

Gage Apartments Water Consumption Analysis

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GAGE APARTMENTS

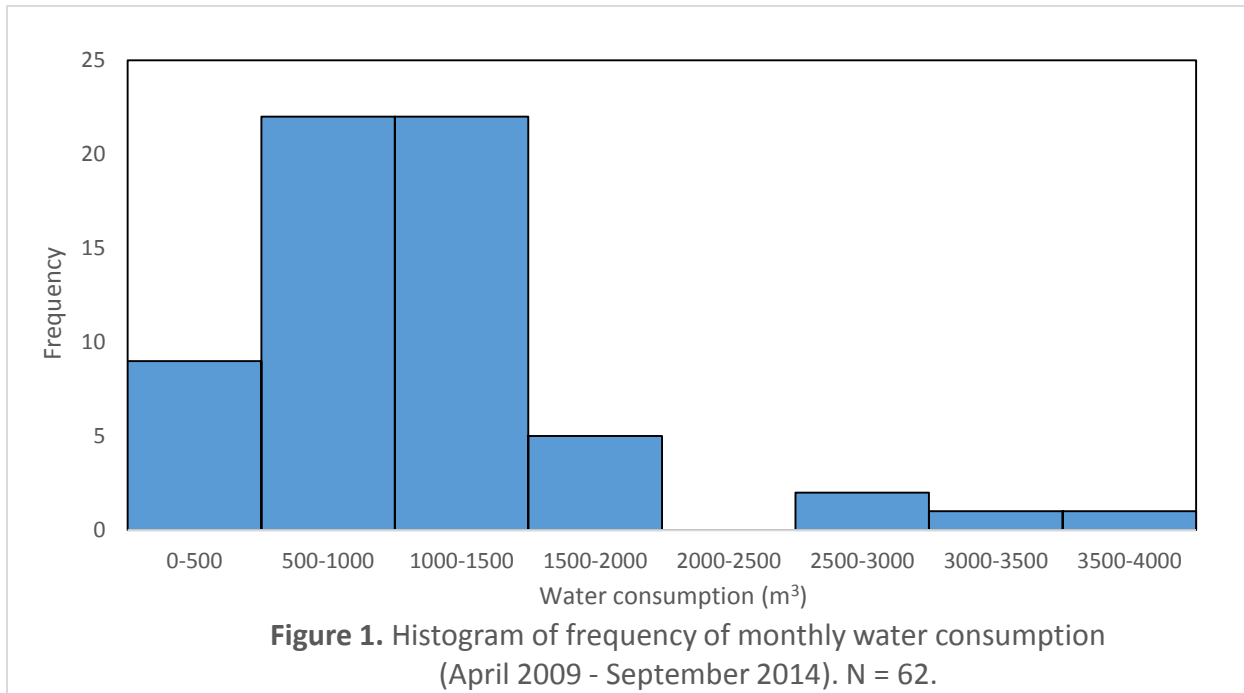
Gage Apartments is the north-east building within the Walter Gage complex. This facility is a student residence and is utilized in a hotel capacity during the summer months. Included in this water consumption analysis is intermittent data from March 2007 to September 2014. Monthly data was available from March 2009 onwards, and quarterly prior to this date. During the summers of 2010 and 2011, 100% of the water features in this building were updated to decrease water consumption. Our overall objective is to quantify what, if any, contribution this had to decreasing water use through increased infrastructure efficiency. The data needed only basic cleaning following input, such as determining consumption per month by adding two meter readings and using basic functions to determine cumulative consumption to date. There was also a need to identify limits in data quality such as that caused by inconsistent monitoring. The implications of this is the sensitivity of analysis possible, that is monthly vs. yearly comparisons, throughout the timeframe. Data was collected in water consumption in m³ and was not converted to ft³.

DATA ANALYSIS- SUMMARY STATISTICS

Table 1. Summary statistics of yearly consumption from 2008-2013 and monthly consumption from April 2009 to September 2014, as limited by data quality.

<i>Yearly Consumption</i>		<i>Monthly Consumption</i>	
Mean	12375.25	Mean	1015.717
Standard Error	651.3209	Standard Error	62.79561
Median	12077.75	Median	991.5
Standard Deviation	1595.404	Standard Deviation	457.1589
Sample Variance	2545313	Sample Variance	208994.3
Kurtosis	-1.59481	Kurtosis	2.912455
Skewness	0.402515	Skewness	1.04755
Range	3965	Range	2650.5
Minimum	10535	Minimum	115
Maximum	14500	Maximum	2765.5
Sum	74251.5	Sum	53833
Count	6	Count	53
Confidence Level (95.0%)	1674.274	Confidence Level (95.0%)	126.0086

DATA ANALYSIS- HISTOGRAM



Monthly water-consumption indicates that between April 2009 and September 2014, the most frequent consumption rates are 0-2000 m³ per month (Figure 1). The histogram in Figure 1 further indicates that there are 4 months with higher monthly consumption rates of 2500-4000 m³. These months are October 2009, October 2010, November 2010, and November 2012. It is possible that these trends relate to occupancy trends, weather trends, or events such as construction that increase water consumption. However, it is not possible to further elaborate on the cause of these 4 anomalies without further information.

DATA ANALYSIS- WATER CONSUMPTION OVER TIME

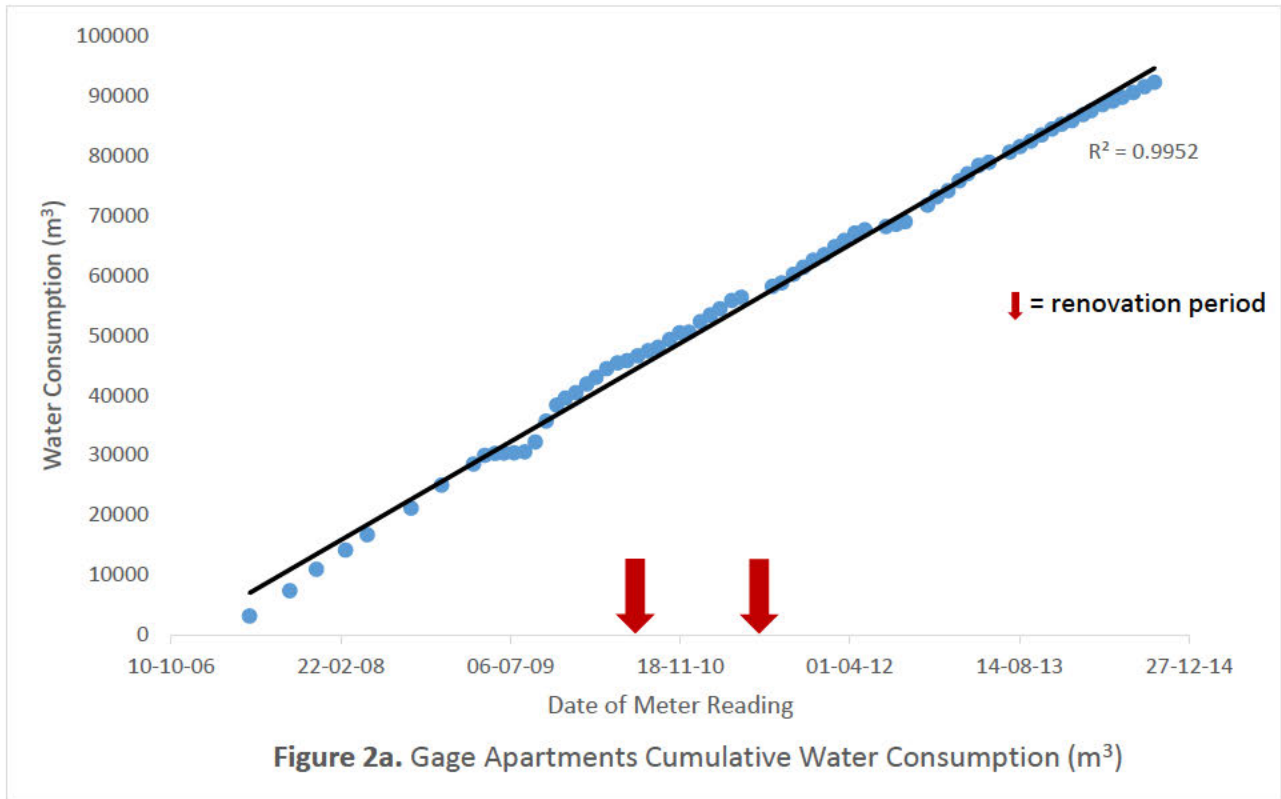


Figure 2a. Gage Apartments Cumulative Water Consumption (m³)

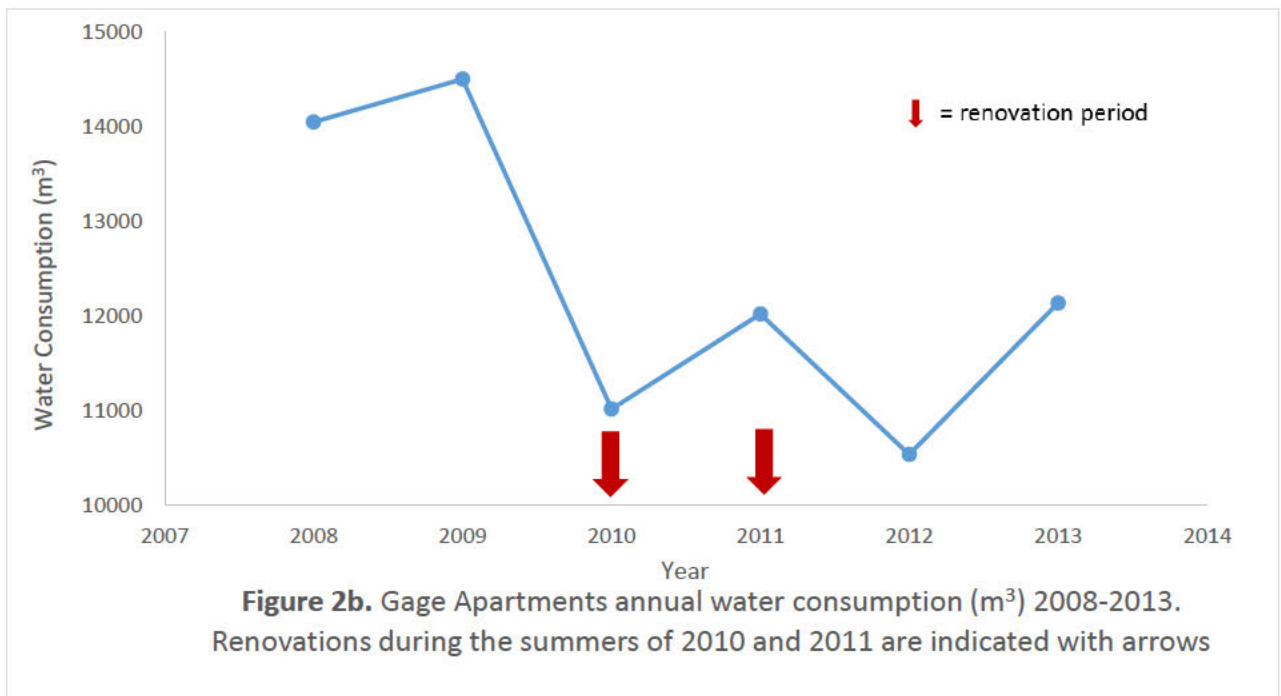


Figure 2b. Gage Apartments annual water consumption (m³) 2008-2013. Renovations during the summers of 2010 and 2011 are indicated with arrows

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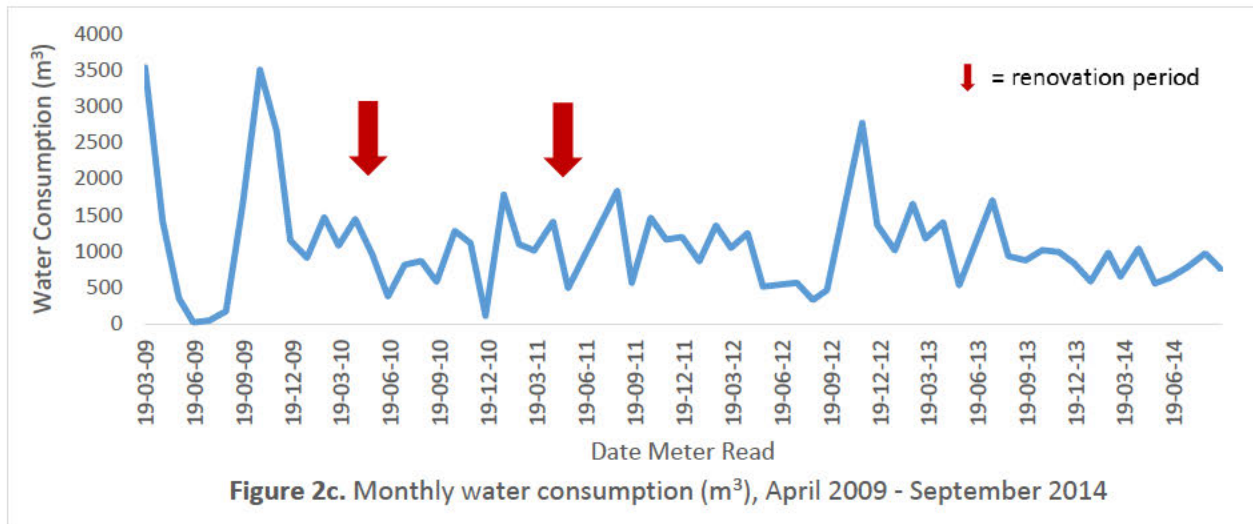


Figure 2a, 2b, 2c reveal water consumption over time in three different formats. Figure 2a indicates that cumulative water consumption based on all monthly and quarterly data available, has had no significant change between 2007 and 2014 ($R^2=0.9952$). In contrast, Figure 2b shows that yearly water consumption had a prominent decline in 2010-2013 relative to 2008 and 2009 data. Seasonal patterns are not evident in Figure 2c based on monthly data. Overall this leads to limited evidence suggesting that renovations may have led to a decrease in water consumption in Gage Apartments.

As briefly mentioned previously, without data pertaining to occupancy, weather conditions, and construction efforts among other variables, we do not have a complete analysis. It is possible, for example, that occupancy has increased in this building over time and water consumption per person over time has declined. Data was also missing that indicated the exact months and magnitude of renovations which would have had implications for water use due to an increase in construction activity and potentially lower occupancy.

Summer 2009 shows a drastic decline in water consumption to nearly 0 m³, perhaps due to no occupancy during this summer period, though this is unknown. Monthly data was missing prior to April 2009 due to quarterly meter reading only, which narrowed the scope of monthly analysis.

DATA ANALYSIS- CONCLUSIONARY STATISTICS

Table 2. t-Test comparing pre- and post-renovation water consumption indicating no significant change (Two-Sample Assuming Unequal Variances).

	<i>Pre-renovation</i>	<i>Post-renovation</i>
Mean	1386.071429	1001.176471
Variance	1333558.995	217938.4073
Observations	14	34
Hypothesized Mean Difference	0	
df	15	
t Stat	1.207141744	
P(T<=t) one-tail	0.123034649	
t Critical one-tail	1.753050356	
P(T<=t) two-tail	0.246069298	
t Critical two-tail	2.131449546	

There is no significant difference in pre-renovation water consumption compared with post-renovation consumption on a statistical basis, despite a difference in mean and variance for these time periods (Table 2).

The steady rate of water consumption in Gage Apartments despite retrofits may be due to several factors. These may include: efficiency of new equipment, behavioural changes, occupancy increases, error in meters or meter reading, and unaccounted for water connections on the same meter.

CONCLUSION

There was no significant decline in water consumption in Gage Apartments following plumbing retrofits during the summers of 2010 and 2011. While many factors have been identified as possible explanations for the lack of water conservation, without further data these are only speculative. Despite these somewhat disappointing results, this exercise has demonstrated the need to maintain accurate monthly data on building water consumption and the need for thorough reviews of expected gain from these extensive retrofitting investments for older buildings.