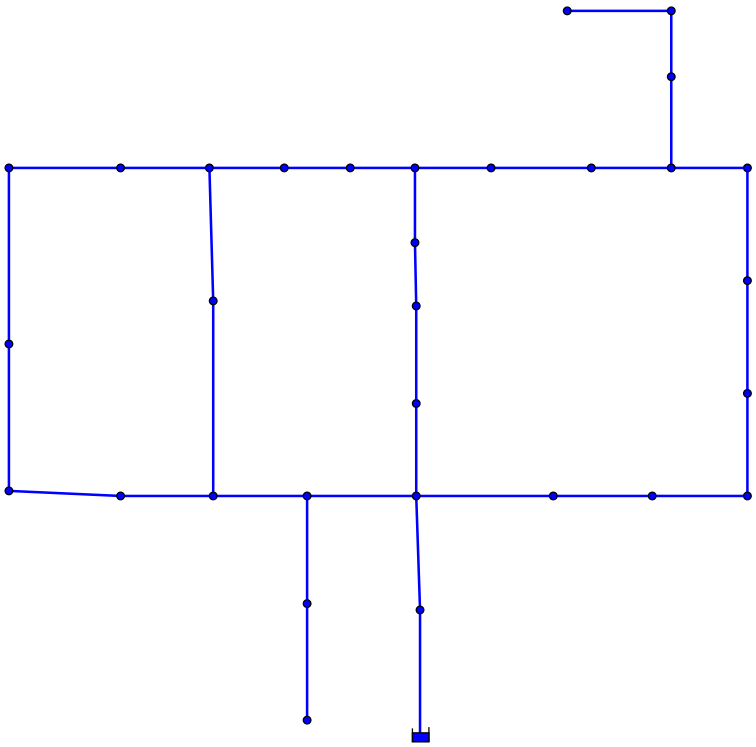
SYSTEM ID: Hanoi System

NARRATIVE DESCRIPTION

The Hanoi system was first presented by Fujiwara and Khang (1990) and is based on the planned trunk network of Hanoi, Vietnam. There are 34 pipes to be sized with a total length of 38.61 km. Possible new pipe sizes range between 12 and 40 inches and the total system demand is 126.5 MGD.

NETWORK SCHEMATIC:



HISTORY OF THE NETWORK FILE

The Network was first optimized by Fujiwara and Khang (1990) using a two phase non-linear programming method. It has subsequently been used as a case study for a number of optimization techniques including genetic algorithms (Savic and Walters, 1997; Marchi et al, 2014), simulated annealing (Cunha and Sousa, 1999), the shuffled frog-leaping algorithm (Eusuff and Lansey, 2003), ant colony optimization (Zecchin et al, 2005), harmony search (Geem, 2006) and differential evolution (Vasan and Simonovich, 2010). A more complete summary of studies aimed at optimizing this network is given by De Corte and Sorensen (2013).

AVAILABLE INFORMATION

Physical attributes	Yes
Schematic diagram	Yes
Network geometry data	Yes
GIS data file	No
Background map	No
Elevation data	Yes
Pipe data	Yes
Pipe material	No
Pipe age	No
Pipe pressure class	No
Nominal or actual diameters	Actual
Pump data	N.A.
Useful horsepower	
Pump operating curves	
Tank data	N.A.
Elevation data	
Stage storage curves	
Water quality information	
Valve data	N.A.
PRV/FCV data	
Isolation valve data	
Hydrant data	
Demand data	Yes
Total system demand	Yes
Nodal demand data	Yes
Temporal data demands	No
System leakage	No
Hydraulic data	Yes
Hydraulically calibrated model	
Field hydraulic calibration data	
Water quality data	No
Disinfection method	No
Chlorine residual data	No
Booster station data	No
Fluoride/Chloride field data	No
Water quality calibrated model	No
Operational data	No
SCADA datasets	No
Operational rules	No

REFERENCES:

Cunha, M., Sousa, J., 1999. Water distribution network design optimization: simulated annealing approach. J. of Water Resources Plan. and Man., 125 (4).

De Corte, A. and Sorensen, K. (2013) Optimisation of gravity-fed water distribution network design: A critical review, European Journal of Operational Research, 228, 1 - 10.

Eusuff, M.M., Lansey, K.E., 2003. Optimization of water distribution network design using the shuffled frog leaping algorithm. J. of Water Resources Plan. and Man., 129 (3).

Fujiwara, O. and Khang, D.B. (1990), A two-phase decomposition method for optimal design of looped water distribution networks, Water Resour. Res., 26(4), 539-549.

Geem, Z.W., 2006. Optimal cost design of water distribution networks using harmony search. Engineering Optimization 38 (3), 259–280.

Marchi, A, Dandy, G., Wilkins, A and Rohrlach, H (2014) A methodology for comparing evolutionary algorithms for the optimization of water distribution systems, J. of Water Resources Plan. and Man. 140 (1), 22-31.

Savic, D., Walters, G., 1997. Genetic algorithms for least-cost design of water distribution networks. J. of Water Resources Plan. and Man., 123 (2), 67–77.

Vasan, A., Simonovic, S.P., 2010. Optimization of water distribution network design using differential evolution. J. of Water Resources Plan. And Man. ASCE, 136 (2), 279–287.

Zecchin, A.C., Simpson, A.R., Maier, H.R., Nixon, J.B., 2005. Parametric study for an ant algorithm applied to water distribution system optimization. IEEE Transactions on Evolutionary Computation 9 (2), 175–191.

DETAILED DATA SUMMARIES

PHYSICAL ASSETS:

Asset Type:	# of Assets
Master Meters	0
Tanks	0
Pumps	0
Pump Stations	0
Water Treatment Plants	0

NETWORK CHARACTERISTICS:

# Total Pipes:	34
# Branch Pipes:	7
Ratio (Branch Pipes / Total Pipes):	0.21
# Nodes	31
# Reservoirs	1
# Tanks	0
# Regulating Valves	Unknown
# Isolation Values	Unknown
# Hydrants	Unknown
Elevation Data	YES

PIPE DATA:

Diameter (in)	Length (ft)
12	To be determined
16	To be determined
24	To be determined
30	To be determined
40	To be determined

PUMP DATA:

Pump Horsepower	NO
Pump Curves:	NO

DEMAND STATISTICS:

Demographic Type	Population	Households
Directly Serviceable:	Unknown	Unknown
Indirectly Serviceable:	Unknown	Unknown
Total Serviceable:	Unknown	Unknown

Production Statistics	
Total Annual Volume Produced (MG):	126.5
Total Annual Volume Purchased (MG):	126.5
Total Annual Volume Provided (MG):	126.5
Estimated Annual Water Loss:	Unknown

Water Costs	
Customer Type	Cost per 1000 gallons
Customers within the municipality	Unknown
Customers outside the municipality	Unknown

CUSTOMERS AND USAGE:

Customer Type	Customer Count	Average Daily Demand (MGD)
Wholesale:		
Residential:		
Commercial:		
Institutional:		
Industrial:		
Other:		
Total Customers:		
Flushing, Maintenance & Fire Protection:		
Total Water Usage:		126.5

DATA FILE ATTRIBUTES:

ATTRIBUTE		UNITS
Pipe Length & Diameter	X	Metres
Pipe Age		
Node Elevation	X	Metres
Node Demand	X	Cubic metres per hour
Valves		
Hydrants		
Tank Levels		
Tank Volume		
PRVs		
WTP		
WTP Capacity		
Pump Data		