generate_swmm_inp

Manual for the QGIS plugin, version 0.18

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Contents

1 Introduction

SWMM is an open-source model and software by the US EPA for the simulation 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 [4].
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. *shapefiles*). However, a direct import function for such files is not available yet in SWMM. 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 use edit layers with the aid of the large toolbox of QGIS.
This documentation explains how install the plugin and how to prepare the geodata in GIS. It is 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.

1.1 Installation

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

Missing Python packages: The plugin needs the Python packages "pandas" and "openpyxl". If they 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:
  - until QGIS version 3.18: Open the OSGeo4W shell and run `py3_env`.
    Then run `python −m pip install openpyxl` (and likewise "pandas" if needed).
    If you have had an "advanced install" of QGIS within osgeo4w-setup, you can simply open osgeo4w-setup again, search for the packages and use the checkbox to install them.
  - for QGIS version 3.20 and later: Open the OSGeo4W shell and directly run `python −m pip install openpyxl`.
- Linux: open the terminal and install via pip: `python −m pip install openpyxl` (and likewise "pandas" if needed).

SWMM: To run the models, SWMM has to be installed. Alternatively you can use the "swmmr" package [2] for R or packages such as "pyswmm" [3] for Python.

1.2 Hints for this documentation

There have been several changes of attribute names from the plugin versions 0.13 to 0.15. These changes are highlighted in red in every section.
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 files. Such a table will look like this:

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
...	...	...	
...	...	...	

The second type shows examples of how tables in the .xlsx 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	...	...
...	...	...	..	...

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 have to chose a folder, in which all data will be saved. To date geodata are provided for the main infrastructures:

- 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)

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 3.1.2) 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. Actions for 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")

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 for the user interface:

1. Choose the input file (".inp")
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.

3 Field names and column names in geodata and tables

3.1 Geodata

In the first versions of the plugin, the main file type for geodata are 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 3.1.2), which refers to "Seepage Loss Rate" in the SWMM GUI.

3.1.1 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. Treatment of pollutatants is not implemented yet.

Junctions

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
Name	string	Name	
Elevation	float	Invert El.	
MaxDepth	float	Max. Depth	
InitDepth	float	Initial Depth	
SurDepth	float	Surcharge Depth	
Aponded	float	Ponded Area	

Storage units

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**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' or 'TABULAR'
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	
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

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.
CHANGES: "CutoffFlow" was renamed in version 0.15, before: "CutOffFlow"

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**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	

Outfalls

DESCRIPTION:
CHANGES: "FixedStage" and "Curve_TS" were added in version 0.15 instead of "Data" to enable different types of boundary conditions

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**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

3.1.2 Links

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

Conduits

CHANGES:
"Kentry" was renamed in version 0.14, before: "Inlet"
"Kexit" was renamed in version 0.14, before: "Outlet"
"Kavg" was renamed in version 0.14, before: "Average"
DESCRIPTION:

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	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):			
Shape	string	Shape	See SWMM manual [4] for shape types
Geom1	float		for most of the shapes this is the 'Max. Depth'
Geom2	float		
Geom3	float		
Geom4	float		
Barrels	float	Number of Barrels	
Shp_Trnsct	string	-	Transect name for IRREGULAR cross sections or shape curve name for CUSTOM cross sections
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	

Pumps

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	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	

Weirs

CHANGES:

"CoeffCurve" was renamed in version 0.15, before: "Coeff_Curv"
"RoadWidth" was renamed in version 0.15, before: "Roadwidth"
"RoadSurf" was renamed in version 0.15, before: "Roadsurf"

DESCRIPTION:

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	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	

Orifices

Name in attribute table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Name	
FromNode	string	Inlet Node	
ToNode	string	Outlet Node	
Type	string	Type	'SIDE' or 'BOTTOM'
Shape	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

Outlets

CHANGES: "RateCurve" was renamed in version 0.15, before: "Rate_Curve"
DESCRIPTION:

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**annotations**
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

3.1.3 Subcatchments

LAYER TYPE: point / polygon
CHANGES: "InfMethod" was renamed in version 0.15, before: "kind"
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 (5.1.015)**	**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	
PctRouted	float	Percent Routed	
Data for INFILTRATION[1]:			
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 [4] for details

[1] 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.

3.2 Tables

3.2.1 Options

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)
CHANGES: Until version 0.15 only a fixed set of options was possible. Now you can use any option (see SWMM manual [4] p. 276 for option names and values).

3.2.2 Curves

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
- 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**	**Notes**
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	

3.2.3 Timeseries

Time series are saved in a .xlsx file (any sheet name). For a normal time series you only fill the columns "Name", "Date" (optional), "Time" and "Value" (See example "TS_1" below).

Column in table	Data type	Name in SWMM GUI (5.1.015)	annotations
Name	string	Time Series Name	
Type	string	-	Can be empty. If you put "rain_gage" here, the tool will try add a rain gage with the time series
Date	date format	Date	
Time	time format	Time	
Value	float	Value	
Format	string	-	Can be empty. If Type is "rain_gage", then you have to choose one of "VOLUME", "INTENSITY" or "CUMULATIVE"
Description	string	-	If Type is "rain_gage", then you have to put the name of the rain gage here. Otherwise leave empty.

Exemplary table for a rain gage and a normal time series:

Name	Type	Date	Time	Value	Format	Description
TS_1		2021-01-02	01:00:00	0		
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		
;						
TS_2	rain_gage	2021-01-02	00:00:00	0	VOLUME	RG_1
TS_2	rain_gage	2021-01-02	01:00:00	0.1	VOLUME	RG_1
TS_2	rain_gage	2021-01-02	02:00:00	0.5	VOLUME	RG_1
TS_2	rain_gage	2021-01-02	03:00:00	0.6	VOLUME	RG_1
TS_2	rain_gage	2021-01-02	04:00:00	0.1	VOLUME	RG_1
TS_2	rain_gage	2021-01-02	05:00:00	0	VOLUME	RG_1

3.2.4 Patterns

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 a DAILY pattern 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
...	...	...

3.2.5 Quality

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 (5.1.015)	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 (5.1.015)	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 [2], 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:

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

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

3.2.6 Inflows

The .xlsx file for inflows contains two tables/sheets. One is for direct inflow (sheet name: "Direct") and one is for dry weather inflow (sheet name: "Dry_Weather"). More than one constituent can have inflows to a node.

Direct

Columns in table	**Data type**	**Name in SWMM GUI (5.1.015)**	**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 (5.1.015)**	**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		

3.2.7 Transects

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 (5.1.015)**	**annotations**
TransectName	string	Name	
Station	float	Station	
Elevation	float	Elevation	

XSections

Name in attribute table	**Data type**	**Name in SWMM GUI (5.1.015)**	**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	

Bibliography

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