

OVERVIEW OF FLUIDIT WATER

Aalto University - 2019-03-18

Mika Kuronen

Content: Session 2

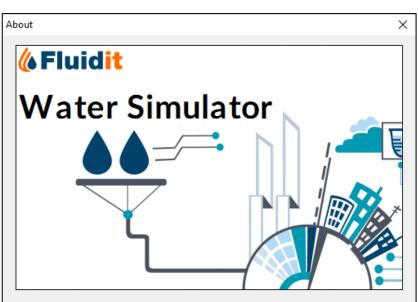
- About Fluidit Water Software and Licenses
- Setting Up & Navigating in Fluidit Water
- Basic Features
- Background Layers & Elevation Model



ABOUT FLUIDIT WATER SOFTWARE & LICENSES

FLUIDIT WATER

- Is a hydraulic network modelling and analysis software from Finland
- Core simulator is an improved version of EPANET 2.2
 - \rightarrow EPANET manual is a good source of basic information
- Fluidit Water model files have postfix ".fwat"
 - "Simple independent files" can be copied, renamed, deleted, etc...
 - All model information (network, results, etc.) is stored in the ".fwat" –file, there is no external database
 - Some background maps and elevation model are fetched from internet or from external files
- Technical information:
 - Runs on Netbeans Platform
 - Written in Kotlin (Java-based language)
 - Also uses Python and JavaScript as scripting languages
 - (but you dont need to know these to use the software)



NetBeans IDE and NetBeans Platform are based on Apache NetBeans from the Apache Software Foundation and is licensed under <u>Apache License</u> <u>Version 2.0</u>. Apache NetBeans is currently undergoing Incubation at the Apache Software Foundation. For more information, please visit <u>netbeans.apache.org</u>.

Product Version: Fluidit Water Simulator
incubator-netbeans-release-380-on-20181217
Java: 1.8.0_202; Java HotSpot(TM) 64-Bit Server VM 25.202-b08
Runtime: Java(TM) SE Runtime Environment 1.8.0_202-b08
System: Windows 10 version 10.0 running on amd64; Cp1252; en_US
(water)
User directory: C:\Users\MikaKuronen\.water\dev
Cache directory: C:\Users\MikaKuronen\.water\dev\var\cache

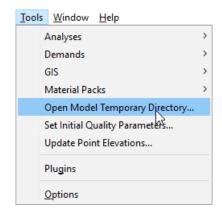
Close



INSTALLATION

- Requires Java JRE 8, 9 or 10 (64-bit)
- Unzip software package, no separate installation
 - Do NOT use folder "Program Files" might run into user right problems
 - At Fluidit we use "C:\prog\"
- To start the software: \bin\water64.exe
- Fluidit Water uses a temporary folder: C:\Users\YourUsername\.water\dev
 - This can also be accessed via: Tools \rightarrow Open Model Temporary Directory (\rightarrow)
- Program version 1.0 (and soon 1.1) is available as Windows installers, which make shortcuts to desktop and start menu
- New versions of the software are available frequently
 - Please check support –service regularly

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LICENSES

• HueWACO has a test license for now, which is valid until the end of March



Fluidit SUPPORT

Support web pages: https://support.fluidit.fi

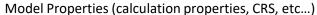
- Wiki / manual
- Latest versions of the software
- HueWACO has one username/password -set

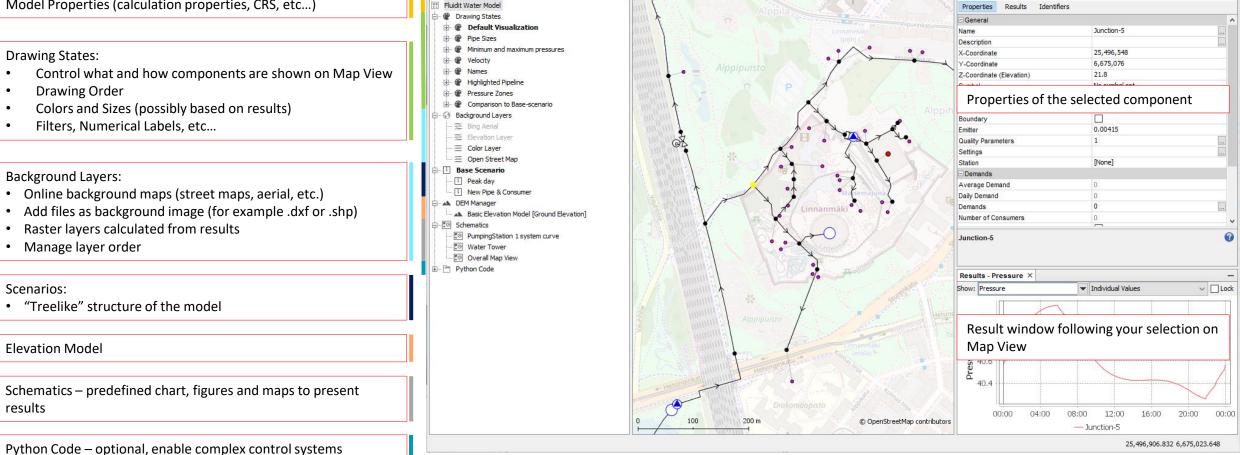
Support: support@fluidit.fi



SETTING UP & NAVIGATING IN FLUIDIT WATER

GENERAL VIEW





🕼 Fluidit Water Simulator - C:\Projektit\Aalto\Model Works 2019\Water\Castlehill_DEMO.fwat [Base So

◎ 沼 沼 涼 ↔ ◇ 🖬 🖬 🏦 🖋 🖋

File Edit Model Simulate Tools Window Help

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Model Browser

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Modeling tools: Add Components

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Map View Window

₩ "T Material:

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() = □

1/2/18 12:00 AM

Junction-5 - Properties ×

CUSTOMIZE YOUR VIEW

- Manage windows
 - Move around by dragging from the tab
 - Close and minimize are found as icons
 - Additional options can be accessed with a right-click on the tab (\rightarrow)
 - Float makes a new separate window, which can be taken to a second screen for example
- New windows can be opened via *Windows* –menu. Common ones include:
 - *Properties* selected component (or scenario, drawing state, etc.) properties
 - *Results* visualize results from selected components as time series
 - Statistics on Selected Components
 - Profile View
- Tooltip what is shown in Map View when cursor is above a component can be customized
 - Tools → Options → Map View → Tooltips
- General Appearance of the software can also be modified
 - Tools \rightarrow Options \rightarrow Appearance \rightarrow Look and Feel

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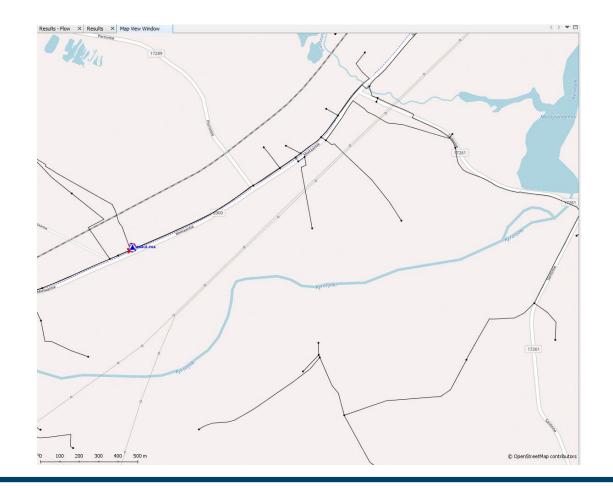
Results - Pre	Close]
Show: Pressur	Close Group	
41.0 40.9 40.8 40.7 40.7 40.6	Maximize Ctrl+Backspace Minimize Group Float Float Group	
40.5 40.4 40.3	Dock Alt+Shift+D Dock Group	
00	Move Shift Left Shift Right	16:0
	Move Group Size Group	96,85
Mil	Clone	

NAVIGATING MAP VIEW

- Move around: middle mouse button or arrow keys
- Zoom: mouse roll or "+" ja "-" keys
- ESC key activates select tool
- Select components by clicking or dragging over an area
 - +CTRL adds to current selection
 - +SHIFT+CTRL removes from current selection
- **CTRL** down \rightarrow shows elevation in lower right corner

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- ALT down \rightarrow can be used to measure distances
- ALT + SHIFT down → can be used measure area



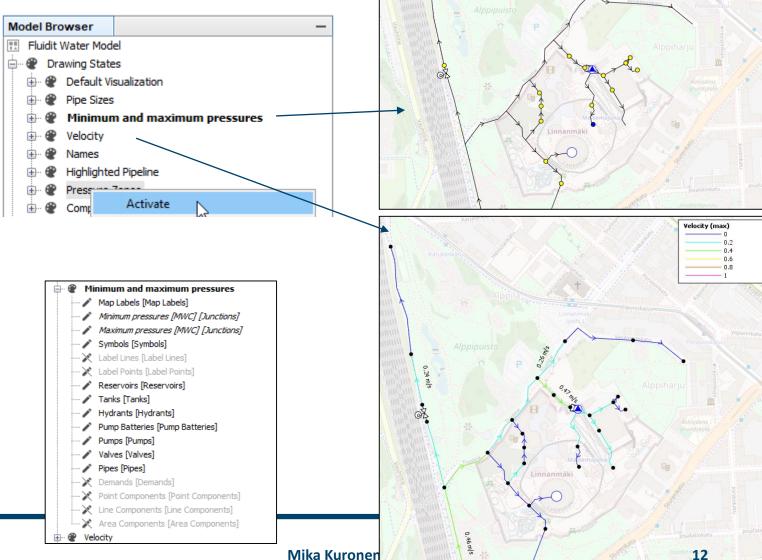
ACTIVATE DRAWING STATE

- Activate a Drawing State
 - By double click
 - Or right click \rightarrow Activate
- A Drawing State defines what components are shown and in what colors & sizes
- A Drawing State also has a specific set of Background Layers visible
- *Drawing States* are model-specific, but can be imported from other models

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• More on Drawing States later...

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Minimum pressures [MW

30

70

COMPONENT LISTS

Man View Window Austines X

[Fluidit Water Simulator [Base Scenario] File Edit Model

Model Br Fluidit 💼 -- 🔗

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	Map view window	Juncuons	^						
I Simulate View Navigate Too	Nodes	averageDe	boundary	dailyDemand	demands	description	emitter	ignoreForG	minimumHead
Junctions	Junc-3873	0,029		2,501	3		0		٠
Tanks	Junc-15466	0,006		0,479	2				\$
Idriks	Junc-19854	0,008		0,734	4				٠
Reservoirs	Junc-21324	0		0	0		0		\$
Pipes	Iunction-71	0,021		1,786	5				•
	Junc-10875	0,002		0,175	2		0		\$
Pumps	Junc-22755	0,017		1,458	6		0		\$
Pump Batteries	Junc-5739	0,01		0,894	3				Ŷ
Valves	Junction-70	0		0	0				•
	Junc-6828	0		0	0				•
Hydrants	Junc-20769	0,016		1,422	4				Ŷ
Demands	Junc-13403	0,015		1,279	5				\$
Current	Junc-18032	0,032		2,781	2				•
Curves	Junc-19875	0,009		0,781	2		0		Ŷ
Patterns	Junc-14934	0		0	0				\$
Pump Definitions	Junc-20253	0,021		1,855	2				\$
	Junc-4294	0,002		0,198	1		0		\$
Chemicals									
Materials									
Material Transient Properties									

All components of the model can be seen as a list from Model -menu

Lists can be used for example to:

- Select components •
- Arrange components by any • property or result
- Edit several components at once ٠
- Copy-Paste (into Excel for example) ٠



Zone Types... Zones...

Edit Result Colors & Sizes...

BASIC FEATURES: MODEL PROPERTIES & SIMULATION

MODEL PROPERTIES

- Coordinate Reference System (CRS)
 - Select from the list, you can type to use search
 - This is the model general CRS. Import material and background layers can be given different CRS and the program will make the transformation.
- Friction Model we recommend using Darcy-Weisbach
- Units we strongly recommend using standard l/s
- Simulation Start Time
- Simulation End Time
- Report Results Start
- Report Step
- Hydraulic Time Step

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• More about simulation settings can be found in the EPANET manual

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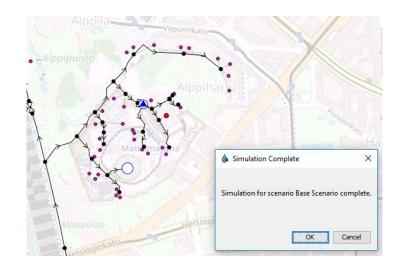
• ...and we can also talk more about advanced setting later in this training

Fluidit Water Model - Properties × Properties Identifiers General Fluidit Water Model Name "Castlehill" (finnish "Linnanmäki") ... Description ETRS89 / GK25FIN (EPSG: 3879) Coordinate Reference System (CRS) Properties 0.0001 Flow Accuracy 0 Head Accuracy 0 Flow Change Limit Demand Dependant Demand Model 0 Minimum Pressure 0 Required Pressure 0.5 Pressure Exponent Active Scenario Base Scenario Background Color [255,255,255] 10 Status Check Frequency 0 Damping Limit 1 Relative Diffusivity 0.5 Emitter Exponent Darcy-Weisbach Friction Model Maximum Status Checks 2 70 Default Pump Efficiency 85 Default Motor Efficiency 95 Default VSD Efficiency 1 Relative Specific Gravity Full Status Report Type 0.0001 Flow Tolerance Head Tolerance 0.0005 Quality Tolerance 0.01 50 Maximum Iterations l/s Units 1 Relative Viscosity 0 Zero Potential Elevation Time 1/1/18 12:00 AM Simulation Start Time Simulation End Time 1/3/18 12:00 AM 1/2/18 12:00 AM Report Results Start Report Step 600 1/1/18 12:00 AM Pattern Start 3600 Pattern Step 15 600 Quality Time Step Hydraulic Time Step 600

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SIMULATION

- From menu "Simulate" → "Simulate" or shortcut **F5 key**
- Simulator writes a report on the progress of the simulation during calculation. This report can be found "Simulate" → "Simulation Report" or shortcut F6 key
 - If simulation fails, this is the main way to find out why







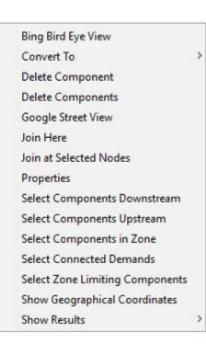
MORE BASIC FEATURES: TOOLS & WINDOWS

MAP VIEW: RIGHT MOUSE BUTTON

- Right mouse click anywhere opens up a menu, which is dependent on the location and selection
- Common uses:
 - Google Street View
 - Split Link / Join Here
 - Select components in Zone/Downstream/Upstream
 - Connect Selected Link/Demand here
 - +++

For example, right click on links and on nodes open the following options in Fluidit Water:

Add Vertex **Bing Bird Eye View** Convert To **Delete Component Delete** Components **Google Street View** Interpolate Elevations Properties Reverse Link Select Components Downstream Select Components Upstream Select Components in Zone Select Zone Limiting Components Show Geographical Coordinates Show Results Split Evenly... Split Here Split at Elevation Extremes





STATISTICS ON SELECTED COMPONENTS

Component Counts

Component Type	Count
Node	47
Link	49
Conduit	43
Inflow	36
Junction	43
Outfall	1
Pump	6
StorageUnit	3

Demand Data

- Total positive demand: 459,645 m³/d
- Total negative demand: 0,000 m³/d
- Average demand: 19,152 m³/h
 Demand without actions: 2,264
- Demand without pattern: 2,361 m³/h
 Negative demand without pattern: 0.0
- Negative demand without pattern: 0,000 m³/h
 Total average demand: 17.08 m³/h (410.00 m³/d)
- Total average demand. (incl. multiplier): 17,08 m³/h (410,00 m³/d)

Patterns by their total demand and share of total

- 1. ModerateHousehold: 8,54 m³/h (50,00 %)
- 2. PeakHousehold: 4,37 m³/h (25,61 %)
- 3. 16h_factory: 4,17 m³/h (24,39 %)
 4. No demand pattern: 2,36 m³/h (13,82 %)

Patterns by use count

- 1. No demand pattern: 48 (137,14 %)
- ModerateHousehold: 21 (60,00 %)
 PeakHousehold: 13 (37,14 %)

This window shows statistical information about components selected in Map View.

Common uses are for example:

- Number of components selected
- Total length of selected links
- Highest and lowest pressures or unit head losses
- +++

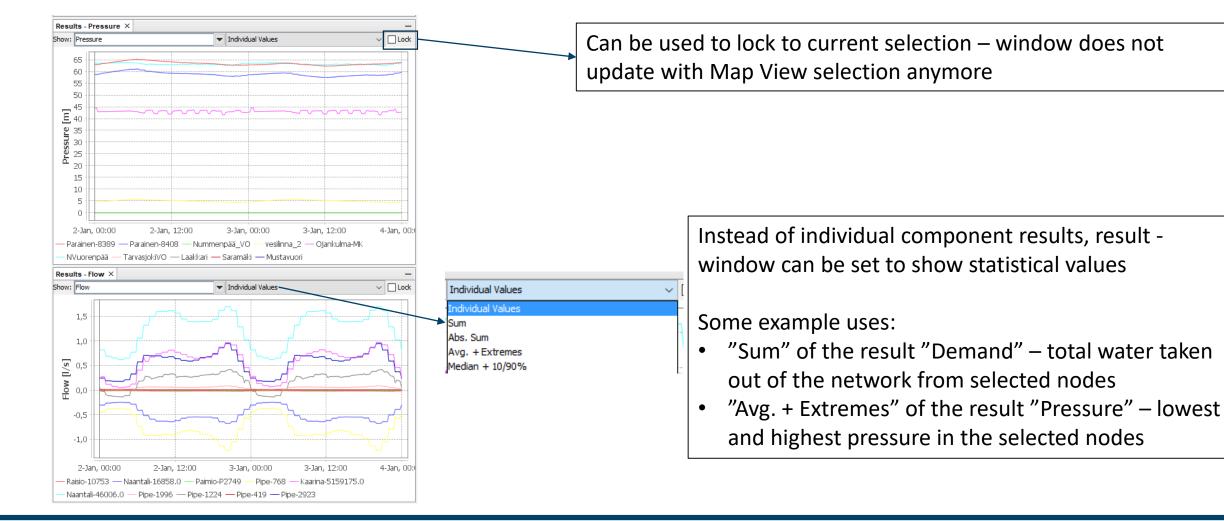
Alt + mouse click on top of the results from individual components (for example highest maximum flow) selects the component

Pipe Results

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Result	Sum	Average	Min (time)	<u> </u>	lax (time)	Smallest sum (time)	Largest sum (time)
Abs. Flow [l/s]	5666591,12	2,12	0,00 (2.1.2017 0:00)	689,64 2	.1.2017 21:00)	1,63 (<u>3.1.2017 6:45</u>)	2,74 (<u>3.1.2017 20:30</u>)
Abs. Flow (avg) [l/s]	29360,58	2,12	<u>0,00</u>	494,1			
Abs. Flow (max) [l/s]	43142,54	3,11	0,00	<u>689,64</u>	>		
Abs. Flow (min) [l/s]	14574,34	1,05	0.00	<u>358,14</u>			

RESULT WINDOWS





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FIND TOOL – CTRL + F

pression	Result
Pipe-3	Search for a component named "Pipe-3"
lopen	Search for closed pipes (non-open)
["Junc-1531", "J-4", "J-3"].indexOf(name) != -1	Search the model for components with names Junc-1531, J-4 and J-3
tags.contains("tag name")	Search for components with a tag "tag name"
<pre>tags.isEmpty()</pre>	Search for components with no tags
result("MIM_PRESSURE") < 25 result("MIM_PRESSURE") > 70	Search for junctions, which have minimum pressure below 25 mwc OR maximum pressure above 70 mwc
hasZone("PressureZone", "Center")	Search for all the components, which have "PressureZone" set to "Center"
<pre>abs(result("MAX_PRESSURE") - model.base.findComponent(uuid).result("MAX_PRESSURE"))</pre>	Change in maximum pressure compared to base-scenario, absolute value
<pre>connections.size()==0</pre>	Search the model for junctions with no connected links
<pre>connectionsList.size() == 1 && connectionsList[0].length<30</pre>	Search for node components, which have only one connection AND the connection is less than 30 meter of lenght
<pre>connectionsList.size() == 2 && connectionsList[0].material == connectionsList[1].material</pre>	Search for nodes, which have two connecting links AND those links have the same material

- Can be used to find components with expressions from simple to very complex
- For example:
 - Junction-1
 - *z* > 20
 - connectionsList.size() == 2 && connectionsList[0].material = connectionsList[1].material
- Tool uses JavaScript
- Example expressions can be found in Wiki



MATERIAL LIBRARY

- Model → Materials
 - Add new materials
 - Modify or delete old materials
- Materials can be imported from another model (*File* \rightarrow *Import Features to Model*)
- Tools → Material Packs
 - There is no full "Vietnamese Material Pack" ready
 - We have started to make one, we should finish it together

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•	Important material features:
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Name

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- Darcy-Weisbach roughness
 - (or Hazen-Williams)
- Inner Diameter (mm)



BACKGROUND LAYERS & ELEVATION MODEL

BACKGROUND LAYERS

- In model tree on the left
 - Mouse right button on "Background Layers" adds layers
 - Double mouse click: on/off
 - Top Layer is shown on top
 - Right mouse button "move up/down" or by drag
- Selection of street maps, aerial imagery, etc.
- Files / network maps / own maps:
 - Add DXF Layer
 - Add Raster Layer \rightarrow Raster layers: for example georeferenced images
 - Add File Layer \rightarrow Vector Layers: for example .shp

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- Add WMS Layer → Map servers: <u>URL</u> and username/password, select layers
- Calculated Layers from model properties/results:
 - Add Elevation Layer

6 Fluidit

• (Add Node Raster Layer \rightarrow general node result visualization raster \rightarrow more later, if we have time)

⊜… 🚱 В	ackground Layers
	E Bing Aerial
	Elevation Layer
-=	Color Layer
	Open Street Map
-	

Add Bing Aerial... Add Bing Street Map... Add Color Layer... Add DXF Layer... Add Elevation Layer... Add File Layer... Add Finland Map Pages... Add Finnish Background Map... Add Finnish Base Map... Add Finnish Cadastral Boundaries... Add Finnish Ortho... Add Generic Layer... Add Node Heatmap Layer... Add Node Raster Layer... Add Open Street Map... Add Raster Layer... Add WFS Layer... Add WMS Layer... Change Order... Paste Ctrl+V



ELEVATION MODEL (FROM FILE)

- "Basic Elevation Model" from Google DEM
 - (quality of the elevation data varies around the world, some fixes to handle the material better is currently under work at Fluidit)
- "Grid DEM" from File: ".tif" raster files
- Possible to have several elevation models
 - Fluidit Water first tries the one on top
 - \rightarrow if no data, then tries the next, etc.
- Fluidit Water also supports *Virtual Elevation Models* elevation layers calculated from other elevation models
 - For example constant "- 1 meter from Basic Elevation Model"
 - Rarely used in Water Distribution (more in Sewer)...

DEM Man=	aar	
Schemat	Add Basic Elevation M	lodel
🗄 🖻 Python C	Add Virtual Elevation	Model
	Add Grid DEM	N
		W
	Paste	Ctrl+V
	Change Order	

Grid DEM [G	Fround Elevation] - Prope	erties × -		
Properties	Identifiers			
General				
Name		Grid DEM		
Description				
Properties				
Туре		Ground Elevation \checkmark		
crs VN-2000 / UTM zone 48N (EPSG: 3405)				
multiplier 1				
source Elevation\elevation3405.tif				



ELEVATION MODEL IN HUEWACO MODEL

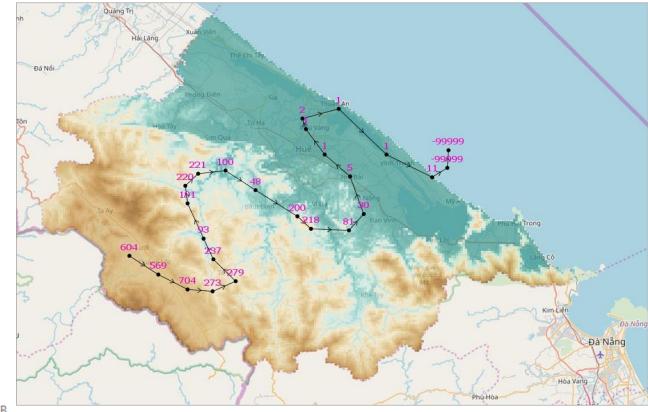
- Fluidit made a conversion to .tif (in QGIS)
- Grid DEM in HueWACO model refers to a file "Elevation\elevation3405.tif" → keep the folder with the file in the same directory as the model
 - Or update the path to the elevation file

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Properties	Identifiers		
General			
Name		Grid DEM	
Description			
Properties			
Туре		Ground Elevation	~
crs		VN-2000 / UTM zone 48N (EPS	G:3405)
multiplier		1	
source		Elevation\elevation3405.tif	

HueWACO test1.fwat	\odot	14.2.2019 18:32	FWAT File	2 891 KB
Elevation	\odot	15.2.2019 10:30	File folder	

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SOME GENERAL TIPS

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GENERAL TIPS

- Save often
- Every now and then make a new copy (Save As...)
- Fluidit Water automatically makes a back-up save of the old model file (".fwat.bak") to the same directory when you save replacing the old version
- Many problems can be solved by simply closing the software and re-opening
- Fluidit Water writes an internal log
 - Windows \rightarrow IDE Log
 - If you have some problems, this can help to find out why
 - Can be copy-pasted and sent to Fluidit Support



PHYSICAL COMPONENTS

PHYSICAL COMPONENTS

- Links
 - Pipes
 - Valves
 - Pumps
 - Pump Batteries

- Nodes
 - Junction
 - Reservoir
 - Tank
 - Demand
 - Technically not a "node" as it is not part of the network





- Basic hydraulic parameters:
 - Length [m] (automatically calculated)
 - Material or
 - Diameter [mm] and Roughness [mm]
 - (Minor Loss Coefficient)

Initial Status

- Open free flow
- Closed no flow
- Check Valve one-way flow (from Start Node to End Node)

Pipe-1 - Properties \times	-	
Properties Results	Identifiers	
General		
Name	Pipe-1	
Description		
Start Node	Junction-3	
End Node	Junction-4	
Tags	Highlight, VELO	
Length	240.37	
Custom Length		
Properties		
Material	160PVC	
Diameter	147.6	
Roughness	0.2	
Initial Status	Open 🗸	
Full Capacity	0	
1st Leak Coeff.	0	
2nd Leak Coeff.	0	
Flow Coefficient	1	
Minor Loss Coeff.	0	
Year	0	
Quality Parameters	0	
Zone Limit		
Settings		
Station	[None]	
Expert		
Changed in Scenario		
New in Scenario		
Zones	1	





 Used to model control valves, gate valves (fully open/closed) can be modeled with closed pipes

• Type

- Flow Control reduces flow to given setting
- Pressure Reducing reduces pressure to given setting
- + 4 others...

Setting

- Depends on the type
- Flow Control = I/s
- Pressure Control = mwc
- etc...

Valve Station1 - Prope	rties × -
Properties Results	Identifiers
General	
Name	ValveStation1
Description	Pressure reducing valve, th
Start Node	Junction-13
End Node	ValveStation 1-PI
Tags	Highlight
Properties	
Diameter	100
Туре	Pressure Reducing (PRV) 🔍
Headloss Curve	[None]
Setting	25.5
Loss Coefficient	0
Open	\checkmark
Settings	
Station	[None]
⊟ Expert	
Changed in Scenario	
New in Scenario	
Zones	0



PUMPS

- Used to model pumps running at known speed (rpm)
 - Speed (setting) can be changed during simulation

Pump Definiton

- Q-H -curve
- Efficiency Curve (+ electric motor information)

• Setting

- 1 = pump running at full speed
- 0.5 = pump running at half speed
- etc...

Pump-36 - Properties ×	-	
Properties Results Identifiers		
General		
Name	Pump-36	
Description		
Start Node	Junction-8	
End Node	Junction-9	
Tags		
Properties		
Pump Definition	BoosterPump	
Open	\checkmark	
Power	0	
Setting	1	
Speed Pattern	[None]	
Settings		
Station	[None]	
Expert		
Changed in Scenario		
New in Scenario		
Zones	1	



PUMP BATTERIES

- Used to model pumping stations with controls for example constant pressure
- Type
 - Constant Pressure keeps the given pressure setting at end node
 - Constant Flow pumps a constant flow through the pump
 - Constant Generated Head adds a constant amount of pressure
- Setting
 - Depends on the type
 - Constant Pressure = mwc
 - Constant Flow = I/s
 - Constant Generated Head = mwc

PressureBooster1 - Properties × -		
Properties Results Identifiers		
General		
Name	PressureBooster 1	
Description	This pumpbattery is on "Cons	
Start Node	Junction-11	
End Node	PressureBooster 1-PI	
Tags		
Properties		
Pumps	2	
Туре	Constant Pressure 🗸 🗸	
Setting	40	
Limit	\$	
Maximum Flow	\$	
Maximum Head	\$	
Open	\checkmark	
Settings		
Station	[None]	
Expert		
Changed in Scenario		
New in Scenario	\checkmark	
Zones	0	





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JUNCTIONS

- Used to model pipe intersections, material changes and points for consumers to take water from network
- Elevation
 - Usually taken automatically from Elevation Model
- Flow out of Junction
 - Consumers are usually modeled with geocoded demands, which attach to junctions
 - Leakage can be modeled steady direct demand in junctions
 - Or with Emitters a coefficient taking water out of the junction depending on pressure
- Demand
 - Can be set directly in the Junction, although usually Geocoded Demands are used
 - Demand can also be negative (water into network)

Junction-25 - Properties \times		_
Properties Results Idea	ntifiers	
General		
Name	Junction-25	
Description		
X-Coordinate	25,496,597	
Y-Coordinate	6,675,141	
Z-Coordinate (Elevation)	30.52	
Symbol	No symbol set	
Tags		
Properties		
Boundary		
Emitter	0.00243	
Quality Parameters	1	
Settings		
Station	[None]	
Demands		
Average Demand	0.116	
Daily Demand	10	
Demands	1	
Number of Consumers	1	
Ignore for Geocoded		
Minimum Pressure	\$	
Required Pressure	\$	
Expert		
Changed in Scenario		
New in Scenario		
Zones	1	



RESERVOIRS

- Used to model water sources
 - Water enter network from Reservoirs: "new water is created"
- Always keeps a desired (usually constant) Head by pushing water into network or taking water from network
 - Reservoir ALWAYS has a Head equal to its Elevation
 - → Pressure = 0 (free water surface)
 - (Pressure = Head Elevation)
- Elevation
 - Possible also to give a Head Pattern (elevation changes over time)

Reservoir-1	- Propertie	es ×		-
Properties	Results	Iden	tifiers	
General				
Name			Reservoir-1	
Description				
X-Coordinate			25,496,330	
Y-Coordinate			6,674,416	
Z-Coordinate	(Elevation)		0.25	
Symbol			No symbol set	
Tags				
Properties				
Boundary				
Quality Param	eters		0	
Head Pattern			[None]	
Hourly Yield			٠	
Daily Yield			٠	
Settings				
Station			[None]	
Expert				
Changed in So	cenario		\checkmark	
New in Scena	rio		\checkmark	
Zones			0	



TANKS

- Used to model any water tanks
 - (usually water towers or underground tanks)
 - Water can flow in and out, but no new water is created

Elevation

• Tank bottom elevation – when the tank is empty

• Levels

- Minimum Level almost always 0
- Maximum Level at what water level the tank is full
- Initial Level water level at the start of the simulation

Area / Diameter / Volume Curve

- Only one of these is given
- Defines the relation between water volume and level in the tank
 - For example if 100 m³ of water flow into tank, how much water level rises

WaterTower - Properties	× –
Properties Results Id	lentifiers
🗆 General	
Name	WaterTower
Description	Example water tower (above
X-Coordinate	25,496,685
Y-Coordinate	6,674,989
Z-Coordinate (Elevation)	60
Symbol	Tank
Tags	
Properties	
Boundary	
Quality Parameters	1
Settings	
Station	[None]
Tank Geometry	
Area	50
Diameter	7.979
Initial Level	2.8
Maximum Level	4
Minimum Level	0
Minimum Volume	0
Volume	200
Volume Curve	[None]
□ Expert	
Changed in Scenario	
New in Scenario	
Zones	1



DEMANDS

- Used to model water consumers
 - Always connect to a Junctions
 - \rightarrow Water leaves the network from Junctions
- Base Demand (I/s) or Daily Demand (m³/d)
 - Water taken out of the network by this demand
- Pattern
 - How water intake varies during the day
 - If Pattern = [None] → steady flow
- Demands are usually imported from CIS / NIS / GIS

Properties Results Identified	ers
General	
Name	
Address	
Description	
Category	
X-Coordinate	25,496,597
Y-Coordinate	6,674,960
Z-Coordinate (Elevation)	35.22
Parent	Junction-24
Identifier	
Symbol	No symbol set
Tags	
Properties	
Base Demand	0.058
Average Demand	0.058
Daily Demand	5
Pattern	ModerateHousehold
Floors	3
Important	
Sticky	
Settings	
Station	[None]
□ Expert	
Changed in Scenario	\checkmark
New in Scenario	\checkmark
Zones	0



NON-PHYSICAL COMPONENTS

NON-PHYSICAL COMPONENTS

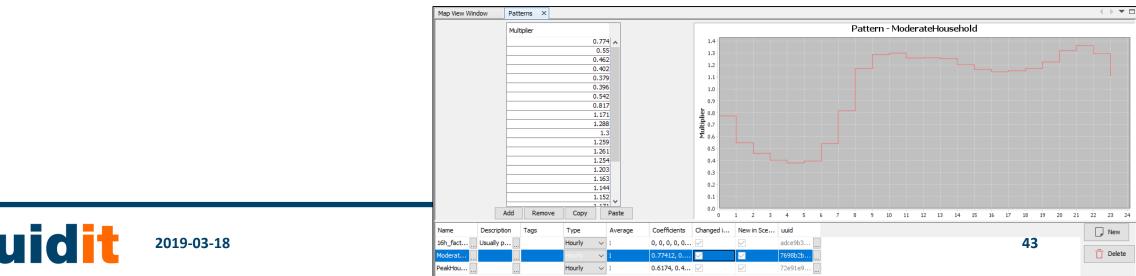
- Patterns
 - Describe repetitive changes in a value, usually relative to the average value
- Curves
 - Describe relation of two variables
 - Different types
- Pump Definition
 - Combine QH-curves, efficiency curves and motor information into a pump
- Chemicals
 - Parameters for water quality simulations

Values can be pasted from clipboard (from Excel, for example) into Fluidit Water and the other way around



PATTERNS

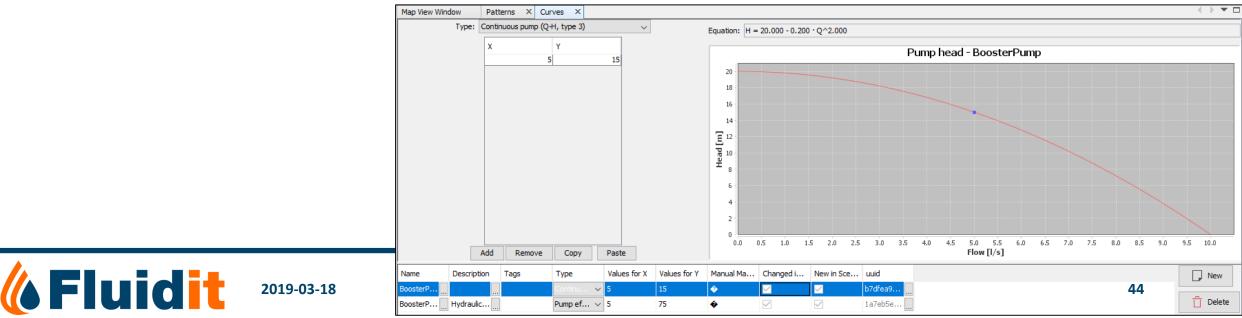
- Most commonly used to hourly change water taken from the network by demands
 - Water taken out from the network = Base Demand (I/s) * Pattern multiplier for every hour
- Can also be used to change:
 - Reservoir Head
 - Pump Setting
- Pattern Time Step can be changed in Model Properties
 - Time Step = How many seconds every step lasts
 - Usually and by default Time Step = 3600 = 1 hour $\rightarrow 24$ values to represent one day
- Usually made so, that pattern average equals $1 \rightarrow$ pattern does not change total consumption (m³/d)
 - Others can also be used, for example to multiply water demands or for setting/head patterns



CURVES

Most common uses include:

- Continuous pump (Q-H, type 3)
 - Can be given in
 - A) One operating point (nominal duty point)
 - B) Three operating points (a curve is fitted through these three points)
 - C) In tabular form (many Q, H -pairs)
- Pump Efficiency
- Volume
 - Used for tanks to define volume water level relations, if tank area is not constant



PUMP DEFINITIONS

- Pump Definitions are used to combine different curves and other information into pumps
 - Q-H –curve, usually "continuous pump, type 3"
 - Efficiency curve to represent pumps hydraulic efficiency (optional)
 - Electric motor information (usually nominal power and efficiency class)
 - Selection if the pump is driven by an inverter (it's losses are taken into account)
 - Inverter is also known as frequency converter or variable speed drive (VSD)

BoosterPump - Properties	× -
Properties Identifiers	
General	
Name	BoosterPump .
Description	
Tags	
 Properties 	
Pump Curve	BoosterPump
Efficiency Curve	BoosterPump_EFF
Inverter	
Motor Efficiency Curve	[None]
Nominal Motor Power	1.5
Motor Efficiency 100%	•
Motor Efficiency 75%	•
Poles	4
IE Class	IE2 High (EFF1)
Nominal Frequency	50
Minimum Frequency	25
Maximum Frequency	50
Max Power	1.144
Maximum Flow	7.5
Maximum Head	20
Minimum Head	8.75
Actual Maximum Flow	7.5
Actual Minimum Head	2.187
Actual Maximum Head	20
- Expert	
Changed in Scenario	
New in Scenario	✓



ZONES, TAGS

- Zones can be used to classify components into different zones
- Common zone types are pressure zone and metering zone
- Zone types are created via *Model* → *Zone Types*
- Zones are created via *Model* \rightarrow *Zones*
- Zones can be used for example
 - To set leakage
 - Search components
 - Filter components
- Tags can be given all components
 - Component can have several tags, separated by a comma
 - Their uses are similar to zone: search, filter, etc...

Name	Description	Zones	uuid
PressureZone	 	(No Prope	be912a 🛄

Name	Description	Туре	Color	hasGeom	uuid
LowerZone		PressureZone	null		bef1f33
MainZone		PressureZone	null		f00ca5
UpperZone		PressureZone	null		ab231b 🛄

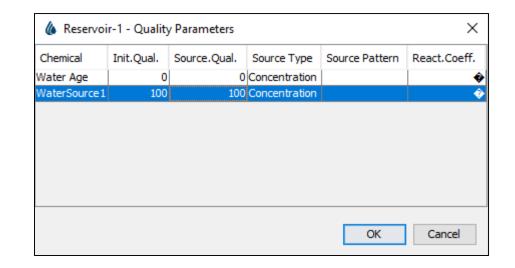


https://support.fluidit.fi/projects/simulators/wiki/Quality Simulations

CHEMICALS

- Common uses:
 - Water Age
 - Water Source (tracing reservoirs)
 - Pollution (contamination) spreading
 - Chloride
- Below are chemical properties for:
 - Water source modeling
 - Water Age modeling

Properties	
Boundary	
Quality Parameters	0
	NV NV



Map View Window	Chemicals	×											
Name	Description	Simulate	Global Bulk	Global Wall	Global Tan	Reaction O	Reaction O	Reaction O	Limiting Po	Roughness	Chemical Unit	uuid	New
WaterSource1			0	0	0	1	1	1	0	0	%	0d1b2d1	
Water Age	This is a		24	24	24	0	0	0	0	0	h	1c55b2a	📋 Delete





ÝÞ

-



TOOLS

- Fluidit Water has a separate tool to assign Demands to their nearest junctions
 - Tools \rightarrow Demands \rightarrow Update Demand Junctions
 - Demands can also be set by hand (select demand \rightarrow right click on junction \rightarrow Connect Selected Demand...)
 - Demands with "Sticky" = true are not affected by the tool
 - Junctions set to "Ignore fo Geocoded" = true are affected by the tool
- Fluidit Water has a tool to update selected point elevations from Elevation Model (DEM)
 - Tools → Update Point Elevations
 - Updates selected components or if nothing is selected, all components
 - Usually elevations come automatically when nodes are created



https://support.fluidit.fi/projects/simulators/wiki/Assign_leaks

LEAKAGE TOOL

• Fluidit Water has a separate tool for setting leakage

2019-03-18

- Tools \rightarrow Demands \rightarrow Assign Leaks
- Leakage can be divided to a specific area (selected area, whole system or by zones)
- Leakage is se to junctions of the selected area depending on
 - Pressure
 - Lengths and diameters of the pipes joining the node
- Can be to set a steady leakage (direct demand) or pressure dependant (emitters)

Select area: selections, zone, etc.	selections, zone, etc. Select a pattern for leakage or to use emitter				1 /			Input field for TOTAL WATER CONSUMPTION (billed + leakage)			Press <i>"Assign"</i>
	use en		1	area	1					agej	
\sim											
(4)	Calibrate l	eakage			/					×	
Model	l Leakage Us	sing: Empty Patte	ern	`	 Group by Zon 	e Type:		~		Assign	
Azdi	gn	Zone Name	Conduit Len	Avg.Diam. [Revenue W	NRW [m³/d]	Total [m³/d]	Calculated [L.Coeff. [l/s	Leakage [l/	
		Selection	0	0	0	0	K	0	0	0	
		Unassigned	4.525	0.264	1,419.771	580.229		2,000	56.2	1.484	
	\checkmark	Whole System	4.525	0.264	1,419.771	580.229	2,000	2,000	56.2	1.484	

• There is also a tool to set given demand to selected nodes evenly (Tools \rightarrow Demands \rightarrow Assign Demands)

SCENARIOS

SCENARIOS

- Fluidit Water has a support for scenarios different versions of the model in the same file
- Scenarios are hierarchical: changes made to parent scenario is inherited to it's child scenarios, but not the other way around
 - Components changed in a scenario are marked with "Changed in Scenario" = true, and changes made to this specific component in it's parent scenario are no longer inherited
 - New components (no corresponding component in parent scenario) are marked with "New in Scenario" = true
 - NOTE: these changes are always compared to it's direct parent scenario (one above) not Base Scenario
 - NOTE: this information is only updated when scenario is loaded. Active another scenario and return.
 - Tip: sorting component tables by these properties (Changed / New in Scenario) is an easy way to locate components modified in active scenario
- Simulated results can also be compared between scenarios: visualize with "Compare to"

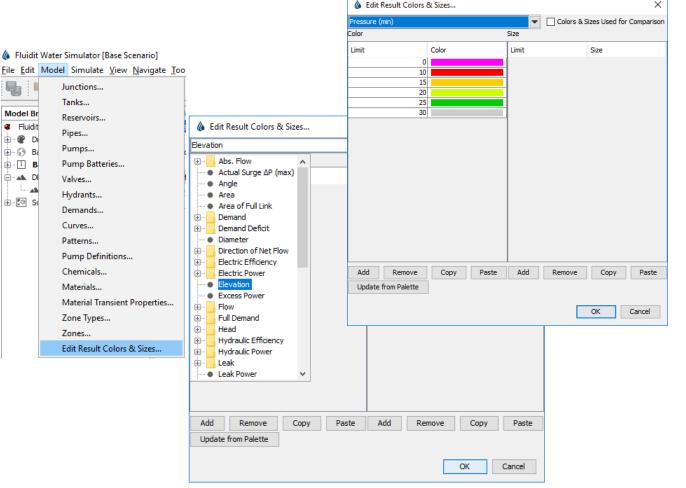




DRAWING STATES



EDITING COLORS & SIZES



- Model \rightarrow Edit Result Colors & Sizes
- Color and size definitions can be copied and pasted to/from clipboard (for example Excel)
- Color and size definitions can also be imported from another model file
 - File \rightarrow Import Features to Model



DRAWING STATES

- Drawing States
 - Each *Drawing State* has definitions how components are displayed in the map view (if at all)
 - Usually component colors (*Color Based on*) or sizes (*Scale Size Based on*) are changed depending on some simulation result
 - ... or text / numerical value is added next to components
 - Pipe arrows (arrowDirection), several options (for example net flow or maximum velocity)
 - Visualizations can be *filtered* to show only some of the components (for example visualize only junctions with very low or high pressure)
 - Active (Background Layers) are also saved in every Drawing State
 - One component type (for example pipes) can have several visualizators in the same drawing state
- Visualization as background layers \rightarrow Node Raster Layer
 - First define colors (*Model* \rightarrow *Edit Results Color & Sizes*)
 - Select which results is used (field)
 - Common settings: transparency (alpha) ja interpolation on/off (interpolation)

Junctions [Junctions] - Properti	es X	-
Properties Identifiers		
General		
Name	Junctions	
Description		
Properties		
Active	\checkmark	
Exclusive	\checkmark	
Filter	<null value=""></null>	
Color Based on		
Compare to Scenario		
Default Color	[0,0,0]	
Scale Size Based on		
Point Type	Circle	\sim
Size	6	
Size in Meters		

Pipes [Pipes] - Properties \times		-
Properties Identifiers		
General		
Name	Pipes	
Description		
Properties		
Active	\checkmark	
Exclusive	\checkmark	
Filter	<null value=""></null>	
Color Based on		
Compare to Scenario		
Default Color	[0,0,0]	
Scale Size Based on		
Arrow Direction	Net Flow Direction	\sim
Arrow Proportional to	\checkmark	
Arrow Size	4	
Arrow Size in Meters		
Line Style	Solid	\sim
Line Width	1	
Show Symbols	\checkmark	
Width in Meters		



SCHEMATICS

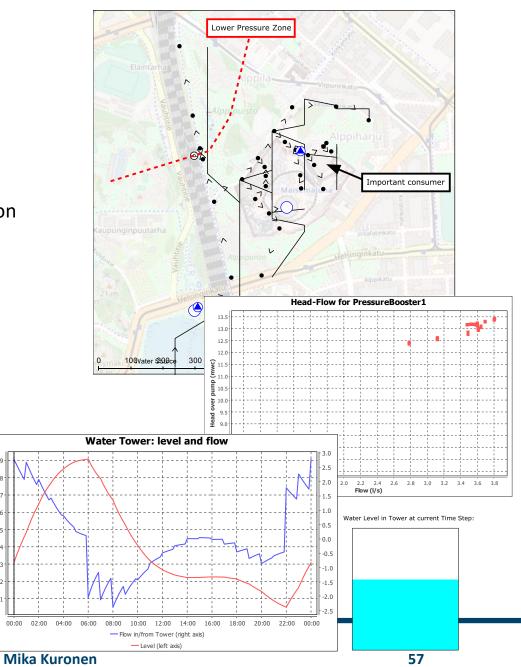
https://support.fluidit.fi/projects/simulators/wiki/Schematics

SCHEMATICS

- Are used to make views of common and essential results
 - Schematic figures are defined which component and which result to show
 - \rightarrow updates automatically if scenario is changed or simulation made
- \rightarrow Makes it possible to see the essential results fast and easy after simulation
- Common schematic tools:
 - Map Views
 - Figures
 - Value View
 - Making notes and drawing on top of these: lines, arrows, text...
- Examples of schematics can be found in wiki and in the demo model
- Can be copied to clipboard
 - By default as ".svg" -vector images
- Most dynamic things are done via calculation context
 - Introduce variables: a result from a component

2019-03-18

Create an expression using the values



MODEL FILE STRUCTURE

MODEL FILE STRUCTURE

- Fluidit Water -files (.fwat) are zipped archives (.zip)
- Can be unzipped with all common compression software (7zip for example)
- Files are human-readable .xml
- Model can be modified in these .xml –files directly
 - Unzip \rightarrow make changes \rightarrow zip \rightarrow change suffix from .zip to .fwat
 - Be careful, it is easy to "brake" a model (for example delete a junction that a pipes refers to)

• Example of a single junction named "Junction-4" in the .xml -data:



			DAVAT CI	CCC KD
Oper	n	:11	FWAT File	555 KB
le Move	e to OneDrive			
7-Zip)	>	Open archive	
CRC	SHA	>	Open archive	
🧾 Edit v	with Notepad++		Extract files	
🖻 Share	2		Extract Here	
Oper	n with	>	Extract to "Castlehill_DEMO\"	
🕑 Scan	for malware		Test archive	
Resto	ore previous versions	_	Add to archive	
Send	to	>	Compress and email	
		_	Add to "Castlehill_DEMO.7z"	
Cut			Compress to "Castlehill_DEM	0.7z" and email
Сору	/		Add to "Castlehill_DEMO.zip"	
Creat	te shortcut		Compress to "Castlehill_DEM	O.zip" and email

kcenario-28c62095-eba3-4871-8797-7966	17.9.2018 17:37	File folder	
scenario-3361a084-67b2-4dce-89c2-1159	9.11.2018 4:56	File folder	
kcenario-92151f25-df4d-4613-a449-091b	17.9.2018 15:59	File folder	
schematics	27.8.2018 10:57	File folder	
📔 model.xml	11.2.2019 11:11	XML File	64 KB

IMPORT & EXPORT

IMPORT FEATURES

Can be found in "File" \rightarrow "Import Features to Model"

Select:

- Do Not Import
- Import Missing imports the feature if there is no similar feature already set in the model
- Update Existing import attributes only to already existing features
- Update and Import both of the above

Demomallit		× 🧊 🖡	୭▼
Purku W Castlehill_I	DEMO.fwat	Layers: Drawing States: Colors & Sizes: Materials: Curves: Patterns: Time Series: Pump Definitions:	Do Not Import Do Not Import Import Missing Update Existing Update and Import Do Not Import Do Not Import Do Not Import Do Not Import
File name: Files of type:	Castlehill_DEMO.fwat Fluidit Water Model		Import Cancel



IMPORT COMPONENTS

Can be found in "File" \rightarrow "Import Components to Model" Method: import new Components into model components or update Import tools is a generic tools – all supported data types can old be imported into all model components **Coordinate Reference** System of the import Supported file types currently: material .shp • GeoJSON • (Import ETRS89 / GK25FIN (EPSG: 3879) ✓ Titles on First Line ✓ Allow Splitting Links Match Type: Always Create New V Tolerance: 1 Hydrant Import Excel • the_geom id descriptio CSV / TSV ٠ POINT (254... kohde 1 POINT (254... kohde2 POINT (254... 3 kohde3 55 GML POINT (254... kohde4 ٠ DXF (no support for importing attributes, only geometry) • Dropdown menu to select what attribute to import into what property Preview of the import file Properties are referred by their programmatical names. "geom" refer to component geometry



EXPORT

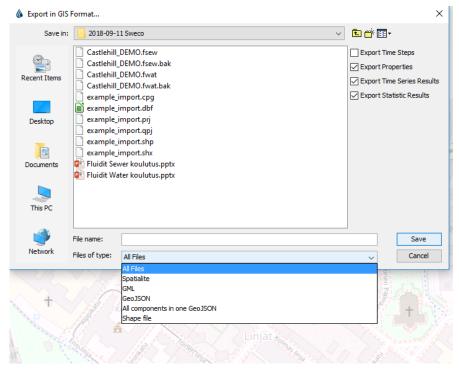
Can be found in "File" → "Export in GIS format" (or "Export in EPANET format", but EPANET does not support all Fluidit Water components)

Supported file types currently:

- GeoJSON
- .shp
- Spatialite
- GML

These common GIS-formats can be directly opened in most GISsoftware, for example Qgis or ArcGIS

If you have a selection in Map View tool will export only those selected components. If nothing is selected the whole model is exported.



Export functionalities:

- With GeoJSON you can select whether to make one GeoJSON with all components or different components into separate files
- Select if you want to export properties, results, etc.



CONTROLS

CONTROLS

- Fluidit Water has several ways to control components
 - Common steady parameters directly in components (Setting for Pump Battery, etc)
 - Support for EPANET Rules and Controls
 - Are enough for most networks
 - Easy to use and well documented in EPANET manual
 - Python programming language can be used to write scripts
 - For complex control systems
 - Not part of this basic training, but if needed Fluidit can provide additional material / training
- More about rules and controls can be found in EPANET manual:
 - Controls page 143
 - Rules page 164
- Example from demo model (\rightarrow)
- Note: Pump Batteries are controlled as "Valves" in EPANET commands

Base Scenario - Properties	× –
Properties Identifiers	
General	
Name	Base Scenario
Description	Base Scenario, of which all ot
Properties	
Controls	<null value=""></null>
Demand Multiplier	
Effective Demand Multiplier	1
Leak Pattern	[None]
Python Main	<null value=""></null>
Rules	RULE 1IF SYSTEM CLOCKTIM

🕼 Base Scenario - Rules	×
RULE 1 IF SYSTEM CLOCKTIME = 6:00 AM THEN VALVE PressureBooster 1 SETTING = 35 RULE 2 IF SYSTEM CLOCKTIME = 10:00 PM THEN VALVE PressureBooster 1 SETTING = 30	
	OK Cancel



COMMON MISTAKES

- Not enough water or too much water is pumped in to a pressure zone
 - Happens with flow control pressure control adjusts to water use
 - Can lead to very (unrealistic) high or low pressures results are not to be trusted
- EPANET is by default a demand dependent calculation engine all demand will always be fulfilled
 - No matter how high or low pressures are required
 - Simulation engine will even open closed pipes to fulfill demand
- Changes made to wrong scenario or wrong drawing state



COMMON PROBLEMS WITH SOFTWARE

- Self-updating windows (Properties, Results, Statistics on Selected Components, etc) are very useful, but can be slow when handling large number on components
 - To make things go faster, before making any huge selections, close all or some of these windows
- Drawing States with lots of components visible and complex filters etc. can be slow
 - To make things go faster, use drawing states with less visible components and no filters etc.
- Some software problems can be solved with a "clean install"
 - Delete the content of your Temporary Directory: C:\Users\YourUsername\.water\dev
 - Install the software (unzip from package) again



HYDRANT ANALYSIS

HYDRANTS

- Usually used to model hydrants or sprinklers
 - But can be used to model any water taken from the network

- Important parameters:
 - Opening and Closing Time
 - As seconds from the start of the simulation
 - Maximum Flow •

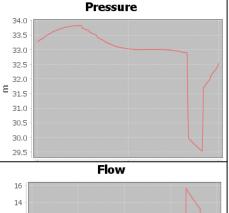
& Fluidit

Minimum Pressure •

Short instructions also available in Wiki

2019-03-18





Hydrant-36 - Properties ×	_
Properties Results Identifiers	
General	
Name	Hydrant-36
Description	
X-Coordinate	25,496,624
Y-Coordinate	6,675,248
Z-Coordinate (Elevation)	27.43
Symbol	No symbol set
Tags	
Properties	
Diameter	150
Opening Time	158400
Closing Time	165600
Boundary	
Maximum Flow	\$
Minimum Pressure	30
Pattern	[None]
Quality Parameters	0
Settings	
Station	[None]
Expert	
Changed in Scenario	
New in Scenario	
Zones	0

ts Identifiers		
	Hydrant-36	
	25,496,624	
	6,675,248	
on)	27.43	
	No symbol set	
	150	
	158400	
	165600	
	\$	
	30	
	[None]	
	0	

PUMP BATTERY ANALYSIS

PUMP BATTERY ANALYSIS

