Appendix M

EPCOR WATER SERVICES INC.

Consumption Forecast Validation Studies

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1.0   RESIDENTIAL VALIDATION STUDY

1.1   Residential Decomposition

1.   Residential consumption is calculated based on spatial disaggregation of residential customers. The aggregation categories are core, mature, established, and developing neighbourhood classification areas, as defined in the City of Edmonton's The Way We Grow document and shown in Figure 1.1-1.

Figure 1.1-1
Neighborhood Classifications (City of Edmonton, 2017)[1]

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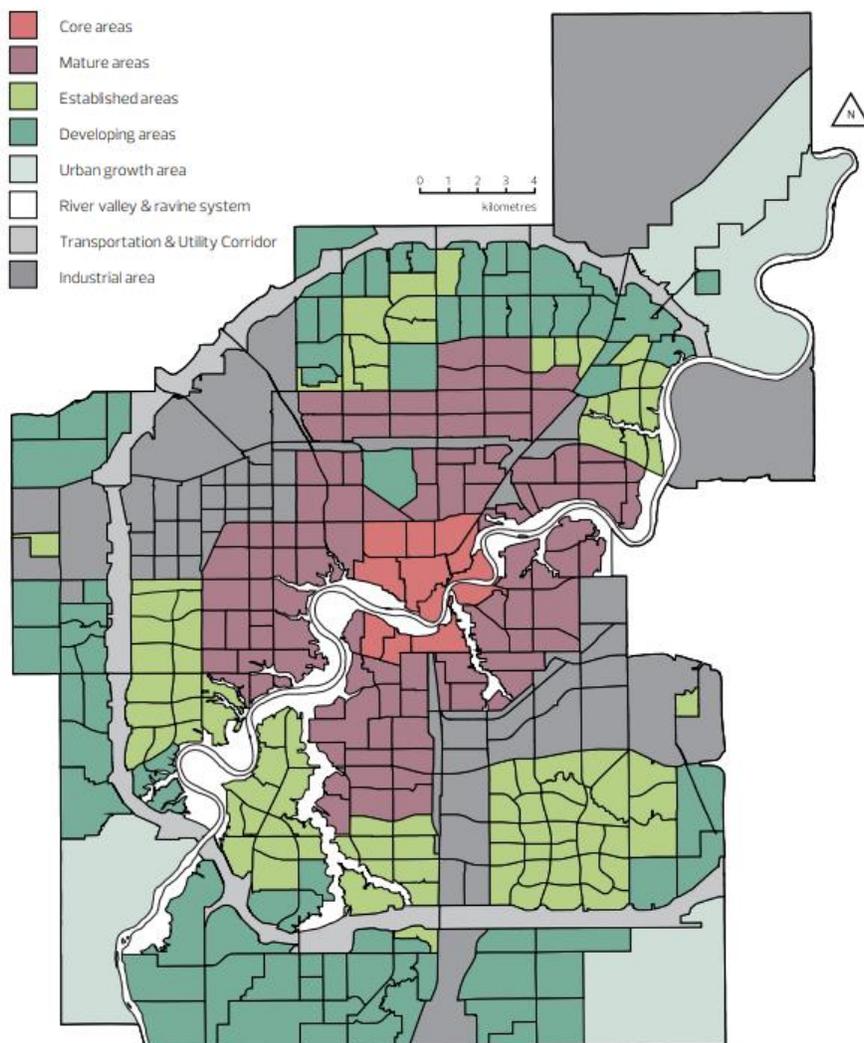
[1] City of Edmonton (2017). Our Growing City – 2017 Annual Growth Monitoring Report. Retrieved from
https://www.edmonton.ca/city_government/documents/PDF/GrowthMonitoringReport2017.pdf

1.2   Historical Trends

2.   As shown in Table 1.2-1, established neighbourhoods have the highest average annual rate of decline of the four neighbourhood classifications over the past five years. Since 2015, established base consumption has reduced annually on average by -2.37%, followed by mature (-2.16%), and core (-2.15%). Developing shows the slowest rate of decline at -0.73%. These trends are anticipated to continue into the near term.

Table 1.2-1
Annual Reduction in Water Consumption by Neighborhood Classification

	Classification	A 2015-2019 Average
1	**Edmonton**	**-1.77%**
2	Developing	-0.73%
3	Established	-2.37%
4	Mature	-2.16%
5	Core	-2.15%

3.   The differences in historical trends across neighborhood classifications is most likely attributable to differences in average household size and use of water efficiency fixtures/appliances.

1.3   Validation Using Household Size

4.   Household size in Edmonton varies by structure type and by the area of the City (City of Edmonton, 2016). Based on *Edmonton Census Atlas* and *Our Growing City – 2015 Annual Growth Monitoring Report*, each neighbourhood classification has a different average household density that is expected to remain constant, grow, or contract over the short term. The reports establish that developing areas primarily attract families, established areas have aging families where children are predicted to leave the family home, mature areas have an older demographic and less families, and core areas primarily attract young professionals.

5.   The single detached house is the most common housing type in Edmonton and within the residential rate code. However it is important to note that while the residential rate code is primarily made up of single detached houses, the *Water Services and Wastewater Treatment EPCOR Bylaw 15816*, states that up to "four separate dwelling units metered by a single water meter" are also classified as residential consumption. Based on the bylaw definition, the residential rate code can include single detached houses, duplexes, tri-/four-plexes, and row houses.

6.   Based on single detached housing stats, household size is smallest in the mature sector (including core), and highest in developing neighborhoods. Household size for single detached homes in the mature neighbourhoods have stabilized after decades of decline, whereas household sizes in the established sector shows continued declines. Single detached housing in the developing areas has the highest household size in the city. With a young demographic, and the dominant preference for lower-density housing among Edmonton homeowners, household sizes are not predicted to decline for many years in the developing neighbourhoods (Watson & Associates, 2019, City of Edmonton, 2016).

7.   *Based on the Residential End Uses of Water Study Version 2* (DeOreo, B. & Mayer, P., 2016), 11.5m^3/month is the base (indoor) efficiency benchmark that is suggested for future planning purposes; however this is based on a household occupancy of 2.6 to 2.7 people per household. The relationship between indoor use and number of residents follows a power curve relationship rather than linear. If a linear relationship is assumed when forecasting future use, homes with fewer residents would be predicted to use too little water, and homes with more residents would be over-allocated. This is because there is an economy of scale factor; for example, water use to launder clothing does not normally double when another person joins a household.

8.   To determine the theoretical low base consumption per household in Edmonton for residential consumption, the demand curve for high efficiency households y=59.58x0.53 (gallons per day) was utilized (DeOreo, B. & Mayer, P., 2016). The household density per residential customer was assumed to be 2.5 (City of Edmonton, 2017). The theoretical low base consumption assuming all residential customers are equipped by high efficiency fixtures and appliances is 11.1 m^3/month in Edmonton. As a reasonability check, the residential consumption forecast in 2026 is above the theoretical low base consumption signaling that reductions in efficiency will continue to occur past the 2026 timeframe.

1.4   Validation Using Water Efficient Fixtures and Appliances

9.   With household size being projected to remain the same in developing, core and mature areas, and average per service water consumption still falling, it has been established that the use of efficient fixtures and appliances is the main reason for these continued decreases. The impact varies by neighborhood classification, as shown in Table 1.4-1.

10.   This is supported by the following research from the *Residential End Uses of Water Study Update* (REUWS2) (DeOreo, B. & Mayer, P., 2016). Key finding include:

- Average North American indoor water use is measurably reduced on both a household and a per capita basis since the original study (1999).
- The primary technologies that have contributed to the reductions in indoor use are high efficiency toilets and washing machines.

Table 1.4-1
Impact of Efficiency on Water Use per Household

	Classification	A Household Size Changes	B Impact of Efficiency
1	**Edmonton**	**No**	**Yes**
2	Developing	No	Low
3	Established	Yes	High
4	Mature	No	Medium
5	Core	No	Medium

1.5   Conclusions

11.   Based on the above literature review, it is prudent to suggest that both renovation (change to water efficient fixtures and appliances) and a decrease in the number of people per household (established classification area only) will continue to reduce consumption per customer in the city of Edmonton. This validates the final PBR forecast.

2.0   MULTI-RESIDENTIAL VALIDATION STUDY

2.1   Background

12.   The multi-residential customer class is the smallest EWSI customer class by both percent of total consumption and percent of revenues. However, it has also proven to be the most challenging to forecast.

13.   The forecast methodology utilized for the multi-residential rate class is the simplest of the three rate classes, due to data limitations. The PBR forecast proposed within this Application, consistent with prior applications, is simply based on the historical average of total consumption. Forecast variance in previous PBR terms has been higher for the multi-residential rate class than for the Residential and Commercial rate classes due to data limitations.

14.   During the period EWSI was developing the forecast for the 2017-2021 PBR Application, historical data (i.e., pre-2017) exhibited an increasing trend in total multi-residential consumption. As a result, EWSI proposed an increasing consumption forecast over the years

2017-2021. However, consumption actuals over the 2017-2020 term have not followed the proposed linear trend and 2019 actual total consumption was lower than 2016 total consumption.

15.   In order to increase EWSI's confidence in its forecast of multi-residential consumption, EWSI developed the following validation analysis. Multiple forecasts were developed in the validation analysis, and EWSI ultimately selected the trend line that most closely matched the linear trend line based on the previous six years of consumption data, 2014-2019. For this reason, the 2022–2026 PBR forecast methodology based on the linear trend line is considered validated.

2.2   Total Consumption: Validation Analysis

16.   The validation analysis normalizes consumption to the number of dwelling units per customer, addressing the impact of varying building size on per-service consumption. Dwelling units refer to each individual suite of a multi-residential building. For example, a single family residential house has 1 dwelling unit, while a multi-residential building, by definition, has 5 or more dwelling units (e.g., a low rise apartment with 20 units).

17.   The number of dwelling units for all multi-residential customers is calculated using two datasets from City of Edmonton. The first dataset is based on verified dwelling unit counts from the Assessment and Taxation department, and the second dataset is a download from the Edmonton open data portal. Suite count from assessment and taxation is given priority, and the data downloaded from the open data portal is used to fill any missing information in the assessment and taxation data.

18.   Once consumption per dwelling unit is calculated for 2009–2019, it is projected forward to 2026 using an exponential trend line. The exponential form provides the most realistic trend (i.e., eventually flattens over time rather than decreasing to zero and does not increase to unrealistically high values) of all functional forms examined.

19.   The dwelling unit count forecast is based on the net increase in multi-residential lots over time. This measure is based on EWSI's customer billing information paired with parcel information from City of Edmonton. The dwelling unit count forecast is created by pairing forecast multi-residential lot growth with an average number of dwelling units per lot. The calculation results in a forecast for multi-residential dwelling units.

20.   Consumption is normalized by multiplying the dwelling unit count forecast and the consumption per dwelling unit forecast to calculate a total consumption forecast.

21.   Historically there have been periods with stagnating total consumption growth: 1998-2004, 2007-2012 (recession), 2014-2019. The proposed forecast trend likewise presents a slightly decreasing annual total consumption year over year, which is considered realistic given the challenging economic conditions.