generate_swmm_inp

Manual for the QGIS plugin, version 0.35

Jannik Schilling

email: jannik.schilling@posteo.de

March 20, 2024

If you use the plugin in scientific work or other studies, please cite as: Schilling, J.; Tränckner, J. Generate_SWMM_inp: An Open-Source QGIS Plugin to Import and Export Model Input Files for SWMM. Water 2022, 14, 2262. https://doi.org/10.3390/w14142262

First versions of this plugin have been developed within the project PROSPER-RO, funded by BMBF, grant number 033L212.

Contents

1 Introduction

SWMM is an open-source model and software by the US EPA for the simulation of rainfall-runoff and routing in water bodies, sewer systems and wastewater infrastructures. An intruduction to the model itself and details about attributes used in SWMM can be found in the official manual [5].
For a new SWMM model, objects such as nodes, links and catchments can either be drawn via the graphical user interface (GUI) of SWMM or specified in a plain text file in ".inp" format (*input file*). The required data regarding sewer geometries and rivers systems are usually available as geodata (e.g. *geopackage, shapefiles...*). A direct import function for such files is not available in SWMM so far. To fix this problem, the plugin "generate_swmm_input" enables the conversion of geodata in QGIS into *input files* for SWMM. Additionally, the plugin provides a tool to import *input files* from SWMM into QGIS. This allows you to edit the model data as layers with the aid of the large toolbox of QGIS.
This documentation explains how to install the plugin and how to prepare the geodata in QGIS. It is (and will remain) a "work in progress". If you find any mistakes or you miss explanations for certain tools, layers, ... please write an issue on GitHub or an email to the author.
An article to with the description of the plugin was published in 2022 [6]. If you´re using the tool (e.g. for scientific or educational purposes, for urban planning etc.), please take this reference for your reports.

1.1 Installation

The plugin: "generate_swmm_inp" can be installed within QGIS from the official QGIS plugin repository. The latest experimental version of the plugin will always be available on GitHub and can be installed from a zip file after downloading it from the GitHub repository of the plugin [1] .

In some cases: missing Python packages. The plugin needs the Python package "pandas". If it is not are not already installed, the tools will raise errors, when running. To install missing packages, various instructions can be found online. Here are some examples...

- Windows:
  - If you have had an "advanced install" of QGIS with the osgeo4w installer, you can simply open the osgeo4w installer again, search for the packages and select the checkbox to install them.
  - until QGIS version 3.18: Open the OSGeo4W shell and run `py3_env`.
    Then run `python −m pip install pandas`
  - for QGIS version 3.20 and later: Open the OSGeo4W shell and directly run `python −m pip install pandas`.
- Linux: open the terminal and install via pip: `python −m pip install pandas`.

SWMM: To run the models, SWMM has to be installed. Alternatively you can use the "swmmr" package [3] for R or packages such as "pyswmm" [4] for Python.

1.2 Hints for this documentation

Two different types of tables will appear in the documentation. The first type shows the column names and attributes which are used in geodata and .xlsx (.xls, .ods) files. Such a table will look like this:

Name in attribute table	**Data type**	**Name in SWMM GUI (5.2.1)**	**annotations**
...	...	...	
...	...	...	

The second type shows examples of how tables in the .xlsx (.xls, .ods) files have to be organised. Such a table will look like this:

1st col.	2nd col.	3rd col.	4th col.	5th col.
some	random	data	...	...
...	...	...	..	...

1.3 Latest changes

Version 0.35: (highlighted in **red** in the following sections)

- fix for hydrograph input in tables

Notable changes in former versions:

- Version 0.34: replacement of column **"Shape"** by **"XsectShape"** in **conduits** layers and **orifices** layers because of issues with ESRI-Shapefiles. Currently, a deprecation warning will appear and the tools will still work with old SWMM layers. However it is recommended to apply these changes from now on.
- Version 0.34: removal of "openpyxl" due to several crashes on Windows
- Version 0.32: bugfixes for package import and "rounded" vertices
- Version 0.30: new feature: import of SWMM report files (QgsAction)
- Version 0.28: new feature: hydrographs und rdii tables (inflows), see subsection 4.2.6
- Version 0.25: new tool '4_SelectSubModel' ; added import and export of descriptions / annotations
- Version 0.23: added option 'empty layers' to tool 1
- Version 0.23: raingages can now only be added as layers. This replaces former rain gage setting in time series (see subsection 4.2.3).
- Version 0.22: new feature forms
- Version 0.20: "RoadWidth" was renamed in version 0.20, before: (unfortunately) "CurbWidth" (see subsection 4.2.8)
- Version 0.19: New features of SWMM 5.2 are integrated in the plugin. Therefore new columns, tables and keywords had to be added. These features are highlighted in **blue** in every section. If you want to continue working with SWMM 5.1 the plugin can still generate suitable input files as long as you don´t choose the new features and keywords.

2 The tools

2.1 1_GenerateDefaultData

The first tool will give you a default data set to see the data structure needed for the export and conversion into a input file later on. You can choose wether you would like empty layers, a data sample for SWMM 5.1 or a data sample for SWMM 5.2. You can directly create the layers with the coordinate reference system (CRS) for your region. The default CRS is "epsg:25833". The files will be saved in the selected folder. Geodata are provided for the main infrastructures:

- rain gages (SWMM_raingages.gpkg)
- junctions (SWMM_junctions.gpkg)
- conduits (SWMM_conduits.gpkg)
- subcatchments (SWMM_subcatchments.gpkg)
- storages (SWMM_storages.gpkg)
- outfalls (SWMM_outfalls.gpkg)
- pumps (SWMM_pumps.gpkg)
- weirs (SWMM_weirs.gpkg)
- outlets (SWMM_outlets.gpkg)
- orifices (SWMM_orifices.gpkg)
- dividers (SWMM_dividers.gpkg)

Further data is provided in tables and can be edited there:

- curves (gisswmm_curves.xlsx)
- inflows (gisswmm_inflows.xlsx)
- options (gisswmm_options.xlsx)
- patterns (gisswmm_patterns.xlsx)
- quality (gisswmm_quality.xlsx)
- timeseries (gisswmm_timeseries.xlsx)
- transects (gisswmm_transects.xlsx)
- streets (gisswmm_streets.xlsx)

2.2 2_GenerateSwmmInpFile

With the second tool, you can directly convert layers from QGIS into input files. You can add further data (e.g. curves, inflows patterns, see chapter 4.2) from tables to the input file. The default data serve as a template for your own model, because column names have to be matching in order to identify the correct information for the input file (see section **??**geodata) for column names). Actions in the user interface:

1. Select the layers and files you want to have in your SWMM model
2. Choose a location and name for the resulting input file (".inp")

The tool will not check if the layers are in the same CRS. This can lead to unexpected results. So make sure, that all selected layers have the same CRS (or save a copy of the layer in the desired CRS).

2.3 3_ImportInpFile

The third tool allows you to import input files into QGIS. All sections (if already implemented) of the input file will be connverted into QGIS layers (e.g. shapefiles) and tables. Actions in the user interface:

1. Choose the input file (".inp") to import
2. Choose the file format for geodata
3. Choose the (expected) CRS of the data in the input file
4. Optional: choose a prefix to specify the name of the resulting files. For example, if the prefix is set to "20210101", then the name of the junctions file will be "20210101_SWMM_junctions". Try to avoid any characters here, which could cause trouble with file systems (e.g. ".", "," , "/"...)
5. Select a folder to save the resulting files in. Creating and chosing a new, empty folder for the import is recommended.

Attention: SWMM was a command line tool in the beginning. Therefore, "visible" geometries (polygons, lines, points) are not neccessary to run a simulation in SWMM. QGIS, by contrast, needs geometries. If a geometry is not available in the input file, the tool will set a default geometry for this feature.

2.4 4_SelectSubModel

This tool allows you to create a new set of layers as a "submodel" of already existing SWMM layers in QGIS. You start by selecting exactly one node/point in any node layer (Junction, Storage, Divider, Outfall). Then you double-click on the tool to open it. You choose, wether you´d like to

- keep/select all the features above the selected node
- exclude all the features above the selected node

for the new SWMM layers. You can define a prefix, which will be added to the layer names. If you do not define a prefix, then "Subset" will be taken by default, here. As in tool 2 (section 2.2) you choose the layers to be included in the model and a folder to save the resulting layers in. The new layers will automatically added to the QGIS project in a new group (named with the chosen prefix).

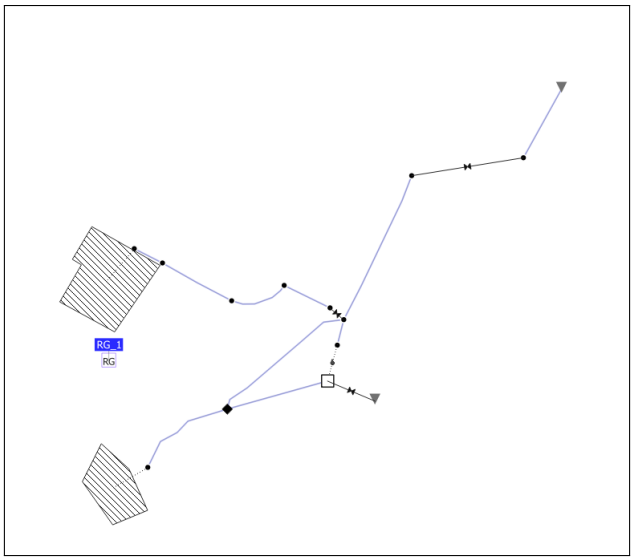

Figure 2.1: Layers before

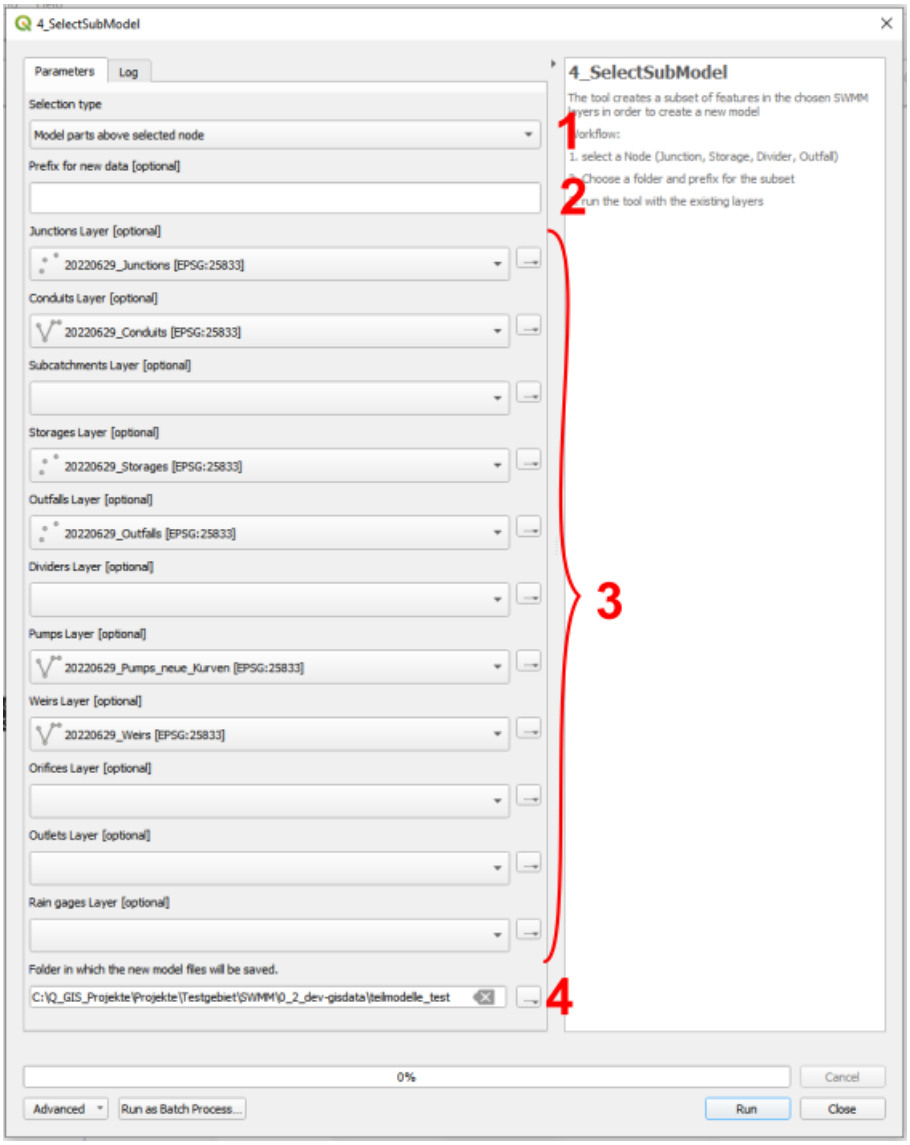

Figure 2.2: GUI of the tool; 1: Above or below selected point; 2: prefix; 3: chosen layers; 4: folder for resulting layers

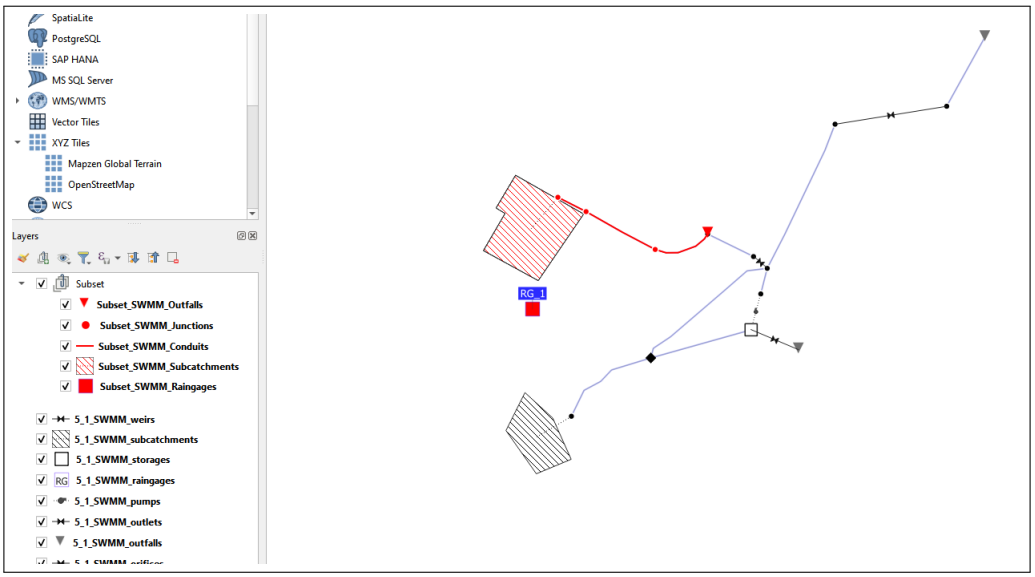

Figure 2.3: New created layers after execution of tool 4

3 Feature forms

Style files (.qml) with custom feature forms for every SWMM layer are added to the layers with the first tool by default. Alternatively you can download the style files or copy them from your QGIS plugin folder. These feature forms will help you to insert suitable values when you add or edit a feature:

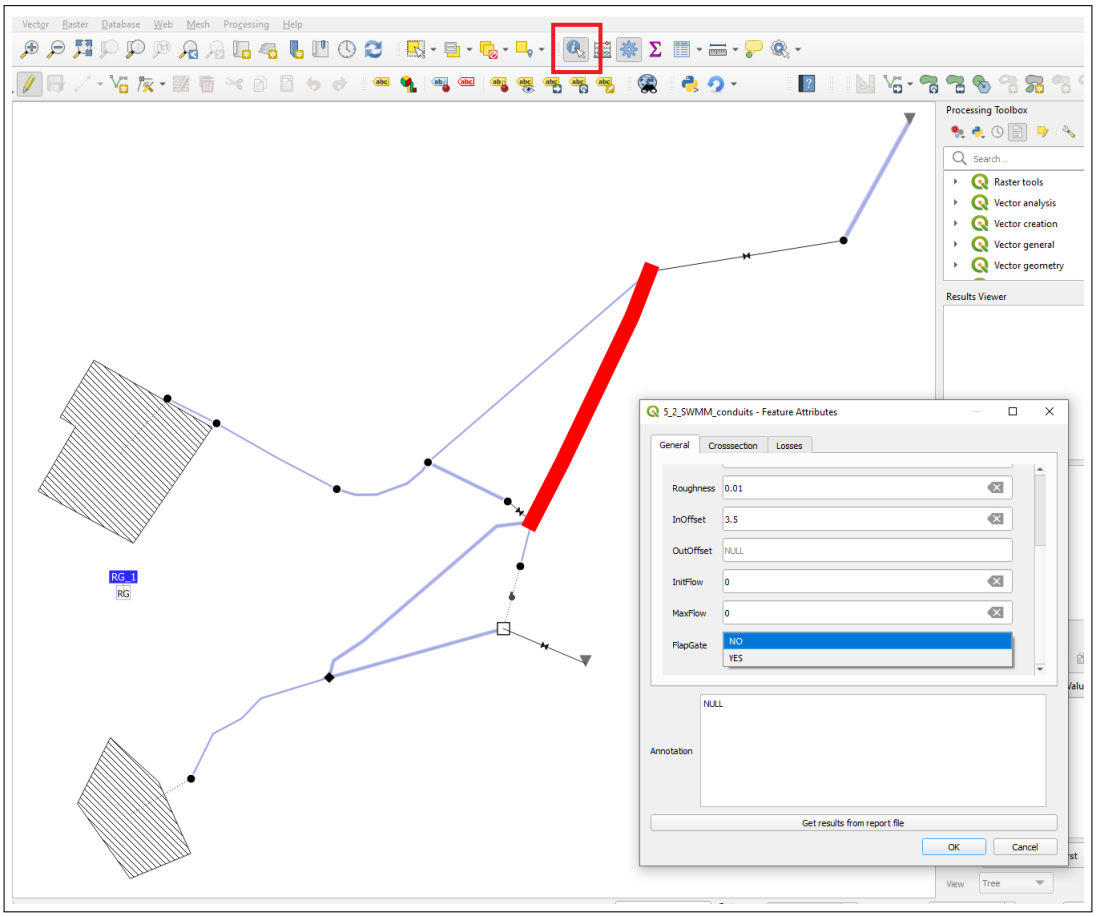

Figure 3.1: Feature form for a conduits layer

After you ran a simulation in SWMM (or with a python package) you can add the results from a report file. You´ll find the button for the QgisAction [1]in the feature form of a SWMM layer (Figure 3.2). You select the report file, the SWMM feature type and the desired report section. The report table will be opened as a new window. You can now save the the table as a csv file. By default, the resulting file will be added to the QGIS project (if you don´t want this, uncheck the checkbox).

[1] https://docs.qgis.org/3.28/en/docs/training_manual/create_vector_data/actions.html

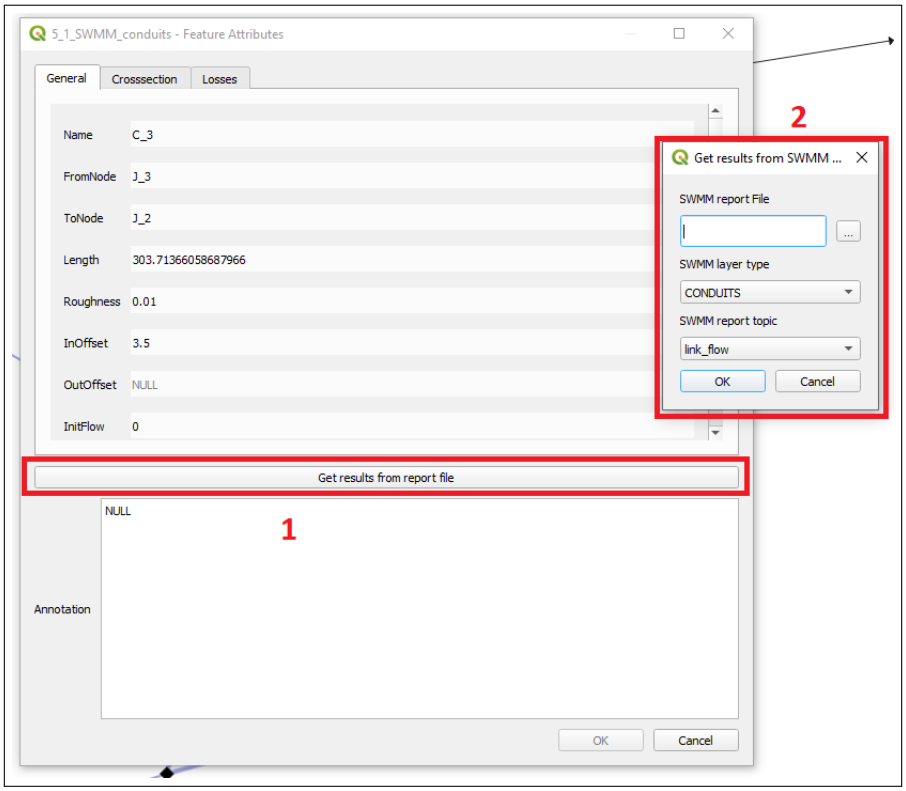

Figure 3.2: Button (1) and widget (2) for the import of a section of a SWMM report file

4 Field names and column names in geodata and tables

4.1 Geodata

In the first versions of the plugin, the main file type for geodata were shapefiles. This limited the length of the field names in the attribute to 10 characters. Hence, in some cases, the field names required for the tools differ from those used in the graphical user interface (GUI) in SWMM. For example, the rate of seepage loss into the surrounding soil of a conduit can be defined with the field "Seepage" in the conduits layer (see section 4.1.3), which refers to "Seepage Loss Rate" in the SWMM GUI.
KNOWN ISSUE: In some layers, you need the a field/column with the name "Shape" (e.g. in a conduits layer). If you´re using shapefiles, creating a field called "Shape" will lead to an error. You can solve this by exporting the layer as a geopackage (.gpkg), adding a new field named "Shape" and re-exporting the file to a shapefile (or use .gpkg in general). See [2]

4.1.1 Rain gages

LAYER TYPE: point
DESCRIPTION: Rain gages are used in SWMM to set precipitation data for subcatchments. The rain gages layer was added in version 0.22 of the plugin.

Name in attribute table	**Data type**	**Name in SWMM GUI**	**annotations**
Name	string	Name	
Format	string	Rain Format	
Interval	string	Time Interval	format: HH:mm
SCF	float	float	Snow Catch Factor
DataSource	string	Data Source	'FILE' or 'TIMESERIES'
SeriesName	string	Series Name	if "DataSource" is 'TIMESERIES'
FileName	string	File Name	if "DataSource" is 'FILE'
StationID	string	Station ID	if "DataSource" is 'FILE'
RainUnits	string	Rain Units	'IN' or 'MM'; if "DataSource" is 'FILE'
Annotation	string	Description	optional column

4.1.2 Nodes

LAYER TYPE: point
Four types of nodes can be added to a SWMM-file: junctions, storage units, dividers or outfalls. Inflows into any kind of nodes can be are defined in the 'Inflows' table (see chapter 4.2.6). Treatment of pollutatants is not implemented yet.

Junctions

Name in attribute table	**Data type**	**Name in SWMM GUI**	**annotations**
Name	string	Name	
Elevation	float	Invert El.	
MaxDepth	float	Max. Depth	
InitDepth	float	Initial Depth	
SurDepth	float	Surcharge Depth	
Aponded	float	Ponded Area	
Annotation	string	Description	optional column

Storage units

DESCRIPTION: Storage units are represented in a point layer [1] in QGIS. Until SWMM version 5.1 the shape of a storage could be described either by a function ('FUNCTIONAL') or in a table ('TABULAR') as a storage curve. With SWMM version 5.2 storage units can have a variety of shape types (see "Type"). Different columns in the attribute table are required for different shape types[2]. Of course you can also have shape types for different storages within one storage layer.

Name in attribute table	**Data type**	**Name in SWMM GUI**	**annotations**
Name	string	Name	
Elevation	float	Invert El.	
MaxDepth	float	Max. Depth	
InitDepth	float	Initial Depth	
SurDepth	float	Surcharge Depth	
Type	string	Storage Curve	'FUNCTIONAL', 'TABULAR', 'PYRAMIDAL','PARABOLIC','CONICAL' or 'CYLINDRICAL'
Curve	string	Curve Name	for TABULAR storage curves; the names of the curves have to be matching with those in the storage curves table
Coeff	float	Coefficient	for FUNCTIONAL curves
Exponent	float	Exponent	
Constant	float	Constant	
MajorAxis	float	(Base) Major Axis Length	NULL if Type is FUNCTIONAL or TABULAR
MinorAxis	float	(Base) Minor Axis Length (Width)	
SideSlope	float	Side (Wall) Slope	
SurfHeight	float	Heigth of Axis Surface	
Fevap	float	Evap. Factor	
Psi	float	Suction Head	for seepage loss; inches or mm
Ksat	float	Conductivity	for seepage loss; in/h or mm/h
IMD	float	Initial Deficit	for seepage loss; difference between porosity and moisture content
Annotation	string	Description	optional column

Dividers

DESCRIPTION: If the routing option (see options section) is set to 'Steady Flow' or 'Kinematic Wave', flow dividers divert inflows in a certain way, prescribed by the user with the attribute "Type". With the 'Dynamic wave' routing model, dividers are treatet as junctions.

[1] With SWMM 5.2.2 storage units can be drawn as polygons in the GUI of SWMM. This is not yet implemented in this plugin.
[2] Not all columns are needed. If a column is not necessary it will be ignored. You'll need:

- When at least one "Type" is 'FUNCTIONAL': Coeff, Exponent, Constant
- When at least one "Type" is 'TABULAR': Curve
- When at least one "Type" is 'PYRAMIDAL': MajorAxis, MinorAxis, SideSlope
- When at least one "Type" is 'PARABOLIC': MajorAxis, MinorAxis, SurfHeight
- When at least one "Type" is 'CONICAL': MajorAxis, MinorAxis, SideSlope
- When at least one "Type" is 'CYLINDRICAL': MajorAxis, MinorAxis

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
Elevation	float	Invert El.	
DivertLink	string	Outlet Node	
MaxDepth	float	Max. Depth	
InitDepth	float	Initial Depth	
SurDepth	float	Surcharge Depth	
Aponded	float	Ponded Area	
Type	string	Type	'CUTOFF', 'TABULAR', 'WEIR' or 'OVERFLOW'
CutoffFlow	float	Cutoff Flow	if Type is CUTOFF
Curve	float	Curve Name	if Type is TABULAR; the names of the curves have to be matching with those in the divider curves table
WeirMinFlo	float	Outlet Offset	
WeirMaxDep	float	Initial Flow	if Type is 'WEIR'
WeirCoeff	float	Maximum Flow	
Annotation	string	Description	optional column

Outfalls

DESCRIPTION: Outfalls are the terminal nodes of the model. Only one link can be connected to an outfall.

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
Elevation	float	Invert El.	
FlapGate	string	Tide Gate	'YES' or 'NO'
RouteTo	string	Route To	Subcatchment outflow ist routed onto; leave blank if not applicable
Type	string	Type	'FREE','NORMAL','FIXED','TIDAL' or 'TIMESERIES'
FixedStage	float	Fixed Stage	for outfalls with FIXED type
Curve_TS	string	Curve Name or Series Name	for TIDAL type: the name of the tidal curve has to be matching with the name in the curves table; for TIMESERIES type: the name of the time series has to be matching with then name in the time series table
Annotation	string	Description	optional column

4.1.3 Links

LAYER TYPE: line
Links are represented as line layers in QGIS. These can be conduits, pumps, weirs, orifices or outlets.

Conduits

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
Length	float	Length	
Roughness	float	Roughness	
InOffset	float	Inlet Offset	
OutOffset	float	Outlet Offset	
InitFlow	float	Initial Flow	
MaxFlow	float	Maximum Flow	
Data for cross sections (XSECTIONS):			
XsectShape	string	Shape	See SWMM manual [5] for shape types
Geom1	float		for most of the shapes this is the 'Max. Depth'
Geom2	float		
Geom3	float		
Geom4	float		
Barrels	int	Number of Barrels	
Shp_Trnsct	string	-	Transect name if "Shape" is IRREGULAR, shape curve name if "Shape" is CUSTOM or street type name if "Shape" is STREET
Culvert	float	Culvert Code	
Data for LOSSES:			
Kentry	float	Entry Loss Coeff.	
Kexit	float	Entry Loss Coeff.	
Kavg	float	Avg. Loss Coeff.	
FlapGate	String	Flap Gate	can be 'YES' or 'NO'
Seepage	float	Seepage Loss Rate	
Annotation	string	Description	optional column

Pumps

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
PumpCurve	string	Pump Curve	has to be matching with the curve name in the pump curves table; set an asterisk ('*') here for ideal pump
Status	string	Initial Status	'ON' or 'OFF'
Startup	float	Startup Depth	
Shutoff	float	Shutoff Depth	
Annotation	string	Description	optional column

Weirs

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
Type	string	Type	'TRANSVERSE', 'SIDEFLOW', 'V-NOTCH', 'TRAPEZIODAL' or 'ROADWAY'
Height	float	Height	
Length	float	Length	
SideSlope	float	Side Slope	Slope (width-to-height) of TRAPEZIODAL weir side walls
CrestHeigh	float	Inlet Offset	
Qcoeff	float	Discharge Coeff.	
FlapGate	string	Flap Gate	'YES' or 'NO'
EndContrac	int	End Contractions	0, 1 or 2
EndCoeff	float	End Coeff.	For TRAPEZIODAL weirs
Surcharge	string	Can Surcharge	'YES' or 'NO'
CoeffCurve	float	Coeff. Curve	the name of the curve has to be matching to the name in the table for weir curves
RoadWidth	float	Road Width	For ROADWAY weir types
RoadSurf	float	Road Surface	
Annotation	string	Description	optional column

Orifices

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
Type	string	Type	'SIDE' or 'BOTTOM'
XsectShape	string	Shape	'CIRCULAR' or 'RECT_CLOSED'
Height	float	Heigth	in ft or meter
Width	float	Width	in ft or meter
InOffset	float	Inlet Offset	
Qcoeff	float	Discharge Coeff.	
FlapGate	string	Flap Gate	'YES' or 'NO'
CloseTime	float	Time to Open/Close	in hours
Annotation	string	Description	optional column

Outlets

Name in attribute table	**Data type**	**Name in SWMM GUI**	**Annotation**
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
InOffset	float	Inlet Offset	
FlapGate	string	Flap Gate	'YES' or 'NO'
RateCurve	string	Shape	'FUNCTIONAL/DEPTH', 'TABULAR/DEPTH', 'FUNCTIONAL/HEAD' or 'TABULAR/HEAD'
Qcoeff	float	Coefficient	for FUNCTIONAL curves
Qexpon	float	Exponent	for FUNCTIONAL curves
CurveName	float	Curve Name	for TABULAR curves; has to be matching with the name in the oulet curves table
Annotation	string	Description	optional column

4.1.4 Subcatchments

LAYER TYPE: point / polygon
DESCRIPTION: Subcatchments can either be points or polygons. Each subcatchment has to have a unique name (attribute *Name*). The required fields in the attribute table are:

Name in attribute table	**Data type**	**Name in SWMM GUI**	**annotations**
Name	string	Name	
RainGage	string	Rain Gage	the name of the rain gage
Outlet	string	Outlet	the name of the junction into which water of the subcatchment flows
Area	float	Area	Area in hectares (or other unit defined in the options table)
Imperv	float	% Imperv	
Width	float	Width	
Slope	float	% Slope	
CurbLen	float	Curb Length	Optional parameter needed only for buildup functions (quality)
SnowPack	string	Snow Pack	for snow melt analysis only
Data for SUBAREAS:			
N_Imperv	float	N-Imperv	
N_Perv	float	N-Perv	
S_Imperv	float	Dstore-Imperv	
S_Perv	float	Dstore-Perv	
PctZero	float	% Zero-Imperv	
RouteTo	float	Subarea Routing	'OUTLET','PERVIOUS' or 'IMPERVIOUS'
PctRouted	float	Percent Routed	
Data for INFILTRATION[3]:			
InfMethod	string	Infiltration Method	'HORTON', 'MODIFIED_HORTON', 'GREEN_AMPT', 'MODIFIED_GREEN_AMPT', 'CURVE_NUMBER'; if empty then the infiltration method defined in the options table will be applied
MaxRate	float	Max. Infil. Rate	Maximum infiltration rate on the Horton infiltration curve in mm/h or in/h
MinRate	float	Min. Infil. Rate	Minimum infiltration rate on the Horton infiltration curve in mm/h or in/h
Decay	float	Decay constant	Decay constant for the Horton curve in 1/h
DryTime	float	Drying Time	Drying time (number of days it takes a fully saturated soil to dry)
MaxInf	float	Max. Volume	Maximum infiltration volume possible (Max. Infil. Vol.) in inches or mm; 0 if not applicable
SuctHead	float	Suction head	Suction head in inches or mm
Conductiv	float	Conductivity	Soil saturated hydraulic conductivity (in/h or mm/h)
InitDef	float	Initial deficit	This is the fraction of soil volume that is initially dry [0 to 1]
CurveNum	float	SCS curve number	see SWMM Manual [5] for details
Annotation	string	Description	optional column

[3]Not all columns are required. If a column is not necessary for the infiltration method of a subcatchment it will be ignored. You'll need at least:

- When "InfMethod" is 'HORTON' or 'MODIFIED_HORTON': MaxRate, MinRate, Decay, DryTime , MaxInf
- When "InfMethod" is 'GREEN_AMPT' or 'MODIFIED_GREEN_AMPT': SuctHead, Conductiv, InitDef
- When "InfMethod" is 'CURVE_NUMBER': CurveNum, Conductiv, DryTime

You can also have different infiltration methods for different subcatchments.

4.2 Tables

4.2.1 Options

File in default data: gisswmm_options.xlsx
Description: You may want to set the options already in your input file. To do so, you simply write them in a table with two columns: "Option" and "Value". So far, **time steps longer than one day cannot be chosen here**, as the date format in python is in conflict with the notation in SWMM (e.g. in SWMM a time step of two days will be written as '48:00:00'. However, Python only accepts 0-23 hours)

4.2.2 Curves

File in default data: gisswmm_curves.xlsx
Description: Any type of curves can be imported as a table in an xlsx file. Each curve type has to be in a seperate sheet/table named with the curve type. Different curves oft the same type are stored in the same table by using different names. Just like in the SWMM GUI, curves always consist of three columns: Name, a x-value and a y-value. More culomns can be added (e.g. for annotations), but only the first three columns are relevant for the import into SWMM. Rows beginning with a semicolon (";") will be ignored. Curve types are:

- Pump1
- Pump2
- Pump3
- Pump4
- Pump5
- Weir
- Storage
- Rating
- Tidal
- Control
- Diversion
- Shape

Example for a table of two storage curves (where "Depth" is the x-value and "Area" is the y-value) :

Name	**Depth**	**Area**	**Annotation**
StC_1	0	3	this is the first storage curve
StC_1	0.5	4	
StC_1	1	4	
StC_1	1.5	5	
;			this row will be ignored
second_StC	0	10	this is the second storage curve
second_StC	1	10	
second_StC	2	11	
second_StC	3	11	
second_StC	4	12	

4.2.3 Timeseries

File in default data: gisswmm_timeseries.xlsx
Description: All time series for one SWMM model are saved in a .xlsx file (any sheet name). For a standard time series you only fill the columns "Name", "Date" (optional), "Time" and "Value" (See example "TS_1" below). Alternatively you can define a time series in an external data file. Rows beginning with a semicolon (";") will be ignored.
In former versions of the plugin, rain gages could also be defined with the time series table by writing 'rain_gage' in the column "Type", the rain format in the column "Format" and the name of the rain gage in the column "Description". Starting with version 0.23 of the plugin this is not possible any longer. Raingages are defined directly in a the rain gages layer in QGIS

Column in table	Data type	Name in SWMM GUI	annotations
Name	string	Time Series Name	
Date	date format	Date	
Time	time format	Time	
Value	float	Value	
File_Name	string	-	file name for external data file; if used, keep "Date", "Time" and "Value" empty (see example TS_2 below)

Exemplary table for a normal time series and a time series with an external data file:

Name	Date	Time	Value	File_Name	Annotation
TS_1	2021-01-02	01:00:00	0		This is the first time series
TS_1	2021-01-02	01:30:00	0		
TS_1	2021-01-02	02:00:00	0		
TS_1	2021-01-02	02:30:00	0.2		
TS_1	2021-01-02	03:00:00	0.3		
;					This line will be ignored
TS_2				external_file.dat	This is the second time series which is using an external data file

4.2.4 Patterns

File in default data: gisswmm_patterns.xlsx
Description: Patterns can be imported in an .xlsx file, where each pattern type is stored in a separate sheet named after the pattern type. Patterns of the same type are written in the same table. Each table consist of three columns: "Name", a Time_Stamp column and "Factor". Pattern types are:

- HOURLY, where the Time_Stamp column is called "Hour" (from 0:00 to 23:00)
- DAILY, where the Time_Stamp column is called "Day" (from Sunday to Saturday)
- MONTHLY, where the Time_Stamp column is called "Month" (from January to December)
- WEEKEND, where the Time_Stamp column is called "Hour" (from 12AM to 11PM)

For example, a table for two DAILY patterns ('p1' and 'p2') will look like this:

Name	Day	Factor
p1	Sun	2.0
p1	Mon	1.6
p1	Tue	1.4
p1	Wed	1.8
p1	Thu	2.5
p1	Fri	2.0
p1	Sat	1.8
;		
p2	Sun	2.8
p2	Mon	2.7
...	...	...

4.2.5 Quality

File in default data: gisswmm_quality.xlsx
Description: Quality parameters can be imported with a .xlsx file with the four tables/sheets: 'POLLUTANTS', 'LANDUSES', 'COVERAGES', 'LOADINGS'.

POLLUTANTS

Columns in table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
Units	string	Units	
RainConcentr	float	Rain Concen.	
GwConcentr	float	GW Concen.	
IiConcentr	float	I&i Concen	
DecayCoeff	float	Decay Coeff	
SnowOnly	string	Snow Only	'YES' or 'NO'
CoPollutant	string	Co-Pollutant	
CoFraction	string	Co-Fraction	
DwfConcentr	float	DWF Concen	
InitConcetr	float	Init. Concen	

LANDUSES

This sheet sets up buildup and washoff functions for different landuses. Since one landuse can have more than one pollutant with individual functions for buildup and washoff, the have defined in different rows of this sheet (see exemplary table).

Columns in table	Data type	Name in SWMM GUI	annotations
Name	string	Land Use Name	
SweepingInterval	float	Interval	in days
SweepingFractionAvailable	float	Availability	between 0 and 1
LastSwept	float	Last Swept	in days
Pollutant	string	-	
BuildupFunction	string	Function	'NONE', 'POW', 'EXP', 'SAT' or 'EXT'
BuildupMax	float	Max. Buildup	kg per textitNormalizer (area or curb length)
BuildupRateConstant	float	Rate Constant	
BuildupExponent_SatConst	float	Power/Sat. Constant	
BuildupPerUnit	string	Normalizer	'AREA' or 'CURB'
WashoffFunction	string	Function	'NONE', 'EXP', 'RC' or 'EMC'
WashoffpCoefficient	float	Coefficient	
WashoffExponenet	float	Exponent	
WashoffCleaninfEfficiency	float	Cleaning Effic.	percent
WashoffBmpEfficiency	float	BMP Effic.	percent

COVERAGES

This sheet refers to *Land Uses* in the GUI of subcatchments. As one subcatchment can have morge than one land use covering its area[4], they are defined in the quality table. Example for one subcatchment with two land use types:

Subcatchment	Landuse	Percent
SC1	LU_1	24.5
SC1	LU_2	75.5

LOADINGS

This sheet refers to *Initial Buildup* in the GUI of subcatchments. As one subcatchment can have morge than one pollutants the initial buildup is defined in the quality table. Values in the column "InitialBuildup" are mass per area (e.g. kg/ha or lbs/ac). Example for two subcatchments with two pollutants:

Subcatchment	Pollutant	InitialBuildup
SC1	COD	1
SC1	TN	0.6
SC2	COD	0.8
SC2	TN	0.4

[4]the tool will not check if Σ Percent > 100

4.2.6 Inflows

File in default data: gisswmm_inflows.xlsx
Description: The .xlsx file for inflows contains four tables/sheets (older files with two tables will still work).

- for direct inflow (sheet name: "Direct")
- for dry weather inflow (sheet name: "Dry_Weather")
- for RDII: sheets "Hydrographs" and "RDII"

More than one constituent can have inflows to a node.

Direct

Columns in table	**Data type**	**Name in SWMM GUI**	**annotations**
Name	string	Name	name of the Node
Constituent	string	Constituent	'FLOW' or name of the pollutant
Baseline	float	Baseline	
Baseline_Pattern	string	Baseline Pattern	
Time_Series	string	Time Series	
Scale_Factor	float	Scale Factor	
Type	string	Type	"MASS", "CONCEN"; applies, when Constituent is not FLOW
Units_Factor	float	Units Factor	

Dry_Weather

Name in attribute table	**Data type**	**Name in SWMM GUI**	**annotations**
Name	string	Name	
Constituent	string	Constituent	
Average_Value	float	Average Value	
Time_Pattern1	string	Time Patterns	
Time_Pattern2	string		
Time_Pattern3	string		
Time_Pattern4	string		

Hydrographs

Columns in table	Data type	Name in SWMM GUI	annotations
Name	string	Name of UH Group	
Rain_Gage	string	Rain Gage Used	
Months	string	Hydrographs For	'All' or name abbreviation of the month
R_ShortTerm	float	R (for short-term response)	
T_ShortTerm	float	T (for short-term response)	
K_ShortTerm	float	K (for short-term response)	
D_max_ShortTerm	float	Dmax (for short-term response)	
D_recovery_ShortTerm	float	Drec (for short-term response)	
D_init_ShortTerm	float	Do (for short-term response)	
R_MediumTerm	float	R (for medium-term response)	
T_MediumTerm	float	T (for medium-term response)	
K_MediumTerm	float	K (for medium-term response)	
D_max_MediumTerm	float	Dmax (for medium-term response)	
D_recovery_MediumTerm	float	Drec (for medium-term response)	
D_init_MediumTerm	float	Do (for medium-term response)	
R_LongTerm	float	R (for long-term response)	
T_LongTerm	float	T (for long-term response)	
K_LongTerm	float	K (for long-term response)	
D_max_LongTerm	float	Dmax (for long-term response)	
D_recovery_LongTerm	float	Drec (for long-term response)	
D_init_LongTerm	float	Do (for long-term response)	

RDII

Columns in table	Data type	Name in SWMM GUI	annotations
Node	string	Constituent	name of the Node
UnitHydrograph	string	Unit Hydrograph Group	
SewerArea_Pattern	float	Sewershed Area	

4.2.7 Transects

File in default data: gisswmm_transects.xlsx
Description: The .xlsx file for transects (for IRREGULAR cross-sections) contains two tables/sheets ("Data" and "XSections"):

Data

Name in attribute table	Data type	Name in SWMM GUI	annotations
TransectName	string	Name	
Station	float	Station	
Elevation	float	Elevation	

XSections

Name in attribute table	Data type	Name in SWMM GUI	annotations
TransectName	string	Name	
RoughnessLeftBank	float	Left Bank	
RoughnessRightBank	float	Right Bank	
RoughnessChannel	float	Channel	
BankStationLeft	float	Left	
BankStationRight	float	Right	
ModifierStations	float	Stations	
ModifierElevations	float	Elevations	
ModifierMeander	float	Meander	

4.2.8 Streets and Inlets

File in default data: gisswmm_streets.xlsx
Description: Streets and Inlets are completely new features in SWMM version 5.2. The .xlsx file for streets (for STREET cross-sections) contains three tables/sheets ("STREETS", "INLETS" and "INLET_USAGE"):

STREETS

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Street Section Name	
RoadWidth	float	Road Width	
CurbHeigth	float	Curb Heigth	
CurbSlope	float	Curb Slope	
RoadRoughn	float	Road Roughness	
GuttDepres	float	Gutter Depression	
GuttWidth	float	Gutter Width	
Sides	int	One Sided / Two Sided	1 or 2
BackWidth	float	Backing Width	
BackSlope	float	Backing Slope	
BackRoughn	float	Backing Roughness	

INLETS

Name in attribute table	Data type	Name in SWMM GUI	annotations
Name	string	Name	
Type	String	Inlet Type	'GRATE', 'CUSTOM', 'CURB', 'SLOTTED', 'DROP_GRATE', 'DROP_CURB' or 'CUSTOM'
Length	float	Length	
Width	float	Width	
Heigth	float	Heigth	
Shape	String	-	Type for GRATE, DROP_GRATE inlets; Throat Angle for CURB inlets; Curve name for CUSTOM inlets
OpenFract	float	Open Fraction	For GRATE inlets with GENERIC shape
SplashVel	float	Splash Velocity	

INLET_USAGE

Name in attribute table	Data type	Name in SWMM GUI	annotations
Conduit	string	-	Name of the conduit
Inlet	string	Inlet Structure	
CaptNode	int	Capture Node	The Name has to be matching to one node name
Number	float	Number of Inlets	1 - 5
PercClog	float	Percent Clogged	0 - 100
MaxFlow	float	Flow Restriction	0 for no flow restriction
DeprHeigth	float	Depression Height	0 for no local depression
DeprWidth	float	Depression Width	
Placement	string	Inlet Placement	'AUTOMATIC', 'ON_GRADE' or 'ON_SAG'

Bibliography

[1] *generate_swmm_inp*. URL: https://github.com/Jannik-Schilling/generate_swmm_inp.

[2] *generate_swmm_inp, issue number 78*. URL: https://github.com/Jannik-Schilling/generate_swmm_inp/issues/78.

[3] Dominik Leutnant, Anneke Döring, and Mathias Uhl. "swmmr - an R package to interface SWMM". In: *Urban Water Journal* 16.1 (2019), pp. 68–76. DOI: 10.1080/1573062X.2019.1611889. eprint: https://doi.org/10.1080/1573062X.2019.1611889. URL: https://doi.org/10.1080/1573062X.2019.1611889.

[4] Bryant E. McDonnell et al. "PySWMM: The Python Interface to Stormwater Management Model (SWMM)". In: *Journal of Open Source Software* 5.52 (2020), p. 2292. ISSN: 2475-9066. DOI: 10.21105/joss.02292. URL: https://joss.theoj.org/papers/10.21105/joss.02292.

[5] Lewis A. Rossmann. *Storm Water Management Modell User's Manual Version 5.1*. Technical Report EPA-600/R-14/413b. U.S. Environmental Protection Agnecy. 2015.

[6] Jannik Schilling and Jens Tränckner. "Generate_SWMM_inp: An Open-Source QGIS Plugin to Import and Export Model Input Files for SWMM". In: *Water* 14.14 (2022), p. 2262. DOI: 10.3390/w14142262.