System Safety/Fire Flow Analysis
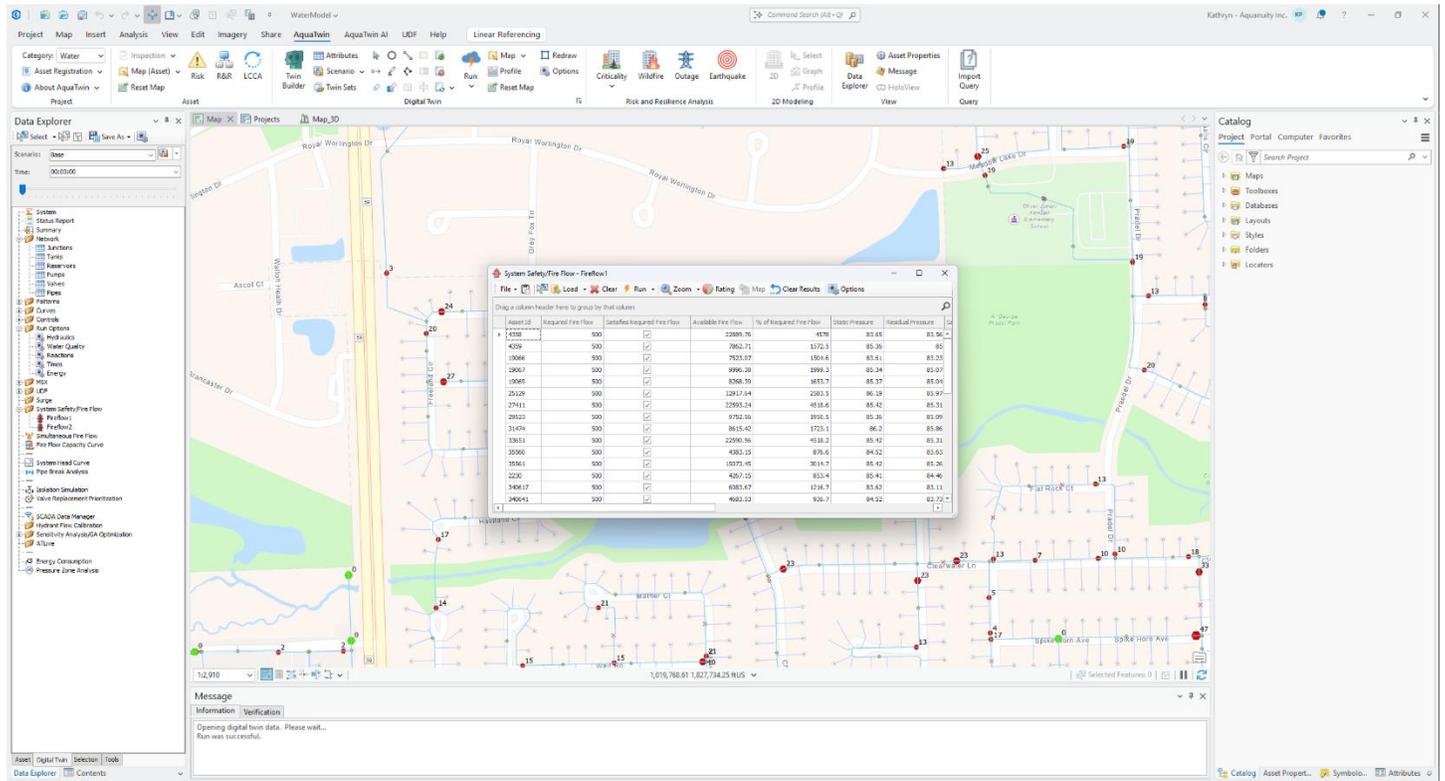

**Figure 1: Digital Twin Safety Systems/Fire Flow Dialogue Box**

Contents

Overview

To analyze available fire flows throughout the water system, there is a System Safety/Fire Flow Analysis wizard in the Digital Twin Tab of the Data Explorer. This tool can be used on *Model Junctions* or an *ArcGIS Hydrants Layer*. To create a new Fire Flow Analysis Run, users can right click on the System Safety/Fire Flow folder and select "New".
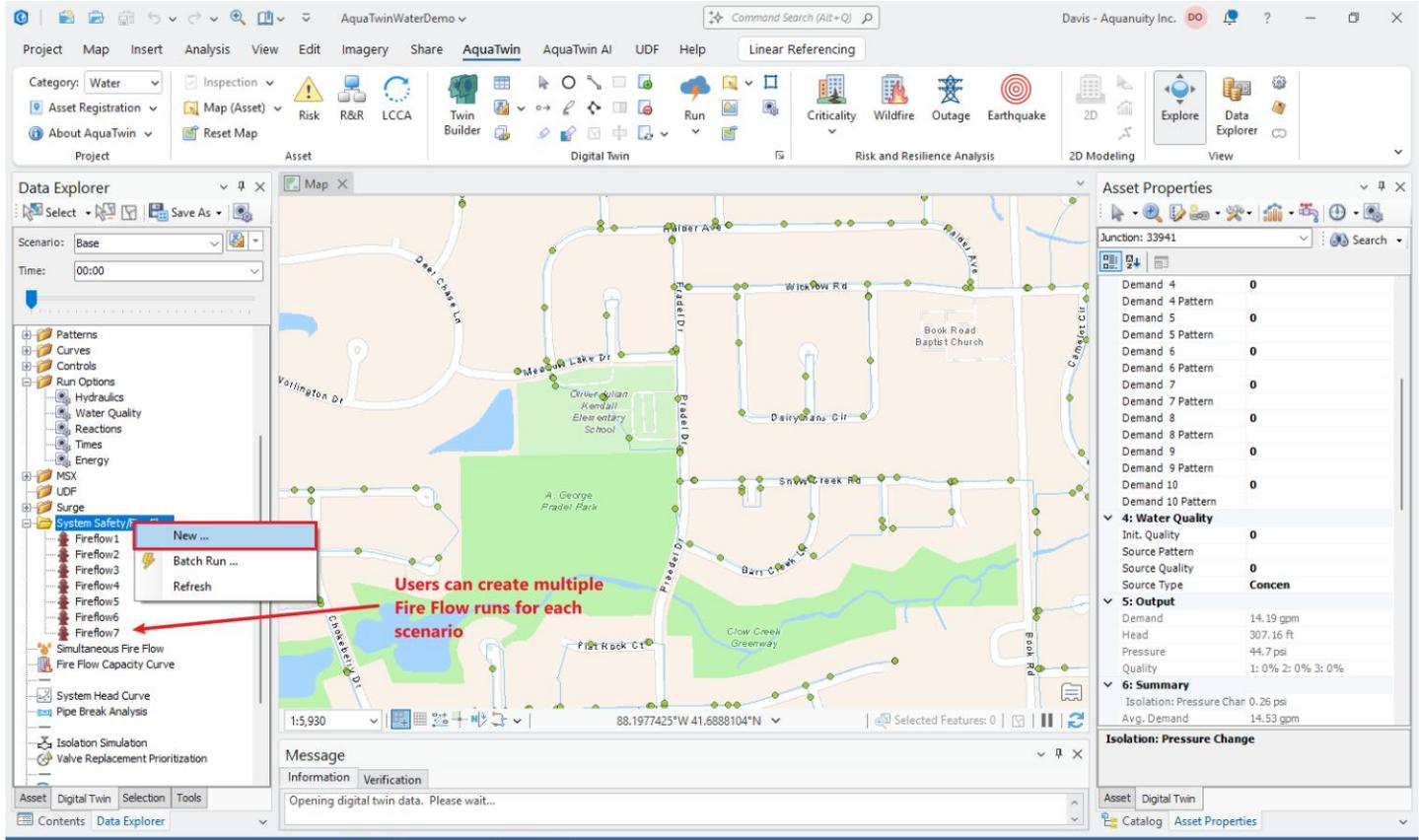
Steps for a Fire Flow Analysis run:

1. First, the user must specify the settings/parameters in the *Options* dialogue box.
2. The user will *Load* the appropriate nodes to be analyzed. This can be done with an *active ArcGIS selection* (in the case of using a hydrants layer) or *Aquatwin Selection or selection set*. If no selection or selection set is specified, the analysis will be run on the entire model.
   a. User will specify the *required fire flows* manually, or automatically by clicking the arrow next to *Load* and **Importing** from a table or feature layer OR **Allocate** required fire flows from a land use polygon feature layer.
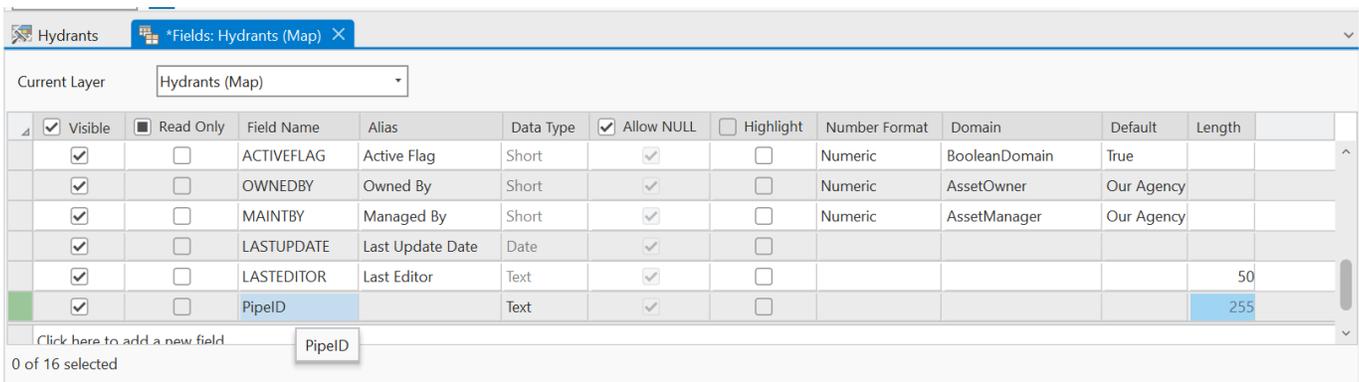   b. Any changes to the *Advanced Options* in Step 1 may require re-allocation in Step 2.

3. The Fire Flow analysis can now be *Run*.
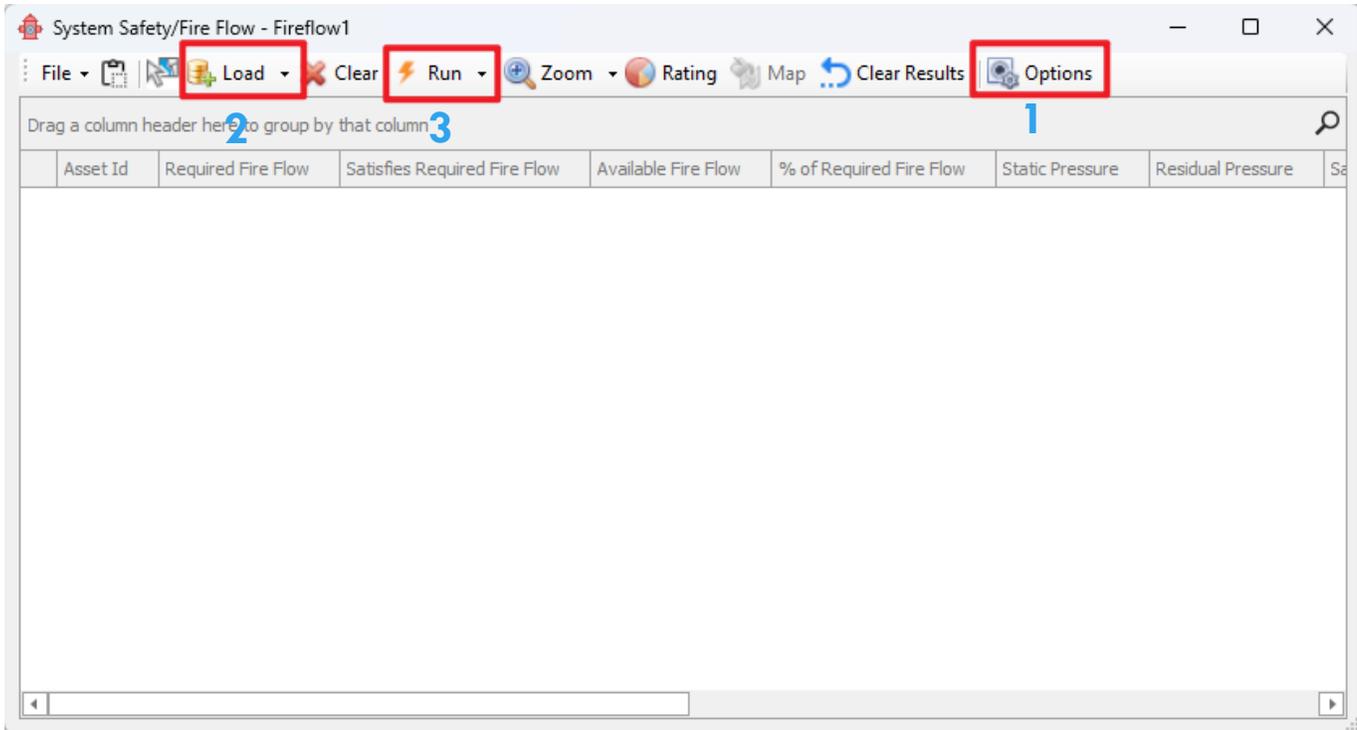
Prerequisites

To analyze available fire flows, a model must have:

1. A stable hydraulic run on the selected scenario
2. A Hydrants Feature layer (if utilizing) with a blank/<null> PipeID Field for associating with the model pipes.

3. Optional: A table or Feature Layer containing required fire flows by model junction to *IMPORT* or a polygon layer with Land Usage to *ALLOCATE* to the required fire flow to junctions/hydrants.

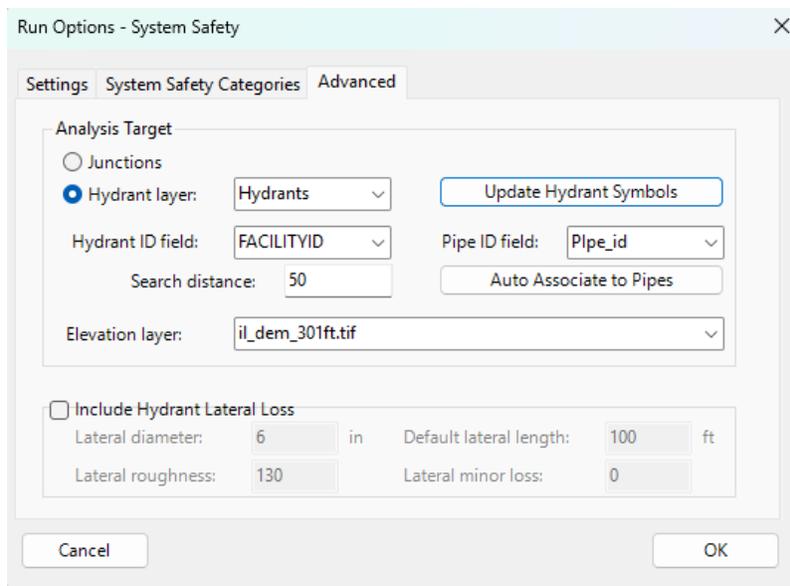4. Optional: A selection set with pipes and junctions of interest.

1. Options

Upon setting up a new System Safety/Fire Flow Scenario from the Digital Twin Tab in the Data Explorer, a blank table appears.
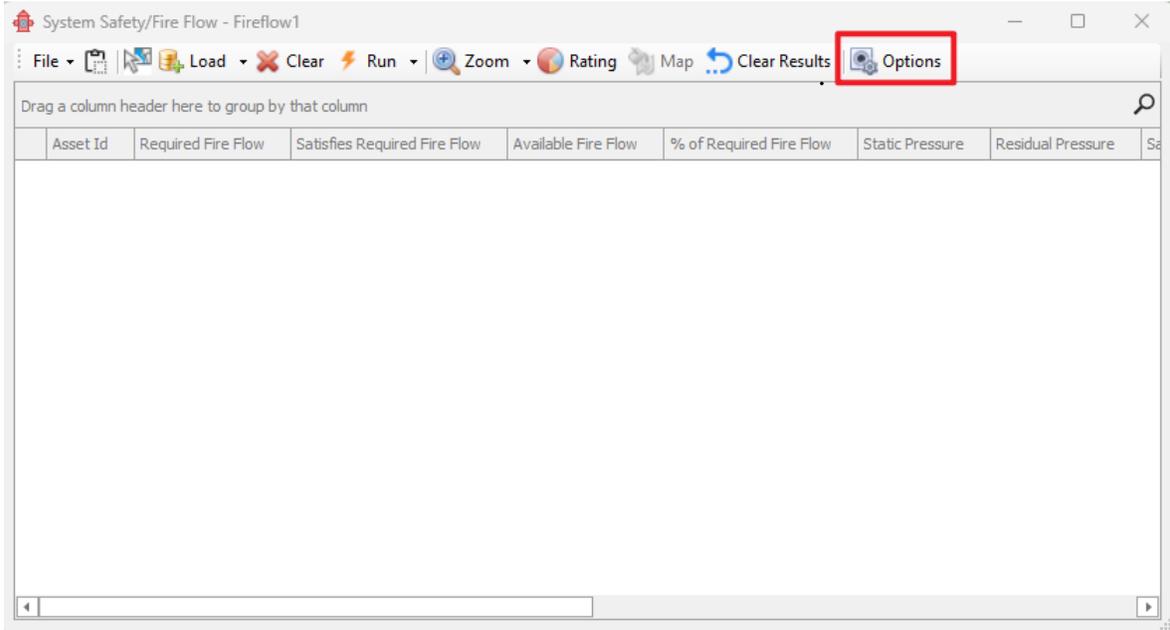
Advanced:

Clicking Options and navigating to the Advanced tab shows the following dialogue box:

When using the Hydrant Feature layer as the basis for the analysis selecting the layer from the drop down menu and clicking **"Update Hydrant Symbols"** will add symbology to the layer to indicate it is being used in AquaTwin. **Hydrant ID field** and **Pipe ID field** will need to be selected before specifying a **Search distance.** *(Pipe ID Field can be <null> values and can be added as a field prior to running the fire flow tool).* Clicking **"Auto Associate to Pipes"** will run a background spatial join process to assign each hydrant to the closest pipe, *even if hydrant laterals are not present in the model.* An *elevation layer* can be selected to provide better accuracy for hydrant pressures.

Hydrant Lateral Losses can be added to either a Junction run or a Hydrant layer run.

4

System Safety Categories:

In the same Run Options dialogue box under the System Safety Categories tab, percentage of required fire flow can be categorized from *Excellent to High Risk* according to user input.

Run Options - System Safety	✕

Settings | **System Safety Categories** | Advanced

| **Categories**	**Fire Flow Availability**
Excellent:	90.00%
Good:	80.00%
Fair:	70.00%
Poor:	60.00%
High Risk:	The rest

Cancel | OK

Settings:

Default fire flow demand: The default Target fire flow demand for all junctions if not otherwise specified

EPS Time: The time of day for the run can be specified

Extended Fire Flow duration: Fire flow analysis can be run for several hours. If left unchecked a steady state run will be performed

Report min. residual pressure: If an extended fire flow duration is run, will show the minimum residual pressure during the run.

Options:

Calculate residual pressure: If checked, model will calculate the residual pressure of each node/hydrant in the analysis at the available fire flow.

Compute available fire flow @ minimum pressure: If checked, model will compute the fire flow available at that node at the specified minimum pressure.

Compute maximum fire flow: If checked, model will compute the maximum fire flow available when confining the entire fire flow area to either a minimum pressure, or a maximum pipe velocity specified by the user.

Saved Selection: Maximum fire flow settings can be applied to a relevant selection set. Useful for systems where there are low pressures at pumping stations and tanks during a normal run, as these nodes can be excluded.
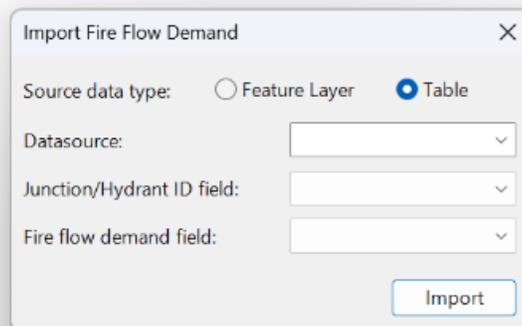
2. Load

Once the Analysis Target has been selected in Advanced Options, the fire flow demand requirements can be Loaded. The user has two options for this, **Import or Allocate:**
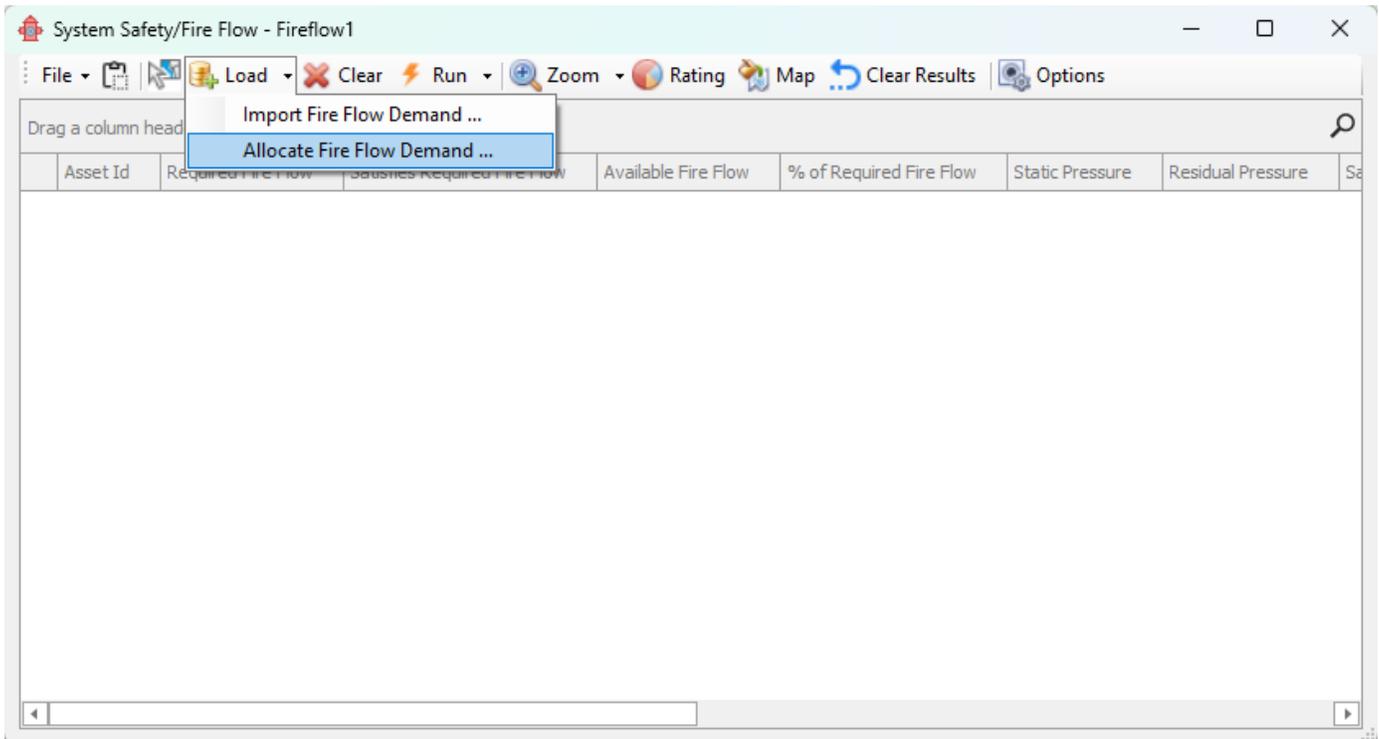
Import

Either a Feature Layer or a Table loaded into ArcGIS Pro containing a Hydrant or Junction ID field and corresponding Fire Flow Demand for that Hydrant of Junction.

Allocate

Using a polygon Feature Layer with Land Use information, the user can specify required Fire Flow Demands based on land usage for each parcel.

Land use info datasource: Feature Layer with Land usage for model

Land use code field: Field where land use classification is stored.

Search Distance: Search radius (in map units) for allocating demands of junctions/hydrants

Load: Loads all categories within the specified "Land use code field"

Clear: Clears all categories and demands

Delete: Deletes selected Category Name

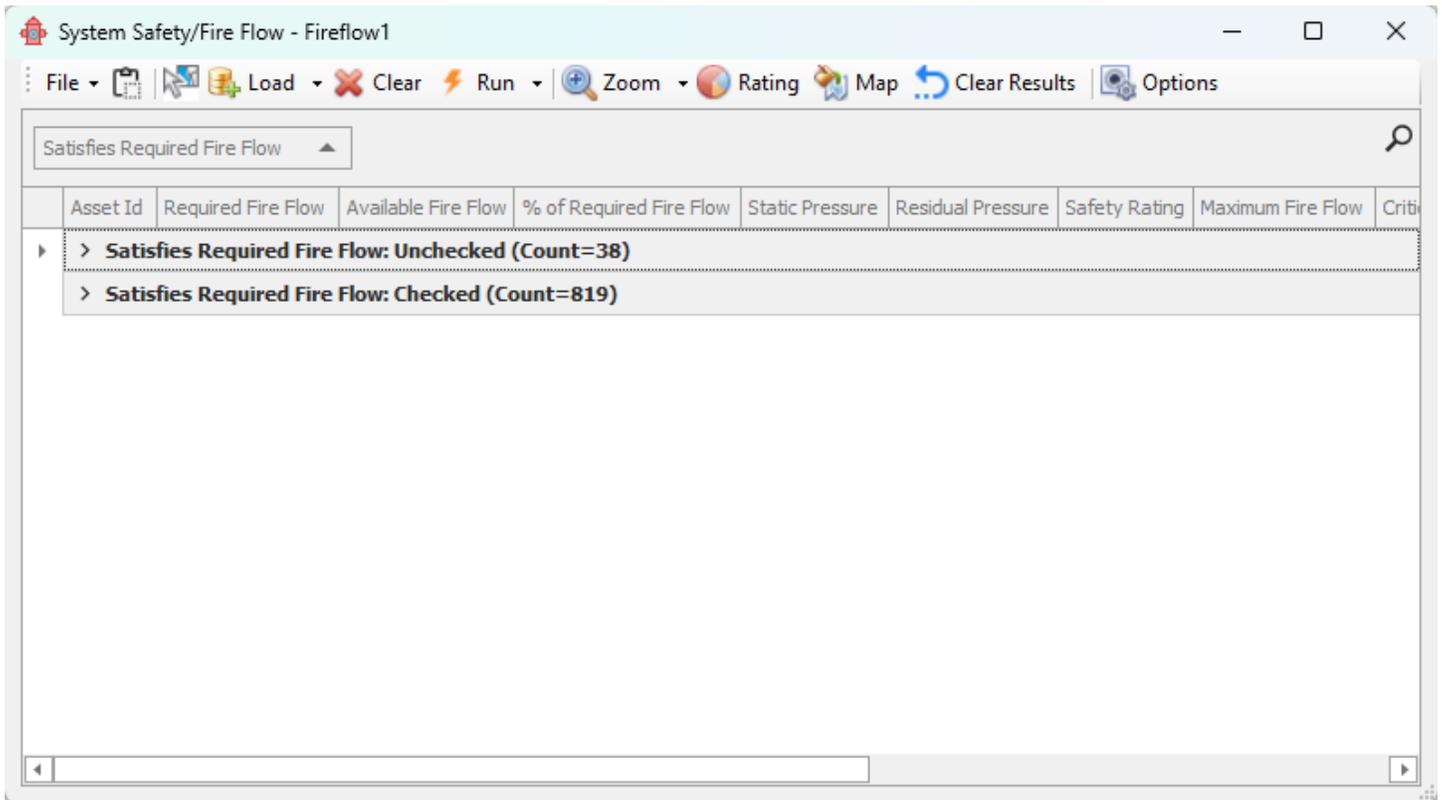Allocate: Allocates the written Fire Flow Demands to the Token Analysis nodes specified in Advanced Options.

3. Run/View Results

Once run Options are set and required demands are Loaded, the Fire Flow Analysis is ready to Run. Results are available to be viewed in a table, as below. User may Zoom to the selected junction/hydrant by clicking Zoom.

As... ▲	Required Fire Flow	Satisfies Required Fire Flow	Available Fire Flow	% of Required Fire Flow	Static Pressure	Residual Pressure	Safety Rating	Maximum Fire Flow	Critical Junction	Critical Pressure	Min Pressure Time	Critical Pipe	Critical Velocity	Max Velocity Time
36928	500	☐	0	0	0	0	High Risk			0			0	
36931	500	☐	0	0	0	0	High Risk			0			0	
36932	500	☑	3133.81	626.8	86.69	84.95	Excellent	3133.81	18945	79.42			0	
36933	500	☑	7663.37	1532.7	81.45	81.12	Excellent	7663.37	8620	56.76			0	
36934	500	☑	10245.67	2049.1	81.02	80.8	Excellent	10245.67	340455	40			0	
36935	500	☑	21026.88	4205.4	84.94	84.81	Excellent	21026.88	340515	49.24			0	
36936	500	☑	20348.66	4069.7	85.84	85.7	Excellent	20348.66	340515	53.63			0	
36937	500	☑	5177.51	1035.5	80.57	79.93	Excellent	5177.51	340473	40			0	
36938	500	☑	4815.68	963.1	80.57	79.84	Excellent	4815.68	340479	40			0	
36939	500	☑	4743.17	948.6	80.57	79.82	Excellent	4743.17	274576	40			0	
36940	500	☑	21216.5	4243.3	82.75	82.63	Excellent	21216.5	340515	44.42			0	
36941	500	☑	4892.58	978.5	80.57	79.86	Excellent	4892.58	340497	40			0	
36942	500	☑	12918.51	2583.7	84.92	84.72	Excellent	12918.51	340515	68.74			0	
36943	500	☑	21040.32	4208.1	81.88	81.76	Excellent	21040.32	340515	41.84			0	
36945	500	☑	20791.9	4158.4	81.01	80.89	Excellent	20791.9	340515	40			0	
36947	500	☑	20547.06	4109.4	80.58	80.46	Excellent	20547.06	340527	40			0	

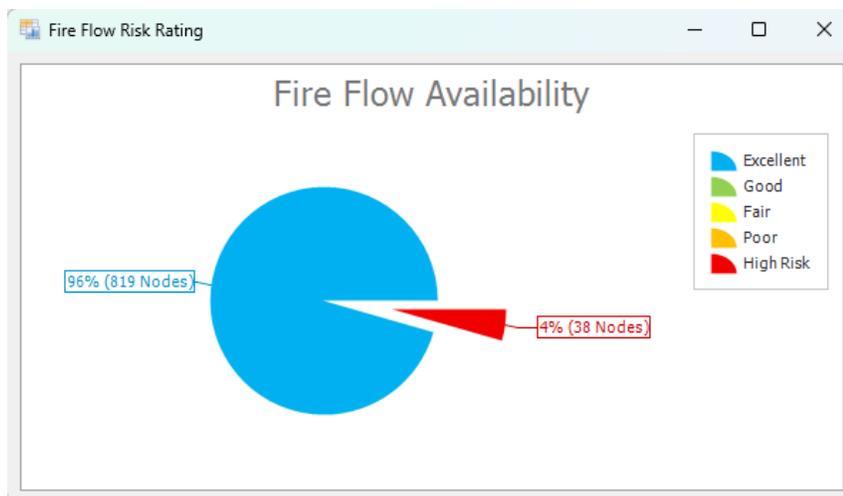|	
Asset ID:	ID of Junction or Hydrant
Required Fire Flow:	Required Fire Flow demand as imported or allocated.
Satisfies Required FF:	Indicates whether the Available FF meets the Required FF
Available Fire Flow:	Fire Flow available at the specified minimum pressure at the specified junction
% of Required FF:	The % of the Required FF met by the Available FF
Static Pressure:	The pressure calculated for the system demand at the fire flow simulation timestep
Residual Pressure:	The pressure calculated for the Required Fire Flow at the current Junction of Hydrant
Safety Rating:	Classification of % of Required FF based on user input rating
Maximum Fire Flow:	Maximum FF while satisfying either a minimum pressure or a max pipe velocity
Critical Junction:	The Junction with the lowest pressure among the monitoring Junctions (only populates if Max FF Option is checked)
Critical Pressure:	The minimum pressure among the monitoring Junctions at the Available Flow
Min Pressure Time:	Time when the critical junction has reached the minimum pressure (only available for the Extended FF)
Critical Pipe:	The Pipe with the highest velocity at Available Flow among the monitoring pipes (only populates if Max FF Option is checked)
Critical Velocity:	The maximum velocity among the monitoring Pipes at the Available Flow
Critical Velocity Time:	Time when the critical pipe has reached maximum velocity (only available for the Extended FF)

As with all AquaTwin tables, the user can create pivot tables by dragging a column name to the top of the table:

The user can produce a Fire Flow Risk Rating pie chart by clicking Rating:

If an external Hydrant layer was used for the fire flow analysis, a map display can be created by clicking **Map**: