAXA, ON

SITE LOCATION MAP

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PREPARED BY: D.S.

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2. Assessment of Existing Infrastructure

To support the Conditions Assessment, a Site Visit was completed on April 8, 2025, by SBA representatives Daymar Creary and Patrick King. The condition of the groundwater well, PH, and distribution system were reviewed. During the site visit, discussion took place with Dufferin Water Company Ltd. Operator Joe Miedema and the Township's Capital Delivery and Environmental Services Manager, Matthew Wick. This meeting allowed SBA staff to gain additional insight on operational concerns for the DWS. The following sections will detail the condition of the Township's water infrastructure, operational concerns and recommendations to support improved operation and/or equipment longevity. Photos from the site visit are included in **Appendix A**.

2.1 Well Source

The source of water for the Marsville Subdivision DWS is ground water from a production well. The well has a 150 mm diameter casing and is drilled to a depth of 91 m (Ahmed, 2020a). It is located immediately north of the PH. It is equipped with a pitless adaptor and a submersible pump that is rated at 173 L/min (249 m^3/d) with a total dynamic head (TDH) of 70 m according to the Drinking Water Works Permit No. 243-01 (Ahmed, 2020a). However, in the R.J. Burnside & Associates Limited, Water System Expansion Municipal Class Environmental Assessment (EA) Report, the pump capacity is noted to be 280 L/min at 44 m TDH (2023). Following discussions with the operator, SBA is of the opinion that these are two (2) different points on the same pump curve as the well pump has not been replaced recently. Nonetheless, the maximum permitted withdrawal under the Permit to Take Water (PTTW) (No. 8328-BQNRXE) is 365 L/min (526 m^3/d) (Meek, 2020), which is a higher flow rate than the submersible pump can supply. However, it is noted that the PTTW also limits water taking to eight (8) hours per day and a maximum daily volume of 182 m^3. The discharge line has a diameter of 75 mm that is connected to the well pump header in the PH (Miedema, 2024). There is a circular concrete barrier around the well to protect it from snowplows in the winter.

There is also another well that is currently not in use or connected to the PH. It has a 200 mm diameter steel casing and is drilled to a depth of 103 m. It is located about 10 m east of the PH and is fitted with a steel cap (Miedema, 2024). It is available for future use if required. However, the subdivision feasibility study suggests that the preferred future alternative is to develop a new well in this area and connect it to a new treatment plant rather than to use the current second well (R.J. Burnside & Associates Limited, 2023).

A copy of the known well records associated with the system are included in **Appendix B**.

The following observations/deficiencies were identified:

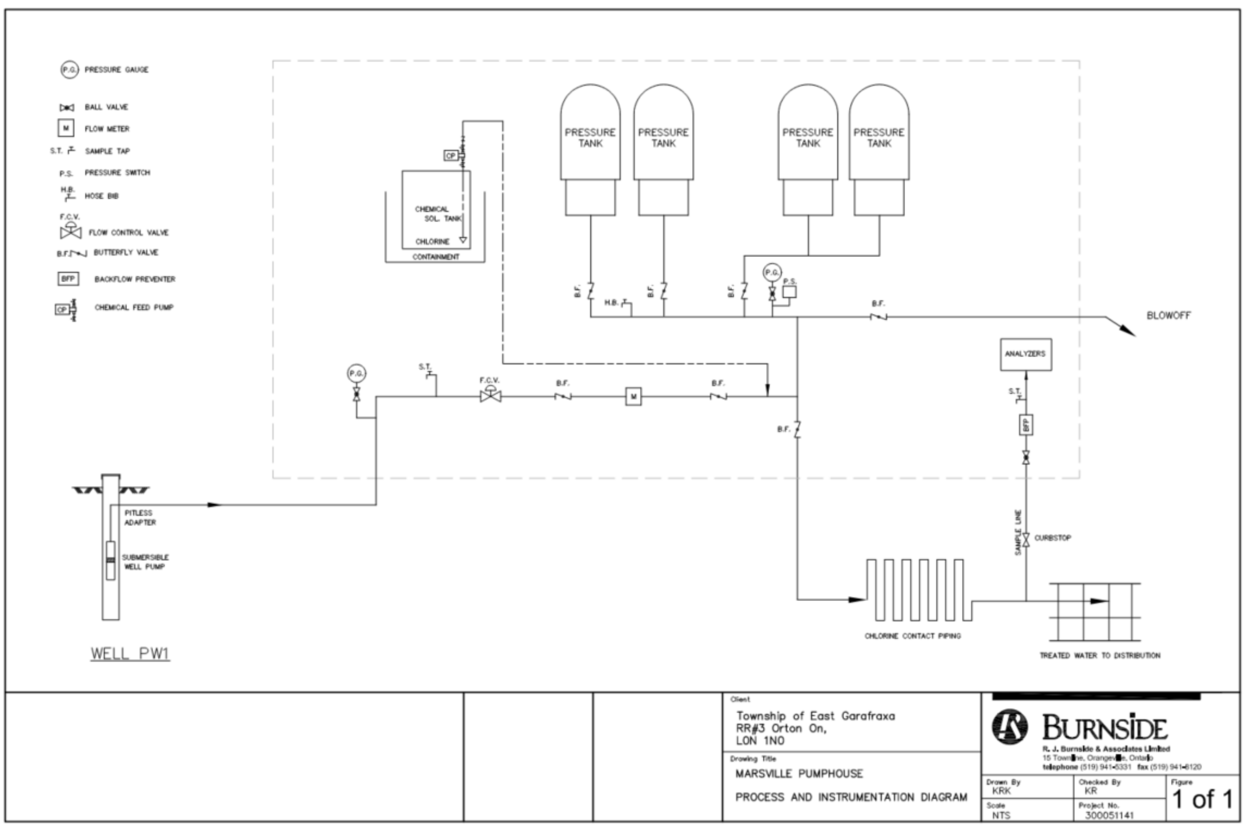
- Vegetation has grown within the concrete barrier and is partially obstructing access to the well.
- There is currently only one (1) production well and therefore there is no water supply redundancy. Although there is an additional well pump in the treatment plant that acts as a shelf spare there is only one (1) motor, and the system must be taken offline if the pumps are to be switched. As per the MECP guidelines, the firm capacity that municipal wells can supply is typically the water supply with the largest well out of service.
- The system does not currently provide fire protection.

2.2 Pumphouse (PH)

The PH has been in service for approximately 45 years. As it serves 33 dwellings (residences), it is classified as a small municipal residential system under O.Reg. 170/03 (Government of Ontario, 2022).

Figure 2 provides an overview of the current PH from the well source to the distribution system. The condition of the PH is discussed in the following section.

Figure 2: Process & Instrumentation Drawing (P&ID) for the Pumphouse from the Raw Water Source to the Distribution System (from Miedema, 2024)



2.2.1. Building

The PH building is located on the northeast end of Grand Crescent. The building itself is in relatively good condition; however, it is showing typical signs of ageing including cracks in the foundation, minor damage to exterior bricks, and minor deformation of the eavestroughs. Furthermore, the PH is small and there is no room for future expansion within the existing building. Hence, if an expansion is needed due to increased demand, a new facility will be needed.

2.2.2. Chlorine Injection System

Raw water from the well enters the PH from a floor penetration near the north wall. The raw water line includes a pressure gauge, sample tap, flow control valve, backflow preventor, flow meter and injection port. Most of the raw water line is ductile iron and is noted to be the original piping. It is aged and shows signs of corrosion. However, the piping from the flow control valve to the flow meter is PVC and is in good condition. Additionally, the isolation valve downstream of the flow meter is ductile iron and is corroding, although it is still operational.

The current disinfection chemical is 12% sodium hypochlorite. The chlorine dosing system includes a 100 L sodium hypochlorite solution tank with secondary containment, a chemical metering pump, chemical discharge tubing, and an injector. The chlorination is controlled by a relay that closes when the well pump cycles (Miedema, 2024). The chemical dosing system is generally in good condition. Only one (1) metering pump was observed during the site visit. The Drinking Water Works Permit does indicate that there is a shelf spare (Ahmed, 2020a), however it is recommended that a second standby chemical metering pump be added to prevent shutdowns in the case of duty pump failure.

It is noted that since the PH is a single room building, the sodium hypochlorite is stored in the same room as the PH equipment. This is not ideal, as chemical vapours can enhance corrosion of any metallic equipment and piping. The MECP *Design Guidelines for Drinking-Water Systems* does mention that "the chemical storage area should be segregated from the main areas of the treatment plant" (2008). Although the chemicals do have adequate secondary storage and are in a corner of the building closer to the pressure tanks than the distribution header, it is recommended to have a separate room for chemical storage. This would improve safety and the longevity of equipment and piping. However, as this is a best practice and not mandatory, SBA has not included this on our costed list of recommended upgrades. Also, as previously noted, it would be difficult to expand the footprint of the PH at its existing location to include a new chemical storage room.

2.2.3. Pressure Regulation

The PH includes four (4) pressure tanks that are connected via a treated water discharge header. All four (4) pressure tanks have a volume of 454 L and are designed to maintain the required operating pressures within the system and prevent excessive cycling by the pump (Miedema, 2024). At the time of the inspection, the pressure gauge downstream of the pressure tanks read 50 psi (35 m). The two (2) older pressure tanks are galvanized and are installed on a concrete platform and do not have a bladder. The two (2) newer pressure tanks are made from fibreglass and are installed on grade and have bladders. The header line includes several valves and appurtenances including flow control valves, a flow meter and pump to waste piping (blowoff line).

The header piping to the west that connects the two (2) older pressure tanks is galvanized iron piping, and is showing signs of ageing, namely corrosion. Several isolation butterfly valves are visibly corroding although they are still operational. Nonetheless, it is recommended that the galvanized piping and valves are replaced to ensure smooth operation and prevent future issues. The PVC piping and valves to the east that connects the newer pressure tanks are in good condition. All four of the pressure tanks are working properly and the operator did not note any concerns with their condition or operational performance.

2.2.4. Chlorine Contact Loop

To allow for full disinfection of the water before it reaches the first user, chlorine contact time is provided by a chlorine contact loop. The chlorine contact loop consists of 112 m long 250 mm diameter watermain. There is also an additional 70 m long 150 mm diameter section of watermain from the PH to the first residential service connection that is currently providing additional contact time. The treated water must pass through these watermains prior to being delivered to the first customer. The 250 mm diameter watermain passes north of the PH building to the northeast end of the park property and then back again to the front (west) of the PH building. At this point, there is a 19 mm service line that connects back to the PH to allow for free chlorine and pH measurement. The 150 mm diameter watermain travels southeast from the PH along Grand Crescent to the first service connection (Miedema, 2024).

The service line enters the PH through a floor penetration at the southwest corner of the building. Prior to the free chlorine analyzer, there is a ball valve followed by a backflow preventer. The water then passes through the free chlorine analyzer which measures free chlorine and pH. At the time of inspection, the free chlorine concentration was 1.14 ppm and pH was 8.03. The free chlorine analyzer effectively monitors the free chlorine residual in the treated water entering the distribution system. The wastewater from the analyzers is then sent to a drain and the PH’s soakaway pit.

If the free chlorine residual drops below a predetermined set point, then an alarm is generated, and the pumping equipment is shut down. The alarm is also sent by an auto dialler to the operator that is on-call. The free chlorine residual is continually monitored and stored to an onsite data logger. The data is downloaded and reviewed three (3) times per week by the operator, typically on Mondays, Wednesdays and Fridays (Miedema, 2024). The above ground components of the chlorine contact loop, including the free chlorine analyzer appear to be in good working condition. No concerns were noted by the Operator.

2.2.5. Emergency Power

As confirmed with the operator, the PH does not have an emergency back-up generator to provide standby power. Hence, in the case of a power outage, the PH is not capable of pumping water to the distribution system. The Operator did mention that in the case of longer power outages (several hours), a portable generator is brought to site to provide back-up power to restore water service.

The MECP *Design Guidelines for Drinking-Water Systems* indicate that a “plan should be developed to ensure that average day demand can be met during a power outage, and that at least an emergency level of lighting and process control operations can be maintained” (2008). The MECP further recommends for systems that do not have floating storage available for fire protection, that full standby power be supplied. In these cases, pumping facilities are usually small making the installation of a standby power unit the most economical approach.

Therefore, it is recommended that a permanent, on-site generator be provided for the PH to provide water supply to customers during power outages and reduce work for operators to bring a portable generator during longer outages.

2.3 Water Distribution System

The water distribution system consists of 630 metres of 150 mm diameter watermain and 33 service connections. The system also has five (5) flushing hydrants and seven (7) mainline valves (Miedema, 2024). The well pumps and pressure tanks are responsible for maintaining the distribution system pressure as the system does not have any high lift pumps or storage reservoirs. The current system does not provide fire protection. Furthermore, as mentioned by the operator, to flush the watermains a water truck must be brought to site as the system cannot produce water at the rate required for flushing.

It is also noted that the current watermains are not looped. Looping the watermains would provide benefits such as redundancy in case of breaks, reduced water stagnation and the potential for improved water quality. It would also improve fire protection capabilities if this were pursued in the future. However, due to the relatively large costs associated with looping and the fact that future subdivision development and future DWS upgrades will inherently create looping, SBA has not included looping at this time as a recommended upgrade for the current system.

2.3.1. Replacement Timelines for Underground Infrastructure

Underground infrastructure for the distribution system includes watermain piping, isolation valves, curb stops and flushing hydrants. Based on the existing as-built drawing information, it is presumed that most of the underground infrastructure was installed in 1971 and therefore is approximately 54 years old at the time of the report preparation. According to the as-built drawings, the watermain is comprised of 150 mm dia. PVC piping. Based on dig-up tests in the U.S. and around the world, there is evidence to suggest that PVC piping can easily exceed a service life of 100 years (Folkman, 2014). Furthermore, in SBA's experience, PVC piping has a general lifespan between 80 to 100 years. Hence, based on this assumption, replacement of the watermain piping should not be theoretically required over the next 20 years. That said, the actual lifespan and longevity will also depend on other factors like the type of PVC piping (i.e. Schedule 40 or 80), operating conditions, the quality of installation and in some cases exposure to ultraviolet (UV) light. If the distribution piping is affected by any of these factors, this would likely reduce the remaining lifespan to less than the theoretically projected 20 years noted above.

Isolation valves will have a typical lifespan of only about 10-25 years. The lifespan of curb stops varies widely depending on the material but is typically no more than 50 years. Similarly, a fire hydrant has a typical lifespan of about 50 years. Therefore, it is believed that the isolation valves, curb stops, and fire hydrants are all at or nearing the end of their service life and will need to be replaced within the next 20 years.

3. Water System Performance and Capacity

As discussed in the following sections, a desktop review was completed to assess the capacity of the existing DWS to meet both the current and future demands. The findings of this section will help provide recommendations to the Municipality for future upgrades and to establish design parameters for the EPANET hydraulic model in **Appendix C**.

3.1 Water Demand

3.1.1. Historical Water Flows

The existing water demands for Marsville were determined from the Marsville Schedule 22 Summary Reports that were prepared by the Township's Operator, Dufferin Water Co. Ltd. This data was utilized to evaluate the capacity of the existing system to meet current needs. Note that the Schedule 22 Summary Reports that were considered covered a 5-year period from 2020 to 2024.

Water demands were also estimated based on the assumption of a current and consistent population of 106 and a population density of 3.209 people per housing unit as outlined in the 2019 Development Charge Background Study (R.J. Burnside & Associates Limited, 2023).

Daily water usage in the Marsville Subdivision was calculated to determine the various demands needed to assess the DWS. Definitions of the different demands used in the analysis are listed below:

- Average Day Demand (ADD): the average daily water consumption expected over the course of one (1) year.
- Maximum Day Demand (MDD): the highest consumption of water from the communal water systems on one (1) day over the course of one (1) year.

- Maximum Day Factor (MDF): the ratio of the ADD to the MDD.
- Peak Hour Demand (PHD): the highest consumption of water from the communal water systems over one (1) hour over the course of one (1) year.
- Peak Rate Factor (PRF): the ratio of the ADD to the PHD.

Normally, ADD and MDD are met by the supply source, while PHD is met by water storage. If water storage is not provided, the PHD must also be met by the supply source. A detailed summary of the historical water demand is provided in **Table 1** and the overall water demand design parameters are shown in **Table 2.**

Table 1: Marsville Historical Water Demand Summary (m^3/d)

	2020			2021			2022			2023			2024		
	ADD	MDD	MDF	ADD	MDD	MDF	ADD	MDD	MDF	ADD	MDD	MDF	ADD	MDD	MDF
Jan	17	25	1.5	25	45	1.8	31	50	1.6	17	25	1.5	22	33	1.5
Feb	17	25	1.5	22	31	1.4	27	35	1.3	17	23	1.4	19	49	2.6
Mar	18	25	1.4	21	27	1.3	27	45	1.7	17	22	1.3	19	24	1.3
Apr	20	27	1.4	24	52	2.2	28	68	2.4	19	41	2.2	20	28	1.4
May	25	50	2.0	31	53	1.7	34	64	1.9	24	60	2.5	24	36	1.5
Jun	34	101	3.0	34	69	2.0	37	63	1.7	27	44	1.6	27	43	1.6
Jul	40	74	1.9	27	62	2.3	37	69	1.9	22	34	1.5	26	46	1.8
Aug	30	56	1.9	33	74	2.2	30	45	1.5	20	34	1.7	24	33	1.4
Sep	23	36	1.6	23	35	1.5	28	37	1.3	20	36	1.8	25	44	1.8
Oct	23	37	1.6	21	27	1.3	30	42	1.4	18	31	1.7	22	32	1.5
Nov	23	32	1.4	22	39	1.8	30	37	1.2	20	41	2.1	21	27	1.3
Dec	26	45	1.7	21	31	1.5	26	40	1.5	20	28	1.4	17	25	1.5
Year	**25**	**101**	**4.1**	**25**	**74**	**2.9**	**30**	**69**	**2.3**	**20**	**60**	**3.0**	**22**	**49**	**2.2**

Table 2: Marsville Water Demand Summary Statistics and Design Parameters

	2020	2021	2022	2023	2024	Average	Design
ADD (m^3/d)	25	25	30	20	22	25	31
MDD (m^3/d)	101	74	69	60	49	101	127
MDF	4.1	2.9	2.3	3.0	2.2	4.1[1]	4.1
Population	106	106	106	106	106	-	-
Residential Demand (L/cap/d)	233	239	287	189	209	231	290

1. Value is the maximum MDF over the 5-year period.

3.1.2. Projected Water Demand

Based on the historical data from 2020-2024, it was estimated that the average residential demand in the Marsville Subdivision was 231 L/cap/d. The system does not have any industrial, institutional or commercial (ICI) demand. For design and evaluation purposes, a 25% factor of safety was added to the historical average residential demand, and therefore a design residential demand of 290 L/cap/d is considered reasonable. This value provides a buffer that ensures that the DWS can supply the required potable water to meet any of the demands experienced over the previous five (5) years including potential instances of unaccounted for water losses in the system due to leaks, metering inaccuracies or other factors.

As well, this slightly higher demand is justified based on the MECP *Design Guidelines for Drinking-Water Systems,* which suggests that typical domestic water demands usually range from 270 to 450 L/cap/d (MECP, 2008). To this end, it is noted that the proposed 290 L/cap/d water demand is slightly lower than the per capita usage recommended in the R.J. Burnside & Associates Limited, EA Report (2023) which was estimated at 300 L/cap/d. This represents only a 3.4% variance that should not impact future water projections given the already built in 25% factor of safety that has been added to the historical ADD.

With an estimated population of 106 and an estimated per capita usage of 290 L/cap/d, this indicated that the current design ADD for the Marsville DWS is approximately 31 m^3/d.

For the MDD, the historical data indicated that a MDF of 4.1 should be used. However, the MECP *Design Guidelines for Drinking-Water Systems* recommends that for water systems servicing 33 dwellings (equivalent population of 99) a MDF of approximately 6.9 should be used (MECP, 2008). With a 25% factor of safety already added to the ADD, the MDF recommended by the MECP would be overly conservative. As well, the guidelines recommend basing peak factors on existing flow data where available. Therefore, it was determined that a MDF based on the real data of 4.1 was reasonable and appropriate, which resulted in a design MDD of 127 m^3/d.

For the PHD, historical data was not included in the Schedule 22 Annual Reports. The MECP *Design Guidelines for Drinking-Water Systems* recommends that for a water system servicing 33 dwellings a PHF of approximately 10.3 be used. This PHF was used to determine the design PHD which was calculated to be 13 m^3/hr (318 m^3/d). A summary of the water demands is included in **Table 3**.

For projecting the future water demand, a population of 1,165 was used which included the existing population plus the new future development as determined in the Water System Expansion EA Report (R.J. Burnside & Associates Limited, 2023). This population estimate is based on the new 330-unit long-term housing development plans proposed for Marsville and we have assumed that this is the minimum housing projection that would be equivalent to the Township's 20-year population growth. As mentioned earlier, residential per capita water demand was estimated at 290 L/cap/d. Based on the MECP Design Guidelines, it was then assessed that the corresponding MDD peaking factor and PHD peaking factor would be lower for the larger projected population at 2.50 and 3.75 respectively. This therefore resulted in a future ADD, MDD and PHD of 338 m^3/d, 845 m^3/d, and 1,267 m^3/d (53 m^3/h) respectively.

Table 3: Summary of Design Water Demands for the Marsville Water System

Scenario	Dwellings	Population	ADD (m^3/d)	MDD (m^3/d)	PHD (m^3/hr)
Current Year (2025)	33	106	31	127	13
Current System + New Development (Future)	363	1,165	338	845	53

Note that future water demands were not assessed in detail as per the direction of the Township. A new water treatment plant (WTP) is planned to be constructed if new subdivisions are developed. Hence, the current PH is not expected to service a larger population in the future. Nonetheless, SBA has included a comparison in the following sections of the current PH capacity to the future water demands (current system + new development) to illustrate that it will not be capable of meeting these demands.

3.1.3. Design Criteria

Water pumping facilities are rated based on their 'firm' pumping capacity, which is defined in the MECP *Design Guidelines for Drinking-Water Systems* (2008) as the "capacity of the raw water pumping station ability to supply the water treatment plant design capacity with the largest unit out of service". This provides redundancy and for the continuation of service if one of the pumps fails. Similarly, treated water and booster pumping stations are also rated on their firm capacity, defined as the capacity of the station with the largest pump out of service (MCEP, 2008).

Pumping stations or well systems are sized based on the MDD for areas with sufficient storage volume and on PHD for areas that do not have sufficient storage. Furthermore, the MECP Guidelines (2008) state that the drinking water system including the PH, and the treated water storage should be designed to accommodate the greater of the following demands:

- MDD plus fire flow (where fire protection is to be provided); or,
- PHD.

Currently the Marsville DWS does not provide fire protection. Thus, SBA discussed with the Township the potential of upgrading the current facility by adding storage and high-volume pumps to allow the system to provide fire protection. The Township indicated that there are plans to include a standpipe with the future PH that is expected to be constructed when the new subdivisions are developed in the community. This would be in accordance with the Water System Expansion Municipal Class EA Report (R.J. Burnside & Associates Limited, 2023). Hence, the greatest demand that the current DWS is expected to supply is the PHD of 13 m^3/hr.

3.2 Pumphouse (PH) Capacity Assessment

Pursuant to the *Safe Drinking Water Act*, 2002 S.O. 2002, c. 32, the DWS has a Municipal Drinking Licence No. 243-101. It indicates that the PH is designed for an approved daily volume (rated capacity) of 182 m^3/d and an approved flow rate of 364 L/min (Ahmed, 2020b). However, it is important to note that this does not confirm system sustainability, and it is common for the rated capacity to never have been achieved or for the capacity to decrease over time. Although the confirmation of the system flow rates is an essential step in the water system evaluation process, it is outside the scope of this assessment and was not included. However, it is recommended that the plant capacity be tested before taking additional steps or performing any upgrades to the system. This may result in a revision to the associated PTTW license if the tests confirm a variance in the treatment plant capacity.

Figure 3 provides a graphical representation of the current ADD and MDD versus the approved daily volume of 182 m^3/d over 8 hours. Clearly, the approved daily volume is larger than the current ADD and MDD, and therefore the PH can meet these demands.

Figure 4 compares the current PHD to the approved flow rate, which is assumed to be the rated or firm capacity of the PH. The current PHD is substantially less than the rated capacity, hence the PH is adequately sized to supply the existing Marsville Subdivision. However, as noted earlier, the plant relies on a single well and pump and hence there are concerns with redundancy.

Figure 3: Current ADD and MDD Versus Approved Daily Volume

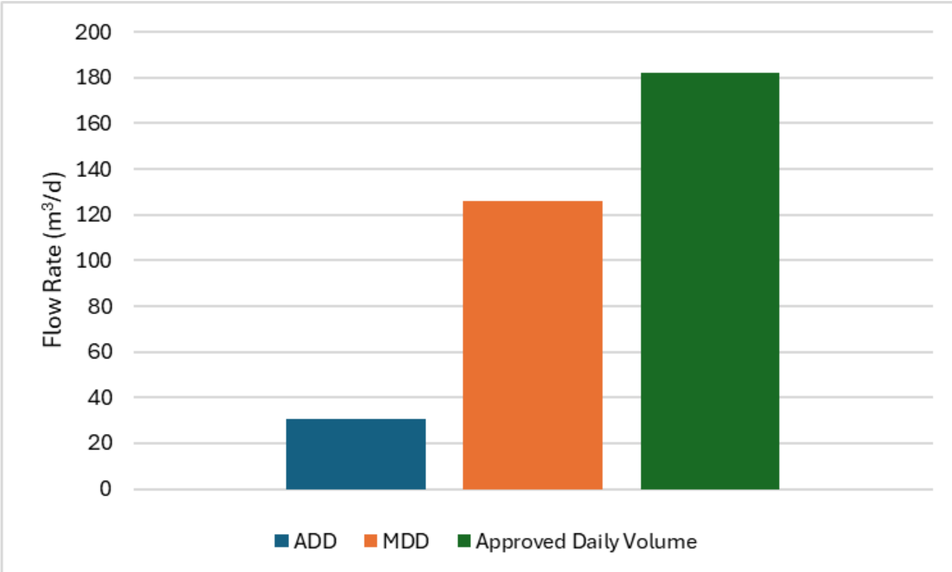
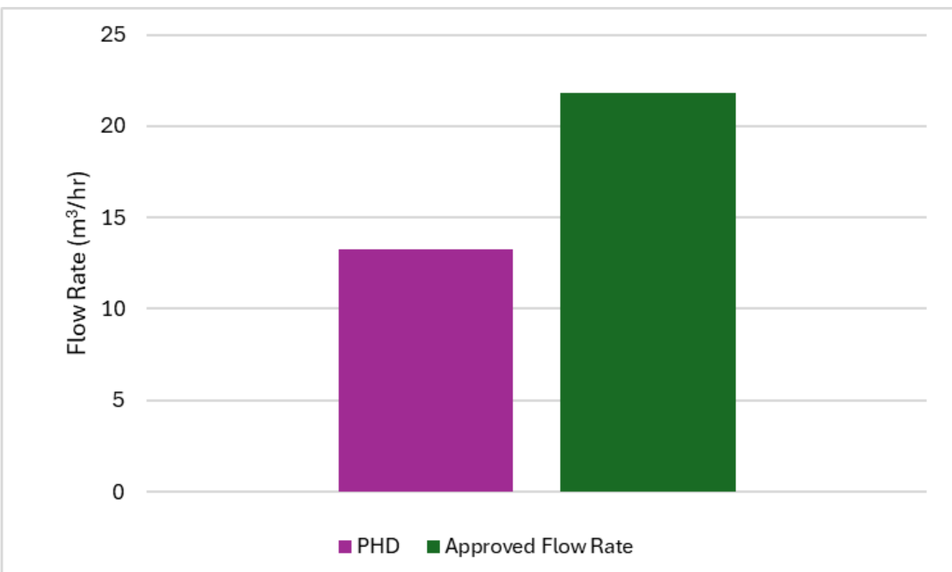


Figure 4: Current PHD Versus Approved Flow Rate[1]



1. *The approved flow rate of 22.5 m^3/hr can only be pumped for eight (8) hours per day resulting in the approved daily volume of 182 m^3/d*

Figure 5 illustrates the current + new development (future) ADD and MDD versus the approved daily volume of 182 m^3/d over eight (8) hours. The approved daily volume is much lower than the projected ADD and MDD, confirming that the existing PH is not capable of meeting this future demand.

Figure 5: Current + New Development (Future) ADD and MDD Versus Approved Daily Volume

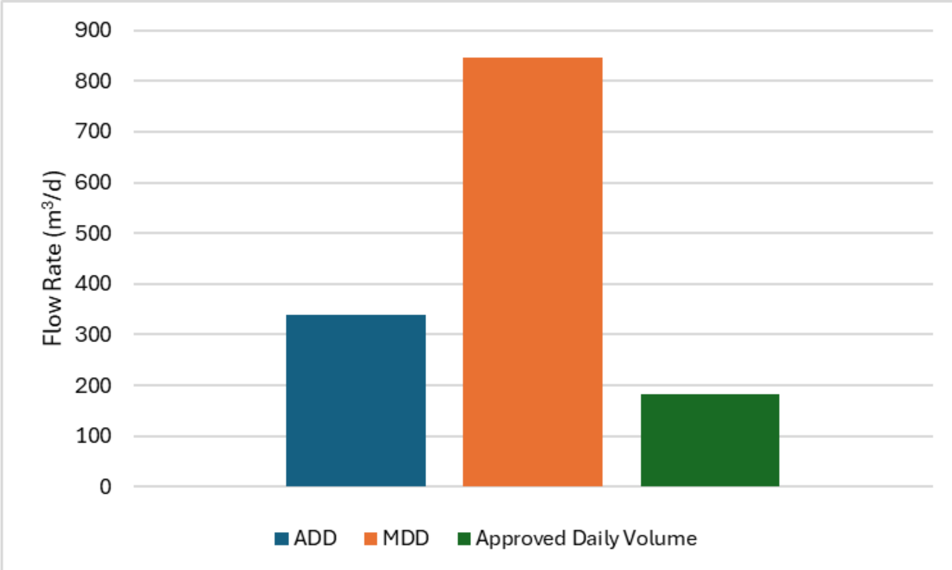
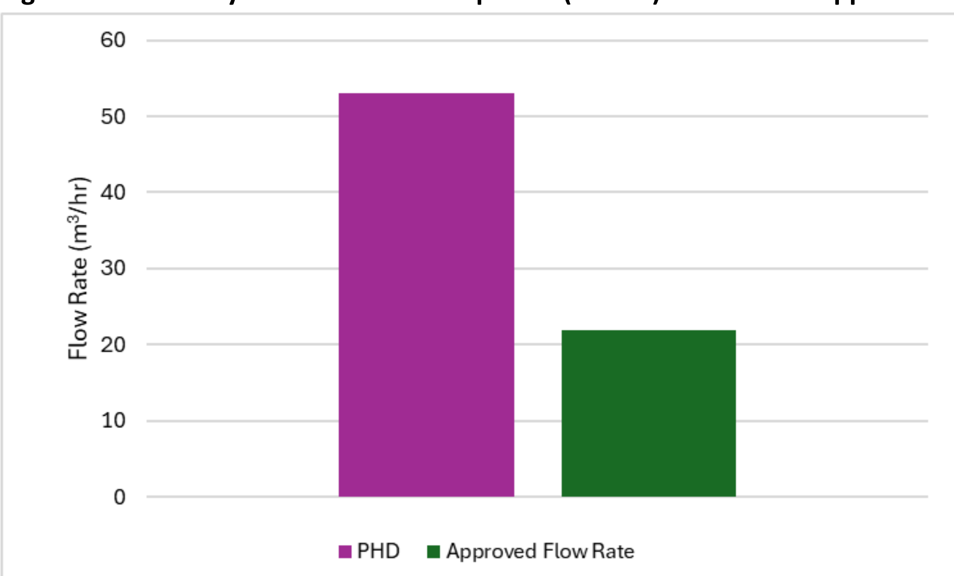


Figure 6 compares the future PHD to the approved flow rate or the rated capacity of the PH. The future PHD is much higher than the rated capacity, hence the PH is not capable of supporting the community growth or the proposed subdivision plans outlined in the R.J. Burnside & Associates Limited EA Report (2023). This is expected due to the large population growth and the fact that the PH was only sized to supply the existing Marsville Subdivision.

Figure 6: Current System + New Development (Future) PHD Versus Approved Flow Rate[1]



1. The approved flow rate of 22.5 m^3/hr can only be pumped for eight (8) hours per day resulting in the approved daily volume of 182 m^3/d

The R.J. Burnside & Associates EA report (2023) also investigated a scenario called the ultimate population, which included the existing system, new development and new connections to the existing buildings and school. As the overall system demand would be even higher than the current + new development (future) scenario, it was not investigated in this report as the PH clearly would not be capable of supplying this system.

3.3 Treated Water Quality

Upon reviewing the Annual Reports from 2020-2024 and interviewing the PH operator, no major issues with treated water quality requiring action have been identified. However, the 2021 and 2022 annual reports did note that fluoride and sodium were measured to be over half of their respective limits in the most recent sample that had been taken in 2017. The fluoride concentration was 1.4 mg/L and the maximum acceptable concentration (MAC) for fluoride is 1.5 mg/L (Government of Ontario, 2024). This poses a potential risk for the system if the fluoride were to exceed the MAC as additional treatment, namely membrane filtration, would be required. The sodium concentration was 16 mg/L and the reporting limit for sodium to the local health unit is 20 mg/L. However, it is important to note that this is just a reporting limit and that there is no MAC for sodium in Ontario. No other water quality issues have been noted.

For informational purposes, the lowest measured chlorine residual was 0.60 mg/L and the highest residual was 2.88 mg/L, both measured in 2022. Hence, all the chlorine residuals were in the range of 0.05 mg/L and 4.0 mg/L recommended in the *Procedure for Disinfection of Drinking Water in Ontario* (Government of Ontario, 2024).

3.4 Fire Flow

This section discusses the fire flow requirements for the current and the current + new development (future) scenarios if the Township were to pursue fire protection. This is based on the methodology outlined in the MECP *Design Guidelines for Drinking-Water Systems* (2008). This recommends fire flow requirements based on the equivalent population serviced by the water system. The method aims to provide a level of protection for both residential and non-residential areas. However, for the current system only residential protection is required and it was assumed that this would be the case for the future system as well. Therefore, for this exercise the equivalent population was assumed to be the same as the residential population. A summary of the fire flow requirements for the current year and future system are shown in **Table 4**.

Table 4: Fire Flow Requirements and Duration

Fire Flow Requirements and Duration			
Scenario	**Equivalent Population**	**Fire Flow (L/s)**	**Duration (hrs)**
Current	106	38	2
Current System + New Development (Future)	1,165	69	2

3.5 Water Storage

The current PH does not provide water storage other than the inherent storage provided by the four (4) 454 L pressure tanks. If water storage were to be provided, it could supplement water supply during periods of peak demands (i.e. PHD) and fire flows. The MECP guidelines utilize the 'ABC' formula (i.e.: A + B + C) to determine the water storage requirements to size water storage reservoirs. The 'ABC' components are described below and summarized in **Table 5**.

A = Fire Storage = Fire Flow x duration
B = Equalization Storage = MDD x 0.25
C = Emergency Storage = (A + B) x 0.25

Table 5: Water Storage Requirements

Scenario	Equivalent Population	Water Storage Requirements (m^3)				Residency Time at ADD (days)
		A	B	C	Total	
Current	106	274	32	77	383	12.4
Current + New Development (Future)	1,165	496	211	177	884	2.6

As the water storage requirements for the current system would result in a relatively large residency time at the current ADD (approximately 12 days), options for fire protection storage and the system operation would need to be reviewed in the short term to address this issue. However, if the new subdivisions are developed and a new WTP is constructed, fire protection storage results in an optimal residency time of 2.6 days under the future and projected ADD.

3.6 Chlorine Contact Compliance

For a typical water system, the absolute worst-case scenario for chlorine contact time (CT) would occur during a fire flow scenario in the winter. However, the Marsville DWS does not provide fire protection and hence the PHD is the maximum expected flow rate that the chlorine contact loop piping is expected to convey. PHD is also the typical consideration required by the MECP for determining CT. However, in an upgraded system with fire protection, consideration for evaluating the system under fire flow requirements could be reviewed to understand and determine the worst-case scenario for chlorine contact time.

For the calculations, a temperature of 5˚C, a chlorine residual of 0.5 mg/L and a pH between 6 to 9 were assumed. This temperature is likely lower than what would be expected for groundwater in Southern Ontario, but it was assumed to provide a conservative estimate. The chlorine residual of 0.5 mg/L was utilized since it is the level that will trigger a low chlorine alarm (Miedema, 2024). The pH of 6 to 9 was assumed as this is a typical range for groundwater. The chlorine contact loop pipe diameter is 250 mm and length is 112 m, providing a total volume of 5.50 m^3. The CT calculation is summarized below in **Table 6**.

Table 6: Chlorine Contact Time Calculation

Scenario	Current Volume Provided (m^3)	Total Retention Time (min)	Total Contact Time (min)[1]	CT Value Provided (mins-mg/L)	CT Viruses Required (mins-mg/L) 2-log[2]	CT Viruses Required (mins-mg/L) 4-log[2]
Current PHD	5.50	24.9	22.4	11.2	4	8
Current + New Development (Future) PHD	5.50	6.2	5.6	2.8	4	8

1. Contact time includes a baffling factor of 0.9 for a piped chlorine contact loop equivalent to near plug flow.
2. From Procedure for Disinfection of Drinking Water in Ontario Table 7 for a temperature of 5˚C and a pH of 6 to 9 (Government of Ontario, 2024)

At a current PHD of 13 m^3/hr, the chlorine contact loop provides a retention time of 24.9 min. However, with a typical baffling factor of 0.9, the contact time is effectively about 22.4 (24.9 x 0.9) minutes. Assuming a minimum chlorine residual of 0.5 mg/L, the CT value that is provided is 11.2 mins-mg/L. This is higher than the CT value that is required for both 2-log and 4-log inactivation of viruses by free chlorine in the *Procedure for Disinfection of Drinking Water Ontario* (Government of Ontario, 2024). Historically, non-Groundwater Under the Direct Influence of Surface Water (GUDI) groundwater wells have been required to provide 2-log inactivation of viruses (as is the case in the current Municipal Drinking Water License). However, the MECP has recently developed a Draft GUDI guideline which has recommended that all future groundwater supplies be developed to satisfy a 4-log inactivation. Therefore, future systems will likely need to provide 4-log inactivation of viruses. Regardless, the Marsville PH appears to be capable of meeting current chlorine contact requirements.

At a future PHD of 53 m^3/hr, the chlorine contact loop capacity may no longer be adequate. With an effective total contact time of 5.6 minutes, a CT value of only 2.8 mins-mg/L would be provided. This would not be enough to meet even 2-log virus removal. Therefore, a larger chlorine contact loop, or tank would be needed to provide adequate disinfection if the new development is pursued.

4. Recommended Upgrades

The attached **Appendix D** summarizes the priority items for the Township with associated Class ‘D’ cost estimates. The supporting document identifies capital, operational or maintenance projects as immediate, high, medium, low and future priority. Please note that a description of the recommended upgrades has been included within the cost estimates. Further studies will be needed to fully establish and define the scope of the future and larger projects.

It is recommended that immediate priority projects are completed as soon as possible. High priority projects shall be considered within a 1–2-year period. Immediate and high priority items relate to health and safety or emergency response concerns. Medium priority projects are recommended for completion within a 2–5-year timeframe and pertain to system functionality or operational efficiency recommendations. It is understood that the current PH may not be in operation by the 10-year milestone due to the construction of a new WTP, so some of the lower priority items may not need to be completed. Low priority projects are recommended for completion in the next 5-10 years and is based on operational and maintenance considerations. Future priority projects are recommended for completion beyond the 10-year (10-20 year) period if plans for the new subdivision, new WTP, and distribution system expansion are not completed.

5. Conclusions and Recommendations

This conditions assessment report encompasses the current condition of the Marsville DWS and discussions with the Township and operations staff that occurred during the site investigation. It is noted that the DWS has been well maintained. Yet, there are some concerns with redundancy and the age of some piping and appurtenances. The highest priority upgrades that SBA is recommending include the following:

1. Replace the eyewash bottles with an eyewash station to improve operator safety when working with the sodium hypochlorite.
2. Install a permanent emergency back-up generator to prevent disruptions to water supply during power outages.
3. Either connect the currently offline future well northeast of the PH or develop another well to connect to the PH to provide redundancy in raw water pumping. For the purpose of this report, we have carried the cost for future testing and connection of the existing offline well located near the PH to satisfy the MECP firm capacity recommendations.
4. Install a second chemical metering pump for dosing sodium hypochlorite to provide redundancy in chemical dosage.

SBA also completed a desktop analysis assessing the capacity of the PH and its ability to meet the current and future system demands. The PH was found to have adequate capacity to supply the current system. This was expected as the population that the PH is servicing has not increased in many years. However, there are concerns with redundancy and aged equipment which present risks to the PH being able to supply its rated capacity reliably. As well, several components of the water distribution system are either near or have exceeded their typical lifespan including the fire hydrants, curb stops and isolation valves and will therefore likely need to be replaced over the next 20 years. The PVC watermain will not surpass its normal lifespan in the next 20 years and hence we have assumed that replacement will not be required in this period. However, due to several discussed factors there is a small chance that significant repairs or replacement could be required earlier than expected.

It is noted that the current PH does not have the capacity to support the future demand that is expected due to the new subdivisions. Therefore, a new water treatment facility will need to be constructed if new subdivisions are developed within the community. If community expansion and a new WTP are not pursued, then it is recommended that more significant upgrades are completed at the PH, most significantly upgrades to include fire protection. However, measures will need to be considered to mitigate the long residency time that would be necessary for the required water storage.

6. References

Ahmed, A. (2020a). *Drinking Water Works Permit, Permit Number: 243-01, Issue Number: 5:* Government of Ontario.

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Folkman, S. (2014). *PVC Pipe Longevity Report, Affordability & The 100+ Year Benchmark Standard, A Comprehensive Study on PVC Pipe Extractions, Testing & Life Cycle Analysis.* Utah State University Buried Structures Laboratory.

Government of Ontario. (2023). *O.Reg. 170/03: Drinking Water Systems.* Under Safe Drinking Water Act, 2002, S.O. 2002, c. 32

Government of Ontario. (2024). *Procedure for Disinfection of Drinking Water in Ontario.*

Meek, G. (2020). *Permit to Take Water, Ground Water, Number 8328-BQNRXE.* Ontario Ministry of the Environment, Conservation and Parks.

Miedema, J. (2024). *Township of East Garafraxa Marsville Water System Operational Plan.* Dufferin Water Co. Ltd.

Miedema, J. (2025). *Schedule 22 Summary Report.* Dufferin Water Co. Ltd.

Ministry of Environment, Conservation and Parks. (2008). *Design Guidelines for Drinking-Water Systems.*

R. J. Burnside & Associates Limited (2023). *Marsville Water System Expansion Municipal Class Environmental Assessment (Schedule B) Project File Report.* Orangeville, ON

Appendix A

Site Investigation Photos

Figure A.1: Production Well for the WTP

Figure A.2: Second Well Near the WTP. It is not Currently Being Used, and it is Not Connected to the WTP

Figure A.3: WTP Exterior Wall Showing Ageing of Bricks and Graffiti

Figure A.4: **WTP Exterior Wall Showing Minor Cracks in Foundation and Damage to Bricks**

Figure A.5: Blowoff Line Protruding through South Wall of WTP

Figure A.6: Raw Water Line Pressure Gauge

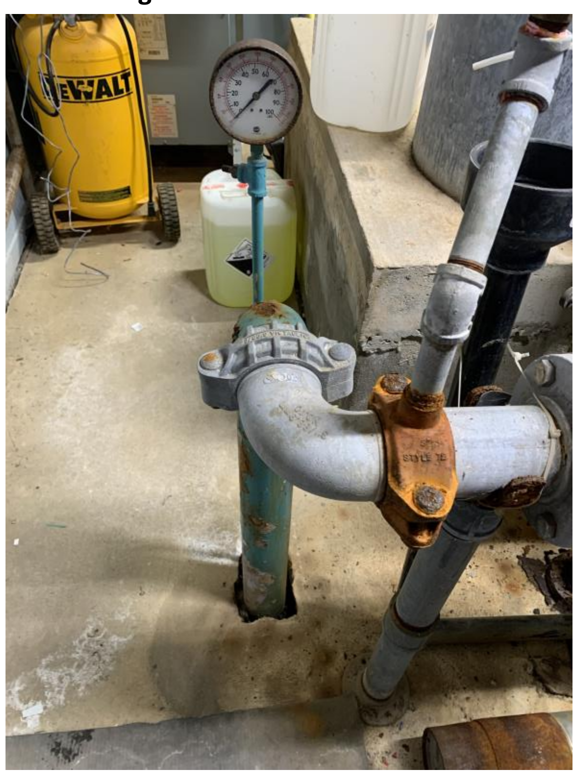


Figure A.7: Flow Control Valve

Figure A.8: Isolation Ball Valve Downstream of Flow Control Valve

Figure A.9: Rosemount Magnetic Flow Meter

Figure A.10: Isolation Butterfly Valve Downstream of Flow Meter

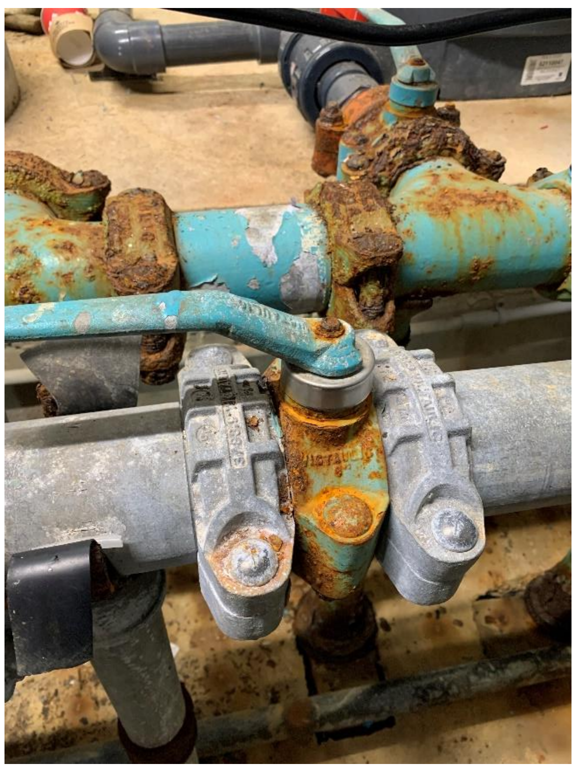


Figure A.11: Chlorine Injection Point

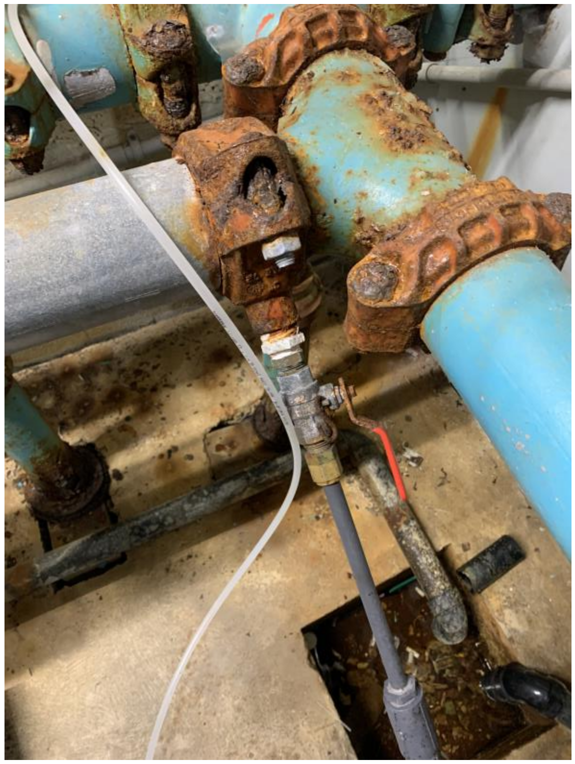


Figure A.12: Sodium Hypochlorite Storage Tank and Secondary Containment Container. The Duty Chemical Metering Pump is Located on top of the Storage Tank

Figure A.13: Northwest Pressure Tank

Figure A.14: Northwest Pressure Tank Butterfly Isolation Valve. The Valve is Significantly Corroded but Still Operational

Figure A.15: Southwest Pressure Tank

Figure A.16: Southwest Pressure Tank Butterfly Isolation Valve. The Valve is Significantly Corroded but Still Operational

Figure A.17: Header Piping to the Two West (Older) Pressure Tanks. The Piping Shows Significant Corrosion

Figure A.18: Isolation Ball Valve on PVC Header to the Two East (Newer) Pressure Tanks

Figure A.19: Flexible Hose Connection to Pressure Tank PVC Header Piping

Figure A.20: Southeast Pressure Tank

Figure A.21: Connection to East (Newer) Pressure Tanks and Isolation Ball Valves

Figure A.22: Water Service Line Floor Penetration

Figure A.23: Ball Valve and Backflow Preventor Upstream of Free Chlorine Analyzer

Figure A.24: Free Chlorine Analyzer

Figure A.25: Free Chlorine and pH Analyzer Display

Figure A.26: Hydrant on Grand Crescent in Front of the Water Treatment Plant

Figure A.27: Hydrant on Grand Crescent Near Intersection with Orangeville-Fergus Road

Figure A.28: Hydrant on Maple Street

Figure A.29: Southwest Hydrant on Victoria Boulevard

Figure A.30: Northeast Hydrant on Victoria Boulevard

Appendix B

Existing Well Records

The Ontario Water Resources Commission Act

40 P/16 E

WATER WELL RECORD

Water management in Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 1701260 | MUNICIP. 17002 | CON. Gdn 13

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT
~~Durham~~ DUFFERIN	East Garafraxa	13	006

[redacted]

ADDRESS: Marsville Ont.

DATE COMPLETED: DAY 25 MO. ~~Aug~~ 08 YR. 71

	EASTING	NORTHING	RC.	ELEVATION	RC.	BASIN CODE
21 17	562220	4852750	4	1605	5	23

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH – FEET FROM	TO
black	top soil			0	2
brown	silty clay			2	38
brown	dry sand and gravel			38	50
brown	silty clay and gravel			50	87
dark	brown clay			87	136
brown	clay and gravel			136	184
brown	silty sandy clay and gravel			184	201
grey	rock			201	242
brown	rock			242	295
light	brown rock			295	301
		total depth - 301 ft.			
Bucyrus Erie 22Ws2(2)					

31 | 0002802 | 0038605 06 | 0050009 11 | 0087005 0911 | 0136605 | 0184605 11 | 1

32 | 0201 1005 0009 | 0242220 | 0301626

41 WATER RECORD

WATER FOUND AT – FEET	KIND OF WATER
0295' ~~301~~	☒ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL
	☐ FRESH ☐ SALTY ☐ SULPHUR ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH – FEET FROM	TO
06	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE	0.280	0	0201
06	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☒ OPEN HOLE		201	0301 ~~301~~
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE			

SCREEN

SIZE(S) OF OPENING (SLOT NO.)	DIAMETER INCHES	LENGTH FEET

MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT – FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)

71 PUMPING TEST

PUMPING TEST METHOD: ☒ PUMP ☐ BAILER

PUMPING RATE: 150 GPM.

DURATION OF PUMPING: 24 HOURS 00 MINS.

STATIC LEVEL: 050 FEET

WATER LEVEL END OF PUMPING: FEET

WATER LEVELS DURING: ☐ PUMPING ☐ RECOVERY

15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
full recovery		24 hrs/	

IF FLOWING, GIVE RATE: GPM.

PUMP INTAKE SET AT: 180 FEET

WATER AT END OF TEST: ☒ CLEAR ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

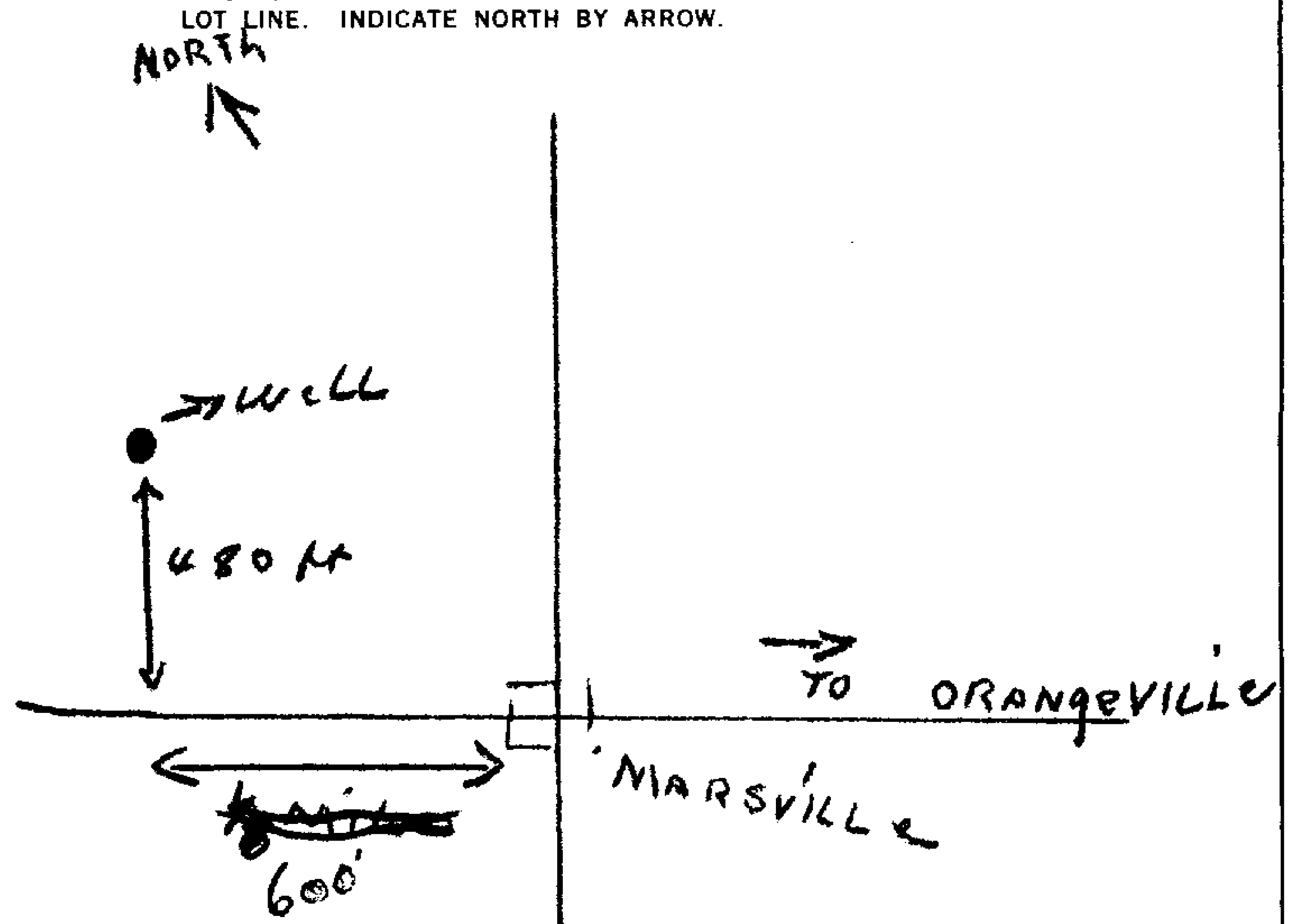
RECOMMENDED PUMP SETTING: 180 FEET

RECOMMENDED PUMPING RATE: 200 GPM.

___ GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL

☒ WATER SUPPLY
☐ OBSERVATION WELL
☐ TEST HOLE
☐ RECHARGE WELL
☐ ABANDONED, INSUFFICIENT SUPPLY
☐ ABANDONED, POOR QUALITY
☐ UNFINISHED

WATER USE

07

☐ DOMESTIC
☐ STOCK
☐ IRRIGATION
☐ INDUSTRIAL
☐ OTHER subdivision
☐ COMMERCIAL
☐ MUNICIPAL
☒ PUBLIC SUPPLY
☐ COOLING OR AIR CONDITIONING
☐ NOT USED

METHOD OF DRILLING

☒ CABLE TOOL
☐ ROTARY (CONVENTIONAL)
☐ ROTARY (REVERSE)
☐ ROTARY (AIR)
☐ AIR PERCUSSION
☐ BORING
☐ DIAMOND
☐ JETTING
☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: GRAHAM WELL DRILLING — LICENCE NUMBER: 2406

ADDRESS: R R # 2 Guelph Ont.

NAME OF DRILLER OR BORER: Clayton Shantz — LICENCE NUMBER:

SIGNATURE OF CONTRACTOR: J L Graham per NEG.

SUBMISSION DATE: DAY 15 MO. Sept YR. 71

OFFICE USE ONLY

DATA SOURCE: 1 | CONTRACTOR: 2406 | DATE RECEIVED: 240971

DATE OF INSPECTION: | INSPECTOR:

REMARKS:

P

WI

CSS.SS

OWRC COPY

Ontario Ministry of the Environment

Measurements recorded in: ☑ Metric ☐ Imperial

Well Tag No. (Place Sticker and/or Print Below)
A 025950

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

[redacted]

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
Grand Cres.	East Garafraxa	6	13

County/District/Municipality	City/Town/Village	Province	Postal Code
Dufferin	Marsville	Ontario	

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	562198	4852995		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
	Water Well Record Generated				
	iN Response to MOE Request				
	As No Record Was Available on File				
	Video inspection only → No Construction				

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m^3/ft^3)

Results of Well Yield Testing

After test of well yield, water was:
☑ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft): 30.5m

Pumping rate (l/min / GPM): 10 IMP. GPM

Duration of pumping: 1 hrs + 0 min

Final water level end of pumping (m/ft): 16.17m

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft):

Recommended pump rate (l/min / GPM):

Well production (l/min / GPM):

Disinfected? ☐ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	15.99		16.17
1	16.10	1	16.10
2	16.10	2	16.07
3	16.11	3	16.06
4	16.11	4	16.05
5	16.11	5	16.04
10	16.14	10	16.03
15	16.15	15	16.03
20	16.15	20	16.02
25	16.15	25	16.01
30	16.16	30	15.99
40	16.16	40	15.99
50	16.16	50	15.99
60	16.17	60	15.99

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☐ Air percussion
☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used
☐ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
20.3cm	Open Hole		102.8m	74.9m
20.3cm	Steel		74.9m	0.0m

Status of Well

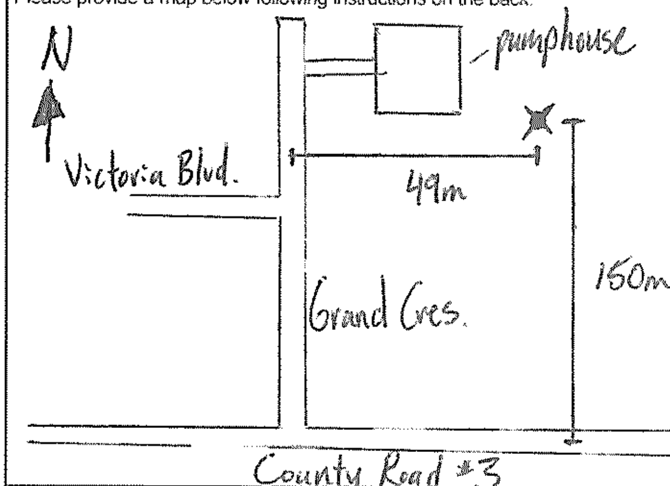
☐ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☒ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Water Details

Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify
Water found at Depth (m/ft) ☐ Gas | Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)

Well Contractor and Well Technician Information

Business Name of Well Contractor: Well Initiatives Limited
Well Contractor's Licence No.: 7221
Business Address (Street Number/Name): 15 Townline Orangeville
Municipality:
Province: Ont.
Postal Code: L9W3R4
Business E-mail Address:
Bus.Telephone No. (inc. area code): 5197630666
Name of Well Technician (Last Name, First Name): Rowntree Regan
Well Technician's Licence No.: 2801
Signature of Technician and/or Contractor
Date Submitted: 20090812

Well owner's information package delivered ☐ Yes ☒ No
Date Package Delivered: YYYYMMDD
Date Work Completed: 20090413

Ministry Use Only
Audit No. Z 94888
Received AUG 31 2009

0506E (12/2007)

Ministry's Copy

Appendix C

Hydraulic Modelling of Existing Distribution System

B.1. Modelling of the Water Distribution System

Hydraulic modelling of the Marsville DWS was required to identify any bottlenecks and operational issues within the existing system. A baseline EPANET model was developed for the water modelling scenarios and considered piping material, sizing and physical orientation as well as system flow demands. The model outputs were compared to the typical pressure ranges that are measured throughout the community of 40 psi to 60 psi (Miedema, 2024). This validation step ensured that the model accurately reflected the hydraulic scenario experienced by the Marsville DWS.

B.2. Water Hydraulic Modelling Procedure

As part of the hydraulic modelling procedure for the Marsville DWS, SBA utilized EPANET software to complete various hydraulic scenarios for the operation of the existing DWS. To commence, a map of the Marsville subdivision from the Marsville Water System Expansion Municipal Class EA Report (R.J. Burnside & Associates Limited, 2023) was used in conjunction with the as-built subdivision drawings. The map was used as a backdrop to overlay nodes that will represent the existing location of tees, hydrants and other points of hydraulic significance throughout the distribution system. Each node was connected with piping and modelled per the layout established in the as-built drawings. The water treatment plant was modelled as a reservoir providing a constant pressure head of 35 m (50 psi). This is in accordance with observations during the site visit, discussions with the operator and the typical pressure range in the operational plan (Miedema, 2024).

The as-built drawings were used to establish the elevations of the nodes as well as the pipe material, diameter and length. SBA was unable to verify the pipe material for the 75 mm watermains and 250 mm watermain. However, most of the distribution system was confirmed to be 150 mm polyvinyl chloride (PVC) watermain. The Hazen-Williams roughness coefficient, or C-Factor, is dependent on pipe material, age and condition. It is used to account for frictional losses within piping. Smooth piping has the highest values while rough or aged piping has lower C-Factor values. For aged PVC piping a C-Factor value of 130 was used. It was assumed that the other 75 mm and 250 mm watermain also had a C-Factor that was 130. As headlosses were relatively small in these sections of watermain, changes to the C-Factor would not have a large impact on pressures throughout the distribution system.

Based on the capacity assessment the ADD, MDD and PHD flows were identified for the Marsville subdivision from 2020-2024. Using the housing density and total population estimated from the Marsville Water System Expansion Municipal Class EA Report (R.J. Burnside & Associates Limited, 2023), SBA applied flow demands to each node relative to the demand associated with the adjacent residences. The model was run to establish pressures and the flow capacity at each node and confirmed whether all flow demands were met throughout the Marsville subdivision. The main inputs for the nodes and pipes are summarized in **Table B.1** and **Table B.2** respectively.

B.3. Water System Model Results

Hydraulic modelling was completed to evaluate the following:

- Pressures throughout the distribution system.
- Velocities throughout the distribution system.
- Locations at risk of poor water quality.

Modelling was completed using EPANET software. The topographic elevations, watermain sizes and community demands were inputted into the model to simulate the current ADD, MDD and PHD. The inputs and modelling results are included in **Table B.1** and **Table B.2** for the nodes and pipes respectively. As well, maps illustrating pressures and velocities throughout the distribution system are shown in **Figure B.1**, **Figure B.2** and **Figure B.3** for the ADD, MDD and PHD respectively.

For watermains under normal conditions (ADD to PHD) the MECP *Design Guidelines for Drinking-Water Systems* (2008) recommend a normal pressure range of 50 psi to 70 psi (or approximately 35 to 49 m of head) and not less than 40 psi (28 m). The model indicated that the existing distribution system can deliver water throughout the subdivision within this range. Under the ADD pressure ranged from 50 psi to 53 psi (35.0 m to 37.0 m), under MDD from 50 psi to 53 psi (35.0 m to 37.0 m) and under PHD from 49 psi to 52 psi (34.8 m to 36.8 m). Since the head losses were low, the pressures were related to the changes in elevation. However, as the elevation only ranged from a low of 486.3 masl to 488.3 masl the difference in low and high-water pressures in the subdivision are small.

The water velocities within the pipes were all acceptable. The highest velocities were 0.08 m/s, 0.33 m/s and 0.83 m/s in the 75 mm dia. watermains leaving the WTP and connecting to the watermain on Grand Crescent. However, many of the water velocities were almost zero near the dead ends on Grand Crescent and Maple St. This can indicate a higher potential for settlement of debris, potential chlorine residual degradation and poorer water quality. As discussed with the operators, flushing is performed regularly to clean the lines. However, the Township should consider looping the watermain in the long term to provide additional benefits.

Table B.1: Summary of Node Inputs and Outputs for EPANET Hydraulic Model

Node	• Description	Elevation (masl)	Number of Residences	ADD		MDD		PHD	
				Demand (L/s)	Pressure (m)	Demand (L/s)	Pressure (m)	Demand (L/s)	Pressure (m)
J1	Start of Chlorine Contact Loop	488.3	0	0.00	35.00	0.00	34.98	0.00	34.90
J2	End of Chlorine Contact Loop	488.3	0	0.00	35.00	0.00	34.98	0.00	34.90
J3	WTP Discharge Line Connection to Grand Cres. Watermain	488.3	0	0.00	35.00	0.00	34.98	0.00	34.87
J4	Tee Between Grand Cres. Watermain and Victoria Blvd. Watermain	487.8	1	0.01	35.50	0.04	35.47	0.11	35.34
J5	Southeast Hydrant on Grand Cres.	486.5	4	0.04	36.80	0.18	36.77	0.44	36.64
J6	Northeast Hydrant on Victoria Blvd.	486.3	7	0.08	37.00	0.31	36.96	0.78	36.80
J7	Southwest Hydrant on Victoria Blvd.	486.3	10	0.11	37.00	0.44	36.96	1.11	36.78
J8	Bend at Intersection of Victoria Blvd. and Maple St.	487.1	9	0.10	36.20	0.40	36.16	1.00	35.97
J9	Hydrant on Maple St.	488.3	2	0.02	35.00	0.09	34.96	0.22	34.77
Total	-	-	**33**	**0.36**	-	**1.46**	-	**3.66**	-

Table B.2: Summary of Pipe Inputs and Outputs for EPANET Hydraulic Model

Pipe	Starting Node	Ending Node	Length (m)	Diameter (mm)	Roughness Coefficient[1]	ADD		MDD		PHD	
						Velocity (m/s)	Headloss (m/km)	Velocity (m/s)	Headloss (m/km)	Velocity (m/s)	Headloss (m/km)
Pipe-WTP	PT	J1	7.9	75	130	0.08	0.16	0.33	2.19	0.83	12.03
Pipe1	J1	J2	115.15	250	130	0.01	0.00	0.03	0.01	0.07	0.03
Pipe2	J2	J3	2.6	75	130	0.08	0.17	0.33	2.19	0.83	12.04
Pipe3	J3	J4	64.3	150	130	0.02	0.01	0.08	0.07	0.21	0.41
Pipe4	J4	J5	86.7	150	130	0.00	0.00	0.01	0.00	0.03	0.01
Pipe5	J4	J6	136.2	150	130	0.02	0.00	0.07	0.05	0.18	0.30
Pipe6	J6	J7	124.8	150	130	0.01	0.00	0.05	0.03	0.13	0.18
Pipe7	J7	J8	153.5	150	130	0.01	0.00	0.03	0.01	0.07	0.05
Pipe8	J8	J9	56.2	150	130	0.00	0.00	0.00	0.00	0.01	0.00

Notes:

1. Hazen-Williams roughness coefficient, 130 was assumed for aged PVC piping.

Figure B.1: Water Distribution System Under ADD (Backdrop Adapted from R. J. Burnside & Associates, 2023)

Figure B.2: Water Distribution System Under MDD (Backdrop Adapted from R. J. Burnside & Associates, 2023)

Figure B.3: Water Distribution System Under PHD (Backdrop Adapted from R. J. Burnside & Associates, 2023)

Appendix D

Prioritization and Cost Estimates

Township of East Garafraxa, Conditions Assessment Report
Prioritization List
SBA File No.: M24019

Date: September 2025

Item	Location	Description	Criteria	Priority	Cost Estimate
1	Production Well	Vegetation has grown within the concrete barrier around the existing well and is partially obstructing access. It is recommended that the vegetation is either trimmed or removed. Also, it is suggested that geotextile fabric and stone be installed around the well to help prevent future vegetative growth.	Maintenance	Medium	$5,000.00
2	Future Well	The WTP currently has only one production well and therefore there is no redundancy in the raw water supply. Furthermore, the water system does not have adequate storage, hence if the production well is out of service for more than a few minutes the WTP cannot supply water. There is an additional shelf spare pump in the WTP, but the system must be put offline if the pumps are to be switched. Also, the pumps cannot be switched quickly enough to prevent disruptions to the water supply. Thus, it is recommended that the second well northeast of the WTP be retested and if possible put into production to provide redundancy with the water supply. If this well is not suitable, then an investigation and drilling of a new well should be completed in order to provide a second production well for the WTP.	Capital	High	$250,000.00
3	WTP Exterior	The WTP building is showing typical signs of ageing including cracks in the foundation, minor damage to the exterior bricks and minor deformation of eavestroughs. It is recommended the cracks are sealed, damaged bricks are replaced and damaged eavestroughs are replaced.	Maintenance	Low	$15,000.00
4	WTP Interior	The galvanized raw water header line and piping to the two older pressure tanks are showing signs of ageing and corrosion. The associated victaulic couplings and isolation valves are also showing signs of ageing and corrosion. As well, the older pressure tanks are nearing the end of their service life and should be replaced prior to failure. It is recommended that the older galvanized piping and valves are replaced with stainless steel and the two older pressure tanks are replaced with new models.	Capital	High	$50,000.00
5	Power Supply	The WTP does not have an emergency back-up generator to provide standby power. In the case of a power outage, the WTP cannot pump water to the distribution system. In the case of longer power outages, a portable generator is rented and brought to the WTP to restore water service. However, to prevent short-term disruptions to water supply and potentially save money long-term, it is recommended that a generator be purchased specifically for the WTP. It should be adequately sized to power the well pump(s), and the critical equipment in the WTP. It could also be sized for the future WTP so that it could be relocated in the future. It is advised that the generator be installed on a concrete pad.	Capital	High	$100,000.00
6	Chlorination System	The chemical dosing system is currently reliant on one chemical metering pump with a shelf spare. If the duty pump goes offline the system is unable to produce safe, treated drinking water until the shelf spare pump is installed. As this would result in disruptions to water supply, it is recommended that the current chemical dosing system be upgraded to a duplex pumping system with a control panel.	Capital	High	$25,000.00
7	WTP Interior	The WTP eyewash station is currently equipped with two separate eyewash bottles. O.Reg. 186/19 mandates that eye wash facilities be provided if a worker is required to work with hazardous chemical agents. Furthermore, the CCOHS recommends an eyewash station be provided if chemical contact with the eyes could occur. The eyewash bottles are only recommended as a short-term measure until an operator can walk to a nearby eyewash station. Also, the eye wash station should be able to provide a constant flow of tepid water for 15 min. It would be very difficult to wash both eyes at the same time for 15 continuous minutes with the current bottles. The bottles are also dirty, which would limit their effectiveness. Therefore, a proper eyewash station, such as those supplied by ULINE, is recommended. Some portable models can even include a shower option. A plumbed system could also be installed, but tepid water would be required which would not likely be economically feasible or practical given the limited space inside the WTP.	Operational	Immediate	$5,000.00
8	Storage	The DWS does not currently provide fire protection. In the future, it is recommended that the system be upgraded to include fire protection capabilities. This could include storage and high volume pumps. If a new WTP is to be developed then this will not be required. However, if plans for a new WTP are abandoned then it is recommended that storage and high volume pumps be added to the current WTP. This will also require an expansion to the existing WTP to house the new high volume pumps and process equipment. Note, that this cost estimate assumes that storage will be provided by a standpipe. If an elevated storage tank (e.g. water tower) is constructed the costs will be significantly higher.	Capital	Future	$850,000.00
9	Distribution System	The distribution system is approximately 54 years old and it is likely that the isolation valves, curb stops and fire hydrants will need to be replaced within the next 20 years. This will need to be completed regardless if the water distribution system is expanded. This cost estimates assumed replacement of seven (7) isolation valves, five (5) fire hydrants and thirty three (33) curb stops.	Capital	Low	$400,000.00
10	Distribution System	The distribution system is not currently looped and has two dead ends. These dead ends have low flow rates which result in increased water age and the potential for debris accumulation, lower chlorine residuals and biological growth. Dead ends are also prone to disruptions in water service if a section of watermain needs to be shut down. Looping is also beneficial if fire protection were to be provided. Hence, it is recommended that looping be included to improve water quality and redundancy in the system. This upgrade may not be needed if the current system is looped as part of an expansion to the distribution system.	Capital	Future	$300,000.00
		Sub-Total			***$2,000,000.00***
		Engineering Approvals, Design and Contract Administration/Inspection (20%)			***$400,000.00***
		Miscellaneous (20%)			$400,000.00
		Contingency (25%)			$500,000.00
		Total			**$3,300,000.00**