

EPANET Pipe Networks in TNTmips

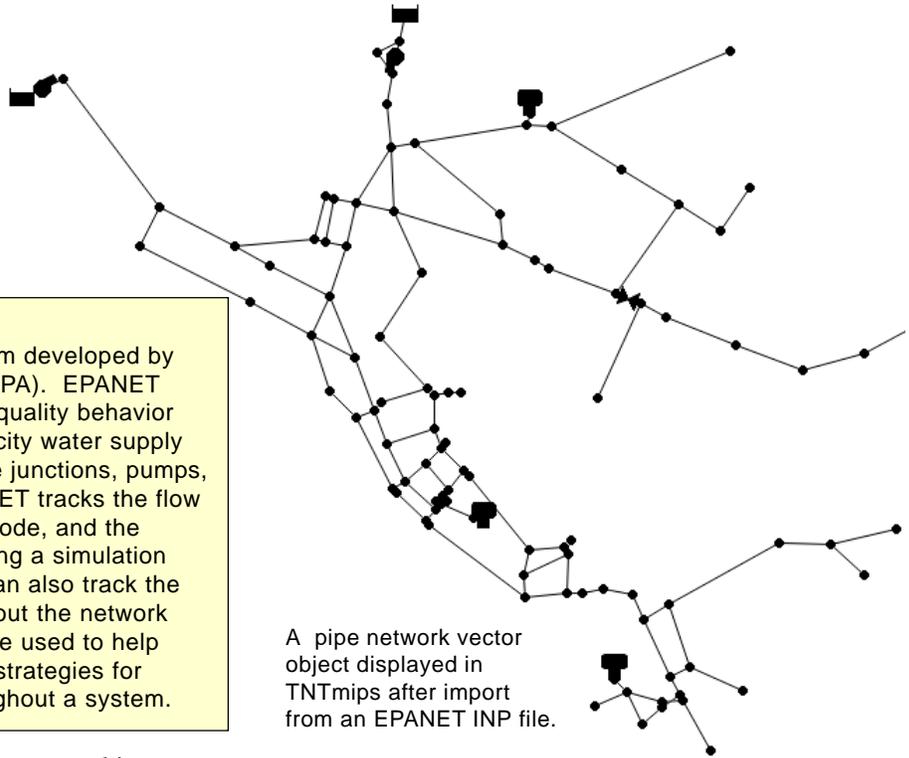
Physical Components in the EPANET Network Model

Line Elements

-  Pipe
-  Pump
-  Valve

Node Elements

-  Junction
-  Tank
-  Reservoir



A pipe network vector object displayed in TNTmips after import from an EPANET INP file.

EPANET

EPANET is a free Windows computer program developed by the U.S. Environmental Protection Agency (EPA). EPANET performs simulations of hydraulic and water quality behavior within pressurized pipe networks, such as a city water supply system. A network can consist of pipes, pipe junctions, pumps, valves, storage tanks, and reservoirs. EPANET tracks the flow of water in each pipe, the pressure in each node, and the height of water in each tank or reservoir during a simulation period consisting of multiple time steps. It can also track the concentration of a chemical species throughout the network during the simulation period. EPANET can be used to help assess alternative design and management strategies for improving water flow and water quality throughout a system.

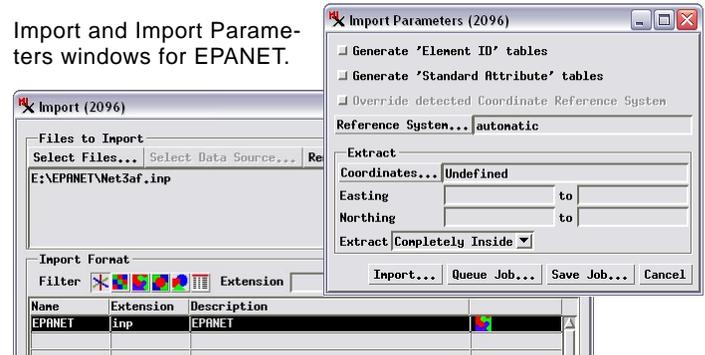
In TNTmips you can create, edit, import, and export vector objects representing pipe networks that conform to the model used by the free EPANET hydraulic simulation program (see box above). The EPANET model represents physical components of a pipe network as geometric elements. Pipes, pumps, and valves are line elements (links in EPANET terminology). Pipe junctions, tanks, and reservoirs are node elements. Many hydraulic properties of these elements, as well as simulation settings, are also stored in attribute tables. The EPANET auxiliary text file format (*.INP) is the interchange format between EPANET and TNTmips. Both TNTmips and EPANET can import and export attributed pipe networks as INP files, along with any simulation settings. TNTmips can also create and edit pipe network vector objects with the EPANET network schema. These networks can be exported to EPANET via an INP file to run hydraulic simulations. A georeferenced pipe network vector object can thus be part of a full infrastructure GIS in TNTmips while still being a source for hydraulic simulations and analysis.

Import from EPANET INP

To import an EPANET network text file, choose the INP file using the Select Files button in the Import process window (Main / Import; see illustration above right). This action automatically selects the EPANET format in the format list. Pressing the Next button on the Import window opens the standard Import Parameters window. There are no format-specific import settings for EPANET files. Press Import on the Import Parameters window to select or create a Project File for the imported vector object and to name the object.

The EPANET import in TNTmips creates a vector object with network topology. This topology level allows the vector object to include line elements that cross without an intersecting node, in

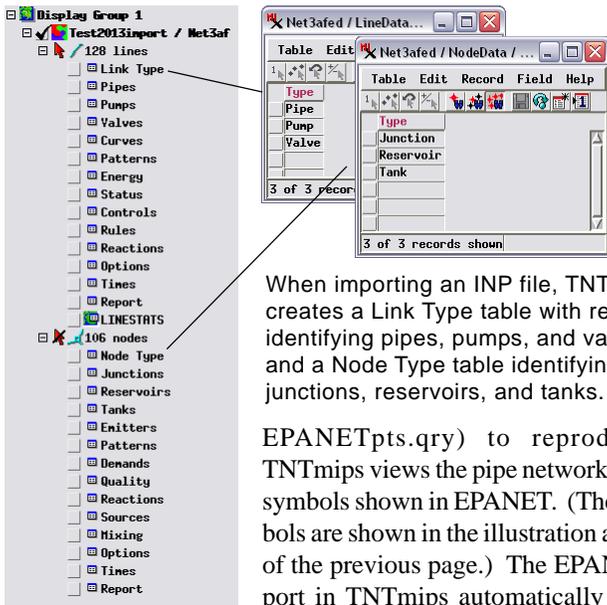
Import and Import Parameters windows for EPANET.



this case representing pipes that cross over/under each other without a physical junction. The EPANET INP file specifies for each line element the identity of the starting and ending nodes. The imported vector object in TNTmips replicates these node-line relationships so that the directionality of all elements in the hydraulic network are preserved.

The EPANET import in TNTmips imports all of the component and network property tables found in the INP file and attaches records to the appropriate network elements. EPANET INP files include separate tables for each type of network component (such as pipes and tanks) but no master node and line tables that identify the component types for each element in one easily accessible place. To remedy this lack and simplify element styling, querying, and other operations in TNTmips, the EPANET import creates Link Type and Node Type tables to identify the element types, as illustrated on the next page.

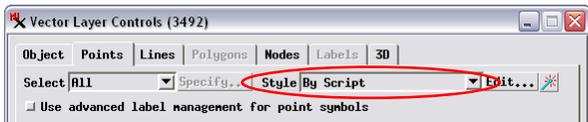
MicroImages has created CartoScripts (EPANETlines.qry and (over)



When importing an INP file, TNTmips creates a Link Type table with records identifying pipes, pumps, and valves; and a Node Type table identifying pipe junctions, reservoirs, and tanks.

EPANETpts.qry) to reproduce in TNTmips views the pipe network element symbols shown in EPANET. (These symbols are shown in the illustration at the top of the previous page.) The EPANET import in TNTmips automatically sets the

style options for the new vector object to use these CartoScripts. Because vector node elements in TNTmips cannot be directly styled by script or by attribute, the controls for point elements are enabled for this purpose instead. As illustrated below, on the Points tabbed panel of the Vector Layer Controls window the Style menu selection is automatically set to By Script and the EPANETpts CartoScript is automatically set as the style script.



Pipe network nodes styled By Script using the Point display controls.

Georeferencing a Pipe Network Imported from EPANET

The network graphic in EPANET can be an accurate map representation or merely a schematic diagram, with arbitrary coordinates designating only relative positions of network elements. Each link (line) element in EPANET must be attributed with a Length value (in feet or meters) along with other hydraulic properties in the element's record in the component table. It is these Length attribute values that are used in EPANET's hydraulic simulation computations rather than values derived from element coordinates. Even if a network was created in EPANET using map coordinates, the INP file contains no information on the coordinate reference system.

In order to display or edit an imported pipe network with other geospatial data, you will therefore need to use the Georeference process in TNTmips (Main / Georeference) to set the coordinate reference system and location of the pipe network vector object. If you can ascertain that the INP file contains map coordinates and have information on the coordinate reference system used, you can use the Georeference process to set up Implied Georeference (which indicates that the internal element coordinates should be interpreted as map coordinates in the designated reference system; see the Technical Guide entitled *Georeference: Simple and Implied*). If the INP files uses arbitrary coordinates, you can use a reference image or geometric object to set up georeference control points for the imported pipe network (see the TechGuide entitled *Georeference: Overview*).

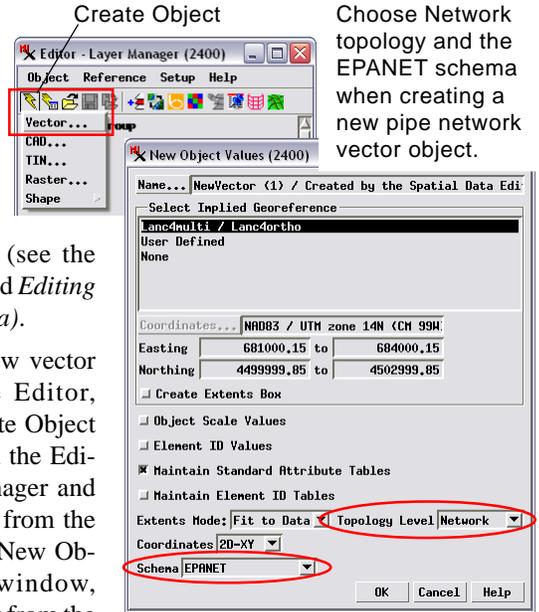
Editing or Creating a Pipe Network in TNTmips

You can change the hydraulic property attributes of a pipe network vector object in the TNTmips Display process by opening the relevant table, selecting the desired element in the View, and editing the value of the property in the table (see the Tutorial entitled *Managing Geottributes*).

You can use the Editor in TNTmips (Main / Edit) to move or add physical components to an imported pipe network or to create a new vector

object in which you can construct your own pipe network for use in TNTmips and EPANET (see the Tutorial entitled *Editing Vector Geodata*).

To create a new vector object in the Editor, press the Create Object icon button on the Editor Layer Manager and choose Vector from the menu. In the New Object Values window, select Network from the



Topology Level menu and EPANET from the Schema menu (see illustration above). These settings create a new vector object with all of the node and line attribute tables required or permitted in EPANET INP files and also set up the network element styling by script in the same fashion as the INP import. As you use the Editor to create the elements of your pipe network, you will need to assign the network properties and the hydraulic properties for each element that are necessary to carry out EPANET simulations.

Exporting a Pipe Network to EPANET INP

You can use the Export process (Main / Export) to export a pipe network vector object to an INP file in order to run a simulation in EPANET. In the Export window, choose EPANET from the format list and then select the vector object to export. Press the Next button to open the Export Parameters window. If the vector object has control point georeference, a toggle button labeled *Export as Map Coordinates* is active in this window. Turn this toggle on if you wish to transfer element coordinates as map coordinates rather than arbitrary object coordinates. Press the Export button to designate the name and location for the new INP file and complete the export.



INP files do not include EPANET simulation results; these can be saved in EPANET in other text and binary file formats. Thus there is no need to re-import the network to TNTmips after running an EPANET simulation.