Flood Modeller Essentials

This guide covers everything you need to know before you start using Flood Modeller. Ideal for beginners, but also highly recommended for those with prior modelling knowledge, you will learn terminology commonly used in the software. Some of the functionality and capabilities of Flood Modeller are shown, and you will see how easy your modelling can be in the intuitive graphical user interface.

Introduction

In this guide, we will cover a selection of “need to know” items, necessary as a starting point before you progress further using Flood Modeller.

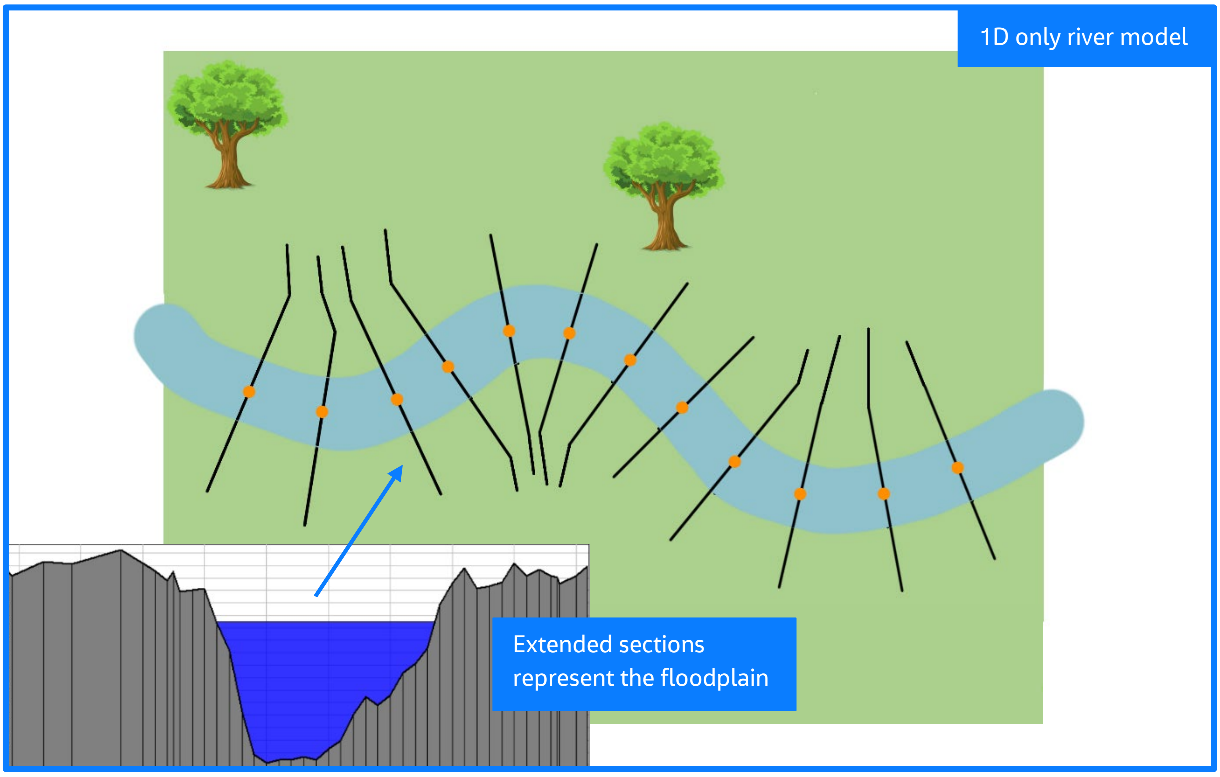
Please note that this guide is intended to introduce users to terminology used in Flood Modeller and provide an overview of functionality available. As such, we mention commonly used approaches only; there are a multitude of caveats and alternatives, and the list of processes and functionality presented here is by no means exhaustive.

What is a simulation?

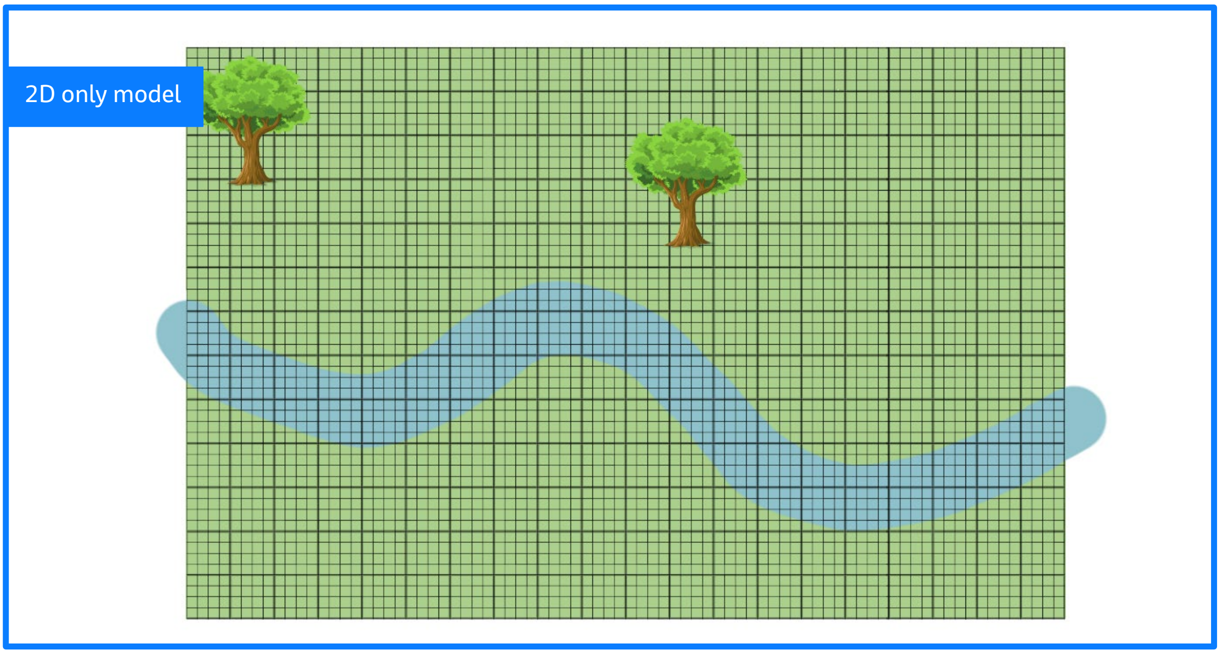
We want to use Flood Modeller to model a (potential) flood. We want to consider multiple scenarios, for example, the affect from different storms, different defence designs, and/or different initial water levels. Simulations will be run for each scenario.

The area of interest could be modelled in 1D, 2D or both. Flood Modeller offers all three options and the decision on which option to select will depend upon multiple aspects, including available data for the site and available time to run simulations. The required outputs from the modelling, i.e. levels of detail and data types (for example, flood maps, animations, etc.), should also be taken into consideration.

1D modelling is most effective in channels or pipes and so river systems and urban drainage systems are often modelled in 1D. In 1D river modelling, nodes specify the underlying riverbed geometry and roughness, plus other features such as structures (bridges, culverts, etc.). In 1D urban modelling, urban nodes and links are used in unison to specify the underlying pipe drainage system. 1D modelling can also be utilised to define volumes of floodplain flow, however it won’t detail the pathways taken by these flows.



If flow pathways and full flood animations are desired, the floodplain may be better modelled in 2D; spatial datasets specify the underlying ground elevation, topographic features such as areas of high ground or pathways between buildings and any variations in land use (defined by changes in roughness coefficient). Certain 1D structures such as culverts and weirs can also be embedded directly into 2D domains. 2D models are used less often for modelling of in-channel flows, usually because raster ground survey data for these areas are a lot less available.

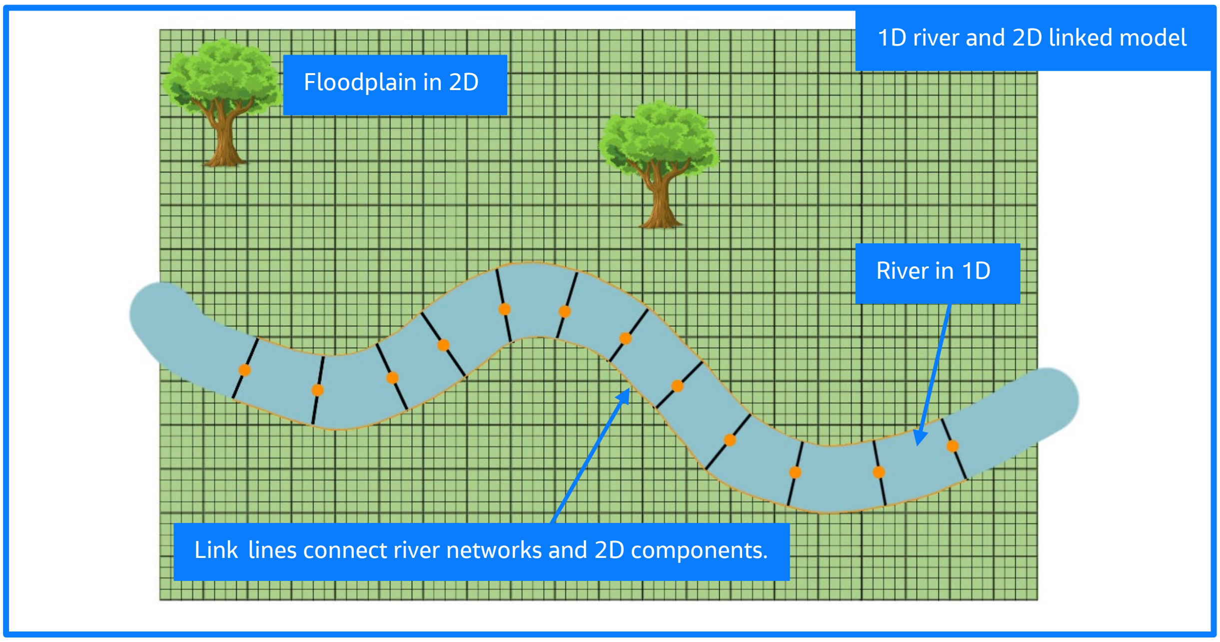


To run a 1D only simulation (for example, if modelling a river network in 1D) the user provides details such as the flow entering the river (e.g. from a design storm) and a timestep. Based on this information and the specified initial water level in the river, the software calculates the new water level (stage) and flow, at all the nodes, at each requested timestep.

To run a 2D only simulation (for example, if modelling a floodplain in 2D) the user provides details such as the flow entering the floodplain (e.g. overtopped from a river) and a timestep. Based on this information and the specified calculation area (active area), the software calculates water levels and flows at each grid cell within the active area, at each requested timestep.

Integrated modelling incorporates 1D river, 1D urban, and/or 2D modelling components with additional linking elements to enable them to exchange information dynamically as a simulation runs. This enables the user to take advantage of the best aspects of each modelling type.

Note: Users should be aware that the above items are the minimum requirements for running the various simulation types, however other properties, e.g. roughness, might need to be adjusted from default settings to maximise performance.



What is needed to run a 1D river simulation?

A 1D simulation always requires a network to represent the 1D components. If modelling a river, a 1D river network describes the river itself.

A river network consists of multiple 1D units, or nodes, to provide the physical properties of the river – geometry and roughness of the river bed in river sections, details of boundaries to describe how water enters and leaves the system, and, if present within the modelled reach, details of other structures and features (bridges, culverts, reservoirs, etc.).

Initial conditions are also required for a 1D simulation. These provide the initial water level throughout the network. If these are not defined realistically the model may become unstable and fail.

When setting up a 1D river simulation, details of your river network and initial conditions must be provided, alongside timing and run options (whether the simulation is steady-state or unsteady). 1D river simulations can be run individually or in batches.

Multiple parameters can be calculated in a 1D river simulation, flow, stage, velocity, total energy, channel conveyance and average shear stress, among others.

What is needed to run a 1D urban simulation?

A 1D simulation always requires a network to represent the 1D components. When modelling a pipe drainage system, a 1D urban network describes the system itself.

An urban network consists of multiple nodes and links to describe the system – nodes provide properties including inflow and outflow (how water enters and leaves the pipe system) and links provide pipe geometry and other details, allowing water to flow between nodes.

To set up 1D urban simulations, details of timing and run-type must be provided alongside other simulation options. Climatology inputs can also be specified . Urban simulations can be run individually, or in batches.

Multiple parameters can be calculated in a 1D urban simulation including the depth, head and volume at all nodes and links.

What is needed to run a 2D simulation?

A 2D simulation requires details about the 2D domain (the area to be modelled).

A ground elevation grid provides the underlying elevation data of the area; most commonly a Digital Terrain Model (DTM) or Digital Elevation Model (DEM) is used. The roughness of the area, alongside other topographic features such as areas of high ground, can be specified in additional datasets.

The calculations are performed within an active area. If not defined by the user, this will be assumed to be the entire DTM.

A 2D simulation also requires boundary information to detail the flow entering / leaving the system. The location of the boundary line(s) and the flow data itself are both necessary.

When setting up a 2D simulation, the timing and simulation type must be provided, alongside the domain and boundary details. By default, depth, elevation, flow and velocity data are all calculated and additional outputs are also available.

What is needed to run an integrated simulation?

An integrated simulation involves 1D river, 1D urban, and/or 2D modelling components. So-called "link-references" (for connecting river and urban networks), "link-lines" (for connecting river networks and 2D components) or "link-elements" (for connecting urban networks and 2D components) must also be specified.

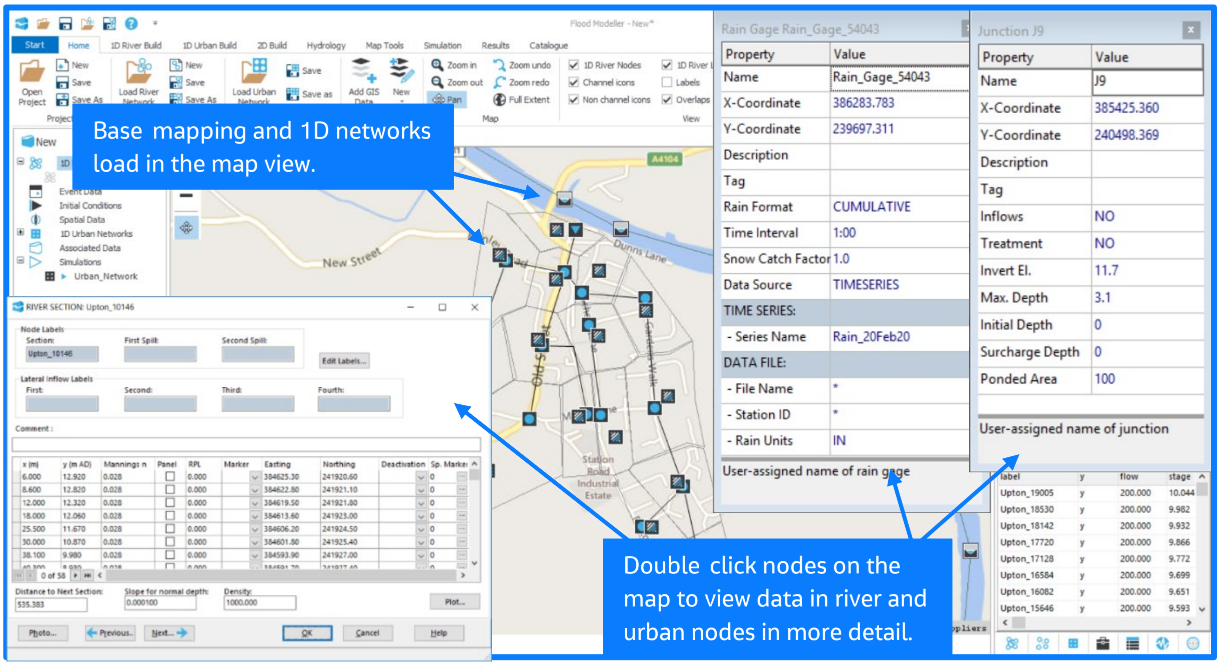
Flood Modeller provides functionality to allow you to define link-references and link-lines by drawing the connections directly onto your map view. Link-elements can be defined directly from a table of nodes. The simulation then accounts for flows between modelling components at these points; link-references allow water to flow between 1D urban and river networks, whilst link-lines and link-elements allow water to flow between 1D networks and the 2D domain.

When setting up an integrated simulation, the 1D simulation must be referenced, alongside details of the connections. Together with the relevant 1D and/or 2D simulation results, the data passed across the linked aspects is calculated and provided as an additional output.

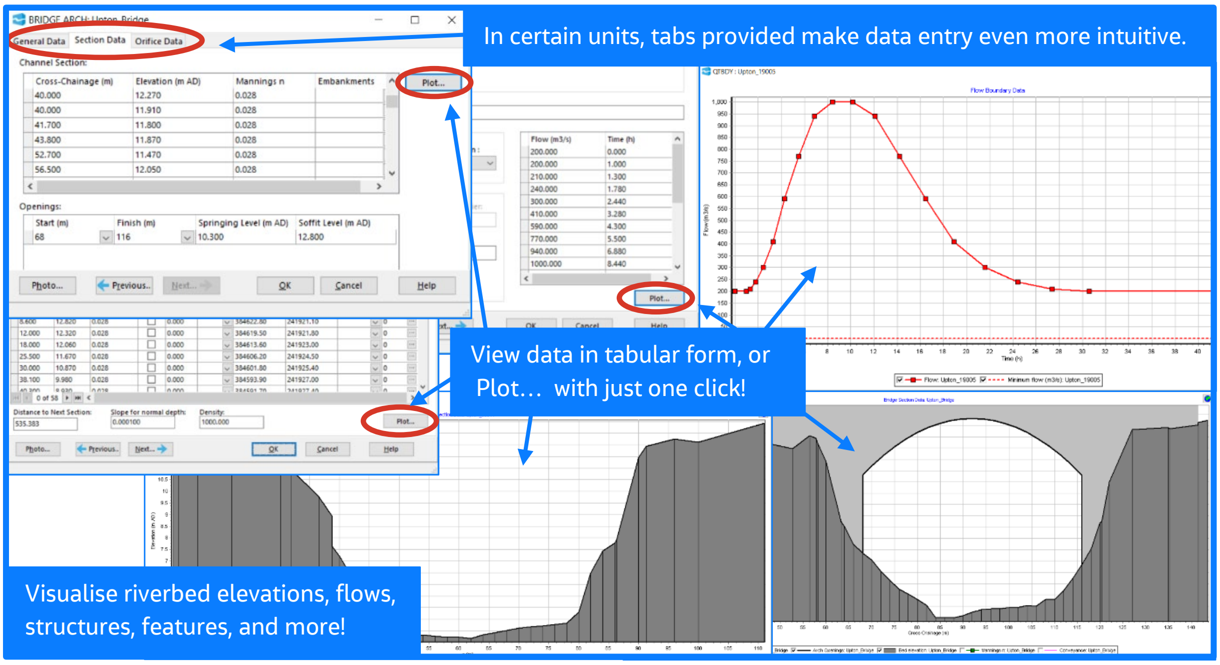
What can I visualise from a simulation?

Flood Modeller's graphical interface provides the ideal platform for visualising all aspects of your model, both throughout the build process, and for result analysis and processing.

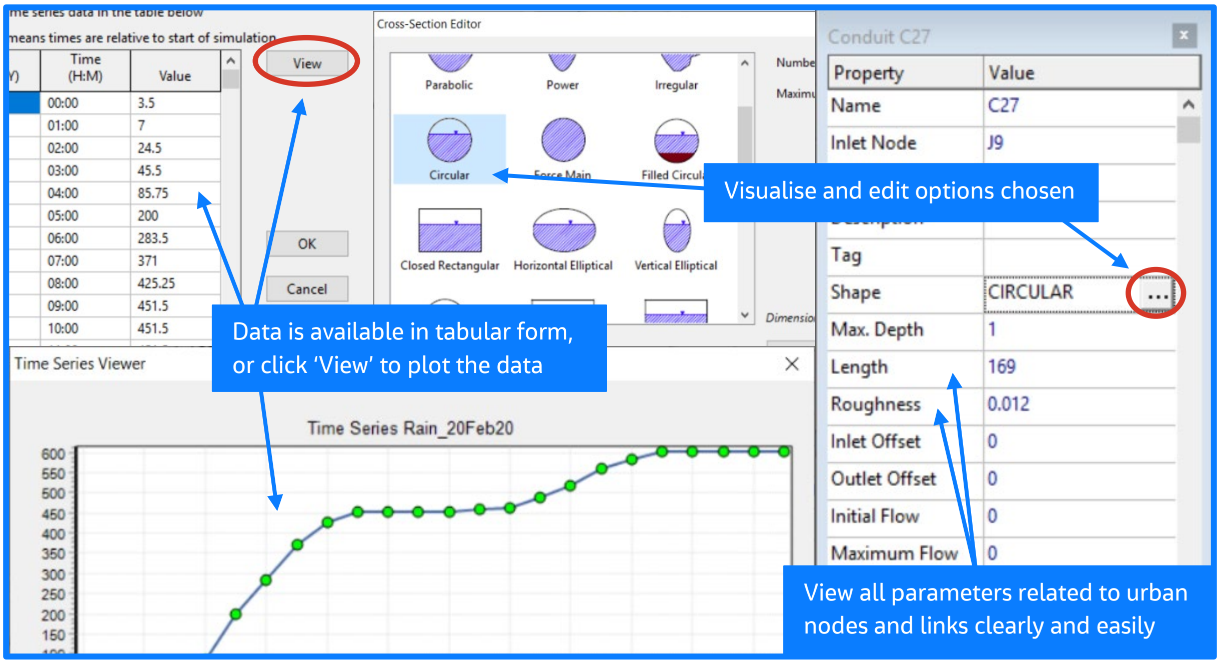
Prior to running a simulation, the map view allows visualisation of all modelling components, together with background mapping. For 1D networks, this consists of unique icons identifying each node of the river or pipe system itself, together with links showing the connectivity of the network.



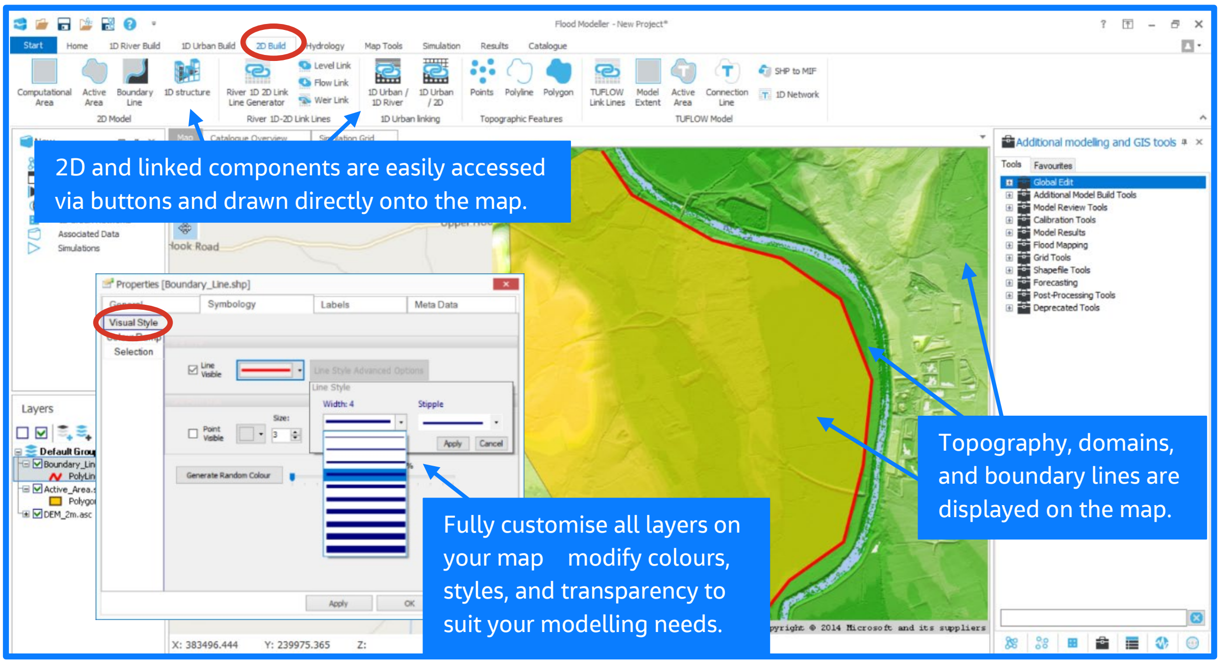
Each node then has further visualisation options; for river nodes, buttons are provided to create 'Cross Section' and 'Long Section' plots from your river data, and inflows can be viewed in tabular or graphical form, for example.



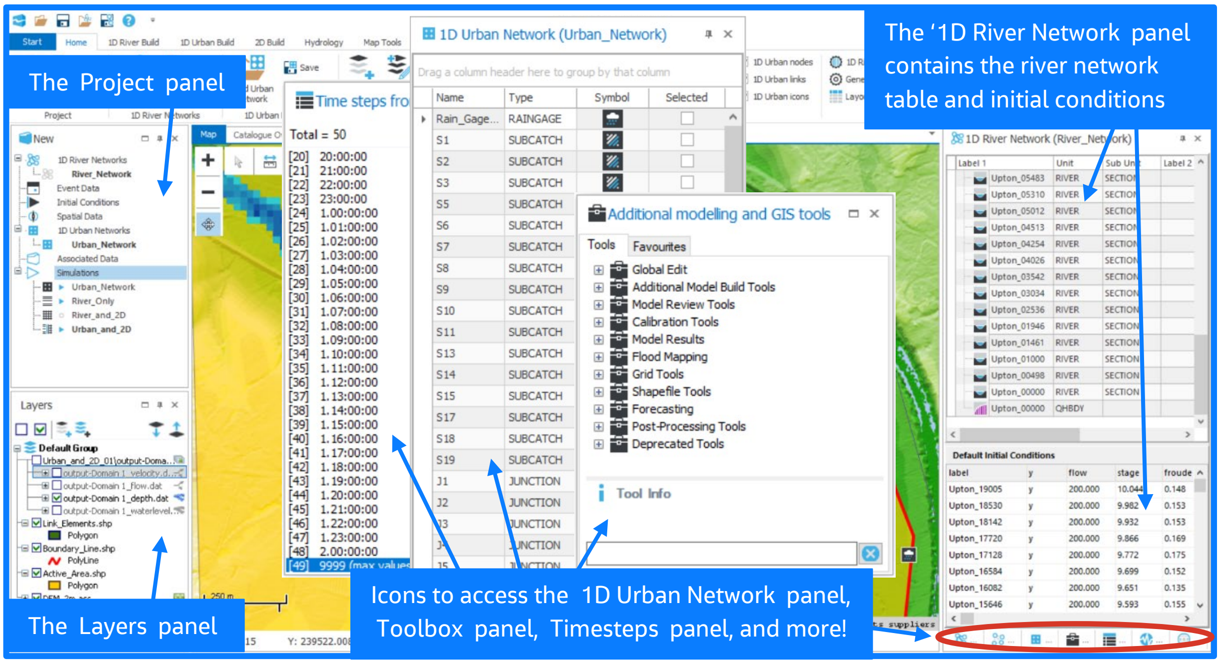
For urban nodes and links, similar functionality is provided. Buttons enable plotting data and visualisation of the underlying pipe geometry, alongside other options.



In 2D, the map view is crucial for viewing all model components, including topography, domains, and boundary lines. These, together with any lines linking 1D and 2D modelling components, are drawn and edited directly on the map.

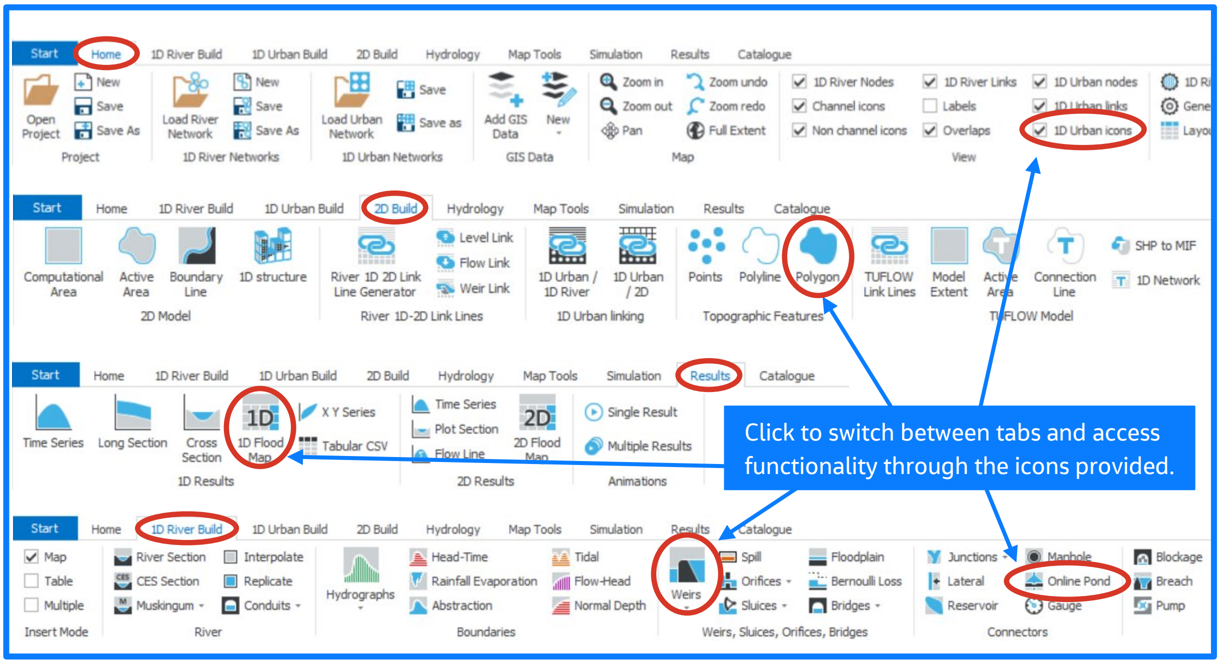


Alongside the map view, a variety of panels allow for further opportunities to visualise modelling components – for example, the ‘1D Urban Network’ panel shows the currently active urban network in tabular form; the ‘Layers’ panel shows all loaded GIS data and shapefiles; and the ‘Project’ panel lists all other model files associated to the current project.

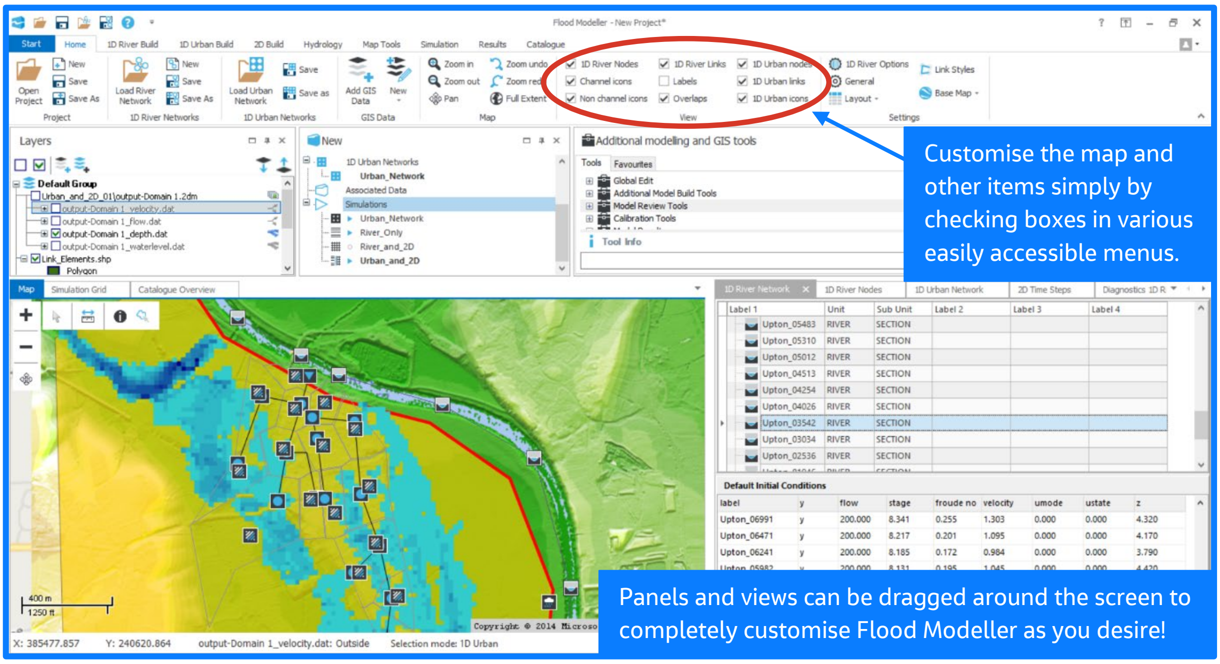


Tip: You can hit the F1 key at any location in the interface to access further guidance on any function or tool!

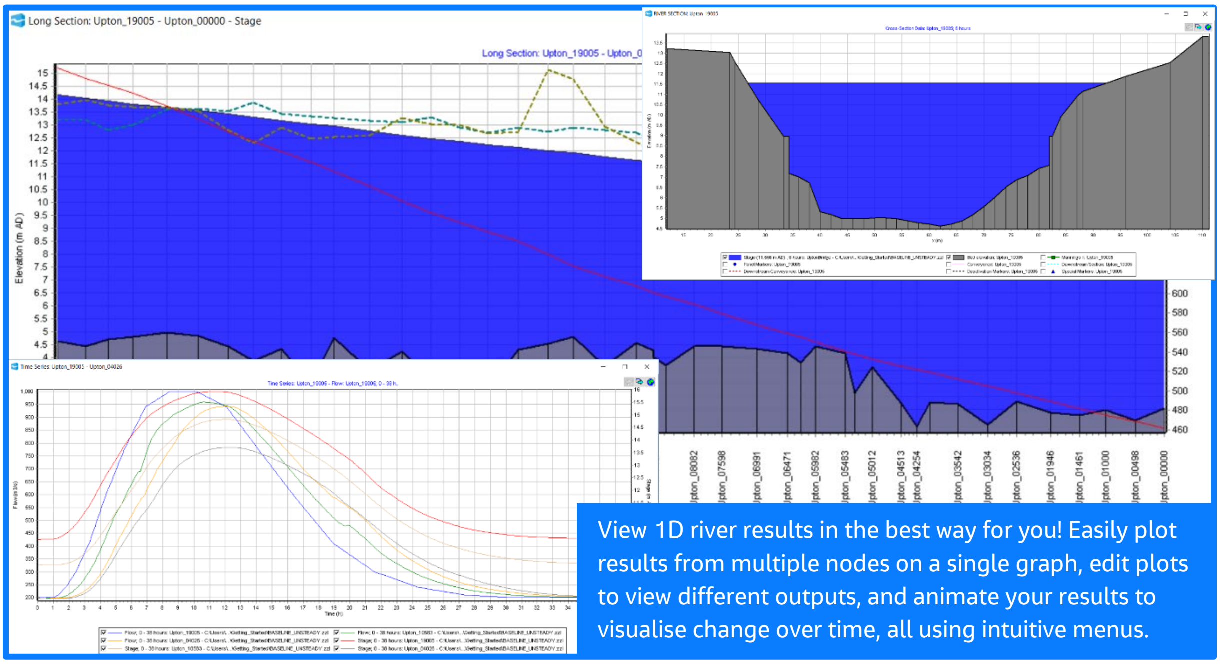
A selection of tabs enables users to quickly switch between ribbons showing a multitude of commonly used functionality, categorised to assist through the model build, simulation run, and results viewing processes. Unique, clear icons are provided along each ribbon, together with user-friendly pop-up “tool tips” further clarifying the function of each button.



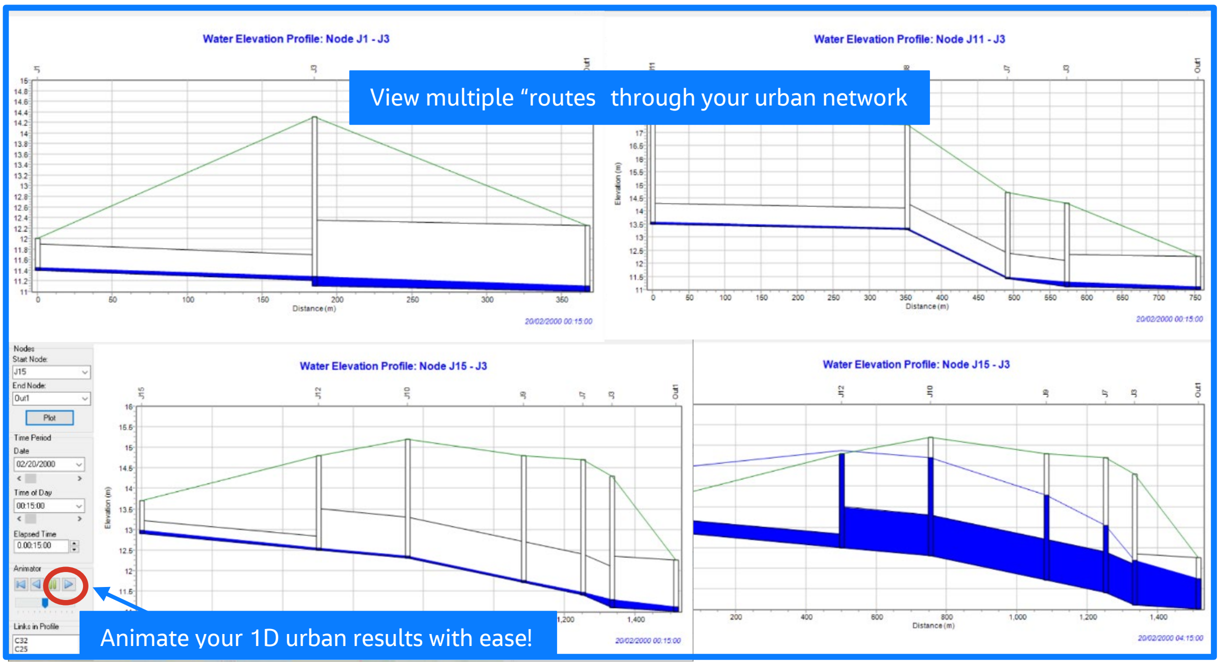
To further enhance the modeller’s experience, these aspects are all fully customisable. On the map view, labels, icons and layers can be hidden from view simply by checking boxes provided, and menus allow for changes to all line styles and colours. Panels can be moved around, resized, or hidden from view altogether to give an interface that suits your modelling needs.



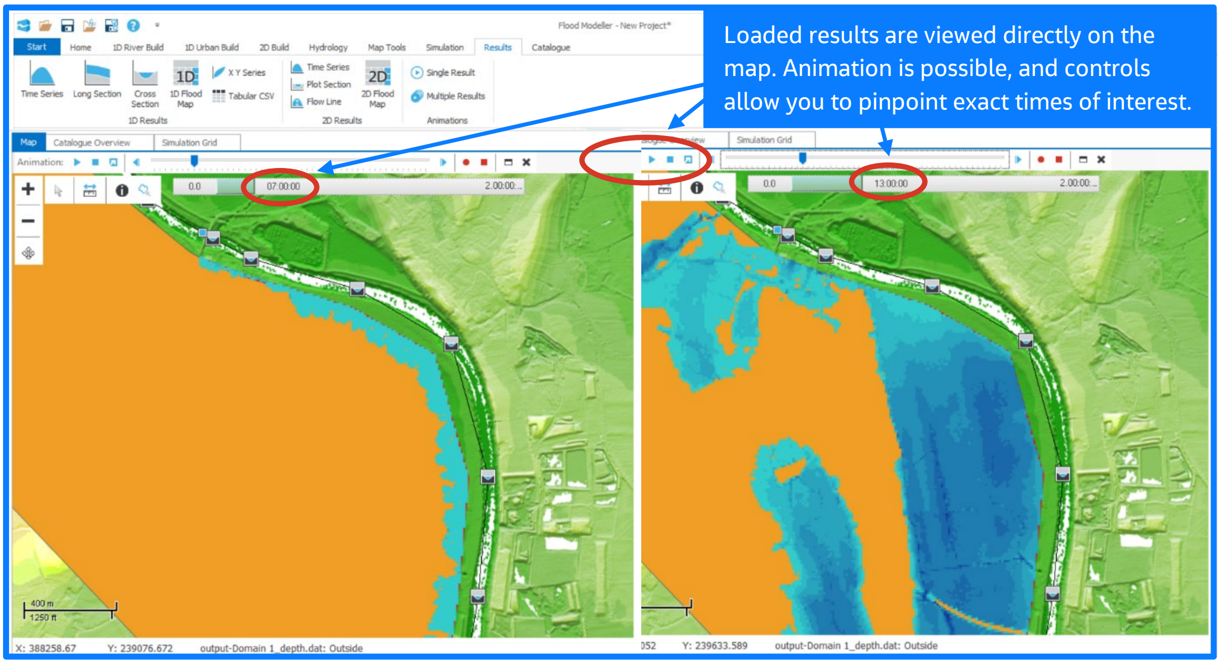
The results from a 1D river simulation can be viewed in 'Time Series' plots, showing changes in the water level over time at a specified node. 'Cross Section' plots (showing a cross-sectional "slice" of the river) and 'Long Section' plots (showing the water level along the river from upstream to downstream) can both be animated to see the water level change over time. Tools are also provided in the interface to post-process model outputs to generate data such as flood maps and animated maps.



Results from 1D urban simulations can also be visualised in multiple ways. In 'Long Section' plots, a "route" through the urban network is shown from specified start and end nodes, and animations can be viewed to see levels adjust over time. 'Time Series' and 'XY Series' plots are also available for viewing your urban results.



For visualising 2D and integrated modelling results, Flood Modeller’s map view again provides the ideal solution. Depth, velocity, flow and water level are all calculated by default for any 2D or 1D-2D linked simulation. Once loaded, flood data maps for each of these outputs can be viewed on the map. These also can be visualised as animations, with controls provided to select the exact timestep of interest.



Summary

You now have had an initial overview of what we mean by a ‘simulation’ and understand the importance of selecting to model components in 1D, 2D, or both. You have seen what is required to run a simulation and have been introduced to various terminology along the way. You have also seen how all aspects of the modelling process can be visualised through the graphical user interface, from building and editing modelling components through to plotting and animating the computed outputs of simulations.

What’s next?

If you would like to find out more about the basics of using Flood Modeller, check out our YouTube channel, user manual or get in touch with our support team.

You also may be interested in the other ‘Getting Started’ guides in this series.