EPANET 2.0



EPANET is a Windows program that performs extended period simulation of hydraulic and water-quality behavior within pressurized pipe networks. A network can consist of pipes, nodes (pipe junctions), pumps, valves and storage tanks or reservoirs. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of a chemical species throughout the network during a simulation period comprised of multiple time steps. In addition to chemical species, water age and source tracing can also be simulated.

The Windows version of EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded network maps, data tables, time series graphs, and contour plots.

EPANET was developed by the Water Supply and Water Resources Division (formerly the Drinking Water Research Division) of the U.S. Environmental Protection Agency's National Risk Management Research Laboratory. It is public domain software that may be freely copied and distributed.

Capabilities:

EPANET provides a fully-equipped, extended period hydraulic analysis package which can:

- handle systems of any size
- compute friction head loss using the Hazen-Williams, Darcy-Weisbach, or Chezy-Manning formulas
- include minor head losses for bends, fittings, etc.
- model constant or variable speed pumps
- compute pumping energy and cost
- model various types of valves including shutoff, check, pressure regulating, and flow control valves
- allow storage tanks to have any shape (i.e., diameter can vary with height)
- consider multiple demand categories at nodes, each with its own pattern of time variation
- model pressure-dependent flow issuing from emitters (sprinkler heads)
- base system operation on simple tank level or timer controls as well as on complex rule-based controls.

In addition, EPANET's water quality analyzer can:

- model the movement of a non-reactive tracer material through the network over time
- model the movement and fate of a reactive material as it grows (e.g., a disinfection by-product) or decays (e.g., chlorine residual) with time
- model the age of water throughout a network
- track the percent of flow from a given node reaching all other nodes over time
- model reactions both in the bulk flow and at the pipe wall
- allow growth or decay reactions to proceed up to a limiting concentration
- employ global reaction rate coefficients that can be modified on a pipe-bypipe basis
- allow for time-varying concentration or mass inputs at any location in the network
- model storage tanks as being either complete mix, plug flow, or twocompartment reactors.

EPANET's Windows user interface provides a visual network editor that simplifies the process of building piping network models and editing their properties. Various data reporting and visualization tools are used to assist in interpreting the results of a network analysis. These include graphical views (time series plots, profile plots, contour plots, etc.), tabular views, and special reports (energy usage, reaction, and calibration reports).

Applications:

EPANET was specifically developed to help water utilities maintain and improve the quality of water delivered to consumers through their distribution systems. It can be used to design sampling programs, study disinfectant loss and by-product formation, and conduct consumer exposure assessments. It can assist in evaluating alternative strategies for improving water quality such as altering source utilization within multi-source systems, modifying pumping and tank filling/emptying schedules to reduce water age, utilizing booster disinfection stations at key locations to maintain target residuals, and planning a costeffective program of targeted pipe cleaning and replacement.

EPANET can also be used to plan and improve a system's hydraulic performance. Pipe, pump and valve placement and sizing, energy minimization, fire flow analysis, vulnerability studies, and operator training are just some of the activities that EPANET can assist with.

Programmer's Toolkit:

The EPANET Programmer's Toolkit is a dynamic link library (DLL) of functions that allow developers to customize EPANET's computational engine for their own specific needs. The functions can be incorporated into 32-bit Windows applications written in C/C++, Delphi Pascal, Visual Basic, or any other language that can call functions within a Windows DLL. There are over 50 functions that can be used to open a network description file, read and modify various network design and operating parameters, run multiple extended period simulations accessing results as they are generated or saving them to file, and write selected results to file in a user-specified format.

The Toolkit should prove useful for developing specialized applications, such as optimization or automated calibration models, that require running many network analyses as selected input parameters are iterative modified. It also can simplify adding analysis capabilities to integrated network-modeling environments based on CAD, GIS, and database packages.

A Windows Help file is available that explains how to use the various Toolkit functions and offers up some simple programming examples. The Toolkit also includes several different header files, function definition files, and .lib files that simplify the task of interfacing it with C/C++, Delphi, and Visual Basic code.

Source: http://www.epa.gov/nrmrl/wswrd/epanet.html

Note the following downloadable programs and documents:

- Self-extracting installation program for EPANET 2.00.10
- EPANET 2 Users Manual
- EPANET 2 Programmers Toolkit files
- EPANET 2 source code files

PROGRAM	PURPOSE	ADDITIONAL FEATURES ¹				LIMITATION	ROM/RAM	DEMO	COSTS
		Simulation	WQA ²	GUI ³	GIS/CAD/DB	max. nodes	MB	available	approx. comparison in US\$
AquaNet	"Simulation and modelling for pressurised pipe systems"	х	х	х	GIS linkable	unlimited	10/16		\$1,999
Archimede	"Simulation and verification of fluid pressurised distribution networks in steady state flow conditions	х	-	х	DXF files	100 to unlimited	10/8	Yes	Full release: \$490 - 980 Lite release: \$180 Free release: (10 nodes)
Branch / Loop	"Least-cost design and calculation of branched / looped water distribution networks"	-	-	-	-	125 750	0.5/0.25		Free
Cross	"Hydraulic calculation for water supply pipes"	х	-	х	CAD module GIS linkable	10'000	10/256		Base module: \$3,700 CAD module: \$3,900
Epanet 2.0	"Extended period simulation of hydraulic and water-quality behavi- our within pressurised networks"	X	х	х	-	unlimited	2/16		Free
Eraclito	"Modular system for the manage- ment of fluid underpressure net- works and open channel systems"	x	-	х	GIS module DB module	200 to unlimited	16/10	Yes	Base module: \$2,600 Each add-on 100 nodes: \$520 GIS module: \$780
H2Onet/ H2Omap	"A comprehensive GIS-based water distribution analysis, design and optimisation software"	х	х	х	DB-driven GIS-enabled	1'000 to unlimited	200/64		Base module: \$4,000 Unlimited nodes: \$16,000
Helix delta-Q	"Designs & optimises pipe networks quickly & easily for compressible & incompressible fluids"	-	-	х	DXF files	unlimited	4/32		\$950
Mike Net	"Advanced EPANET based water distribution modelling software"	х	х	х	DB-linked GIS-enabled	250 to unlimited	20/16	Yes	Basic: \$995 to \$10,995 WQA: \$1'495 to \$12,495
<u>Netis</u>	"Design and analysis of intermittent water distribution systems"	X	х		Exp – Imp DB	unlimited	100/16		Free
<u>OptiDesianer</u>	"Optimal design of water distribu- tion systems" (EPANET based)	-	-	-	-	unlimited	5/32	Yes	\$350
Pipe2000	"Hydraulic modelling software for simple or complex pipe systems"	х	X	х	AutoCAD files GIS-enabled	250 to 20'000	20/128	Yes	Base module: \$1,495 Each add-on 1000 node: \$500 GIS-CAD module: \$500
<u>Stanet</u>	"Simulation and analysis of distribution networks"	X		х	Exp – Imp CAD/GIS/DB	200 to unlimited	20/16	Yes	Base module: \$1,910 Light version: dep. on nodes
Wadiso SA	"Comprehensive computer program for the analysis and design of potable water distribution systems"	х	х	х	Integr. CAD Exp – Imp GIS	1'000 to 16'000	100/128	Yes	Base module: \$3,500
WaterCAD 5.0	"Complete water distribution analysis and design tool"	X	х	х	CAD interface GIS integrated	10 to unlimited	25/32	Yes	\$195 - \$25,000

Summery of Exiting Water Distribution Modeling Tools (Skat Consulting, St. Gallen, Switzerland, 2002)