Reducing Peaks in Drinking Water Demand in the City of Guelph: Estimating the Potential Cost Savings of Delaying Water System Capacity Expansions

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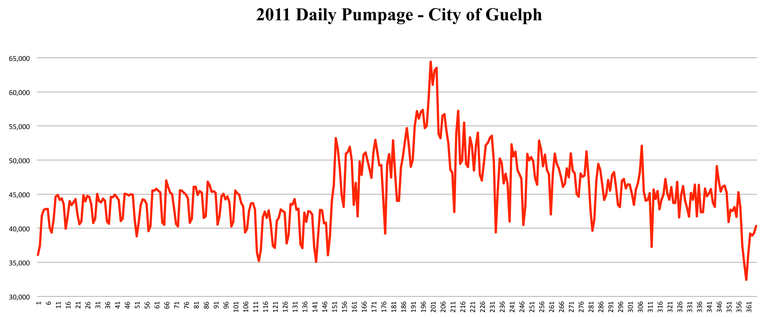
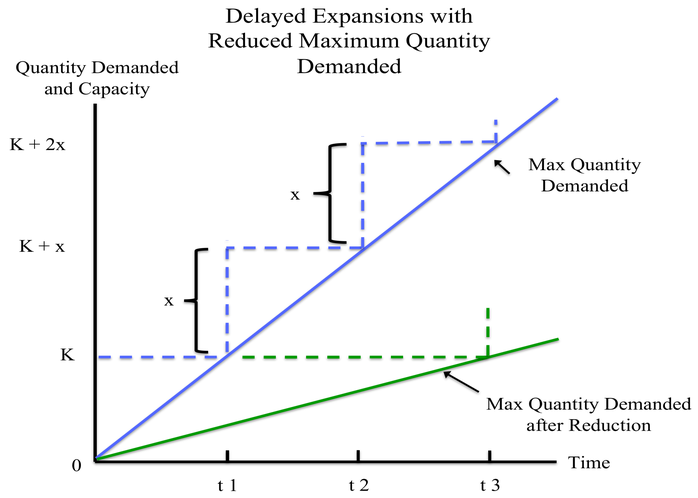
BACKGROUND

- Ontario drinking water utilities must always meet the quantity demanded by consumers[1,2]
- System capacity is scaled to meet the highest peak in quantity demanded (maximum quantity demanded) over a given time period[2,3]



Source: City of Guelph

- System capacity is the lesser of available water source(s) or infrastructure to treat and distribute potable water
- Maximum daily quantity demanded (m^3/day) determines the level of capacity that a drinking water utility must construct and/or maintain[2]
- A reduction in maximum daily quantity demanded leads to a reduction in the required level of system capacity[1]



Adapted from Manne (1961)

- A conservation strategy that effectively targets maximum daily quantity demanded has the potential to relieve stress on water sources and a utility's budget

OBJECTIVES

i) Using a deterministic model, an estimation of the cost savings associated with specific percentage reductions in maximum quantity demanded will be calculated

ii) A stochastic model will be developed to capture the risk associated with unknown future demand allowing for real option analysis

iii) A general framework will be developed to transfer the same method to water utilities in Canada and abroad

METHODS

- **Cost Effectiveness Analysis**:
  Discounting of expected expansion costs to determine the present value of all feasible expansion strategies

PRELIMINARY RESULTS

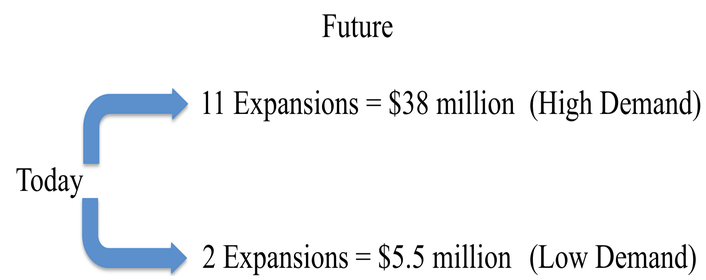
- 20% reduction in maximum daily quantity demanded would allow the City to forestall all eleven planned projects for cost savings/deferment of ~$38 million*
- Several other strategies exist with maximum quantity demanded reductions < 20% which delay capacity expansions
- These estimates likely understate the true savings to society when environmental benefits are considered (water source replenishment, etc.)

Expansion Strategy	% Reduction in Max Quantity Demanded	Total # of Expansions	Estimated Cost of Expansions
A	20%	0	0
B	10%	2	~$5.5 million*
C	0%	11	~$38 million*

*Discount rate of 2.85%

FUTURE RESEARCH

- Using historical daily demand data from the City of Guelph we intend to develop more accurate demand simulations over the 25-year period
- These simulations can be used to determine the probabilities of experiencing large or small increases in maximum quantity demanded in the future
- Using this simulation, an option value – the value of waiting to expand until more is known about future demand – can be estimated



- Future studies will develop the most efficient means of achieving the desired percentage reductions in maximum daily quantity demanded through the use of dual water rates
- Dual water rates would consist of a priority rate like current water services and an interruptible rate which would be less expensive but would allow the utility to restrict usage
- The interruptible rate would be a voluntary way for consumers to pay less and for the utility to be able to reduce maximum daily quantity demanded during peak periods

CONCLUSION

Preliminary results suggest there are substantial cost savings associated with delaying capacity expansions as much as possible for water utilities and that effective conservation may depend primarily on targeting maximum quantity demanded.

REFERENCES

1) Renzetti, Steven. 2009. C.D Howe Institute: Commentary 281:1-21.
2) MOE. 2008. Design Guidelines for Drinking-Water Systems.
3) AECOM and Golder Associates Ltd. 2014. "Water Supply Master Plan Update." The Corporation of the City of Guelph.
4) Manne, Alan S. 1961. *Econometrica* 29(4):632.