Trends and distribution of monthly water consumption in UBC Gage B Residence, 2010-2014.

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PLAN 597

October 10, 2014

PLAN 597: Assignment 1. Instructor: Jordi Honey-Roses
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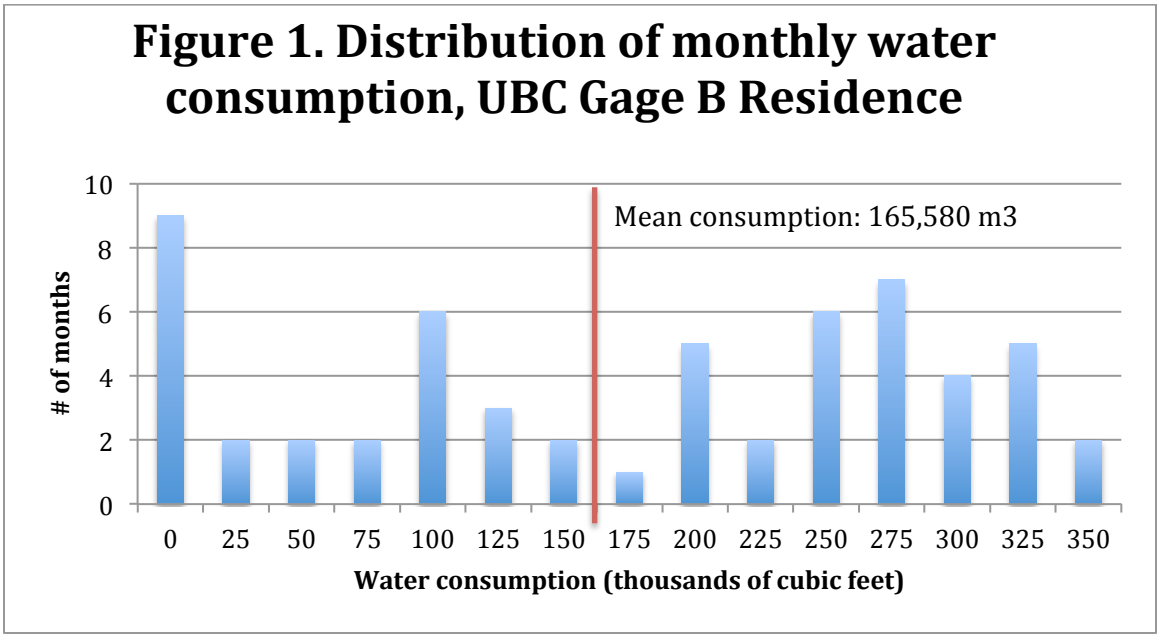
Data collection process and challenges:

Information on UBC Gage B residence was gathered from UBC Energy and Water Services. Fifty-eight data points were collected on the buildings' monthly water consumption between December 2009 (the earliest available data) and September 2014. Erin Kastner (Geospatial Information Manager, UBC Energy and Water Services) provided access to monthly and quarterly data from physical copies of the buildings' water meter readings. Monthly data was the only metric available, thus this document provides monthly analysis, extrapolating seasonal patterns. Several months (mostly in the summer) were not recorded. In order to demonstrate a consistent monthly trend in water consumption, these values were recorded at zero rather than left out, otherwise the next available reading would indicate more than one month of consumption and would skew the analysis. Other challenges arose in the analysis. For example, there was no reading taken for the 'low' meter in any of the months; a zero was written in for all low meter readings. The layout of the physical copy of the water meter readings made it difficult to distinguish that a zero from the 'low' column was not a part of the meters 'high' column read-out; as a result this extra zero was present at the end of all quarterly Excel data provided from 2010. This seemed to indicate that *total* consumption was somehow significantly higher in 2010 than any time beyond that. After receiving confirmation from UBC Energy and Water Services, removing these extra zeros showed the expected gradual increase in water consumption over time from Gage B residence.

Data Analysis

Monthly water consumption was calculated by subtracting each month's water readings from the month that followed; for example, to calculate water consumption for February 2010, the water readings from January were subtracted from February to see the difference. This difference was then converted from cubic meters into cubic feet, at the request of Erin Kastner. The mean monthly consumption of water in Gage B Residence between December 2009 and September 2014 was 165,580 cubic feet of water, where as median consumption was 187,870 cubic feet. Variance was quite high, at 12,595,920 (a standard deviation of 112,230 cubic feet). Figure 1 below describes the distribution of months with high and low water consumption. Note that months with zero water consumption are most represented by the data; despite this, 26 months are below the mean, while 32 are above, indicating that, overall, monthly water consumption is above the mean.



Trends in Water Consumption

Figure 2 below describes the buildings' trends in water consumption from December 2009 to September 2014. The black trend line indicates a slight overall increase in water consumption since December 2009, while the orange line indicates the mean consumption. Large rises in consumption over the fall and winter each year, and the large dips mostly between May and September demonstrate high seasonal variability. February, April, and October tend to be the months with the highest consumption, while June and July are the most likely to have the least amount or no data recorded. While most of the missing data is for summer months, total water consumption still increased the least during these times. One might expect higher consumption of water in the hot, dry summer months; however, decreased water demand due to low student populations over the summer months could explain this. Other explanations might include summer maintenance work, or upgrades to the water system as part of UBC's steam to hot water conversion project, construction of which likely happens during the summer months and would likely interrupt water supply.

In addition to this seasonal variation, there are also large variations within each season. The summer of 2013 had both the lowest below average consumption (133,750 cu. ft. below mean) and lowest total consumption (127,320 cu. ft); by comparison, the summer of 2012 had high variability in consumption levels and higher overall consumption (314,170 cu. ft.). Conversely, the fall and winter of 2011-2012 had the highest above average water consumption (98,900 cu. ft. above mean), yet the fall and winter of 2013-2014 had the highest total consumption (2,358,420 cu ft) of any season recorded, despite a significant drop in consumption in January 2014.

The renovation of the building (installation of low flow faucets and toilets) occurred in the summer of 2014. The data indicates that total water consumption for summer 2014 (394,430 cu. ft.) exceeds that of any other summer recorded. A possible explanation could be that, since fixtures now use less water, occupants feel less concerned about conserving water and end up using more (i.e. rebound effect). Other explanations could be that student population levels or construction patterns could have changed in 2014 compared to previous summers, resulting in both more supply and demand for water. In any case, more data collection and analysis is needed to arrive at any significant conclusions about long-term trends in overall consumption, and the effect of the buildings renovations on water consumption.

Figure 2. UBC Gage B Building Water consumption, January 2010-September 2014