PORT BURWELL AREA SECONDARY WATER SUPPLY SYSTEM
JOINT BOARD OF MANAGEMENT

SPECIAL MEETING
April 24, 2024 – 1:00 PM
Malahide Council Chambers
51221 Ron McNeil Line, Springfield, ON

Board Members:
Municipality of Central Elgin – Norman Watson
Township of Malahide – Chester Glinski
Municipality of Bayham – Tim Emerson

Staff:
Municipality of Central Elgin – Alex Piggott and Geoff Brooks
Township of Malahide – Nathan Dias, Jason Godby, Sam Gustavson, Adam Boylan, and Allison Adams
Municipality of Bayham – Ed Roloson and Thomas Thayer

(1) Call to Order

(_____) is appointed Chair and the meeting is called to order at (_____).

(2) Disclosure of Pecuniary Interest

Disclosures of pecuniary interest may be declared at this time: (_____).

(3) Reports

- Port Burwell Area Secondary Water Supply System - Pipeline Desktop Condition Assessment Report

Moved by:
Seconded by:

THAT Report No. PBAWSS-24-06 entitled "Port Burwell Area Secondary Water Supply System - Pipeline Desktop Condition Assessment Report" be received;

AND THAT the Port Burwell Area Secondary Water Supply System Joint Board of Management direct the Staff of the administering Municipality to initiate and develop a Request for Proposal (RFP) to obtain an Engineering Consultant to prepare a detailed Tender ready engineered design for the replacement of the entire Port Burwell Area Secondary Water Supply System transmission main.

(4) Presentation

- Pure Technologies Ltd. - Desktop Assessment of the Port Burwell Area Secondary Water Supply System

Moved by:
Seconded by:

THAT the presentation from Pure Technologies Ltd. relating to the Desktop Assessment of the Port Burwell Area Secondary Water Supply System be received for information.

(5) Adjournment

Moved by:
Seconded by:

THAT the Port Burwell Secondary Water Supply System Joint Board of Management adjourn at __ p.m.

Port Burwell Area Secondary Water Supply System

REPORT NO.: PBASWSS-24-06

DATE: April 24, 2024

ATTACHMENT: Desktop Condition Assessment Report of the Port Burwell Area Secondary Water Supply System from Pure Technologies, a Xylem Brand

SUBJECT: **PORT BURWELL AREA SECONDARY WATER SUPPLY SYSTEM - PIPELINE DESKTOP CONDITION ASSESSMENT REPORT**

Recommendation:

THAT Report No. PBAWSS-24-06 entitled "Port Burwell Area Secondary Water Supply System - Pipeline Desktop Condition Assessment Report" be received;

AND THAT the Port Burwell Area Secondary Water Supply System Joint Board of Management direct the Staff of the administering Municipality to initiate and develop a Request for Proposal (RFP) to obtain an Engineering Consultant to prepare a detailed Tender ready engineered design for the replacement of the entire Port Burwell Area Secondary Water Supply System transmission main.

Background:

The Port Burwell Area Secondary Water Supply System (PBASWSS) is a secondary transmission main which receives all of its water from the Elgin Area Water Treatment Plant on Dexter Line in Central Elgin, ON. The PBASWSS is jointly owned by the Municipality of Central Elgin, the Township of Malahide and the Municipality of Bayham. The water system provides critical fire protection and a safe potable supply of water to the residents who receive water from this system. The long-term sustainability of the pipeline is critical to ensuring that residents and communities which it serves have access to a reliable supply of water that meets Public Health requirements.

The original 12'' AC transmission main is approximately 24km long and was installed in the late 1960s. In the late 1970s, the system was extended by approximately 7km from the Water Tower on Nova Scotia Line easterly to service Vienna and Port Burwell. Historical maintenance on this 7km section has revealed that appropriate bedding material and pipe restraining hardware were not included in the original construction in

accordance with present-day industry installation standards. Accordingly, this section of pipe has become problematic and with inherent vulnerability for breaks to occur when pressure transients travel through the pipeline.

Since 2019, there have been four (4) Category 2 (suspected contamination) watermain breaks which resulted in a complete loss of service to the Bayham Water Distribution System. When a break occurs, the community is without municipal water supply or fire protection until the service can be restored. Repairs can be very challenging and time-consuming to complete, leaving the affected residents without service until the work is complete, the water is proven to be safe, and the boil water advisory is lifted by the Health Unit. This also has a major impact on local business owners, especially those who require a potable water source to operate.

At their scheduled meeting on June 7, 2023, report PBASWSS-23-07 was presented to the Board Members for the PBASWSS. At that time the Joint Board of Management directed the staff of the administering municipality to obtain Pure Technologies, to complete a desktop condition assessment of the water system transmission main.

Comments/Analysis:

Through the course of 2023, Pure Technologies undertook a document review including but not limited to; known historical failures, inspection reports, pressure monitoring, review of existing engineering drawings, SCADA flow and pressure data, and discussions with current staff.

Using this information, Pure Technologies has completed their condition assessment. The full report is attached for the Board's review; however, it can be generally summarized as having the following recommendations:

- seek provincial and federal funding opportunities to assist with future replacement of this watermain
- consider additional leak and gas pocket detection
- ensure that the operating strategy for the watermain focuses on maintaining consistent operating pressures and limiting pressure surges/transient pressures
- obtain a cost estimate for the addition of a second watermain crossing of the Catfish Creek in Port Bruce
- consider shifting ownership of the original AC watermain on Old Dexter Line to the Municipality of Central Elgin as it is functioning as a local distribution system for Central Elgin customers and is no longer a part of the transmission watermain
- have a high-level estimate prepared for the future replacement of this watermain

Staff generally concur with the recommendations provided by Pure Technologies, with one notable difference. Staff recommend proceeding with a detailed engineering design for the complete replacement of the transmission watermain, rather than just developing a budget. By having the detailed engineering design work completed now, the Board will receive accurate budgetary values for inclusion in the future capital plans, and will have

the necessary engineering design work ready for tender, so that if there are other funding opportunities available, the Board will be better positioned to apply for funding.

Financial Implications to Budget:

There will be some general administrative costs to the Board. These costs will be required to have the Staff of the Administering Municipality develop and implement an RFP to obtain a qualified Engineering Consultant to complete a tender-ready engineered design for the replacement of the entire Port Burwell Secondary transmission main.

The results and findings of the proposed Engineering design will be incorporated into future capital budgets for the Board's consideration.

Summary:

In order to ensure the long-term sustainability and useful function of the Secondary Water Supply System a condition assessment was required to evaluate the existing condition of the pipeline and establish a plan to identify and prioritize the most vulnerable portions of the system for future capital investment.

This also ensures future budgets allow capital upgrades to be scheduled appropriately and ensures future budgets plan for lifecycle replacements. Keeping the Owners informed ensures that they are made aware of the needs of the water system and allow for effective long-term planning of required maintenance and upgrades so a proactive approach can be achieved.

Submitted by:	Approved by:	Approved by:
Sam Gustavson Water/Wastewater Operations Manager	Jason Godby Director of Public Works	Nathan Dias Chief Administrative Officer

March 2024 – Rev 3

Sam Gustavson
Water/Wastewater Operations Manager
Township of Malahide
87 John St South
Aylmer, Ontario, N5H 2C3

RE: **Desktop Assessment of the Port Burwell Area Secondary Water Supply System**

Dear Mr. Gustavson,

Pure Technologies Ltd., a Xylem brand (Pure Technologies) has completed the desktop assessment of the Port Burwell Area Secondary Water Supply System. The report is intended to provide an amalgamation and assessment of information regarding the history of the transmission main from various sources, as well as recommendations for next steps based on Pure Technologies extensive pipeline condition assessment experience.

1. Document Review

Pure Technologies reviewed the following documents, in addition to email communications from Port Burwell Area Secondary Water Supply System staff, to formulate this report:

- Ontario Water Resources Commission Project No. 5-0087-68, Lake Erie Secondary Water Supply System #2 (Port Burwell), Plan and Profile Drawings, 1970
- Dexter Line (County Road 24) – Realignment Drawings, 2017
- Elgin Area Water System Overview Metre Map, 2022
- Ontario Clean Water Agency Chamber Inspections Reports
- Flow and Pressure data from SCADA system for the Port Burwell Area Secondary Water Supply System
- Flow and Pressure data provided by Flowmetrix at Chamber E038, V001 and E034
- Various Watermain Break and Repair photos, emails, and repair reports submitted by Staff.

2. Transmission Main Background and History

The Port Burwell Area Secondary Water Supply System (Port Burwell Transmission Main) is a transmission main jointly owned and operated by the Port Burwell Area Secondary Water Supply System (PBASWSS), which is comprised of the Townships of Malahide, Municipality of Bayham, and the Municipality of Central Elgin. In 1998, the Province of Ontario granted equal ownership to the municipalities and created the PBASWSS. This established a Joint Board of Management comprised of one member from each municipality and established the Township of Malahide as the Administering Municipality.

The Port Burwell Transmission Main is 31.3 kilometres in length and is comprised of 300-millimetre Asbestos Cement (AC) and Polyvinyl Chloride (PVC) and was installed in 1970. The original PVC section is approximately 7 kilometres in length and runs from the Port Burwell Water Tower to the east termination of the transmission main. The AC sections run approximately 6.2 kilometres from Chamber MV1 to the intersection of Quaker Rd and Dexter Line, 1.1 kilometres from the Quaker Rd and Dexter Line to Old Dexter/New Dexter Rd at Chamber VC-01, and 12.3 kilometres from the Dexter re-chlorination chamber to the Port Burwell Water Tower. These lengths do not include the original 3 kilometres of AC pipe on Old Dexter Line, which is still in service. This portion of the Transmission Main west of Port Bruce underwent significant relocation in 2016 along the shores of Lake Erie due to heavy soil and shoreline erosion and is not intended to be replaced. It remains a liability to the Board, and end users are served with the newly re-aligned 3.5 kilometre long 300-millimetre PVC section along New Dexter Line, which is estimated to have 100 years of shoreline protection from the time of installation.

Record drawings do not indicate the pipe material at installation; however, it is assumed from conversations with former staff that the PVC section was installed between 1970 and 1972. This assessment will look at the AC and PVC sections separately, as they have different operating conditions, pipe materials and failure history.

The pipeline transports water from the Elgin Water Treatment Plant east to the townships of Malahide, Port Bruce and Port Burwell. Included within the system is a water storage tower, two re-chlorination facilities and 50 access chambers. The water tower provides pressure to the east and west to parts of Central Elgin, Malahide, and Bayham Township serving the communities of Port Bruce, Copenhagen, Vienna and Port Burwell, by way of gravity. The system feeds approximately 3,000 residents through over 1,400 rate connections and terminates at the Metre Chamber V001 (Vienna) and Chamber E038 (Port Burwell) where it enters the Bayham Water Distribution System.

Based on limited budget, extensive past investment, and an aging pipeline, the Joint Board has expressed concern of its ability to maintain the Port Burwell Area Secondary Water Supply System in its current state.

3. Main Breaks and Transmission Main Integrity

The Dexter Line Water Main has seen a considerable number of breaks in recent years, leading to increased downtime and costs for the operating municipalities. Main breaks have caused boil water advisories due to risk of loss of pressure, which can cause known or suspect contaminants to enter the main, having significant impacts to public health, and the system does not have redundant feeds for domestic drinking water. Loss of pressure anywhere along the Main also has implications for Fire Protection in all the services communities, as fire hydrants are directly connected.

2.1 PVC Section

Since 2013, the PVC section of the Port Burwell Transmission Main has experienced 11 recorded breaks. This equates to a breakage rate of 0.15 breaks per kilometre per year, or approximately 1 break per year. While a breakage rate of this magnitude may be acceptable on similar sized distribution networks of large utilities, the Port Burwell Area Secondary Water System is a transmission main with no alternative water supply. Research has shown that small utilities have up to two times more main breaks than large utilities, as they are less funded, have fewer engineers for design, data analysis and to develop asset management practices (Folkman, 2018). Serving approximately 3,000 residents, the Port Burwell Transmission Main has a much higher ratio of kilometres per customer than that of larger utility transmission mains. This means that breaks in a utility such as Port Burwell have a greater overall impact on the community.

The Secondary Board does not have the resources to complete repairs itself or retain stand-by emergency contractors for repairs of main breaks. This requires staff to coordinate and obtain contractors in emergency situations, and hope that an available contractor can provide services in a timely and cost-effective manner.

Repairs of just the pipe can cost between $25,000-$50,000 for a single break, not including the cost of bulk water when a boil water advisory is given. This cost does not include the loss of revenue during which the main is out of service, or the potential impacts to private businesses, including Port Burwell Provincial Park, as well as public schools, old age homes, medical clinics and other critical customers requiring potable water supply. More catastrophic repairs such as breaks which cause road washouts or occur at river crossings can increase these costs significantly. A catastrophic failure that requires significant time would require bulk water to be supplied to residents and businesses, further increasing costs. Failures can also result in loss of fire protection to the community, creating increased risk.

Figure 2.1 shows a spatial analysis of the recorded breaks on the transmission main, highlighting the high concentration of breaks on the PVC section at the eastern extent of the transmission main.

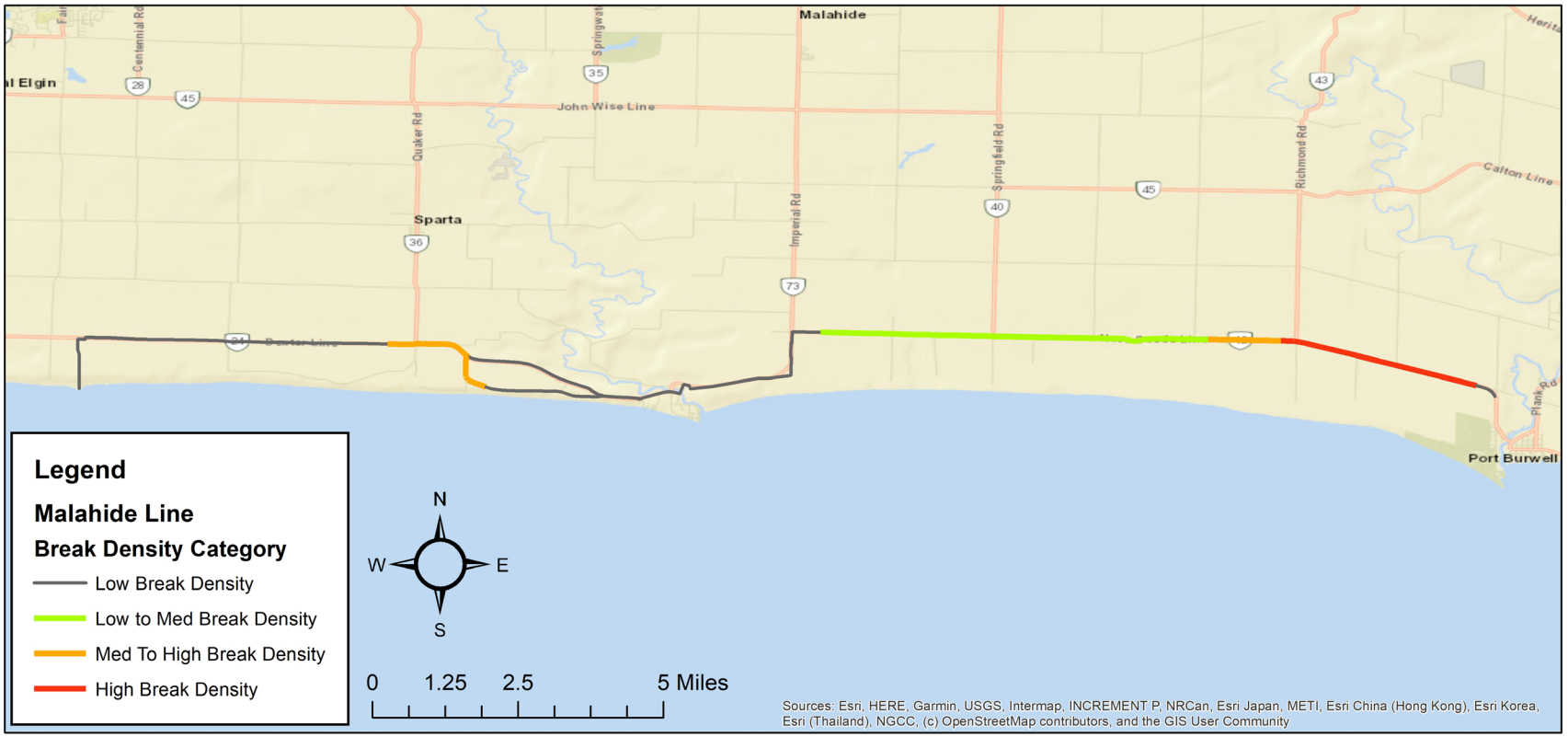


Figure 2.1: Overview of Break Density on the Port Burwell Area Secondary Water System

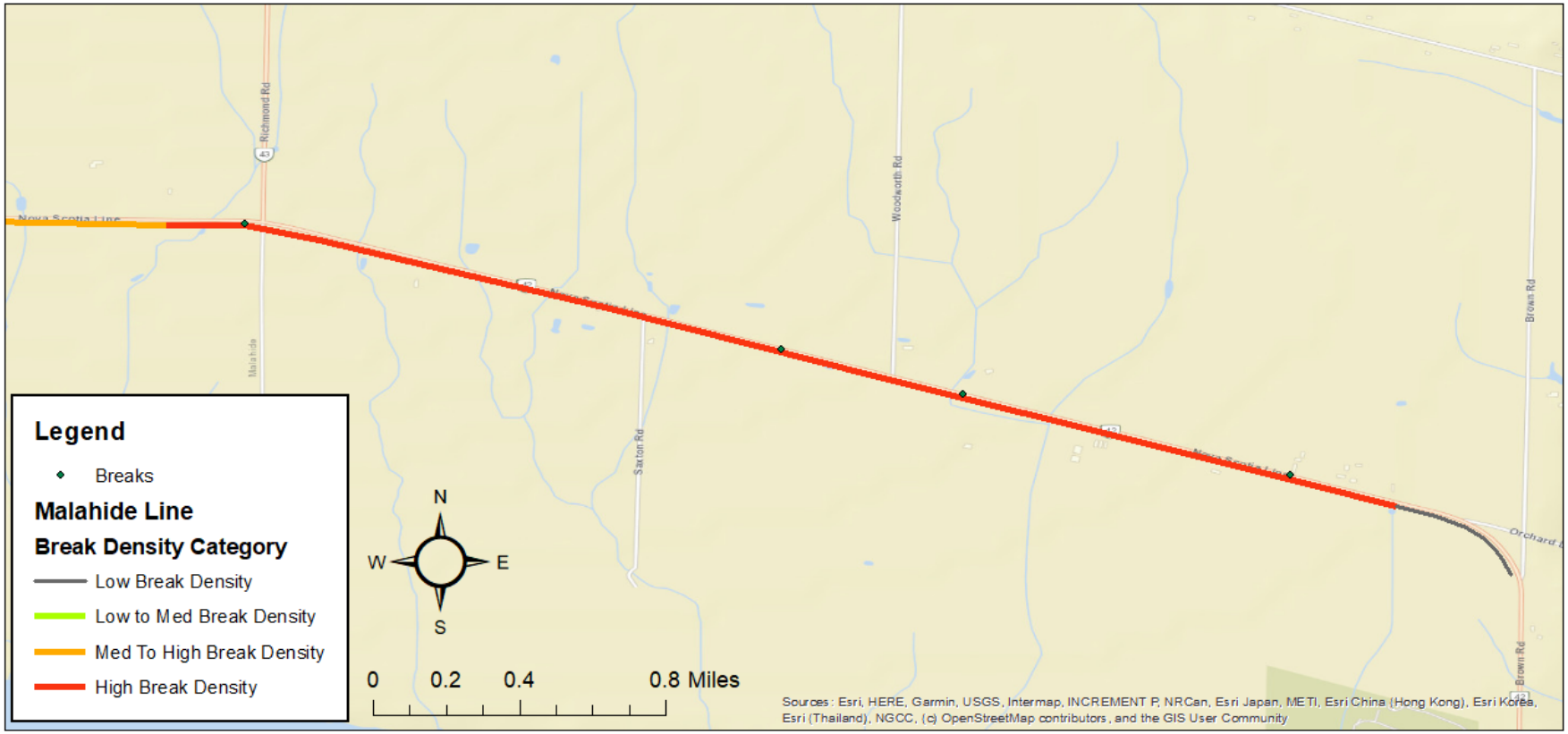


Figure 2.2: Transmission Main Breaks on the PVC Section of the Port Burwell Area Secondary Water System

Figure 2.3: Main Break on the PVC Section of the Port Burwell Transmission Main

Figure 2.3 shows a main break which occurred in April of 2018, on the PVC section of the transmission Main. The type of crack shown on the right, is potentially a form of Rapid Crack Propagation (RCP), which is a large longitudinal crack, often spanning many metres in length, which cracks suddenly and causes extensive water loss, as seen on the left image. RCP is commonly caused by a sudden surge pressure, or water hammer. Records from the operation of the Port Burwell Transmission Main show that almost all breaks occurred after downstream hydrants were opened quickly for firefighting, causing pressure surges back through the system. The last four (4) breaks on the Main created points of entry for contaminants and were classified as Category 2 breaks (as classified in the field in reference to the MECP 2020 Watermain Disinfection Procedure), resulting in loss of pressure to downstream users and boil water advisories at the direction of the local Medical Officer of Health. This creates added public health risks to the community and risk to fire protection services.

Failures of this type can also be caused by improper installation, where the spigot end of one pipe is inserted too far into the bell end of the adjoining pipe. This type of installation error causes longitudinal cracking originating from the bell end of the pipe. Municipal Staff have expressed concern over the quality of the installation of the original pipe, noting that joints do not appear to be aligned properly in multiple locations. This, coupled with the knowledge of non-engineering bedding being used, suggests that the PVC failure issues may go beyond the pressure surges, and may be additionally caused by poor installation. A 2018 study showed

that in Canada and the United States, 45 percent of PVC failures were caused by poor installation or construction practices (Folkman, 2018), the highest of any pipe material.

Additionally, the manufacturing process of the PVC pipe can lead to pipes that are more susceptible to failure, especially with pressure surges. Figure 2.4 shows the 2022 pipe failure, where a longitudinal crack can be seen the length of the pipe, and the two fractured sections overlapping. This can be caused by issues during the manufacturing process of the pipe. PVC pipe is extruded through a circular die under high pressure, where the plastic fuses together after flowing through the die. This process can sometimes lead to weak fusion of the pipe material, causing pre-mature failure. When this happens, the curling of the two fractured sections shown in Figure 2.4 occurs due to high residual stress in the pipe wall. Pipes with high levels of residual stress are more likely to fail. Operations staff have noted that this type of failure has occurred on every PVC main break.

Figure 2.4: 2022 PVC Failure

2.2 AC Section

The AC section of the main has experienced two breaks, at unknown dates, prior to breaks in the PVC. Operations staff have noted that there are additional issues with the AC pipes related to leaking gaskets, which expand and contract significantly causing their eventual failure. When the pipeline is has been depressurized due to failure, the gaskets relax, and expand again upon repressurization. This expansion and contraction cause strain on the gaskets and results in leaks and loss of water. Aging metallic fittings such as saddles and metallic connections in chambers have an increased risk of failure as the AC pipe ages. Based on conversations with current and previous operations staff members, between 15-20 service saddles have been replaced between 2000 and 2012.

Pure Technologies performed a design analysis of the asbestos cement pipe in the Port Burwell Transmission Main. Using pressure data obtained from the pressure monitoring and the Port Burwell SCADA system, the external loading and design pressure were calculated. The analysis uses data from the American Water Works Association C400-64 standard "*The Selection of Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. for Water and Other Liquids*", to determine the crushing strength and load coefficient of the 12-inch (300-millimetre) pipe.

The analysis uses a combined approach, where the combination of the design pressure and external load (orange and black lines respectively) must remain inside the green design curve. As seen in Figure 2.5, the design requirements for the Port Burwell AC pipe are satisfied for safe operation.

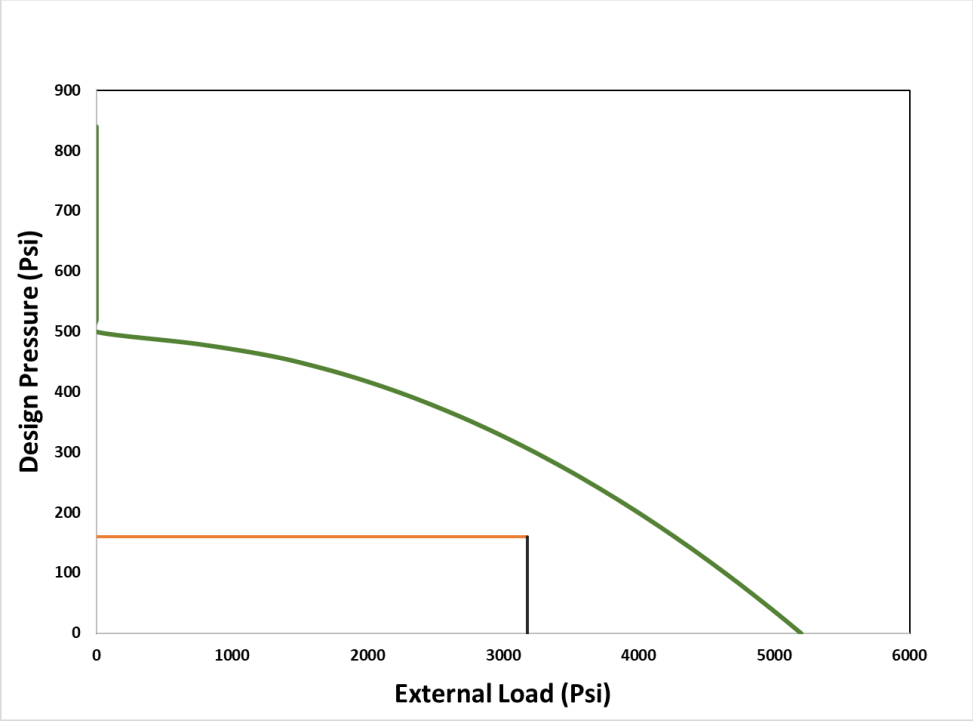


Figure 2.5: AWWA C401 Design Parabola for Asbestos Cement Pipe

Since the old section of the AC pipe has been realigned, the new section is able to convey water to Malahide and Bayham assuring that the Board has maintained its responsibility to convey water to these municipalities, while eliminating the threat or shoreline erosion. Unfortunately, the AC section on Old Dexter Line could not be decommissioned as it served existing Central Elgin residents. As such, the pipe has remained in place to serve these properties. This puts the Board in a difficult position as this section of pipe is still vulnerable to damage from erosion, however it does not impact the Board's ability or obligation to deliver water to the larger number of customers downstream. Currently, this entire section of main and the handful of customers connected to it are entirely in Central Elgin, however any repairs on this section would be funded by all member municipalities. The majority of any potential repair costs in this location would be funded by Malahide and Bayham as they have large proportional flow demand from the system. This distribution of responsibility creates undue financial burden on Malahide and Bayham, as they are already supplying water to their customers through the New Dexter Line section.

Further discussion between the members of the Joint Board of Operations would be of value in determining the future of this section of pipe.

4. Assessment of Risk

As part of the assessment of risk of the Port Burwell Transmission Main, Pure Technologies has created the following criteria and weightings for calculating the Likelihood of Failure (LoF) in the future. Scores were assigned of 1, 3 and 5 points for each category.

- *Pipe age*: Although age itself is not an indication of whether a pipe will fail, break rates increase with age in all pipe materials: Pre 1970 (5 points), 1970-2000 (3 points), 2000-present (1 point).

- *History of breaks*: Pipes that have broken once are likely to break again. Higher points are assigned for having a history of breaks: Multiple breaks (5 points), one break (3 points), no breaks (1 point). This is due to the impact of the break or the stress of the repair, or continued deterioration from external sources or operating conditions. This is reflected across the literature on pipe failure, as failure prediction models have consistently found that failure history is the most important predictive attribute (Kerwin et al., 2020).

- *Pressure surges*: As part of the assessment, Pure Technologies and the Township of Malahide installed transient pressure monitors at various locations along the transmission main, to capture potentially harmful transient pressure surges. As discussed in Section 1, previous failures were attributed to pressure surges caused by the opening of downstream fire hydrants and the activation of the Vienna Booster Station, which is designed to maintain the pressure in Vienna between 45 and 70 psi (which is in the Bayham Distribution System). Pressure monitoring indicated that the average pressure in the PVC section is approximately 40 psi, with pressure increasing to 80 psi when downstream hydrants are open. The Board has attempted to reduce the impact of these pressure surges by installing a surge busting check valve at the V001 Metre Chamber upstream of the Vienna Booster Station; however, the pressure data shows that transients can still occur. Pressure data can be found attached to this report as Appendix A. As the AC section is significantly farther upstream from the hydrants and the booster station, pressure increases in this area are minimal.

    - The Vienna Booster Station has been permanently turned off since a main break on March 9, 2023, which happened while the Fire Department was actively fighting a fire and the water supply was interrupted due to the main break.

    - The pressure surge seen in Appendix A was caused by the Bayham Water Department slowly opening Hydrant #47 in Vienna, to simulate a transient. This was done without the Vienna Booster Station online, as the risk was too great. Were the hydrant to be opened in uncontrolled situations, such as fire

protection, the magnitude of the transient would significantly increase, putting significant physical strain on the PVC pipe.

- *Soil condition*: As PVC is resistant to corrosion, and no corrosivity testing has been completed on the AC section of pipe, the rating is based on the findings of previous excavations of the water main, where Municipal Staff found the pipes to be bedded in non-compacted native fill (Type IV previously excavated fill), which is mostly comprised of clay. Higher levels of soil stiffness from compacted bedding reduces deflection in pipes, which is important in flexible pipes such as PVC to reduce deflection. Although the deflection of the PVC pipe in uncompacted clay is estimated to be between up to 2 percent (using calculation 4-10 in the American Water Works Association M23 Manual), which falls within the acceptable range based on AWWA Standards, the lack of engineered fill based on staff observations increases the long-term risk of the pipeline. For AC pipes, ground movement creates a higher risk of failure, as these pipes have low strain limits, and are therefore sensitive to cyclical shrinkage, settlement, and downward soil creep. The AC section of the main has already been relocated due to shore erosion, which included the installation of approximately 3.5 kilometres of new PVC pipe. Erosion of the Lake Erie shoreline west of Port Bruce is active and expected to continue (W.F. Baird, 2015), leaving the remaining pipe section closest to the lake at risk of future damage. Based on the ongoing erosion and the Port Burwell Transmission Main having already been realigned once for this reason, the AC pipe section was assigned the highest score for soil condition.

Table 2.1 shows the results of the likelihood of failure calculations.

Table 2.1: Likelihood of Failure

Criteria	Weight (%)	PVC - Score	AC - Score
Pipe Age	10	3	3
History of Breaks	60	5	5
Pressure Surges	20	3	1
Soil Condition	10	3	5
Total	**5 Points**	**4.2**	**4.0**

As seen in Table 2.1, both sections of the Port Burwell Transmission Main face significant likelihood of failure in the future.

To properly assess the risk, the Consequence of Failure (CoF) must also be determined. CoF is usually determined by considering a triple bottom line approach, that is, the financial, social, and environmental impact of a pipe or pipeline failure.

- *Land Use Impact*: Pipes which follow along, or cross under arterial roads have a larger consequence of failure than those along right of ways or non commercial or residential lands. Most of the PBASWSS follows Dexter Line and Nova Scotia Line, which are considered Collector Roads by Elgin County. These roads are for equal access to land and traffic flow. Were they to close for any period, there are alternative routes in the area, however it could cause minor delays to the flow of traffic and goods. Significant portions of the Port Burwell Transmission Main are adjacent to agricultural industries, including highly valuable cash crops which are a major part of the local economy. Damage to agricultural fields can result in significant costs for the Board, including compensation for future crop yields that may be affected. Scores are assigned based on: Under or crossing major arterial road or agricultural field (3 points), under or crossing minor arterial or collector Road, adjacent to agricultural field (2 points), under or crossing local road or suburban link, or within 100 metres of agricultural field (1 point).

- *Financial – Redundancy:* The Port Burwell Transmission Main has no redundancy, and therefore any failure or leak which requires the pipeline to be shutdown has an immediate impact not only on local businesses, but also on the revenue of the Joint Board of Management. Lost revenue due to pipeline downtime, repair costs, and potential requirements for bulk water to be supplied to customers impacts the Board's ability to save money for future expenditures and eats into reserves. For this reason, the pipeline has been given a maximum score of 3 points.

- *Transportation Crossing*: Pipelines that cross transportation crossings such as a railway or provincial highway are assigned 3 points. All others are assigned 1 point. The Port Burwell Transmission Main does not cross either a provincial highway or railroad.

- *Social – Public Safety and Critical Customers including Fire Fighting*: Generally, pipelines serving major industrial or commercial customers are assigned 3 points. Although the Transmission Main does not serve large single industrial customers, it is the primary or only source of water for various old age/retirement homes, health clinics and fire fighting in the region, as well as the source of water for the Port Burwell Provincial Park. Fire fighting requires the use of hydrants connected to the Transmission Main and has been the source of previous pipeline failures due to the pressure transients caused when hydrants are opened suddenly. Given the risk of failure would directly impact the ability of the local Fire Department to extinguish fires, this category has been assigned the maximum score of 3 points.

- *Water and Sensitive Habitat Crossings*: Pipelines that cross waterways and sensitive habitats can be damaging to wildlife and water quality should they fail, and repair can be significantly more expensive than that of a pipe along a right of way or road. Pipes

that cross either of these environmental locations are assigned 3 points, and all others are assigned 1 point. As the AC section of the Port Burwell Transmission Main crosses Catfish Creek, as shown in Figure 3.1, it is assigned 3 points. The PVC section, while not crossing the same level of water, travels under multiple small creeks and watershed discharges into Lake Erie and is therefore also assigned 3 points.

Figure 3.1: AC Section Crossing of Catfish Creek

Table 2.2 shows the results of the consequence of failure calculations.

Table 2.2: Consequence of Failure			
Criteria	**Weight (%)**	**PVC - Score**	**AC - Score**
Financial – Land Use Impact	20	2 (0.4)	2 (0.4)
Financial - Redundancy	25	3 (0.75)	3 (0.75)
Social – Transportation Crossing	10	1 (0.1)	1 (0.1)
Social - Public Safety and Critical Customers including Fire Fighting	25	3 (0.75)	3 (0.75)
Environmental – Water Crossings or Sensitive Habitats	20	3 (0.6)	3 (0.6)
Total		**2.6**	**2.6**

The PVC section of the Port Burwell Transmission Main is assigned a CoF score of 2.6, while the AC section is assigned a CoF score of 2.6.

Calculating the total risk for each section as:

$$Risk = Likelihood\ of\ Failure\ X\ Consequence\ of\ Failure$$

The overall risk for the PVC section is 10.9, and for the AC section is 10.4, out of a possible 15 points. Given that both sections score above 67% risk level of the maximum total weighted risk score, they are both candidates for further condition assessment and rehabilitation.

5. Costs and Previous Investments

The Joint Board has dedicated considerable budget towards the Port Burwell Transmission Main, including repairs (estimate at approximately $15-25,000 per repair), and upgrades to the transmission main infrastructure, since taking over ownership in 1998. In addition to the failure repairs, the Port Burwell Transmission Main has required the following major expenditures greater than $10,000 since 2016:

- 2016 Water Main realignment along New Dexter Line – $1,589,000.
- Water Tower Refurbishment - $685,459.
- Chamber E038: Entire chamber replaced with new piping and flow metre - $75,000. Previous chamber piping in poor condition shown in Figure 4.1.

- PLC Replacement at MV1, Port Burwell Water Tower, and Lakeview Re-chlorination - $54,171.

- 2018 Lakeview Re-chlorination building repairs and chemical feed system replacement - $42,000.

- 2020 – APAM SCADA server replacement and software upgrades - $39,519.

- 2019 Port Burwell Water Tower chemical feed system replacement and building repairs - $25,000.

Figure 4.1: Poor Condition of Piping and Chamber E038 Prior to Remediation

- Chamber E023: Replacement of chamber lid and chimney, valve replacement - $15,000.

- Chamber E029: Replacement of chamber chimney and valve replacement - $14,700.

- Chamber E027: Replacement of chamber chimney and valve replacement - $13,000.

- Chamber E007: Chamber chimney replacement – $11,200. Poor condition chimney prior to repair shown in Figure 4.2.

Figure 4.2: Poor Condition Chimney in Chamber E007

In addition to these completed or budgeted works, 19 chambers required upgrades or repairs, at an estimated cost of approximately $60,000, based on 2014 estimates. Updated pricing would be required to better estimate these costs. These upgrades and repairs are required to maintain a suitable level of service of the Port Burwell Transmission Main; however, they have used a considerable amount of financial capital, and the Board is only able to complete 1-2 chamber repairs or upgrades per year. Over half of the access chambers on the transmission main have not received major repair or upgrade and will be expected to require significant work in the coming years.

The 2024 budget for the Port Burwell Secondary Water Supply System estimates a total revenue of $987,000, with expenditures totalling $545,000, and $447,000, or approximately 46 percent, being transferred to the reserve fund. From this fund, an estimated $51,500 will be spent on capital costs, leaving a total addition $394,500 to the reserve fund. As of the end of 2024, the reserve fund is estimated to be approximately $2.5 million. The current estimate for replacement of the 7 kilometre stretch of PVC pipe is $21 million. The Joint Board cannot fund this capital replacement without significant contributions from the individual owners through financing, which would affect their capacity to fund future capital projects, such as the eventual replacement of the AC pipe section. The cost to rate users would have to be increased over 300 percent to fund the PVC replacement, which is likely unaffordable by many households, therefore the Joint Board should explore external funding options for the future replacement of the PVC section of the transmission main.

6. Future Considerations

The area serviced by the Port Burwell Transmission Main is expected to see significant growth in the next 10 years. In 2021, automaker Volkswagen and the Federal and Provincial governments announced the plans for an EV battery cell gigafactory in nearby St. Thomas. This plant will be the largest in North America of its kind and is expected to directly add 3,000 jobs to the region. Additionally, it could add up to tens of thousands of indirect jobs through construction companies, suppliers, and local retail, not only in St. Thomas but in surrounding towns of Port Burwell, Malahide, and Aylmer. This increase in population is expected to increase the current 3,000 customers serviced by the Port Burwell Transmission Main, putting further strain and demand on the aging pipeline. Pure Technologies recommends that repairs and replacement of critical pipeline components occur alongside other infrastructure upgrades in the region to continue to service its residents.

When the Port Bruce Bridge along Bank Street was replaced, the Joint Board included in the construction plans the ability for the bridge to support the Port Burwell Transmission Main above ground. This would reduce the risk of failure in an environmentally sensitive water crossing, as the pipeline could be assessed visually on a regular basis. Pure Technologies recommends that to reduce the environmental risk of the AC pipe section, the Board obtain an estimate for adding a second pipe be supported by the bridge, creating a redundancy in this critical area.

7. Recommendations

Based on the overall risk of failure of the Port Burwell Transmission Main, Pure Technologies recommends the following:

- The Joint Board seek a high-level estimate to prepare the budget for the future replacement of the Port Burwell Transmission Main, with a focus on replacing the PVC section first:
    - The 7-kilometre PVC section of the transmission main has experienced a high rate of failure for a non-redundant transmission main, and concerns regarding the manufacturing, installation, and past operation lead to uncertainty regarding its future operability. On average, one (1) failure per year has occurred on this section for the past 10 years. This is a significant failure rate for a transmission main and has had adverse effects on the community, including a risk for fire fighting. Previous failure of this section of pipe indicates that future failures are more likely, as past breaks are the strongest predictor of future ones.
    - While the AC section of the transmission main has similar risk levels as the PVC section, it has seen less overall failure since installation. Although it is approaching 50 years of age, and will continue to degrade and corrode over time, the AWWA design analysis shows that the pipe is able to withstand the current internal and external loads due to low pressure. The Board should obtain an estimate to realign the Catfish Creek crossing to be supported by the Port Bruce Bridge, to reduce the environmental risk associated with the transmission main.
- The Joint Board should seek outside investment through the provincial and federal infrastructure funds, to assist with the future replacement of the transmission main. Past investment in the transmission main, while required, has used reserve funds, and the future reserves are not enough to fund the entire replacement. The building of the Volkswagen EV plant in nearby St. Thomas, is expected to put additional strain on the system as 3,000 new jobs are created, and thousands of ancillary jobs. The timing of the replacement should coincide with the increased demand from the expected population growth. This will ensure that that Port Burwell Transmission Main is in good condition to not only ensure the delivery of water now, but for decades to come.
- To manage the Asbestos Cement portion of the transmission main, the Joint Board should explore the feasibility of a leak and gas pocket detection inspection. Asbestos Cement pipe actively corrodes and deteriorates overtime, and the pipe has already crossed 50 years of operation. Leak and gas pocket detection can pin-point leaks, and identify potential areas of concern, at a fraction of the cost of replacement. Various

options exist for inspection, including tethered and free-swimming inspection tools which have little to no impact on pipeline operation.

- In the short term, the transmission main should be operated with significant effort put towards maintaining a consistent operating pressure and limiting pressure surges. Previous PVC failures have most likely occurred due to pressure surges when operating hydrants, and although the check valve installed in 2022 is intended to mitigate this, pressure spikes were still recorded during the monitoring period.

- Pure Technologies recommends that to reduce the environmental risk of the AC pipe section, the Board obtain an estimate for adding a second pipe be supported by the Bridge, creating a redundancy in this critical area.

- Consideration should be given by the Joint Board of Management to no longer consider the original AC section along Old Dexter Line as part of the PBASWSS, as it functions as a tertiary or local distribution system for the few remaining customers on this road.

With the increasing costs of maintaining the aging Port Burwell Transmission Main, the Joint Board faces challenges in assuring that the system can provide clean drinking water to its residents, ensure system reliability and fire protection for current and future generations. Based on the available data, significant investment is required to ensure the future operability of the Port Burwell Transmission Main.

Kind regards,

Ashan McNealy, P.E.
Manager, Condition Assessment Engineering
808-445-1709
ashan.mcnealy@xylem.com

Tatiana Wendt
Project Manager

437-774-5543
tatiana.wendth@xylem.com

Josh Greenberg
Condition Assessment Specialist
647-261-4850
josh.greenberg@xylem.com

8. References

American Water Works Association. (1964). *Standard for Asbestos-Cement Pressure Pipe For Water and Other Liquids*. Denver: American Water Works Association.

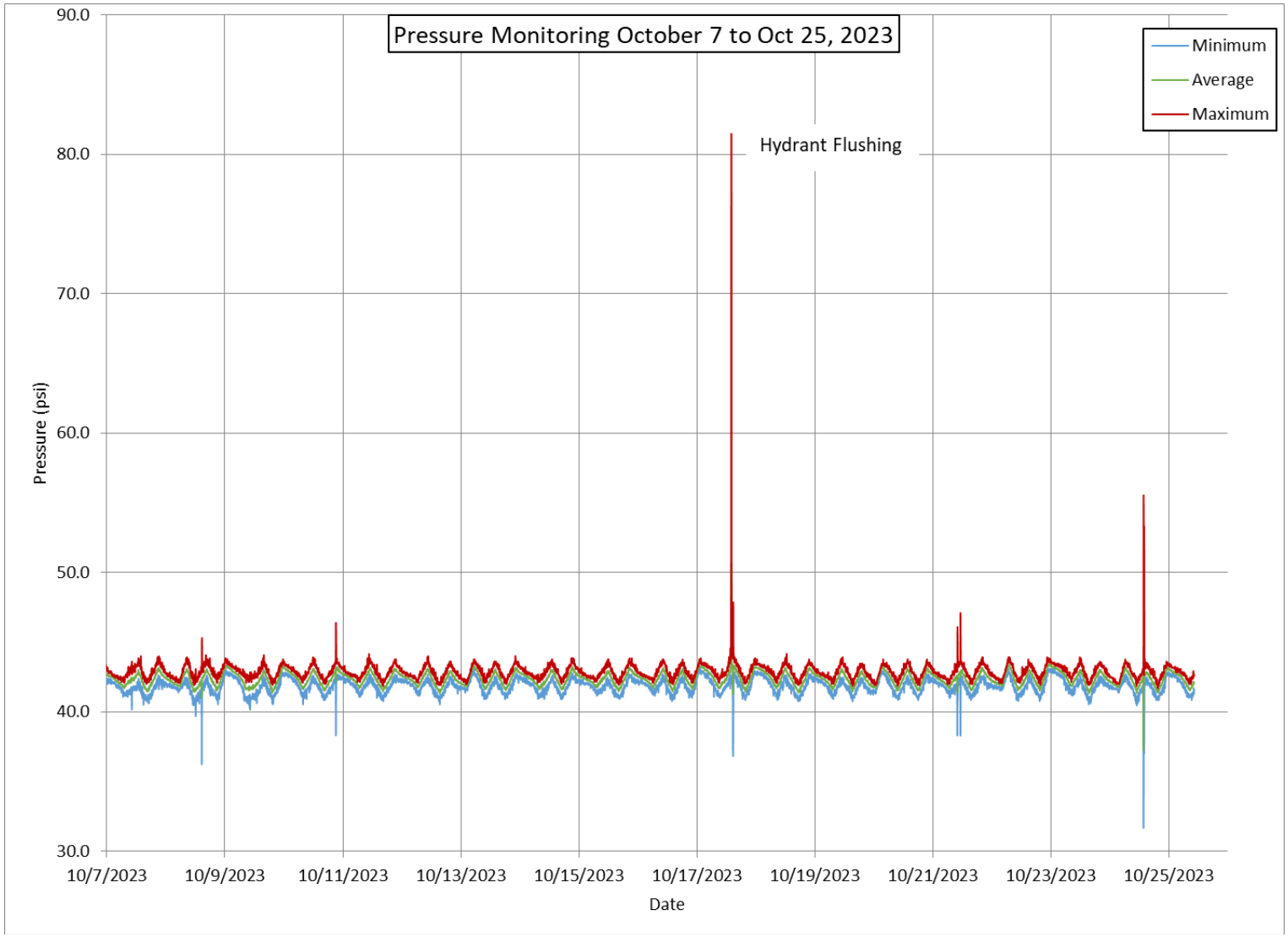
American Water Works Association. (2000). *PVC Pipe - Design and Installation*. Denver: American Water Worls Association.

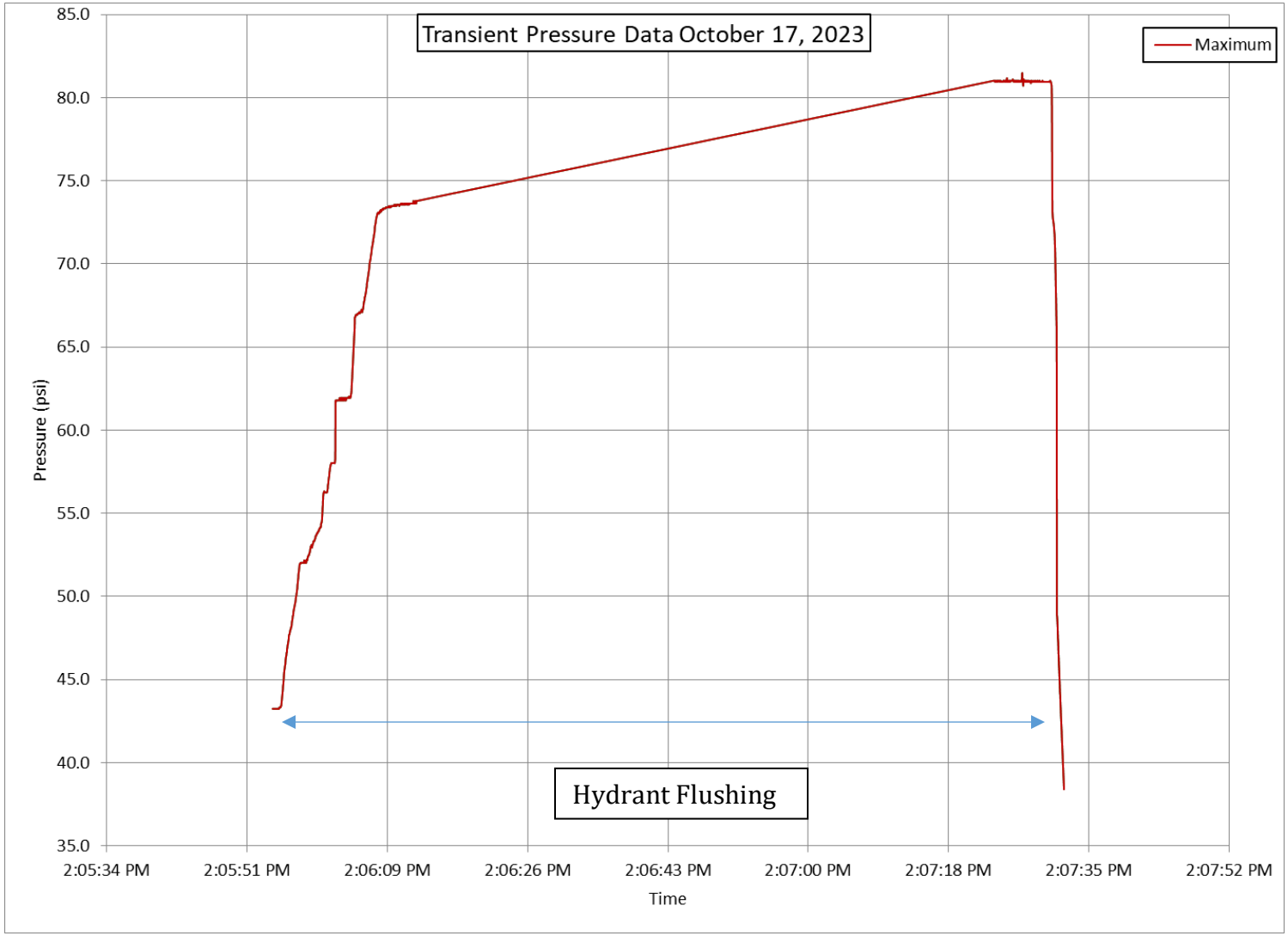
Kerwin, S., Garcia de Soto, B., Adey, B., Sampatakaki, K., & Heller, H. (2020). Combining recorded failures and expert opinion in the development of ANN pipe failure prediction models. *Sustainable and Resiliant Infrastructure*, 86-108.

Folkman, Steven, "Water Main Break Rates in the USA and Canada: A Comprehensive Study" (2018). Mechanical and Aerospace Engineering Faculty Publications. Paper 174. https://digitalcommons.usu.edu/mae_facpub/174

W.F. Baird & Associates Coastal Engineers Ltd. (2015). *Elgin County Shoreline Management Plan*.

APPENDIX A: Pressure Monitoring




Transient Pressure Data October 17, 2023
Maximum
Pressure (psi)
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
2:05:34 PM
2:05:51 PM
2:06:09 PM
2:06:26 PM
2:06:43 PM
2:07:00 PM
2:07:18 PM
2:07:35 PM
2:07:52 PM
Time
Hydrant Flushing