Memo

To: Magda Bardura – West Elgin

From: Nick Emery – Dillon Consulting Limited (Dillon)

cc: Mina Yacoub – Dillon
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Date: February 4, 2025

Subject: West Elgin Water Consumption Calculations

Our File: 24-7728

1.0 Introduction

Dillon Consulting Limited (Dillon) completed an assessment of the Municipality of West Elgin's (West Elgin) water consumption calculation methodology to:

1. Document current and previous calculation methods; and
2. Provide recommendations for a representative calculation methodology.

Dillon reviewed the calculation methodologies and the data used to complete the consumption calculations, and identified assumptions and uncertainties associated with each method. The results of the review were used to develop a recommended consumption calculation method.

2.0 Background

West Elgin is part of the Tri-County Water System, whose other members include the Municipality of Southwest Middlesex, the Village of Newbury, the Municipality of Chatham/Kent, and the Municipality of Dutton/Dunwich.

West Elgin is located at the upstream end of the water supply network. Water from the water treatment plant (WTP) located on the Lake Erie shoreline is conveyed through West Elgin to the other member municipalities by approximately 12 km of trunk watermain owned by the Tri-County System. Meter chambers are located at the connections to the other member municipalities, as shown on the attached figure.

Due to its location in the network, the volume of water supplied by the Tri-County System to West Elgin is calculated rather than directly measured. The calculation methodology was modified in 2022, resulting in larger consumption values than that reported in 2021, as summarized in **Table 1**.

Table 1: Reported West Elgin Annual Water Consumption Summary

Year	Annual Calculated Consumption (m^3)
2021	522,103
2022	580,852
2023	636,050

3.0 Consumption Calculation Before 2021

Until 2021, West Elgin's annual water consumption was calculated using the following equation.

Equation 1:

West Elgin Consumption = West Lorne Consumption + Rodney Consumption

where:

West Lorne Consumption = The sum of the individual West Lorne customer service meter readings; and

Rodney Consumption = The flows measured at the four meter chambers that supply Rodney, including FIT301, FIT304, FIT312, and FIT313.

The resulting water consumption calculation for 2021 is summarized in the following table.

Table 2: Reported West Elgin Annual Water Consumption Summary

Portion of the Water Distribution System	Annual Calculated Consumption (m^3)
West Lorne	148,374
Rodney	373,729
Total	**522,103**

This calculation methodology likely underestimates West Elgin's annual water consumption, because it includes customer meter readings and does not include losses due to flushing and leakage.

The flow measurements from the Tri-County meter chambers that supply Rodney are likely reasonably reliable, since the flowmeters are maintained and monitored by the system operator. In contrast, the data used to calculate the West Lorne water consumption are from the customer service meter readings and are less reliable. Service meters are not frequently monitored and maintained, and malfunctioning or older meters typically underestimate flow. Consequently, the water use calculated for West Lorne is likely lower than the actual annual water consumption.

This calculation method also neglects some of the water losses in the West Lorne portion of the water distribution system due to leakage and flushing. The flows measured at the Rodney meter chambers include both water used by customers and downstream system losses. However, since the West Lorne component of the consumption calculation is based on end-of-pipe flows at the customer meters, it does not include the losses that occur between the treatment plant and the water service connections.

4.0 Consumption Calculation After 2021

After 2021, West Elgin's water consumption was calculated by subtracting the flows measured at the meter chamber connections to Southwest Middlesex, Newbury, Chatham-Kent, and Dutton/Dunwich from the total flow supplied by the WTP, as summarized in the following equation.

Equation 2:

West Elgin Consumption = Flow Supplied by WTP - Sum of Flows Supplied to other Tri-County Members

The resulting values are summarized in the following table.

Table 3: West Elgin Annual Water Consumption Calculation Post-2021 (m^3)

Municipality	2022	2023
Southwest Middlesex	381,735	370,319
Newbury	58,300	47,959
Chatham-Kent (Bothwell)	96,139	92,052
Dutton/Dunwich	244,189	229,423
West Elgin	667,979	731,458
Total Flow from WTP	**1,448,342**	**1,471,211**

This calculation method likely overestimates West Elgin's annual water consumption, because it attributes water losses from the Tri-County system and any errors in flow measurement to West Elgin.

An analysis was completed to calculate how much additional flow is allocated to West Elgin using this methodology. A flow deficit was calculated by subtracting the flows measured at the Tri-County meter chambers and West Lorne customer meter readings from the total flow supplied by the WTP, using the following equation.

Equation 3:

Annual Deficit = Flow Supplied by WTP - Sum of Flows Supplied to all Tri-County Members

The resulting flow deficit represents unmeasured flow in the Tri-County system that is currently being attributed to West Elgin.

Table 4: Tri-County Flow Deficit Summary (m^3)

Consumption	2022	2023
Other Tri-County Member Municipalities		
Southwest Middlesex [1]	381,735	370,319
Chatham-Kent [1]	96,139	92,052
Newbury [1]	58,300	47,959
Dutton-Dunwich [1]	246,763	236,547
Other Municipalities Subtotal	**782,937**	**746,877**
West Elgin		
Rodney [1]	206,882	198,566
West Lorne [2]	128,913	122,978
Crinan [1]	122,660	120,709
West Elgin Subtotal	**458,455**	**442,253**
Total Consumption	**1,241,391**	**1,189,130**
Supply from WTP	**1,448,342**	**1,471,211**
Flow Deficit (m^3)	-206,951	-282,081
Flow Deficit (%)	-14.3%	-19.2%

Notes:

[1] From Tri-County meter chamber data.

[2] From customer meter data.

The calculation results suggest that there is a significant difference between the total flow supplied by the WTP and the total calculated consumption for the Tri-County members. The reasons for this difference may include:

- Measurement errors at one or more Tri-County meter chamber;
- Leakage from the Tri-County trunk watermains;
- Leakage from the portion of the West Lorne water distribution system that is not located downstream of a Tri-County meter chamber;
- Underestimated customer meter readings in the West Lorne portion of the West Elgin water distribution network; and
- Losses due to system flushing.

The average calculated flow deficit based on the 2022 and 2023 data is approximately 17 percent of the total flow supplied by Tri-County. The magnitude of this flow deficit cannot be reasonably attributed solely to losses in the West Lorne portion of the West Elgin water system caused by leakage, flushing and/or inaccurate customer meter data. Consequently, a significant portion of this water deficit is likely associated with the Tri-County portion of the network.

5.0 Discussion

Using the current West Elgin water consumption calculation methodology, any flow measurement errors and water losses from the Tri-County system are included in West Elgin's consumption. The result significantly overestimates West Elgin's actual water use. A more accurate method for calculating West Elgin's consumption is presented by the following equation:

Equation 4:

West Elgin Consumption = Rodney Consumption + Crinan Consumption + West Lorne Consumption + West Lorne Flushing + West Lorne Leakage

This equation accounts for the significant components of the West Elgin water consumption using the best available data. The resulting West Elgin water consumption is summarized in the following table.

Table 5: Revised West Elgin Annual Water Consumption Calculation (m^3)

Value	2022	2023
West Elgin Water Use		
Rodney [1]	206,882	198,566
West Lorne [2]	128,913	122,978
Crinan [1]	122,660	120,709
Use Subtotal	**458,455**	**442,253**
West Lorne Water Losses		
Flushing [3]	1,000	1,000
Leakage [4]	12,891	12,298
Loss Subtotal	**13,891**	**13,298**
TOTAL CONSUMPTION	**472,346**	**455,551**

Notes:

1. From Tri-County meter chamber data.
2. From customer meter data.
3. Based on seven unmetered blow off locations and one unmetered autoflusher.
4. Based on 10% of the West Lorne measured water use.

The annual system flushing volume for the blow offs located in the West Lorne portion of the network was estimated based on the following information:

- Seven blow off locations;
- Annual flushing frequency of seven times per year;
- Flushing duration of 10 minutes; and
- An assumed flow rate of 30 L/s.

The resulting calculated volume of approximately 880 m^3/year was rounded up to 1,000 m^3/year to account for the annual volume used by the Gray Line autoflusher.

Leakage from the West Lorne portion of the system is estimated assuming that water losses account for a percentage of the supplied flow. Based on information from Environment Canada presented in its 2011 Municipal Water Use Report, water losses represent approximately 13.3% of total water use in municipal water distribution systems. The report also notes that large cities tend to have more water lost through leaks than smaller communities. Based on this, a reasonable assumption for leakage from the West Lorne system is 10%.

Dillon reviewed the water distribution network to evaluate whether additional meter chambers could be installed to better measure the flow supplied by Tri-County to the West Lorne portion of the system. The results of the review suggest that this strategy probably isn't feasible because the many connections from the Tri-County trunk watermain to the West Lorne network would require a significant number of meter chambers. These chambers would likely interfere with flows under high demand conditions within the West Lorne Settlement Area and could affect available fire flows. Furthermore, installing a meter chamber on the Tri-County trunk watermain isn't feasible because it would prevent flows from the West Lorne standpipe from feeding the southern portion of the network.

6.0 Conclusions and Recommendations

The current method used to calculate West Elgin's water consumption overestimates the Municipality's water use. The available data suggest that there is a significant deficit between the flow supplied at the WTP and the flows used by the Tri-County member municipalities. Using the current calculation methodology, this deficit is borne exclusively by West Elgin.

Based on the results of Dillon's review, Equation 4 provides a more accurate method for calculating West Elgin's water consumption using the available data. While there is some uncertainty associated with the values used to calculate the total consumption for the West Lorne portion of the system, the accuracy of these values can be improved through additional investigation, including:

- Confirming the flushing losses by reviewing the calculation assumptions. The Municipality could also consider directly measuring the flushing volumes;
- Completing a detailed review of the water billing records to confirm the accuracy of the West Lorne customer meter data. Some of the review tasks may include:
    - Filtering the data to remove duplicate records;
    - Sorting the data to identify meters that may be undermeasuring flows;
    - Analyzing the data to identify trends, such as comparing the per meter water use in West Lorne with Rodney and Crinan;
- Compiling pipe age and pipe material data to characterize the West Lorne water distribution network. Once tabulated, this data can then be compared with the pipe data for the Tri-County trunk watermains to identify areas with highest risk of leakage.

The Tri-County Board should consider investigating the causes for the difference between the flow supplied at the WTP and the flows used by the Tri-County member municipalities. The investigation may include:

- Inspecting the Tri-County meter chambers and verifying the flow meter accuracy; and
- Completing a leak detection investigation of the Tri-County trunk watermain.

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Attachments: Figure – Tri-County Water Lines

TRI-COUNTY TRUNK WATER LINES

Newbury meter

To Chatham-Kent (Bothwell) meter

FIT310
To SW MDSX, Newbury & Bothwell meter location on Finney Street

FIT314
To Crinan (rural WE)

FIT304
To Rodney, meter located on Pioneer Line

To Dutton, meter located on Marsh Line - WE properties are Dutton customers

FIT301
To Rodney, meter located on Marsh Line

FIT312
To Rodney, meter located on Silver Clay Line

FIT313
To Rodney, meter located on Talbot West

FIT302
To Dutton, meter on Talbot Line

Meter readings inside WTP
(Split mode -
East to Dutton/Wallacetown,
West to remainder of Tri-County)

CLEARWELL STORAGE=250m3

LEGEND

- TRI-COUNTY
- DUTTON/DUNWICH
- SOUTHWEST MIDDLESEX
- WEST ELGIN

0 2000m

SPRIET ASSOCIATES LONDON LIMITED
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