FLO-2D®

TWO-DIMENSIONAL FLOOD ROUTING MODEL

QGIS PLUGIN

TECHNICAL REFERENCE MANUAL

JUNE 2018

FLO-2D Software, Inc.

Table of Contents

List of Figures

Overview

The FLO-2D Plugin for QGIS is a tool to develop, format, analyze, and display data used by the FLO-2D Flood Model. The Plugin can import project data, generate data and export appropriately formatted FLO-2D data input files for a FLO-2D Project. This reference manual describes the assumptions, functions, and processes applied in the QGIS Plugin. A companion manual, the FLO-2D QGIS Plugin User's Manual, describes the workflow, outlines the data structure and presents tutorials for the Plugin. It does not address the functionality and use of the FLO-2D model which has a separate set of reference manuals.

Data File Structure

The FLO-2D QGIS Plugin uses native QGIS layers to display FLO-2D project data. Several aspects of the Plugin file structure are fundamental to understand project data organization and workflows.

GeoPackage File

All FLO-2D project data is stored in an SQLite database conforming to the GeoPackage specification. The GeoPackage specification is a product of the Open Geospatial Consortium (OGC) and stores spatial data in a non-proprietary database format. For the FLO-2D QGIS Plugin, the GeoPackage file is a *.gpkg file. This file is the central repository for project metadata, spatial information, data layers, and attributes. The Plugin generates and requires a single GeoPackage file for each project.

The GeoPackage file can be perused manually using any compatible SQLite database viewer. Manual editing of the file, however, is not recommended and manual review of the file is not required for the use of the Plugin. Plugin tools process and store data within the project GeoPackage. Before executing the FLO-2D model for a given project, the input files are generated by exporting the adequately formatted data from the GeoPackage. Figure 1 shows the layout of the layers and tables in QGIS that are used by the FLO-2D Plugin.

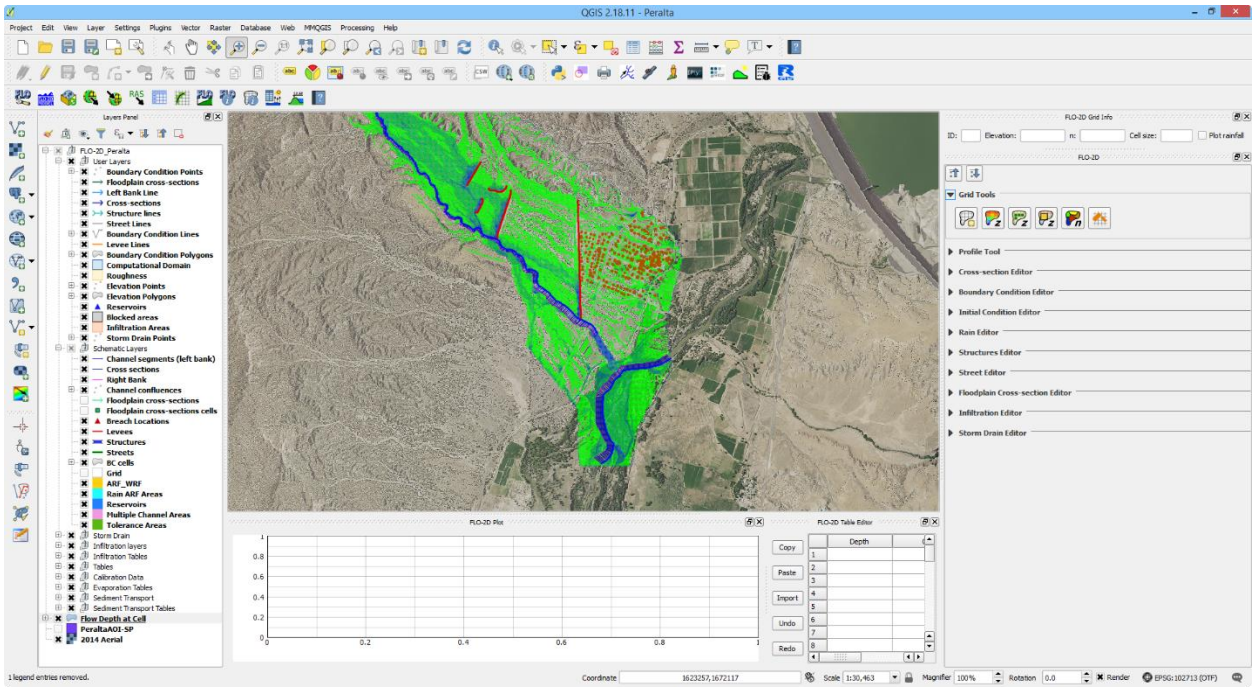

Figure 1. Overview of the QGIS Layout and Layer Structure.

Project Metadata

Non-spatial project metadata, such as data in the CONT.DAT and TOLER.DAT files, as well as the project spatial reference, are stored in tables within the project GeoPackage file. While the project spatial reference is not a spatial dataset, the spatial project data within the GeoPackage file is sensitive to the reference coordinate projection and changes to the selected spatial projection will require regeneration of the project GeoPackage.

Project Spatial Data

Project spatial data is stored within the project GeoPackage file. All input datasets are assumed to have the same spatial coordinate reference system (CRS) as assigned to the FLO-2D project. Datasets in other spatial reference systems should first be projected into the FLO-2D project spatial reference system before attempting to use any of the FLO-2D QGIS Plugin tools.

FLO-2D Plugin

Python Plugin

The FLO-2D Plugin is built with python code. The code is open source and available for any programmer to review or edit. The code is stored in the flo2d directory of the qgis/python/plugins folder (Figure 2).

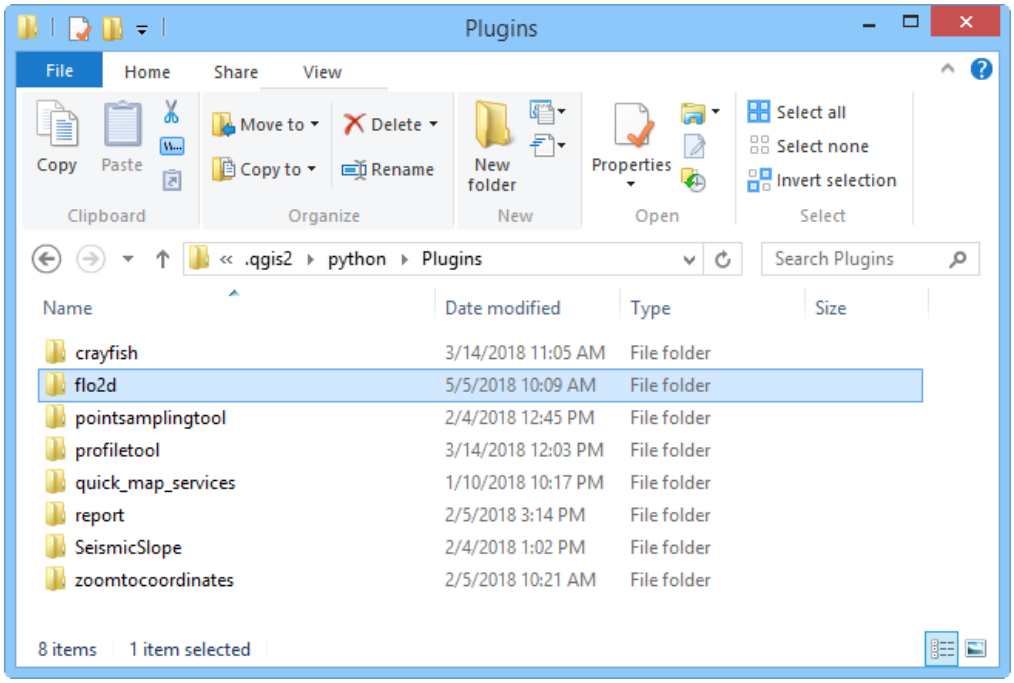

Figure 2. Plugin Folder.

The code can be viewed, queried and edited with any text editor including UltraEdit, Notepad++ or Textpad. The files include the following:

*.png – Image files define buttons

*.py – python code files

*.qml – QGIS layer styles

*.svg – Vector image files define buttons

*.sql – SQL code relational database information

*.ui – Widget and editor windows

The plugin is organized into utility-based directories for plugin files that perform specific functions. For example, there is a folder for the toolbar and one for the sidebar widgets.

Plugin Processes

The Plugin builds a GeoPackage file. It is generated by running the *FLO-2D Plugin Settings* Tool. The GeoPackage contains data to define the layers and tables, create layer styles and views. The Plugin includes all the tools to digitize, import, view, edit and export FLO-2D project data. The processes include:

- Import/export tools
- Grid system developer
- Elevation interpolation and adjustment tools
- Levee calculation
- Sampling spatial data
- Schematization
- Rainfall interpolation
- Infiltration interpolation
- Storm drain import, export and digitize
- Storm drain SWMM.inp development tools
- Channel development tools
- HAZUS development tools

Grid System

The grid system is defined by using the extent of the *Computational Domain* to generate a grid system boundary. The code generates a bounding box using the x(max, min), and y(max, min) of the computational domain polygon. The bounding box is rounded to a whole number divisible by the cell size. The cells of the grid are individual polygons ordered by row and column. Only polygons that intersect the *Computation Domain* layer are created. The default numbering system is in order of row and then column (Figure 3).

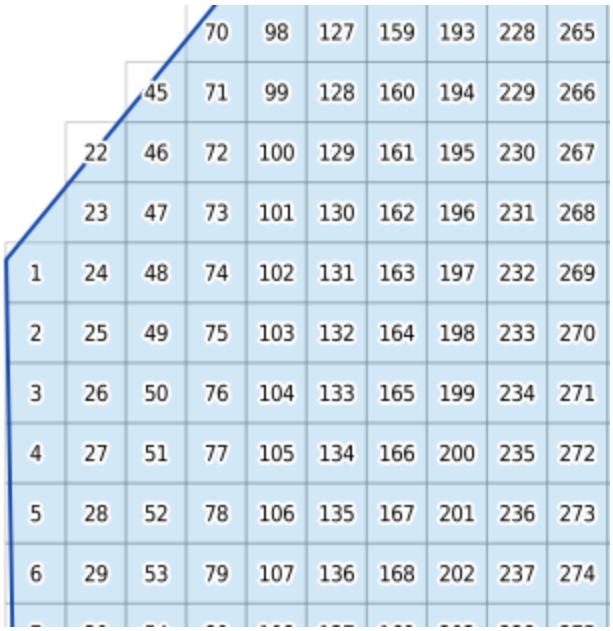

Figure 3. Grid Numbering Scheme.

The *Computational Domain* is a polygon layer that is used to define the size and extent of the FLO-2D grid system (grid layer). Its attributes are *FID* and *cell_size*. The units and coordinate reference system (CRS) are established when the project GeoPackage is developed using the *FLO-2D Plugin Settings* Tool.

Elevation from Raster

The *Elevation from Raster* calculator uses the alignment and cell size of the grid system to set the origin and raster resolution of the *Warp* tool. The *Geospatial Data Abstraction Library* (GDAL) *Warp* tool is used by the FLO-2D Plugin to generate a temporary elevation file based on one of twelve sampling methods: Near, bilinear, cubic, cubic spline, Lanczos, average, mode, max, min, med, q1 and q3 (Figure 4). After the temporary raster is complete, the *grid layer elevation* attribute is filled using a centroid point sampling tool. The temporary raster is then deleted. The raster layer must have the same coordinate geometry as the FLO-2D Project.

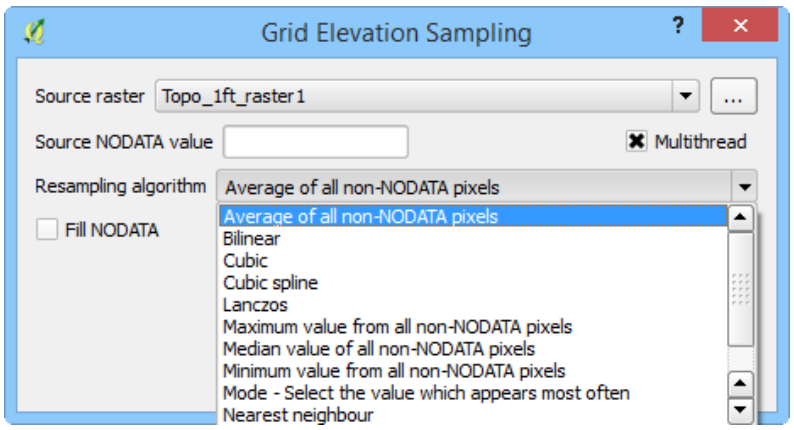

Figure 4. Raster Elevation Dialog Box.

Elevation from Points

The *Elevation from Points* tool uses the cell size and grid layer to sample the elevation value from a temporary elevation raster. The tool uses zonal statistics to rasterize the point data into pixels that are aligned to the grid. The tool uses a calculation for average, maximum or minimum elevation value. It can also use a search buffer. Any vector layer can be used by the tool. The data must have the same coordinate system as the project. It can be imported from delimited text or point shape files (Figure 5).

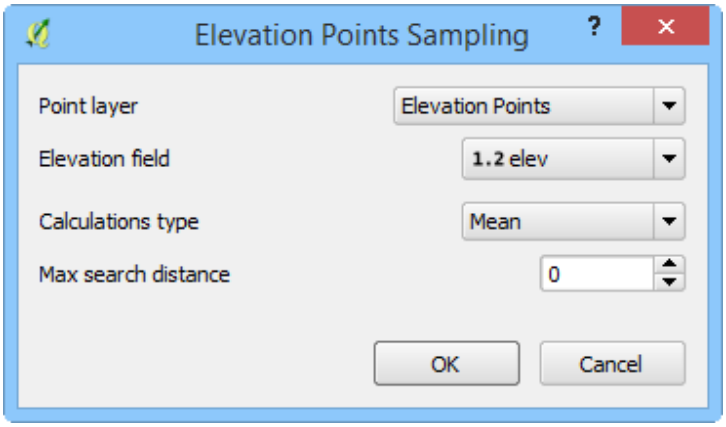

Figure 5. Point Elevation Dialog Box.

Elevation Adjustment Tool

The *Grid Element Adjustment* tool is used to make modifications and corrections to the grid element elevations without having to manipulate the original elevation dataset. It is used to make corrections where the elevation might be assigned incorrectly because of the grid element size. This process can be used to define first floor building

elevations, invert elevations at headwalls, inlet rim elevation corrections and channel invert and bank elevation corrections. The *Grid Elevation Adjustment* tool uses several unique processes to redefine baseline elevation data.

User Layers Mode

The following User Layer corrections are available (Figure 6):

- TIN (based on elevation points and polygons)
- TIN (based on elevation polygon boundaries)
- Elevation polygons attributes
- Grid statistics within blocked areas

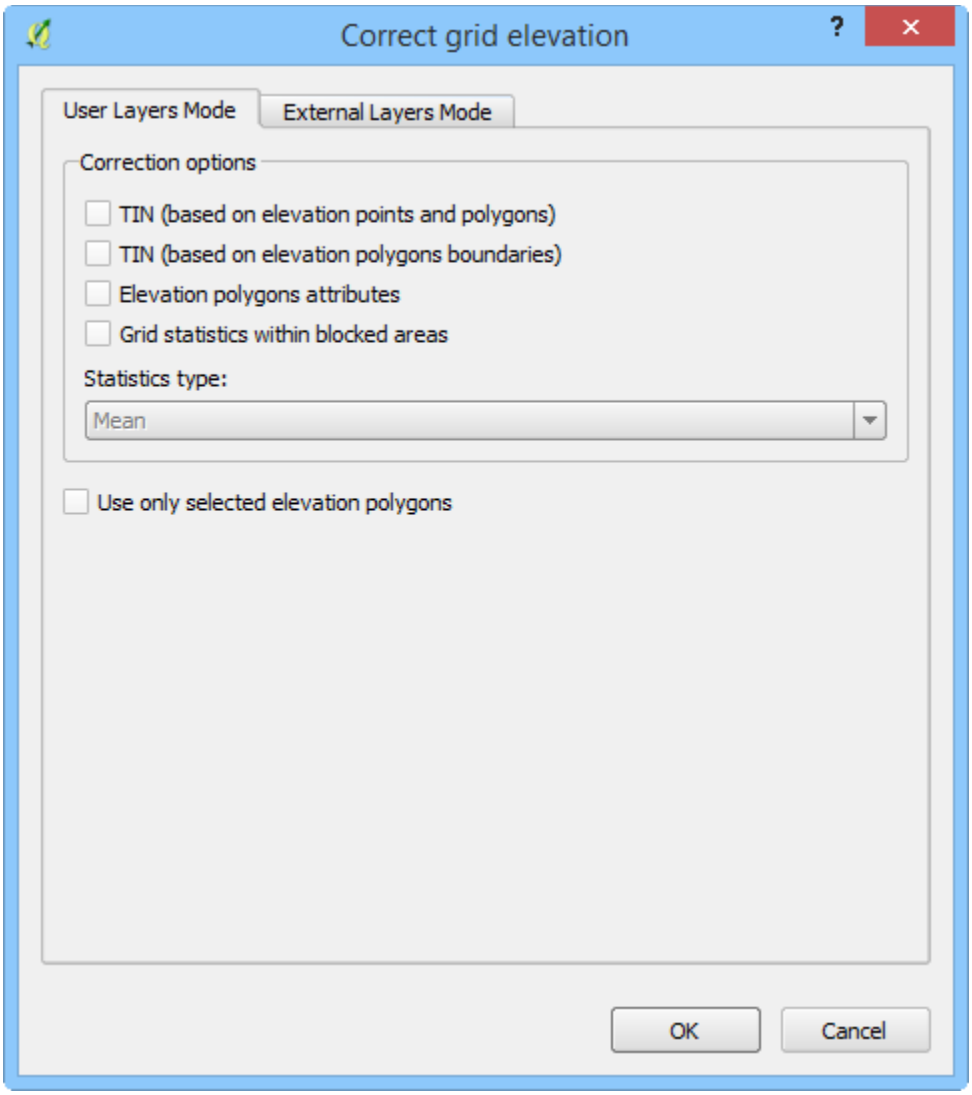

Figure 6. Correct Elevation Dialog Box.

TIN (based on elevation points and polygons)

This method uses a set of elevation points surrounded by triangular irregular network (TIN). The TIN generator is derived from the QgsTINInterpolator feature class that is built in to the QGIS processor libraries. The TIN generator uses the x y coordinates of the elevation correction polygon and the points within the polygon to define the TIN mesh and elevation. The TIN is finally intersected to the grid and the new elevations are assigned to each grid element covered by the TIN.

TIN (based on elevation polygon boundaries)

This method uses a polygon boundary to define a TIN. The TIN generator is derived from the QgsTINInterpolator feature class that is built in to the QGIS processor libraries. The TIN generator uses the x y coordinates of the *elevation correction polygon* where it intersects to the grid system. The elevations along the boundary of the polygon are used to fill or cut the data from channels or levees. The TIN is finally intersected to the grid and the new elevations are assigned to each grid element covered by the TIN.

Elevation Polygons Attributes

This method intersects the polygon layer to the grid and assigns the elevation or the elevation correction that is defined in the *Polygon Attribute Elevation* or *Correction* fields.

Grid Statistics within Blocked Areas

This method intersects the polygon to the grid and calculates the elevation statistics of min, max and mean for each cell within the polygon. The user can select the statistic to use as the final grid element elevation assignment. Each cell within the polygon will be assigned the same elevation.

External Layers Mode

The grid element correction from *External Layers Mode* offers several methods to correct or edit elevations in the *Grid* layer from polygon layers that can be imported into the FLO-2D Project in QGIS (Figure 7). The tool uses the same correction calculations discussed above in the *User Layers Mode* but applies them to imported polygon layers.

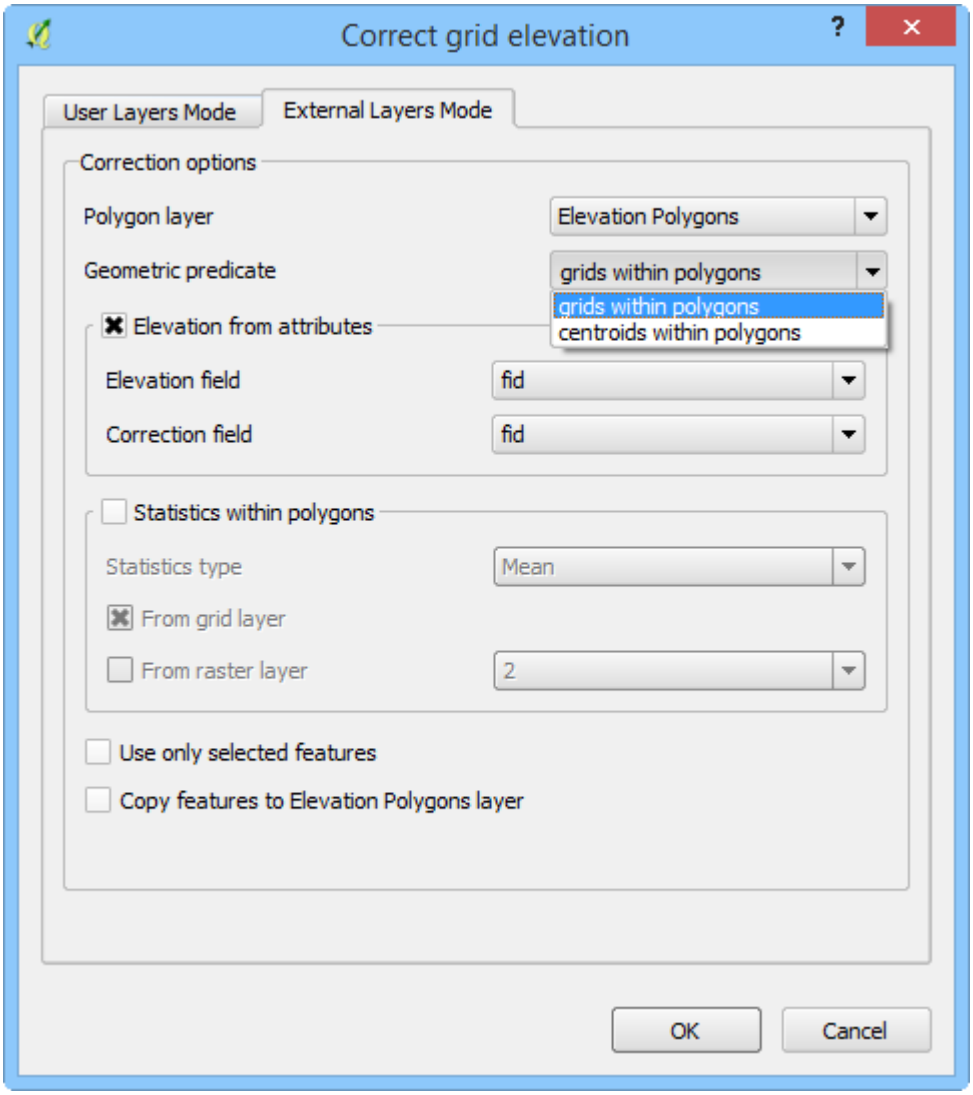

Figure 7. Correct Grid Elevation Dialog Box.

Levee Tool

The *Levee Elevation Tool* sees the grid as a set of octagonal sides at a specified distance from the node (Figure 8).

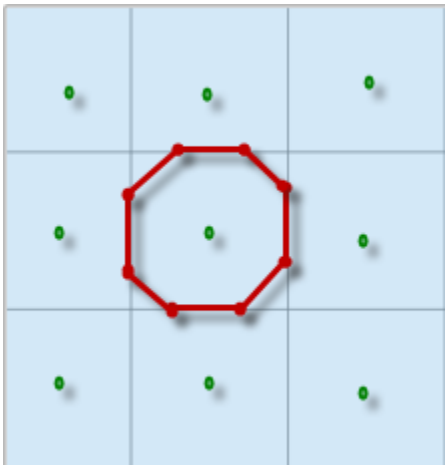

Figure 8. Grid Centroid and Octagonal Sides.

The *Levee Elevation Tool* uses polylines (*Levee Lines*) and crest elevation points (*Elevation Points*) to calculate and digitize the sides of the grid to the *Levees* layer as "cutoff directions". The tool uses a combination of polyline to polygon intersection and point to point interpolation to establish the levee position and crest elevation. It intersects each side of the octagon with the *Levee Line* and a buffer to create individual polylines for each levee cutoff direction as shown in Figure 9.

Figure 9. Levee Cutoff Directions.

Spatially Variable Data Processing

The plugin processes data for several spatially variable data sets. These include:

- Manning's n-value
- Spatial Tol (LID)
- Spatial Limiting Froude
- Spatial Shallow n-value
- Gutters

To assign spatially variable data, the Plugin uses a combination of intersecting polygons to the grid and uses the centroid to point sample data to the grid. The spatial data is stored in the attributes table for each polygon. Figure 10 shows an example of a polygon with spatial TOL data. It needs to be assigned to any grid element that intersects the pink polygon. The processor will intersect the pink area to each grid element and extract the grid element number and the TOL variable into a specific layer. In some instances, the intersection is not necessary. A point sample that represents the center of each grid element is used to sample the polygon and extract the data of a known point based on the grid element ID.

Figure 10. Spatially Variable Data.

Area and Width Reduction Factor

The calculator intersects the polygons in the *Blocked Areas* (buildings) layer to the polygons in the *Grid* layer and uses the centroid to set up the ARF/WRF table of variables. The ARF calculator intersects the *Blocked Areas* polygon with the grid polygon and calculates the area of the building that occupies each grid. If the grid is totally blocked, the ARF = 1. If the blockage is greater than 0.9, the ARF is reset to 1. If the area of the building is a percentage of the grid, then the value is assessed and written to the ARF attribute. Figure 11 shows an ARF that would have a value of 4.74 / 9.29 = 0.51.

Figure 11. Area Reduction Intersection.

The WRF calculator intersects the *Blocked Areas* polygon to grid element. It is different in that it intersects the building to the octagonal side of the grid. The WRF calculator uses the grid centroid, half width and a Lambda function (Python, 2018) to define the grid octagon. The Lambda function defines the position of the octagon sides. The octagonal sides are intersected to the polygons in the *Blocked Areas* layer to calculate the width reduction factor (Figure 12).

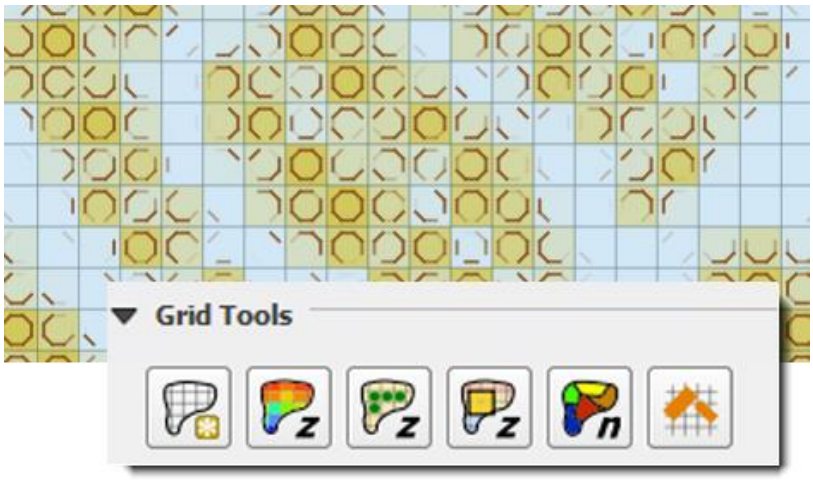

Figure 12. Area and Width Reduction Factors.

The QGIS and GDS have slight differences in calculators.

1. The Plugin will reset ARF = 1 for any cell greater than 0.90 ARF. This can be seen in the following image. GDS left ARF = 0.94 and QGIS Right ARF = 1 (Figure 13).

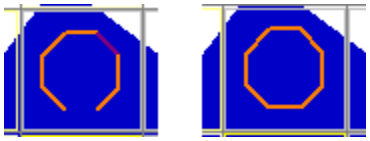

Figure 13. ARF GDS / QGIS Comparison

2. The GDS inserts redundant WRFs for cells that would otherwise be empty. This makes the GDS WRFs look more conservative, but it isn't necessary. GDS on the left and QGIS on the right (Figure 14).

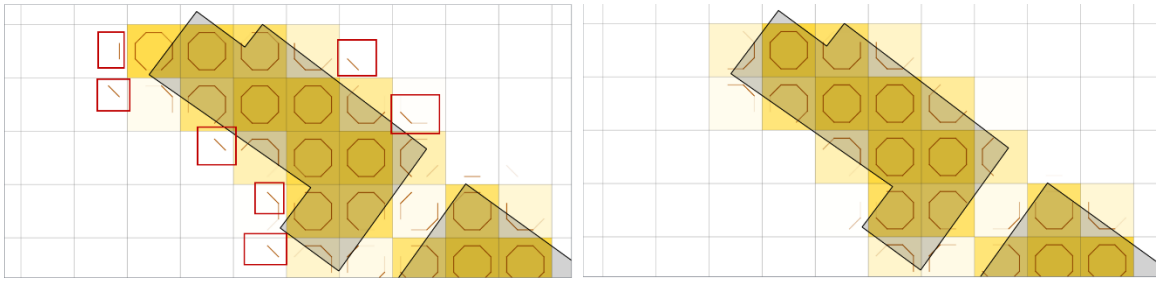

Figure 14. WRF Redundancy GDS / QGIS Comparison.

3. QGIS calculator is more accurate on cells that have partial WRFs. The GDS WRF on the left is calculated as 0.98. The QGIS WRF on the right is calculated at 0.44 and that is more accurate (Figure 15).

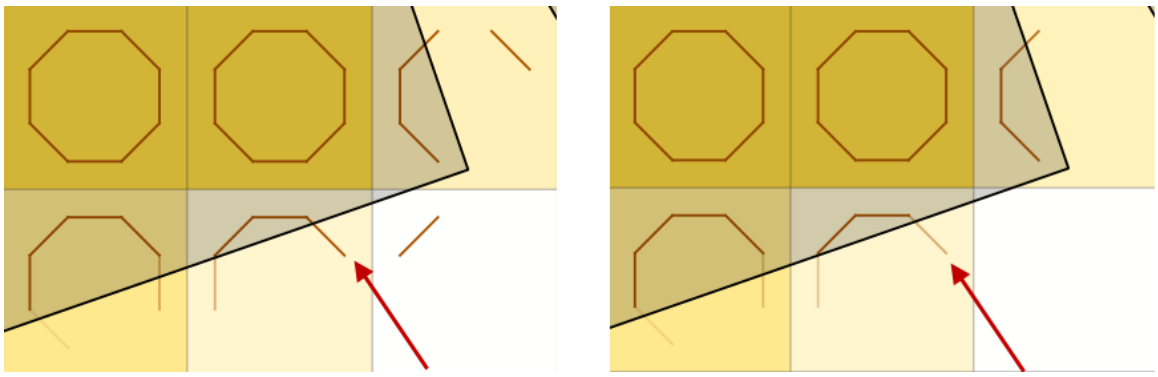

Figure 15. WRF Calculator GDS / QGIS Comparison.

Rainfall Interpolation Tool

The *Rainfall Interpolation Tool* uses depth rasters in inches or millimeters. The raster should have a defined CRS that is the same as the project. The interpolation processor performs a GDAL *Warp* function to realign the raster to the grid and recompute the raster data at the cell resolution. The new raster data is sampled to the grid using the centroid. A field calculation is used to determine the maximum rainfall value on the grid. The final RAINARF variable is calculated with a ratio of the local rain depth to the max rain depth. The original raster resolution is on the order of 2000 by 2000 ft pixels (Figure 16).

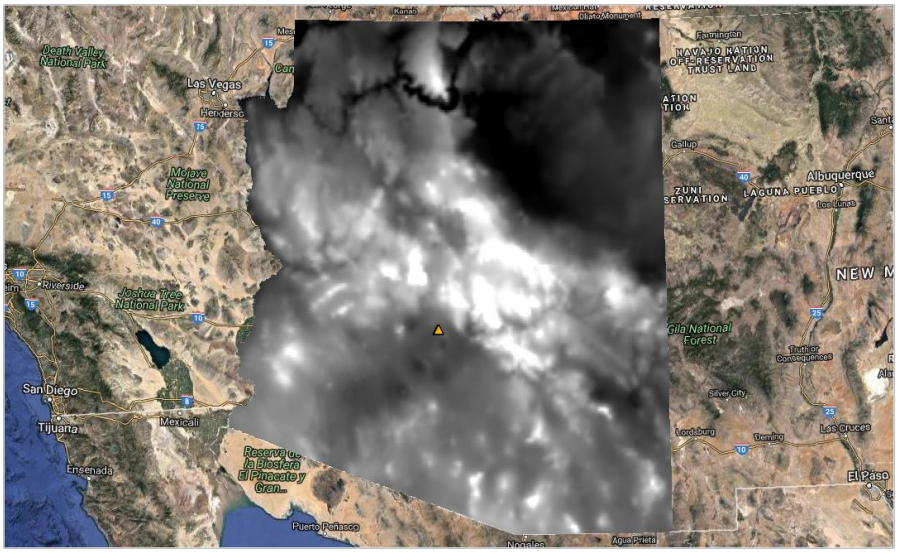

Figure 16. Rainfall 24hr 100yr NOAA Atlas 14.

The resampled raster is not loaded into the map. It is stored in a temporary location. It would look like the raster in Figure 17. A maximum rainfall is written to the raster. In

this example, it is 3.63 inches. A spatially variable rainfall value is calculated for the grid system at the centroid of each grid element. This is the RainARF or depth area reduction rainfall value. The point value is the ratio of the value at the centroid over the max value. For the purpose of comparison, Figure 14 also shows the range of values for the whole Arizona NOAA 14 raster.

Figure 17. Warped Rainfall Raster.

Real-time Rainfall Sampling Tool (NEXRAD Data)

The *Real-Time Rain Interpolation Tool* requires ArcGIS ascii grid files *.asc files and a catalog file *.rtc with the rainfall heading data and list of grid files to import. The *.asc files are read as rasters and sampled to the grid using the centroid. The grid assignment is a point sample. The data is not interpolated. The plugin will export a RAINCELL.DAT file or a binary *.HDF5 file. The FLO-2D model will read either file.

Infiltration Layers

The *Infiltration Editor* is used to assign infiltration data globally or spatially from polygon layers. The Infiltration calculators can use embedded layers for infiltration or imported layers. The infiltration calculators intersect the infiltration polygons to each cell to calculate area weighted infiltration parameters. The infiltration calculator is optimized to run on large projects with millions of cells. The optimization process isolates blocks of

polygon data and runs them individually as defined by small bounding boxes that break up the data for processing. Individual calculations are addressed below for each infiltration type.

Green and Ampt

There are two methods for assigning spatially variable Green and Ampt data. The Schematize method assigns data directly to the grid from polygons digitized to the *Infiltration Areas* layer. The calculator calculates data from external soils and landuse layers.

Schematize Method

The Schematize Method intersects the Infiltration Areas polygons to the grid and assigns the infiltration values that are written in the Green Ampt fields. These fields are the fields that are written to the INFIL.DAT file:

- green_char – green ampt character
- hydc – hydraulic conductivity
- soils – soil suction
- dtheta – soil moisture deficit
- abstrinf – initial abstraction
- rtimpf – impervious percentage
- soildepth – soil depth

Calculate Green and Ampt Method

The Calculate Green and Ampt Method intersects the landuse and soils polygons to the grid polygons and calculates a spatially variable infiltration from the external layers.

The general calculations are as follows:

$$\overline{XKSAT} = ALOG\left(\frac{\sum A_i \log(XKSAT_i)}{A_{GE}}\right)$$

Where:

$XKSAT_i$ is obtained from the soil attribute table

A_i is the subarea intercepted by the grid element from the 3rd column of the landuse table and A_{GE} is the grid element area.

$$\overline{XKSAT} = ALOG\left(\frac{\sum A_i \log(XKSAT_i)}{A_{GE}}\right)$$

Where:

$XKSAT_i$ is obtained from the soil attribute table

A_i is subarea intercepted by the grid element from the 3rd column of the landuse table and A_{GE} the grid element area.

1. For each grid element, compute wetting front capillary suction PSIF according to the following regressions as a function of *XKSAT* (Generated from Figure 4.3 of the Maricopa County Drainage Design Manual, Volume I).

XKSAT (in/hr)	PSIF (in)
$0.01 \leq XKSAT \leq 1.2$	PSIF=EXP(0.9813-0.439*Ln(XKSAT)+0.0051(Ln(xksat))^2+0.0060(Ln(XKSAT))^3)

2. For each grid element, compute volumetric soil moisture deficiency *(DTHETA)* according to the following table. The specific table used for DTHETA depends on the *saturation* field of the soil table (6th column).

Saturation = DRY

XKSAT (in/hr)	DTHETA DRY
$0.01 \leq XKSAT \leq 0.15$	DTHETA =EXP(-0.2394 + 0.3616 Ln(XKSAT))
$0.15 < XKSAT \leq 0.25$	DTHETA =EXP(-1.4122 - 0.2614 Ln(XKSAT))
$0.25 < XKSAT \leq 1.2$	DTHETA = 0.35

XKSAT (in/hr)	DTHETA NORMAL
$0.01 \leq XKSAT \leq 0.02$	DTHETA = EXP(1.6094 + Ln(XKSAT))
$0.02 < XKSAT \leq 0.04$	DTHETA = EXP(-0.0142 + 0.5850 Ln(XKSAT))
$0.04 < XKSAT \leq 0.1$	DTHETA = 0.15
$0.1 < XKSAT \leq 0.15$	DTHETA = EXP(1.0038 + 1.2599 Ln(XKSAT))

$0.15 < XKSAT \leq 0.4$	DTHETA = 0.25
$0.4 < XKSAT \leq 1.2$	DTHETA = EXP(-1.2342 + 0.1660 Ln(XKSAT))

Saturation = NORMAL

Saturation = WET or SATURATED

DTHETA = 0 for all XKSAT

3. Adjust *XKSAT* (computed in step No. 1) as a function of the vegetation cover VC from the landuse table when XSAT < 0.4 in/hr. This requires a computation of the ratio of the hydraulic conductivity for the vegetative cover to the bare ground hydraulic conductivity (C_K):

$$C_K = \frac{VC_K - 10}{90} + 1$$

$$\mathrm{XKSATC} = \mathrm{XKSAT} \sum_k \mathrm{P_k} C_k$$

Where:

P_k is the percentage of the area within the grid element corresponding to C_k and XKSATC for each grid element is written to the INFIL.DAT file.

4. For each grid element compute the initial abstraction *IABSTR*:

$$IABSTR = \left(\frac{\sum A_i (IA_i)}{A_{GE}} \right)$$

Where:

IA_i is the initial abstraction in the subarea A_i intercepted by the element and is based on the 3rd column of the landuse table;

The intercepted subareas are computed using the land use shape file and *IABSTR* is added to the INFIL.DAT file for each element.

5. Compute effective impervious area (%) for each grid element *(RTIMP_1)*.

$$RTIMP\_1 = \left(\frac{\sum A_i (RTIMPS * EFF)_i}{A_{GE}} \right)$$

Where:

Ai is determined from the soil shape file;

A_{GE} is the grid element area; effective impervious area *EFF* is obtained from the 5th column of the soil table and

6. *RTIMPS* is the percent rock outcrop obtained from the 4th column of the soil table.

$$RTIMP = RTIMP\_1 + \left(\frac{\sum A_i (RTIMPL)_i}{A_{GE}} \right)$$

Where:

Ai is obtained from land use shape file and

A_{GE} is the grid element area and *RTIMPL* is obtained of the land use table.

SCS Curve

There are two methods for assigning spatially variable SCS data. The Schematize method assigns data directly to the grid from polygons digitized to the *Infiltration Areas* layer. The Calculator assigns the SCS curve number from a single external polygon. It can also calculate the Pima County method from a combined layer with soil, coverage density and impervious areas. Each method intersects the infiltration polygons to the grid and assigns an area weighted average to each grid element.

Horton

The Schematize Method assigns data directly to the grid from polygons digitized to the Infiltration Areas layer. The required data fields are:

- fhorti – Initial infiltration rate
- fhortf – Final infiltration rate
- deca – Decay coefficient

The schematize method intersects the Horton polygons to the grid and assigns the variables using an area weighted average.

Channel Development Tools

The channel development tools use several methods and calculators for channel development. A channel is composed of three polyline layers for the banks and cross sections and a point layer for confluences. The channel layers are defined by intersecting the left banks to the grid at the nearest centroid to the left bank.

Left Bank Layers

The *Left Bank User Layer* defines the geographical position of the left bank. The Plugin uses this polyline layer to intersect and connect the left bank grid elements. The position of the left bank elements is dependent on the position of the polyline vertices. It is important to note that if left bank schematization does not have accurate bank coverage, more vertices may be required along the length of the polyline.

The *Left Bank Schematic Layer* is polyline layer that represents the real position of the FLO-2D channel with a single vertex representing each channel element in a segment. Multiple polyline features are used to represent separate channel segments. Figure 18 shows a sample of the two separate layers.

Figure 18. Left Bank Layers.

Cross Section Layers

The *Channel Cross Section User Layer* is used to define the channel geometry and the position of the right bank (Figure 19). The cross sections can be defined using different

methods. The data requirement is station elevation data from the left top of bank to the right top of bank. The station elevation data is obtained from several sources including survey data or profile data from rasters or points. The data can also be defined for trapezoidal or rectangular channels. The last data source is a variable area equation such as: A = a*d^b. Where the area is defined by a coefficient, depth and exponent.

Figure 19. Cross Section User Layer.

Right Banks

There are three ways to generate right banks using the plugin and each can be deployed at the user's discretion based on individual channel characteristics that favor a specific method.

Method 1

Standard schematization button will produce a right bank according to the position of the cross sections. This method works well when many cross sections are used to define the channel geometry.

Method 2

The *Right Bank Schematize* button can be used when a *Right Bank User Layer* is defined. The *Right Bank User Layer* is a polyline layer that contains right bank features that represent the physical position of the right top of bank.

The schematization system works in the same manner as the left bank intersection. It results in a right bank feature in the schematic layer that has one right bank per each left bank. It is best suited to channels with long distances between cross sections. It is a good method for making right bank corrections. It is important to note that the vertices

of the polyline determine the relative position for each grid. If an adjustment is required, it may be necessary to add more vertices to the polyline.

Method 3

The final method for creating a schematized right bank is to use the *FLO-2D Right Bank Calculator*. This is an external program extracted from the PROFILES code. This method uses the cross section top width and area (top width * length) to determine the total extensions needed to assign right banks.

Bank Elevation

The plugin uses two methods to define bank elevation. The first is to assign the bank elevation in the cross section data. This is the only method for N (Natural) channels as the bank elevation is assigned in the *Station Elevation* table. Assigning bank elevation is the preferred method for T (trapezoidal), R (rectangular), and V (variable area) channels. With this method, the left and right bank data is assigned to *Left Bank Elevation* and *Right Bank Elevation* fields in the *Cross Section User Layer* attributes.

The second bank elevation method is to leave the *Left Bank Elevation* and *Right Bank Elevation* variables NULL. This method only works with the T, R, and V channel types. The NULL variable assignment results in No Data being assigned to the Schematized Left Bank Layer. When no data is assigned, *the Left Bank Elevation* and *Right Bank Elevation* is not written to CHAN.DAT. The model uses the grid element elevation in lieu of the missing data.

Interpolation

The Plugin uses the same interpolator that the PROFILES program uses. It is an external App that is installed into the FLO-2D Pro subdirectory along with the FLO-2D software. The Plugin exports the XSEC.DAT and CHAN.DAT and executes the interpolation program. The data is reloaded into the Plugin *Schematic Layers*.

Import HEC-RAS

The *Import HEC-RAS* tool is used to import channel data from HEC-RAS geometry files. The RAS project must be georeferenced and in the same coordinate system as the GeoPackage. This system can import, channel geometry, full cross sections, bank to bank cross sections, interpolated cross sections and levees.

Figure 20. HEC-RAS Import.

Upon import, the HEC-RAS channels are saved to the *User Layers* (Figure 20). The data is saved to the left bank and cross section layers. It is important to note that the data imported to QGIS is read from the *.g0 file in linear order. The channels are imported as segment 1 being the top most data set and segment 2 is next in order of the geometry file. If the channel data is in the wrong order, it should be corrected before being imported.

Cross sections are saved to the Cross Section layer in the order by which they were written to the geometry file. The cross section names are extracted from the River Mile field (Figure 21).

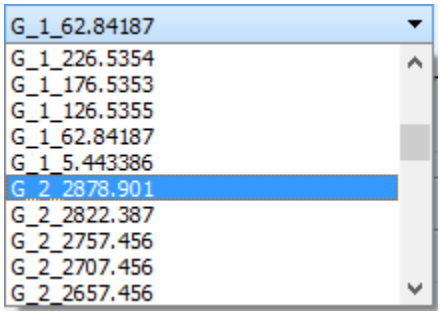

Figure 21. Channel Cross Sections.

Storm Drain Model

The FLO-2D surface water model has a dynamic exchange with the storm drain system. FLO-2D calculates the surface water depth at grid cells. Those cells that contain the storm drain inlets use the surface water depth and the inlet geometry, to compute the discharge inflow to the storm drain system. The storm drain engine then routes the flow in the pipe network and calculates potential return flow to the surface water system (Figure 22).

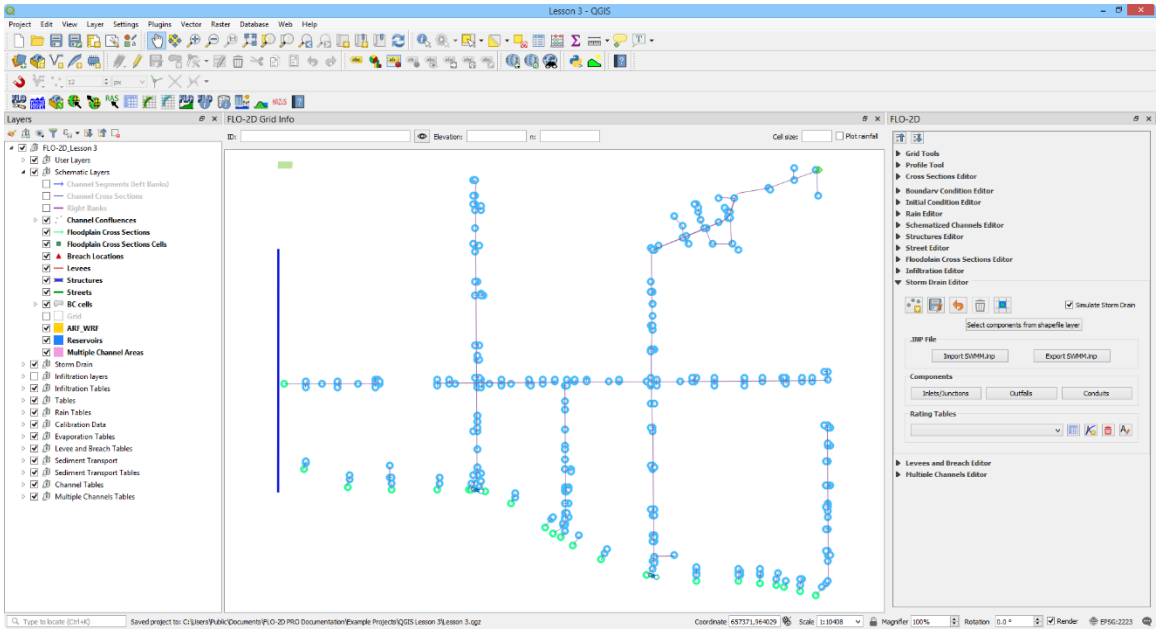

Figure 22. Storm Drain Layout in QGIS.

The Storm Drain data files (SWMM.INP and *.DAT files) can be developed from scratch in the *QGIS Storm Drain Editor* by assigning the data from shapefiles to the storm drain features. Figure 23 shows the *Storm Drain* dialog box.

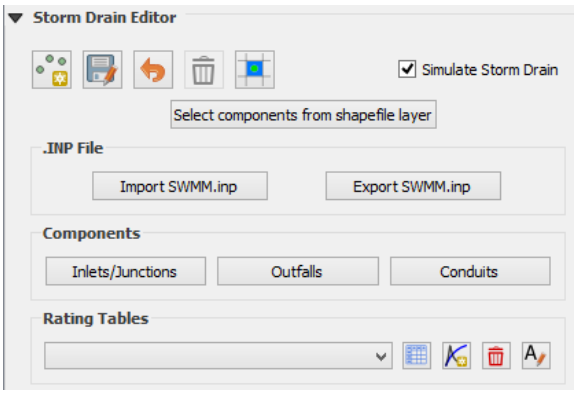

Figure 23. Storm Drain Dialog Box.

QGIS can be used to create the storm drain shapefiles for Inlets/Junctions, Outfalls and Conduits. These shapefiles contain all the required data to fill the Storm Drain data files (see FLO-2D Plugin User's Manual and FLO-2D Storm Drain Manual for more information about the required data for each component). If the storm drain shapefiles exist, they can be imported into the QGIS project. If the storm drain shapefiles do not exist, they can be digitized into *Storm Drain User Layers* (Figure 24).

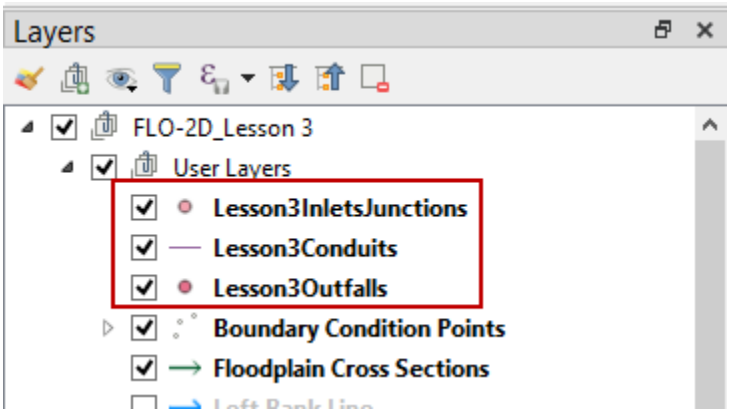

Figure 24. Storm Drain Shapefiles.

Storm Drain Components

The Inlet/Junctions, Outfalls and Conduits layers each have attribute tables that define the geometry and elevation data for the storm drain system. These tables should contain the storm drain inlet names, geometry and coefficients that will be required by the SWMM.INP, SWMMFLO.DAT, SWMMFLORT.DAT and SWWMMOUTF.DAT files. The following option can be used with external storm drain shapefiles or the predefined storm drain user layers. Figure 25, Figure 26, and Figure 27 show the required fields for assigning up the storm drain attribute data. The plugin uses this data to build the Storm Drain User Layers. It also intersects the storm drain nodes to the grids and assigns the feature IDs.

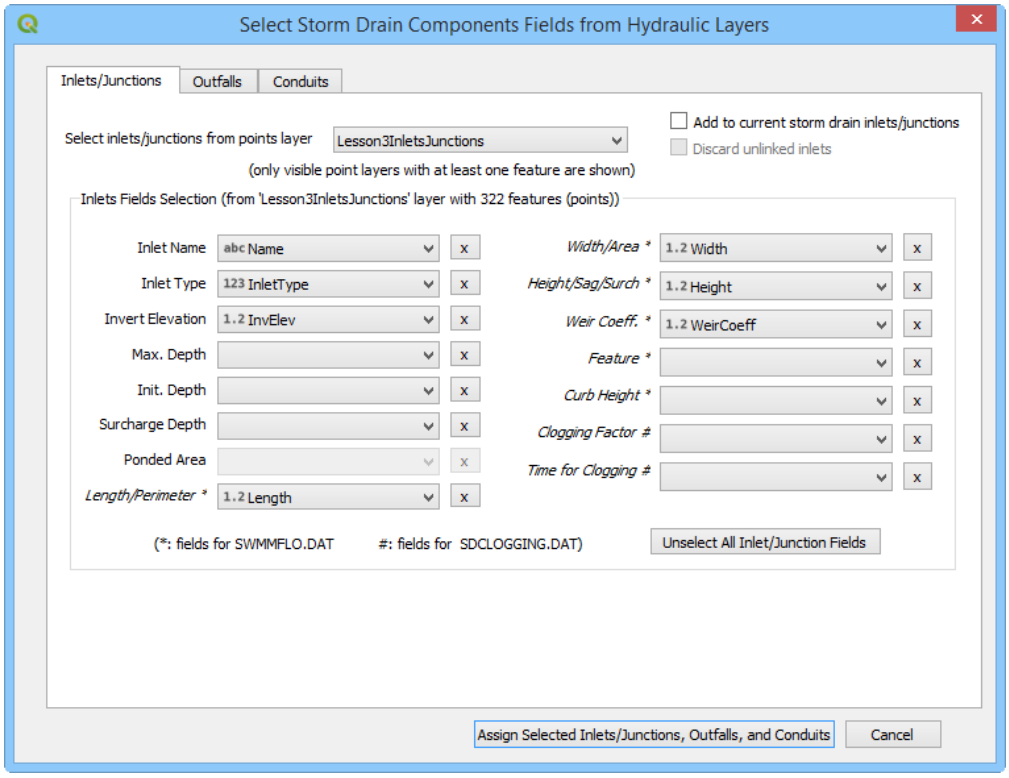

Figure 25. Select Components from Shapefile Layer: Inlet/Junctions.

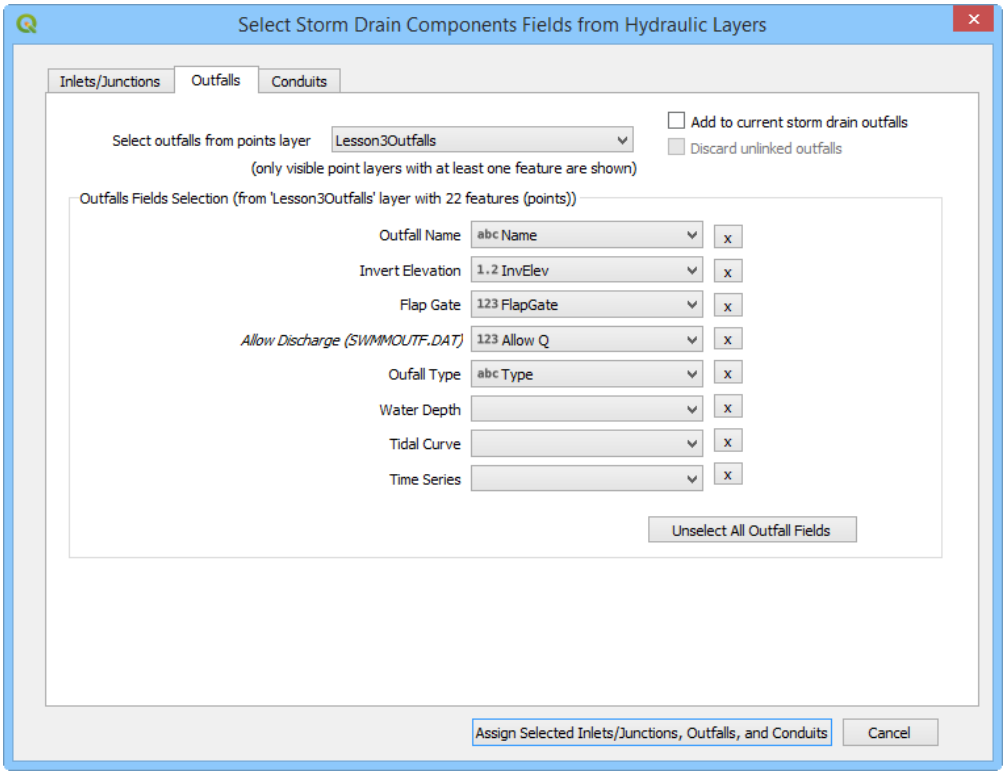

Figure 26. Select Components from Shapefile Layer: Outfalls.

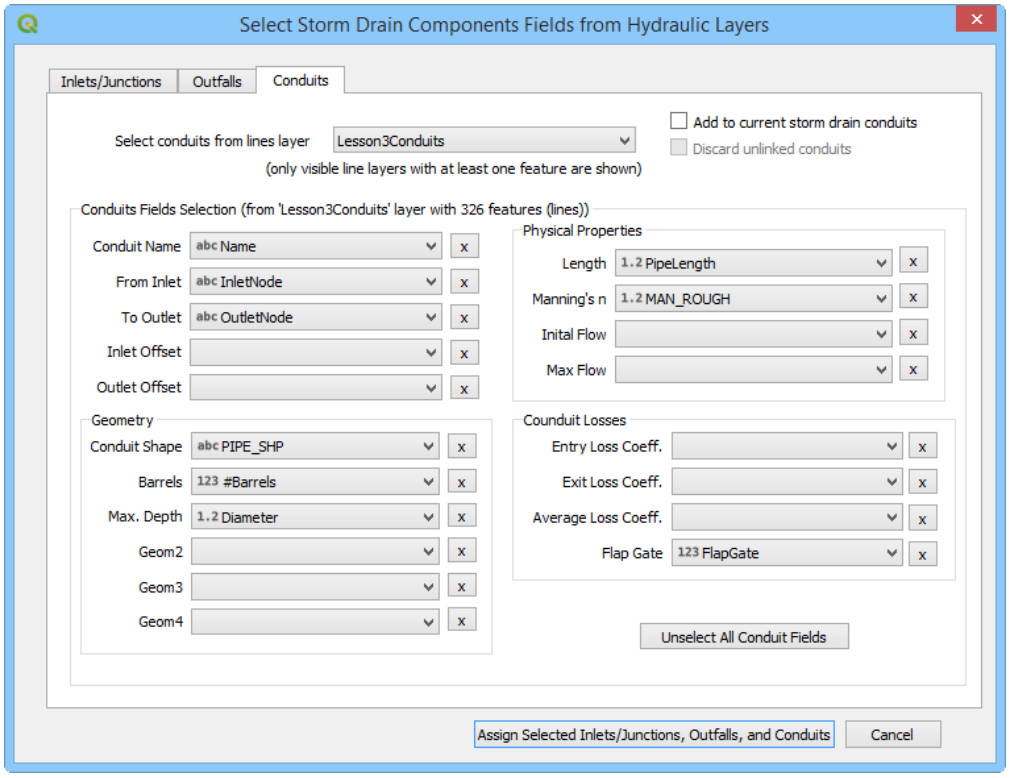

Figure 27. Select Components from Shapefile Layer: Conduits.

Storm Drain User Layers

The finished tables can be reviewed to check that the storm drain data was successfully updated in the QGIS FLO-2D Project, see Figure 28 to Figure 30. These boxes can be edited to update the *Storm Drain User Layers*.

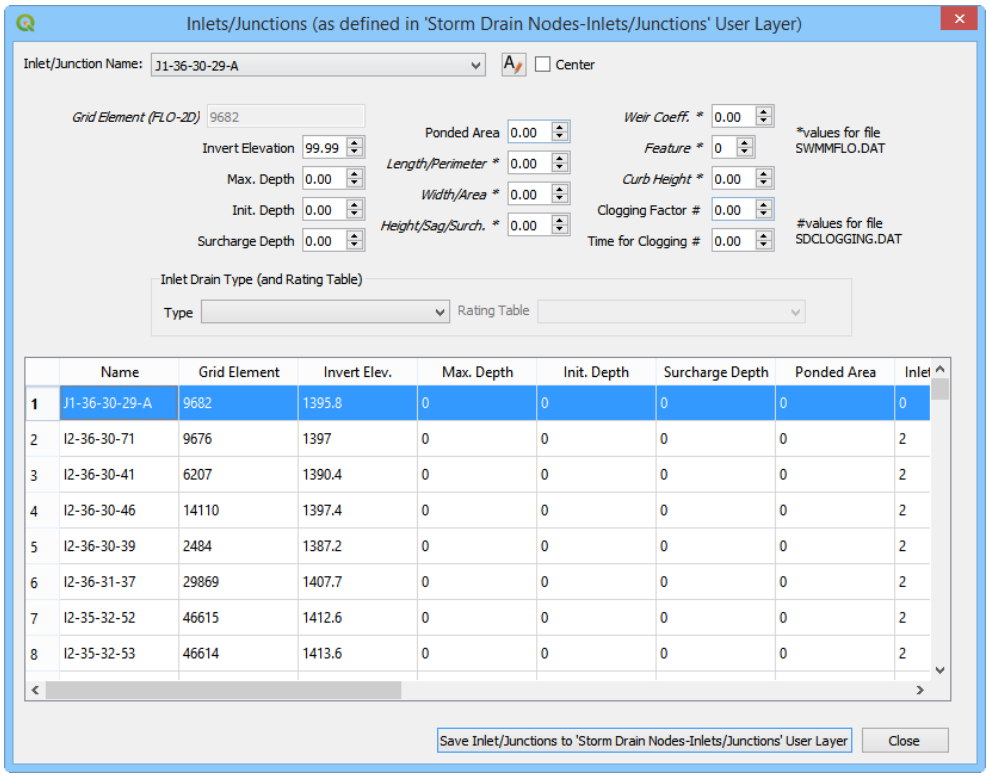

Figure 28. Review Components from Shapefile Layer: Inlets/Junctions.

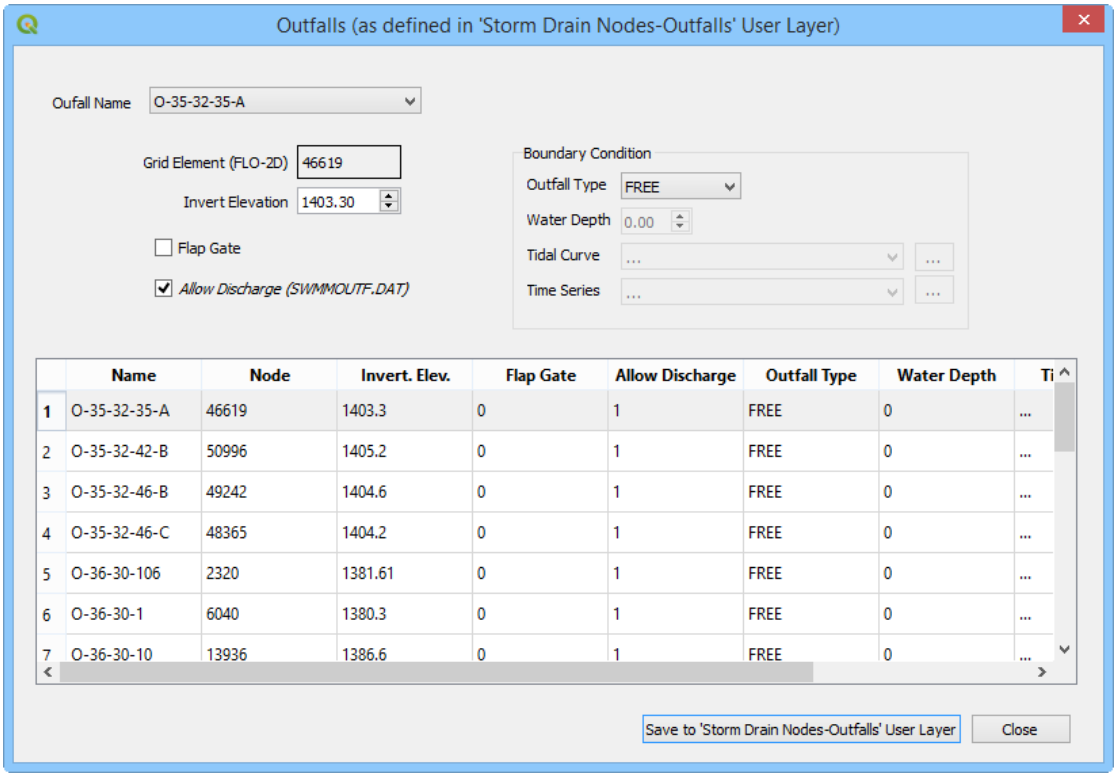

Figure 29. Review Components from Shapefile Layer: Outfalls.

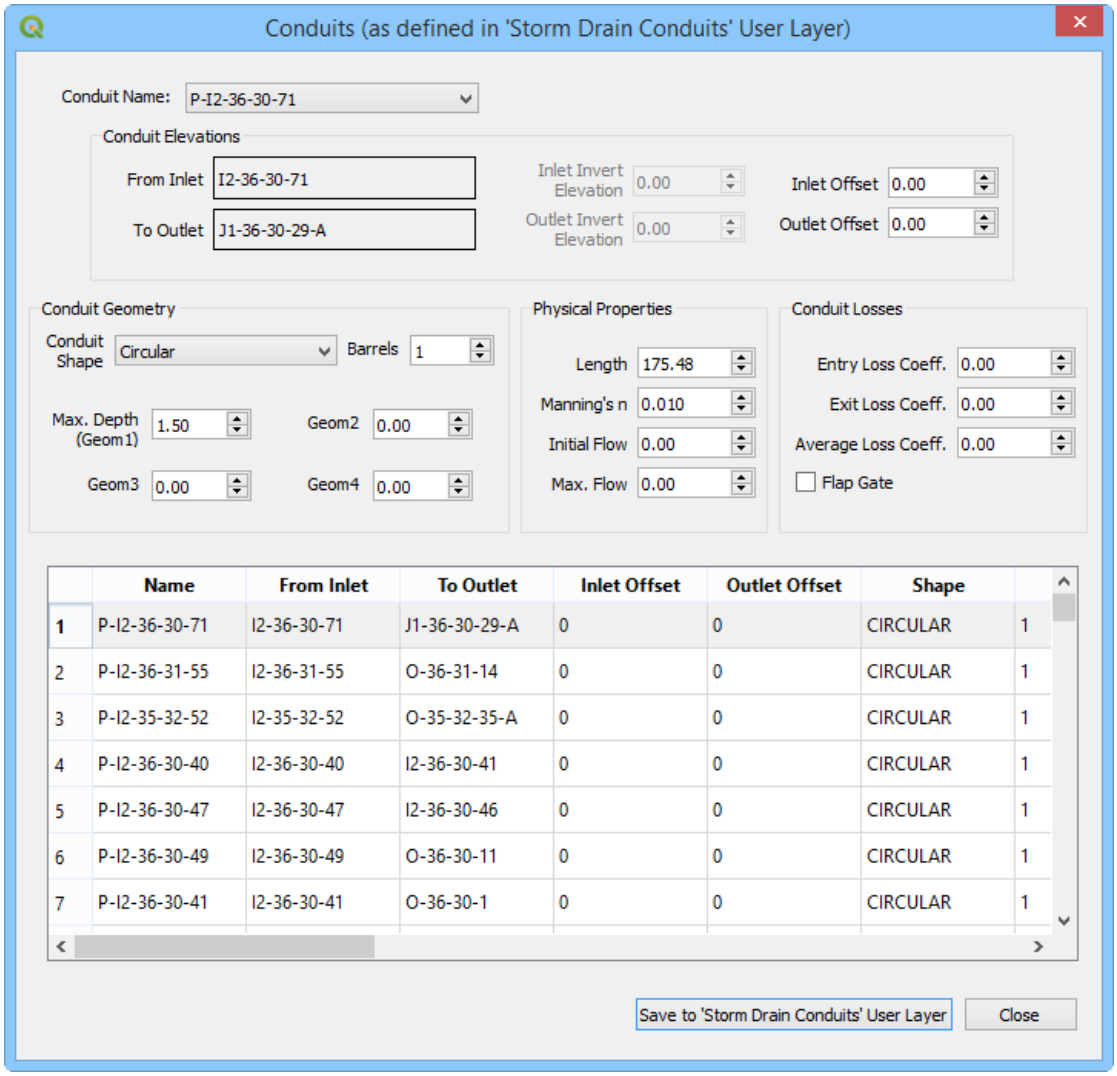

Figure 30. Review Components from Shapefile Layer: Conduits.

Digitizing Storm Drain Features

Storm Drain features can be created in QGIS for the development of the INP file. Point layer shapefiles must be created for Inlets/Junctions and outfalls. Line Layer Shapefiles must be created for conduits. Once the shapefiles have been created, features from the shapefiles can be selected and assign to the storm drain data.

The storm drain editor has an option *to Select Components from Shapefile Layer* in the *Storm Drain Editor*. The selected attributes will be assigned to the *Inlets/Junctions, Outfalls and Conduits Components Tables* in *User Layers*.

The data must be schematized using the schematize button in the *Storm Drain Editor*. Then the *.INP can be created by clicking Export SWMM.inp. Storm drain data files as:

SWMMFLO.DAT file, SWMMOUTF.DAT File and SWMMFLORT.DAT file will be created when FLO-2D Data Files are exported in the QGIS Project. The Storm Drain component needs to be turned ON in the FLO-2D Control and Tolerance Variables.

*Importing existing *.INP file*

An existing *.INP file can be imported once the FLO-2D surface model has been already created. The *Storm Drain Editor* has an option to Import SWMM.inp that can be used to read an existing *.INP file. Storm drain systems created using other software can be imported if the format is compatible with EPA SWMM Version 5.

The storm drain features will be read from the *.INP file and the *Inlets/Junctions, Outfalls* and *Conduits* tables in the components section in the *Storm Drain Editor* will be completed.

Hazus tools

The *Hazus* tool will generate a raster maximum depth file that can be used as an input for the FEMA Hazus program. The required layers include building shape files, grid cell elevations, grid cell depth and water surface elevations. The user must define ground elevation, water surface elevation and maximum flow depth for each building. An adjustment factor can be applied to calculate the finished floor elevation. Figure 31 shows the tool requirements.

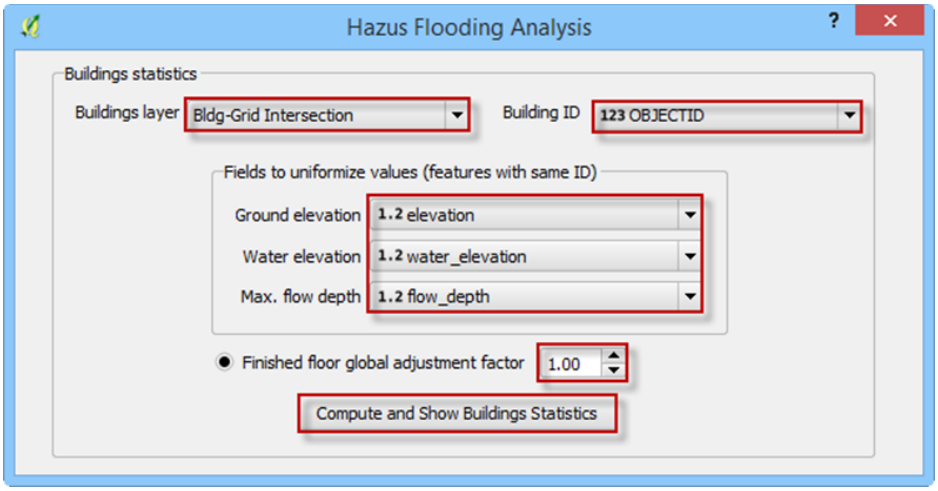

Figure 31. Hazus Tool

The process to generate a Hazus raster is outlined in the User's Manual. It requires the use of several general QGIS tools for importing, intersecting, calculating, and rasterizing data. The requirements and calculations are outlined below for each layer.

- **Building layer** – This layer is used to define the building locations and set the building ID.
- **Depth and water surface data** – FLO-2D results imported as text files.
- **Assign water surface and depth** – This calculation process uses a simple Join feature to write the results into the Grid layer.
- **Intersect buildings layer** – This QGIS process splits the building polygons into separate polygons for each grid element.
- **Homogenize the building intersection layer** – This process joins the split buildings to the grid elevation, depth and water elevation data and calculates statistics for the building.
- **Join building statistics to building polygons** – This QGIS process writes the stats back to the Buildings layer.
- **Rasterize** – This QGIS process rasterizes building depth and water surface data for Hazus.

References

Library of Congress, 2017. Geopackage Encoding Standard (OGC), version 1.0, https://www.loc.gov/preservation/digital/formats/fdd/fdd000419.shtml

Python Software Foundation, 2018. The Python Tutorial, Python English 2.7.15 Documentation, https://docs.python.org/2.7/tutorial

all_schem_bc

A table that stores the boundary condition cell data from the BC cells schematic layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
type	TEXT	Defines inlet or outlet.
tab_bc_fid	INTEGER	Link to the hydrograph or stage timetable.
grid_fid (DUM)	INTEGER	Grid element id of the cell.
geom	POLYGON	Polygon of the cell.

blocked_cells

This table lists the data stored in the ARF_WRF layer of the Schematic group. The ARF_WRF layer stores the data written to the ARF.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unique id not related to the grid element.
grid_fid (igd / ittawf)	INTEGER	Grid element id of the cell.
area_fid	INTEGER	Id of the blocked areas layer in the User Layers group.
arf	REAL	Area reduction factor.
wrf1	REAL	Width reduction factor north.
wrf2	REAL	Width reduction factor east.
wrf3	REAL	Width reduction factor south.
wrf4	REAL	Width reduction factor west.
wrf5	REAL	Width reduction factor northeast.
wrf6	REAL	Width reduction factor southeast.

wrf7	REAL	Width reduction factor southwest.
wrf8	REAL	Width reduction factor northwest.
geom	POINT	A point layer but the style of the layer is set up to look like blocked cells with 8 direction blockage.

breach

Individual breach data stored in the breach.dat file. This table works with import and export. It can be edited in the Breach layer of the Schematic Layers group.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
ibreachdir	INTEGER	Breach direction.
zu	REAL	Upstream face slope.
zd	REAL	Downstream face slope.
zc	REAL	Upstream and down-stream core slope.
crestwidth	REAL	Crest width of the dam or levee.
crestlength	REAL	Crest length of the dam or levee
brbotwidmax	REAL	Maximum breach width at the bottom.
brtopwidmax	REAL	Maximum breach width at the top of the breach.
brbottomel	REAL	Minimum erosion eleva-tion of the breach.
weircoef	REAL	Weir coefficient.

d50c	REAL	Mean sediment size core.
porc	REAL	The porosity of the core material.
uwc	REAL	Unit weight core.
cnc	REAL	Manning's n core.
afrc	REAL	Angle of internal friction core.
cohc	REAL	Cohesive strength core.
unfcc	REAL	Sediment gradient core.
d50s	REAL	Mean sediment size shell.
pors	REAL	The porosity of the shell.
uws	REAL	Unit weight shell.
cns	REAL	Manning's n shell.
afrs	REAL	Angle of internal friction shell.
cohs	REAL	Cohesive strength shell.
unfcs	REAL	Sediment gradient shell.
bratio	REAL	The ratio of initial breach width to depth.
grasslength	REAL	Average grass length on downstream face.

grasscond	REAL	The condition of the grass. Poor or Good.
grassvmaxp	REAL	Maximum permissible velocity for the the grass-lined downstream face.
sedconmax	REAL	Maximum sediment concentration.
d50df	REAL	Mean sediment size of the downstream upper one foot face.
unfcdf	REAL	Sediment gradient of the downstream upper one foot face.
breachtime	REAL	Length of time between the initial breach condition and the start of the breach.
geom	POINT	Breach layer is a point layer.

breach_cells

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id or the breach id.
breach_fid	INTEGER	Id that joins to the breach point layer.
grid_fid (dum)	INTEGER	Grid element id of the cell.

breach_fragility_curves

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
fragchar	TEXT	Fragility character.
prfail	REAL	Levee fragility failure probability.
prdepth	REAL	The distance below levee crest paired with the failure probability.

breach_global

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
ibreachsedeqn	INTEGER	Breach sediment transport equation.
gbratio	REAL	The ratio of the initial breach width to breach depth.
gweircoef	REAL	Weir coefficient.
gbreachtime	REAL	Time to start of erosion from when pipe elevation is reached.
gzu	REAL	Upstream face slope.
gzd	REAL	Downstream face slope.
gzc	REAL	Upstream and down-stream core slope.
gcrestwidth	REAL	Crest width of the dam or levee.
gcrestlength	REAL	Crest length of the dam or levee.
gbrbotwidmax	REAL	Maximum breach width at the bottom.

gbrtopwidmax	REAL	Maximum breach width at the top of the breach.
gbrbottomel	REAL	Minimum erosion elevation of the breach.
gd50c	REAL	D50 of the core material.
gporc	REAL	The porosity of the core material.
guwc	REAL	Unit weight core.
gcnc	REAL	Manning's n core.
gafrc	REAL	Angle of internal friction core.
gcohc	REAL	Cohesive strength core.
gunfcc	REAL	Sediment gradient core.
gd50s	REAL	Mean sediment size shell.
gpors	REAL	The porosity of the shell.
guws	REAL	Unit weight shell.
gcns	REAL	Manning's n shell.
gafrs	REAL	Angle of internal friction shell.
gcohs	REAL	Cohesive strength shell.
gunfcs	REAL	Sediment gradient shell.

ggrasslength	REAL	Average grass length on downstream face.
ggrasscond	REAL	Condition of grass. Poor or Good.
ggrassvmaxp	REAL	Maximum permissible velocity for grass lined downstream face.
gsedconmax	REAL	Maximum sediment concentration.
d50df	REAL	Mean sediment size of the downstream upper one foot face.
gunfcdf	REAL	Sediment gradient of the downstream upper one foot face.

buildings_areas

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
adjustment_factor (arf-blockmod)	REAL	Global adjustment of totally blocked cell ARFs. Coefficient.
geom	POLYGON	Polygon of the building footprint.

buildings_stats

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
building_id	INTEGER	ID of a unique building.
grnd_elev_avg	REAL	Average elevation of the cells within the building footprint.
grnd_elev_min	REAL	Min elevation of the cells within the building footprint.
grnd_elev_max	REAL	Max elevation of the cells within the building footprint.
floor_avg	REAL	Average floor elevation.
floor_min	REAL	Min floor elevation.
floor_max	REAL	Max floor elevation.
water_elev_afb	REAL	Average water surface elevation of the cells surrounding the building footprint.
water_elev_max	REAL	Max water surface elevation of the cells surrounding the building footprint.

depth_afg	REAL	Average depth of the cells around the building foot-print.
depth_min	REAL	Average depth of the cells around the building foot-print.
geom	POLYGON	Polygon of the building footprint.

chan

Table for the Channel Segments (left banks) layer in the Schematic Layers group. This layer stores the data that is written to the chanbank.dat for each channel segment control line. It also sets the rank of each channel in the chan.dat file so that the channel matches the position of the cross-sections. Channel are written in order from rank = 1 to n number of segments.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Segment name.
depinitial	REAL	Initial depth.
froudc	REAL	Limiting Froude.
roughadj	REAL	Mannings n adjustment factor.
isedn	INTEGER	Channel sediment switch.
notes	TEXT	Notes.
user_lbank_fid	INTEGER	Left bank id links channel segment to a left bank line.
rank	INTEGER	Rank order in the chan.dat file.
geom	LINESTRING	Polyline.

chan_confluences

Table of data associated with the Channel Confluences layer in the Schematic Layers group. This table identifies the connecting channel cells and identifies if a confluence cell is a tributary or main channel element.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id, confluence or the channel id.
conf_fid	INTEGER	Id of confluence pair.
type	TEXT	Tributary or Main.
chan_elem_fid (iconflo1, iconflo2)	INTEGER	Left or right bank id of the channel cell being connected.
notes	TEXT	Notes.
geom	POINT	Point associated with the channel cell for a tributary or main element.

chan_elems

Table associated with all Channel Cross Sections layer in the Schematic Layers group. This table uses several id fields to link the cross sections to the correct channel segment, left bank element, right bank element and station or geometry data.

Field Name	Field Type	Description
id	INTEGER	Unit fid is unique and not associated with the grid id, seg id, xsec id.
Fid (leftbank)	INTEGER	Left bank grid element id.
seg_fid	INTEGER	Segment id from chan layer.
nr_in_seg	INTEGER	Rank of channel element in segment.
Rbankgrid (rightbank)	INTEGER	Right bank grid element id.
fcn	REAL	Mannings n number of channel cross section.
xlen	REAL	Length of channel element.
type	TEXT	Geometry type. R, T, N, V
notes	TEXT	Notes.
user_xs_fid (nxsecnum)	INTEGER	Cross section id links each polyline to the cross section data table.

interpolated	INTEGER	Interpolated cross section. 0 non interpolated 1 interpolated.
geom	LINESTRING	Polyline.

chan_elems_interp

This table is used for a calculation scheme that calculates the distance between channel cross sections for the purpose of interpolation. The table is referenced in two python files. They are Schematic_tools.py and flo2dobjects.py.

Field Name	Field Type	Description
id	INTEGER	Id of the interpolated cross section.
fid	INTEGER	Unit fid is unique and not associated with the grid id.
seg_fid	INTEGER	Channel segment id.
up_fid	INTEGER	Id of the upstream cross section.
lo_fid	INTEGER	Id of the downstream cross section.
up_lo_dist_left	REAL	Distance from upstream cross section to current cross section.
up_lo_dist_right	REAL	Distance from current cross section to down-stream cross section.
up_dist_left	REAL	Distance from left bank to center.
up_dist_right	REAL	Distance from right bank to center.

chan_n

Table that stores the data that links natural cross-sections to left bank elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
elem_fid (ichangrid)	INTEGER	Left bank grid element id of the cell.
nxsecnum	INTEGER	Natural cross section number.
xsecname	TEXT	Cross section name.

chan_r

The table that stores the cross-section data for rectangular cross sections and links them to left bank elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
elem_fid (ichangrid)	INTEGER	Left bank grid element id of the cell.
bankell	REAL	Left bank elevation.
bankelr	REAL	Right bank elevation.
fcw	REAL	Channel width.
fcd	REAL	Channel depth.

chan_t

The table that stores the cross-section data for trapezoidal cross sections and links them to left bank elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
elem_fid (ichangrid)	INTEGER	Left bank grid element id of the cell.
bankell	REAL	Left bank elevation.
bankelr	REAL	Right bank elevation.
fcw	REAL	Channel width.
fcd	REAL	Channel depth.
zl	REAL	Left bank slope.
zr	REAL	Right bank slope.

chan_v

The table that stores the cross-section data for variable area regression cross sections and links them to left bank elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
elem_fid (ichangrid)	INTEGER	Left bank grid element id of the cell.
bankell	REAL	Left bank elevation.
bankelr	REAL	Right bank elevation.
fcd	REAL	Channel depth.
a1	REAL	Coefficient area a1.
a2	REAL	Exponent area a2.
b1	REAL	Coefficient wetted perimeter b1.
b2	REAL	Exponent wetted perimeter b2.
c1	REAL	Coefficient top width c1.
c2	REAL	Exponent top width c2.
excdep	REAL	Second equation starts when channel reaches this depth.

a11	REAL	Coefficient area (depth 2) a11.
a22	REAL	Exponent area (depth 2) a22.
b11	REAL	Coefficient wetted perimeter (depth 2) b11.
b22	REAL	Exponent wetted perimeter (depth 2) b22.
c11	REAL	Coefficient top width (depth 2) c11.
c22	REAL	Exponent top width (depth 2) c22.

chan_wsel

Table connecting the initial conditions to specific channel segments.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
seg_fid	INTEGER	Channel segment id.
istart	INTEGER	Channel element number that starts the water surface elevation.
wselstart	REAL	Elevation at the start.
iend	INTEGER	Channel element number that ends the water surface elevation.
wselend	REAL	Elevation at the end.

cont

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name field.
value	TEXT	Value field.
note	TEXT	Notes.

culvert_equations

The table that stores the data for the generalized culvert equations and linked to the Structures Layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
struct_fid	INTEGER	Hydraulic structure id from structures layer.
typec	INTEGER	Culvert type box or circular.
typeen	INTEGER	Entrance type.
culvertn	REAL	Manning's n value.
ke	REAL	Contraction value.
cubase	REAL	Culvert width.

evapor

The table that stores the start time and date for the Evaporation group.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
ievapmonth	INTEGER	Starting month of simulation. 1-12
iday	INTEGER	Starting day of the week. 1-7
clocktime	REAL	Starting clock time hours.

evapor_hourly

Temporal evaporation information related to the evaporation of a specific calendar.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
month	TEXT	Name of evaporation month.
hour	INTEGER	Evaporation hour.
hourly_evap	REAL	Evaporation rate.

evapor_monthly

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
month	TEXT	Month.
monthly_evap	REAL	Monthly evaporation rate.

fpfroude

The table that lists the data for the Froude Areas layer in the User Layers group. This polygon layers stores the spatially variable limiting Froude data.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
froudefp	REAL	Limting Froude.
geom	POLYGON	Polygon features that out-line the limiting Froude ar-eas.

fpfroude_cells

A table of cells that are written to the froudefp.dat when the project is exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
area_fid	INTEGER	This ID is joined to the fpfroude table from the User Layers.
grid_fid (idum)	INTEGER	Grid element id of the cell.

fpxsec

Table for the Floodplain Cross Sections layer in the Schematic Layers group. Stores the order of cross sections listed in fpxsec.dat.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
iflo	INTEGER	Flow direction 1 – 8.
nnxsec	INTEGER	Cross section number.
geom	LINESTRING	Polyline representing the exact location of the flood-plain cross section.

fpxsec_cells

Table for the Floodplain Cross Sections Cells. Lists the cells in each floodplain cross section as written to fpxsec.dat.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
fpxsec_fid	INTEGER	Floodplain cross-section id.
grid_fid (nodx)	INTEGER	Grid element id of the cell.
geom	POINT	Point geometry to identify the cells in each floodplain cross section.

gpkg_contents

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
table_name	TEXT	
data_type	TEXT	
identifier	TEXT	
description	TEXT	
last_change	DATETIME	
min_x	DOUBLE	
min_y	DOUBLE	
max_x	DOUBLE	
max_y	DOUBLE	
srs_id	INTEGER	

gpkg_data_column_constraints

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
constraint_name	TEXT	
constraint_type	TEXT	
value	TEXT	
min	NUMERIC	
minIsInclusive	BOOLEAN	
max	NUMERIC	
maxIsInclusive	BOOLEAN	
description	TEXT	

gpkg_data_columns

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
table_name	TEXT	
column_name	TEXT	
name	TEXT	
title	TEXT	
description	TEXT	
mime_type	TEXT	
constraint_name	TEXT	

gpkg_extensions

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
table_name	TEXT	
column_name	TEXT	
extension_name	TEXT	
definition	TEXT	
scope	TEXT	

gpkg_geometry_columns

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
table_name	TEXT	
column_name	TEXT	
geometry_type_name	TEXT	
srs_id	INTEGER	
z	TINYINT	
m	TINYINT	

gpkg_metadata

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
id	INTEGER	
md_scope	TEXT	
md_standard_uri	TEXT	
mime_type	TEXT	
metadata	TEXT	

gpkg_metadata_reference

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
reference_scope	TEXT	
table_name	TEXT	
column_name	TEXT	
row_id_value	INTEGER	
timestamp	DATETIME	
md_file_id	INTEGER	
md_parent_id	INTEGER	

gpkg_spatial_ref_sys

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
srs_name	TEXT	Coordinate reference system.
srs_id	INTEGER	Coordinate reference id number.
organization	TEXT	
organization_coordsys_id	INTEGER	
definition	TEXT	
description	TEXT	

gpkg_tile_matrix

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
table_name	TEXT	
zoom_level	INTEGER	
matrix_width	INTEGER	
matrix_height	INTEGER	
tile_width	INTEGER	
tile_height	INTEGER	
pixel_x_size	DOUBLE	
pixel_y_size	DOUBLE	

gpkg_tile_matrix_set

OGC GeoPackage Encoding Standard Table (Open Geospatial Consortium, 2017).

Field Name	Field Type	Description
table_name	TEXT	
srs_id	INTEGER	
min_x	DOUBLE	
min_y	DOUBLE	
max_x	DOUBLE	
max_y	DOUBLE	

grid

Table for the Grid layer in the Schematic Layers group. Used to store the grid element number, n_value and elevation. Data saved to topo.dat and mannings.dat.

Field Name	Field Type	Description
fid (dum)	INTEGER	Grid element id of the cell.
n_value (fpnvalue)	REAL	Manning's n-value for each cell.
elevation (elev)	REAL	Elevation for each cell.
water_elevation	REAL	Imported water surface elevation.
flow_depth	REAL	Imported flow depth.
geom	POLYGON	Polygons define the grid system based on the cells size.

gutter_areas

The Gutter_Areas layer is used to define the spatial position of gutters. It also contains local variables used in gutter cells.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
width (widstr)	REAL	Individual cell street width.
height (curbht)	REAL	Individual cell curb height.
n_value (xnstr)	REAL	Individual cell street n-value.
direction (icurbdir)	INTEGER	Curb direction.
geom	POLYGON	Polygons define the grid system based on the cells size.

gutter_cells

The gutter cells calculated from the gutter_areas. These are written to the GUTTER.DAT file when the project is exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
area_fid	INTEGER	The fid that is associated with the gutter area polygons.
grid_fid	INTEGER	Grid element id of the cell.

gutter_globals

The gutter_globals layer is a table that stores the global gutter variables. It is exported to GUTTER.DAT when the project is exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
height (strwidth)	REAL	Global curb height.
width (curbheight)	REAL	Global street width.
n_value (street_n-value)	REAL	Global street n-value

infil

The table that stores the data that is parsed from the infil.dat file when imported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
infmethod	INTEGER	Infiltration method; Green-Ampt, SCS, Horton.
abstr	REAL	Global initial abstraction.
sati	REAL	Spatial initial saturation.
satf	REAL	Spatial final saturation.
poros	REAL	Spatial porosity.
soild	REAL	Spatial soil depth.
infchan	INTEGER	Switch for channel infiltration.
hydcall	REAL	Global hydraulic conductivity.
soilall	REAL	Global capillary suction.
hydcadj	REAL	Hydraulic conductivity adjustment variable.
hydcxx	REAL	Initial hydraulic conductivity for channel segment.

scsnall	REAL	Global SCS curve number.
abstr1	REAL	Green Ampt global flood-plain abstraction.
fhortoni	REAL	Horton initial infiltration rate.
fhortonf	REAL	Horton final infiltration rate.
decaya	REAL	Horton decay coefficient.

infil_areas_chan

This table stores the infiltration data for channels cells. It has a geometry that is a grid element. The hydraulic conductivity is exported into the INFIL.DAT file when the project is exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
hydconch	REAL	Hydraulic conductivity global channel.
geom	POLYGON	Polygon of infiltration areas for a channel.

infil_areas_green

Table for the Areas Green Ampt layer in the Infiltration Layers group. This table stores polygon features for spatially variable Green and Ampt infiltration. It is not grid element dependent.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
hydc	REAL	Hydraulic conductivity overland.
soils	REAL	Capillary suction.
dtheta	REAL	Soil moisture deficit.
abstrinf	REAL	Initial abstraction.
rtimpf	REAL	Percent impervious.
soil_depth	REAL	Soil limiting depth.
geom	POLYGON	Polygon of similar infiltration conditions.

infil_areas_horton

Table for the Areas Horton layer in the Infiltration Layers group. This table stores polygon features for spatially variable Horton infiltration. It is not grid element dependent.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
fhorti	REAL	Horton infiltration rate.
fhortf	REAL	Horton final infiltration rate.
deca	REAL	Horton equation decay coefficient.
geom	POLYGON	Polygon of similar infiltration conditions.

infil_areas_scs

Table for the Areas SCS layer in the Infiltration Layers group. This table stores polygon features for spatially variable SCS infiltration. It is not grid element dependent.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
scsn	REAL	Curve number.
geom	POLYGON	Polygon of similar infiltration conditions.

infil_cells_green

Tables that link the infiltration polygons to the grid elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (infgrid)	INTEGER	Grid element id of the cell.
infil_area_fid	INTEGER	Infiltration area polygon id.

infil_cells_horton

Tables that link the infiltration polygons to the grid elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (infgrid)	INTEGER	Grid element id of the cell.
infil_area_fid	INTEGER	Infiltration area polygon id.

infil_cells_scs

Tables that link the infiltration polygons to the grid elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (infgrid)	INTEGER	Grid element id of the cell.
infil_area_fid	INTEGER	Infiltration area polygon id.

infil_chan_elems

Tables that link the infiltration polygons to the grid elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (infch)	INTEGER	Grid element id of the cell.
infil_area_fid	INTEGER	Infiltration area polygon id.

infil_chan_seg

Hidden table linked to the Infiltration editor. Data is not available to view via a table.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
chan_seg_fid	INTEGER	Channel segment.
hydcx	REAL	Hydraulic conductivity channel.
hydcxfinal	REAL	Final hydraulic conductivity channel.
soildepthcx	REAL	Soil depth channel.

inflow

Table for Inflow layer stored in the Tables layers. Data is stored when the boundary condition schematize button is pushed.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the inflow node.
time_series_fid	INTEGER	Hydrograph id.
ident	TEXT	Inflow type channel or floodplain.
inoutfc	INTEGER	Inflow or outflow.
note	TEXT	Note.
geom_type	TEXT	The field that identifies if the inflow source was from a point, line or polygon.
bc_fid	INTEGER	Id linking the inflow data to the BC layer.

inflow_cells

The table stores the data for Inflow Cells layer in the Tables group. This table joins the grid layer to the inflow layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
inflow_fid	INTEGER	Inflow id from the BC layer.
grid_fid	INTEGER	Grid element id of the cell.
area_factor	REAL	Not used.

inflow_time_series

The table that stores the number and name of the inflow time series. This data is used to join the time series data to the inflow cell data and the time series tables.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the time series.

inflow_time_series_data

Table of the time series hydrograph data.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
series_fid	INTEGER	Id that joins the hydro-graphs to the time series names.
time (hp(j,1))	REAL	Hydrograph time.
value (hp(j,2))	REAL	Hydrograph discharge.
value2 (hp(j,3))	REAL	Mudflow concentration.

levee_data

The table storing the data in the Levees layer in the Schematic Layers group. This data is written to the levee.dat file when the file is exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (lgridno)	INTEGER	Grid element id of the cell.
ldir	INTEGER	Levee cutoff direction.
levcrest	REAL	Levee crest elevation.
user_line_fid	INTEGER	Id from the user layer.
geom	LINESTRING	The line that represents a levee aligned along the cut-off direction.

levee_failure

The table that stores the data for a prescribed levee breach. This layer is hidden. It is not editable. It is filled when the project is imported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (lfailgrid)	INTEGER	Grid element id of the cell.
lfaildir	INTEGER	Levee fail direction.
failevel	REAL	Fail start elevation.
failtime	REAL	Levee fail time to start.
levbase	REAL	Fail base elevation.
failwidthmax	REAL	Max breach width.
failrate	REAL	Vertical fail rate.
failwidrate	REAL	Horizontal fail rate.

levee_fragility

The table that stores the levee fragility data. This data is written to the hidden layer when the data is imported. This table is not editable.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (levfraggrid)	INTEGER	Grid element id of the cell.
levfragchar	TEXT	Fragility character representing levee frag line.
levfragprob	REAL	Fragility probability.

levee_general

The hidden table that is filled when the file is imported. Not editable.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
raiselev	REAL	Global height to raise all levees.
ilevfail	INTEGER	Levee fail switch.
gfragchar	TEXT	Levee fragility character.
gfragprob	REAL	Levee fragility probability.

mud

Table of data for the sed.dat file mudflow line. Data is imported into this table when GDS import is used. It is not editable.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
va	REAL	Viscosity coefficient.
vb	REAL	Viscosity exponent.
ysa	REAL	Yield stress coefficient.
ysb	REAL	Yield stress exponent.
sgsm	REAL	Specific gravity.
xkx	REAL	Laminar flow resistance.

mud_areas

The table that stores the data for the polygons that represent a debris storage basin. The polygons are stored in the Mud Areas layer in the Sediment Transport group. Data is for the sed.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
debrisv	REAL	The volume of debris basin.
geom	POLYGON	Polygons features of debris basins.

mud_cells

The table that joins the mudflow debris basin polygons to the grid. Data is for the SED.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (debnod)	INTEGER	Grid element id of the cell.
area_fid	INTEGER	Id of the mud areas layer.

mult

The table that stores the data imported from the GDS import. Hidden table not editable. Data is for the mult.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
wmc	REAL	Incremental global width expansion.
wdrall	REAL	Global maximum width.
dmall	REAL	Maximum depth.
nodchansall	INTEGER	Number of channels in each grid element.
xnmultall	REAL	Global Manning's n.
sslopemin	REAL	Minimum slope.
sslopemax	REAL	Maximum slope.
avuld50	REAL	Bed material D50.

mult_areas

Table of values stored in the spatially variable multiple channel areas. The Multiple Channel Areas layer is part of the Schematic Layers group. Data is for the mult.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
wdr	REAL	Individual max width.
dm	REAL	Individual max depth.
nodchns	REAL	An individual number of channels within the element.
xnmult	REAL	Individual Manning's n.
geom	POLYGON	Feature polygon representing individual multiple channel areas.

mult_cells

The table that joins the multiple channel areas to the grid layer. Data is for the mult.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid (igrid)	INTEGER	Grid element id of the cell.
area_fid	INTEGER	Multiple channel areas id.
line_fid	INTEGER	Multiple channel line id.
wdr	REAL	Local width.
dm	REAL	Local depth.
nodchns	INTEGER	Number of mult channels in a grid.
xnmult	REAL	Channel n-value.

noexchange_chan_areas

This table stores the areas that are converted into noexchange channel cells.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
notes	TEXT	
geom	POLYGON	

noexchange_chan_elems

This table stores the data that assigns a noechange channel element to the grid. This data is written to the CHAN.DAT file when the data files are exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
noex_area_fid	INTEGER	No exchange channel area id.
chan_elem_fid	INTEGER	Channel element id.

out_hydrographs

This is a table of polygon areas that define the outflow condition as O1 – O9. This table is used for schematizing the out_hydrographs_cells table.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
hydro_sym (outchar)	TEXT	O1 – O9
name	TEXT	Name of outflow cell with hydrograph.
geom	POLYGON	Polygon that will intersect a group of cells that will be assigned as outflow nodes.

out_hydrographs_cells

This table stores the grid elements and outflow polygons that are used to write the O1 – O9 outflow hydrograph data. This data will be exported to the OUTFLOW.DAT file when the project is exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
hydro_fid	INTEGER	Fid for the polygons in out_hydrographs table.
grid_fid	INTEGER	Grid element id of the cell.

outflow

Table of data for the Outflow layer. This layer is part of the Tables group. The table is listed in the import lines of the flo2dgeopackage.py code. It is used by the import function and its the main purpose is to set up the id fields and switches to join various data tables to the outflow nodes. It is referenced in the import GDS code, schematic to user layers code and export GDS code.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the outflow feature.
chan_out	INTEGER	Switch to identify a channel node. Set to 1 for a channel. Leave null for no channel.
fp_out	INTEGER	Switch to identify a floodplain node. Set to 1 for floodplain. Leave null for no floodplain.
hydro_out	INTEGER	Switch to identify that a hydrograph should be captured for a downstream model.
chan_tser_fid	INTEGER	Id to join to time series data for a channel.
chan_qhpar_fid	INTEGER	Id to join to channel rating curve data.

chan_qhtab_fid	INTEGER	Id to join to depth discharge data.
fp_tser_fid	INTEGER	Id to join to outflow time series data.
type	INTEGER	Inflow or outflow.
geom_type	TEXT	Point, line or polygon.
bc_fid	INTEGER	Id from the BC layer in Schematic layers.

outflow_cells

Table to join the outflow data to the grid layer. This layer is part of the Tables group.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
outflow_fid	INTEGER	Id for the outflow features from the user layer.
grid_fid (kout, noddc)	INTEGER	Grid element id of the cell.
area_factor	REAL	Not used.

outflow_time_series

The table that lists the time series tables by name.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the time series table.

outflow_time_series_data

The table that lists the time series stage-time tables by time and elevation data.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
series_fid	INTEGER	Id to join to the time series table.
time (sta_time)	REAL	Time for each stage.
value (sta_stage)	REAL	Stage in elevation.

qh_params

Table to store the names of features for channel outflow discharge curve.

Field Name	Field Type	Description
fid	INTEGER	Id of outflow curve.
name	TEXT	Name of outflow curve.

qh_params_data

Parameters for the stage-discharge curve for a channel outflow node. This table joins to the qh_params table to identify the name of the table and assign the data to the correct outflow node. The data is imported and exported to the outflow.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
params_fid	INTEGER	Id of outflow curve.
hmax (hout(j,1))	REAL	Max depth for valid equation.
coef (hout(j,2))	REAL	Coefficient.
exponent (hout(j,3))	REAL	Exponent.

qh_table

Table for storing the name and id of the channel time discharge curve.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the hydrograph.

qh_table_data

Table to store the depth discharge data for channel outflow nodes and join to the qh_table data. Data is imported and exported for outflow.dat.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
table_fid	INTEGER	Id from qh_table.
depth (chdepth)	REAL	Channel depth.
q (cqtable)	REAL	Discharge for depth discharge outflow condition.

rain

Table of global and control rain data. Data is imported and exported to the rain.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	
irainreal	INTEGER	Real-time rainfall switch.
irainbuilding	INTEGER	Rain on building switch.
time_series_fid	INTEGER	Id for the time series data.
tot_rainfall (rtt)	REAL	Total rainfall.
rainabs	REAL	Global rainfall abstraction.
irainarf (rainarf)	INTEGER	RainARF switch. This variable is miss labeled in QGIS. It is not an array but a global variable.
movingstrom	INTEGER	Moving storm switch.
rainspeed	REAL	The speed of moving storm.
iraindir	INTEGER	The direction of moving storm.
notes	TEXT	Notes.

rain_arf_areas

Table for a polygon layer that represents rain areas with similar depth area reduction factors.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
rain_fid	INTEGER	Grid element of the rain arf cells.
arf	REAL	Depth area reduction factor.
notes	TEXT	Note.
geom	POLYGON	Polygon representing feature with a single depth area reduction factor.

rain_arf_cells

The table that facilitates the join between the rain arf areas layer and the grid layer. Data is imported and exported to the RAIN.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
rain_arf_area_fid	INTEGER	Id of the rain arf areas polygons.
grid_fid	INTEGER	Grid element id of the cell.
arf	REAL	Depth area reduction factor.

rain_time_series

A table that lists the names of the rainfall time series tables.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
Name	TEXT	Name of time series table.

rain_time_series_data

Data in the rainfall time series tables. This date is imported and exported to the rain.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
series_fid	INTEGER	Id from the rain time series table.
time (r_time)	REAL	Time of rainfall.
value (r_distr)	REAL	Percent total rainfall 0 to 1.

raincell

Control data for the real-time rainfall data. This data is imported and exported to the raincell.dat or raincell binary file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
rainintime	REAL	Time interval minutes.
irinters	INTEGER	Number of intervals.
timestamp	TEXT	Start and end time.
name	TEXT	Name of the rainfall event.

raincell_data

Data for the real-time rainfall event. This data is imported and exported to the raincell.dat file or the raincell binary file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
rrgrid	INTEGER	Grid element.
time_interval	REAL	Time of rainfall.
iraindum	REAL	Rainfall in inches or mm.

rat_curves

Table of values for the rating curves for hydraulic structures. This data is imported and exported to the hystruc.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
struct_fid	INTEGER	Id of the structure polyline feature.
hdepexc	REAL	Maximum valid depth for curve q.
coefq	REAL	Coefficient for curve q.
expq	REAL	Exponent for curve q.
coefa	REAL	Coefficient for replacement curve.
expa	REAL	Exponent for replacement curve.

rat_table

Table of values for the depth discharge tables for hydraulic structures. This data is imported and exported to the hystruc.dat file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
struct_fid	INTEGER	Id to join to structure pol-yline.
hdepth	REAL	Headwater depth value for the depth discharge table.
qtable	REAL	Discharge for the depth discharge table.
atable	REAL	Area for the depth dis-charge table.

rbank

Table of data linked to the Right Bank layer of the Schematic Layers group.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
chan_seg_fid	INTEGER	Id of the channel segment.
geom	LINESTRING	Polyline representing a right bank.

repl_rat_curves

Table of data that stores the replacement rating curve data for hydraulic structures. This data is saved to the HYSTRUC.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
struct_fid	INTEGER	Id to join to structure polyline.
repdep	REAL	Replacement depth. Replacement curve starts at this depth.
rqcoef	REAL	Replacement discharge coefficient.
rqexp	REAL	Replacement discharge exponent.
racoef	REAL	Replacement area coefficient.
raexp	REAL	Replacement area exponent.

reservoirs

This table stores the reservoir node data for the schematic layer. It writes to the R line of the INFLOW.DAT file

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
user_res_fid	INTEGER	Id of the reservoir feature in the user layer.
name	TEXT	Name of the reservoir feature.
grid_fid	INTEGER	Grid element id of the cell.
wsel	REAL	Reservoir water surface elevation.
note	TEXT	Note.
geom	POLYGON	The geometry of this layer is a polygon and it would be the same size and shape as a single grid element.

sed

A table of values that define like groups of sediment transport data. This data is written to the SED.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
isedeqg	INTEGER	Sediment transport equation.
isedsizefrac	INTEGER	Sediment size fraction.
dfifty	REAL	Sediment size D_{50}
sgrad	REAL	Sediment gradient coefficient.
sgst	REAL	Sediment specific gravity.
dryspwt	REAL	Dry specific weight.
cvfg	REAL	Fine sediment volumetric concentration.
isedsupply	INTEGER	Supply sediment to floodplain or channel.
isedisplay	INTEGER	The element used for a list of output for each sediment transport equation.
scourdep	REAL	Maximum allowable scour depth.

sed_group_areas

The table used to connect the sediment transport polygons to the sediment table.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
group_fid	INTEGER	Id of the sediment transport data table.
geom	POLYGON	Polygon layer.

sed_group_cells

Table and layer that joins the sediment layers to the grid layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid	INTEGER	Grid element id of the cell.
area_fid	INTEGER	Id for the sediment layer.

sed_group_frac

This table lists the names of the sediment fragment groups.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	

sed_group_frac_data

This table stores the sediment data for the sediment fragment groups.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
dist_fid	INTEGER	This is the Id of the sediment fragment group.
sediam	REAL	Diameter of the sediment in this group.
sedpercent	REAL	Percentage of the sediment with the specified diameter.

sed_groups

This table stores the data for sediment fraction groups like bed thickness and volumetric sediment concentration.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
isedeqi	INTEGER	Sediment transport equation number.
bedthick	REAL	Sediment bed thickness for sediment routing by size fraction.
cvfi	REAL	Fine sediment volumetric concentration local.
name	TEXT	Name of sediment group.
dist_fid	INTEGER	Id of sediment group.

sed_rigid_areas

This table lists the polygons that represent rigid bed areas.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
geom	POLYGON	

sed_rigid_cells

This table connects the rigid bed areas to the grid elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid	INTEGER	Grid element id of the cell.
area_fid	INTEGER	Id from the rigid bed areas.

sed_supply_areas

This table lists the sediment supply data for polygons that are used to define the location of specific local sediment supply areas.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
isedcfp	INTEGER	Floodplain or channel switch for this sediment supply area.
ased	REAL	Sediment rating curve coefficient.
bsed	REAL	Sediment rating curve exponent.
dist_fid	INTEGER	Id of the sediment supply group.
geom	POLYGON	Polygon features that represent the sediment supply areas.

sed_supply_cells

These are the cells that are intersected with the sed_supply_areas table.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid	INTEGER	Grid element id of the cell.
area_fid	INTEGER	Id from the sediment_supply_areas.

sed_supply_frac

A table that lists the sediment supply groups.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the sediment supply groups.

sed_supply_frac_data

A table of sediment supply data representing sediment diameter and percentage of a given diameter.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
dist_fid	INTEGER	Id of the sediment supply group.
ssediam	REAL	Sediment diameter.
ssedpercent	REAL	Percentage of the sediment for a given diameter.

spatialshallow

A table of data that lists the polygons that have local shallow n data.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
shallow_n (shallown)	REAL	Spatially variable shallow n-value.
geom	POLYGON	Polygon of a group with the same spatial shallow n.

spatialshallow_cells

A table that connects the spatial shallow polygons to the grid elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
area_fid	INTEGER	Fid associated with the spatial shallow n polygons.
grid_fid	INTEGER	Grid element fid.

storm_drains

The table of data for simple storm drains written to the HYDROSTRUC.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
struct_fid	INTEGER	Id of the hydraulic structure.
istormdout	INTEGER	Grid element number of the combined outflow node for the simple storm drain.
stormdmax	REAL	Maximum discharge value for the outlet.

street_elems

The table that links local street nodes to the street segment.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
seg_fid	INTEGER	Id of the street segment.
istdir	INTEGER	Flow direction from the center of the node.
widr	REAL	Local street width.

street_general

Table of global street data assigned to each street segment.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
strman	REAL	Manning's n.
istrflo	INTEGER	Inflow node to the street or floodplain switch.
strfno	REAL	Maximum Froude number.
depx	REAL	Global street curb height.
widst	REAL	Global street width.

street_seg

Table of local street data.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
str_fid	INTEGER	Id field to join local streets to individual street features.
igridn	INTEGER	Id field to join the individual street features to the grid element.
depex	REAL	Local curb height.
stman	REAL	Local Manning's n.
elstr	REAL	Local elevation of the street.
geom	MULTILINESTRING	A geometry with multiple components.

streets

Table of street names for individual street segments.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
stname	TEXT	Name of the street segment.
notes	TEXT	Notes.

struct

Table of values assigned to the polyline features of the hydraulic structures layer. This data is imported and exported to HYSTRUC.DAT.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
type (struchar)	TEXT	Character that identifies the line in hystruc.dat.
structname	TEXT	Name of the structure.
ifporchan	INTEGER	Switch to configure the structure floodplain or channel inlet and outlet designation.
icurvtable	INTEGER	Switch to configure structure calculation source.
inflonod	INTEGER	Inlet grid element.
outflonod	INTEGER	Outlet grid element.
inoutcont	INTEGER	Switch to configure the tailwater condition.
headrefel	REAL	Head reference elevation.
clength	REAL	Culvert length.
cdiameter	REAL	Culvert diameter.

notes	TEXT	Notes.
geom	LINESTRING	Geometry is a line that begins in the inlet node and ends in the outlet node.

swmmflo

Table of values that stores the FLO-2D parameters for storm drain inlets. This data is imported and exported from SWMMFLO.DAT.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
swmmchar	TEXT	Line identifier for
swmm_jt	INTEGER	Grid element assigned to the inlet.
swmm_iden	TEXT	Storm drain inlet name.
intype	INTEGER	Type of inlet.
swmm_length	REAL	Curb opening length or grate wetted perimeter.
swmm_width	REAL	Curb opening width or grate area.
swmm_height	REAL	Curb opening height or grate sag or manhole sur-charge depth.
swmm_coeff	REAL	Weir coefficient.
flapgate	INTEGER	Flapgate switch.
curbheight	REAL	Curb height.

name	TEXT	Name (used by plugin not assigned to SWMMFLOW.DAT or SWMM.inp.)
geom	POINT	The feature is a point geometry that is assigned to the grid element closest to the actual inlet location.

swmmflort

A table of data that joins the grid element to the rating table data for the SWMMFLORT.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid	INTEGER	Grid element id of the cell.
name	TEXT	Name field used by the plugin.

swmmflort_data

Table of data that stores the rating tables for individual inlets. This data is imported and exported from SWMMFLORT.DAT.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
swmm_rt_fid	INTEGER	Id for individual inlets.
depth	REAL	The depth of flow.
q	REAL	Inlet discharge received for each depth.

swmmoutf

Table of data to join the storm drain outfalls to the grid element. This data is imported to and exported from to the SWMMOUTF.DAT.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid	INTEGER	Grid element id of the outfall cell.
name	TEXT	Name of the outfall. This field is used by the SWMMOUTF.DAT and SWMM.inp file.
outf_flo	INTEGER	Outfall discharge switch.
geom	POINT	The feature is a point geometry that is assigned to the grid element closest to the actual outfall location.

tolspatial

Table of data that stores the depth assigned to individual polygons.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
tol	REAL	Depth associated with a storage value for individual grid elements.
geom	POLYGON	Polygon geometry.

tolspatial_cells

Table of values that join the tolspatial polygons to grid elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
area_fid	INTEGER	Id field from the tolspatial layer.
grid_fid	INTEGER	Id of the grid element spatially joined to the tolspatial polygon.

trigger_control

Table of data that lists a layer and sets a repaint control switch that is linked to the schematization buttons so that the layer is repainted when the layers are schematized.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Layer name.
enabled	INTEGER	Switch to enable trigger.

user_1d_domain

Table of data assigned for a 1d layer. This table is not currently used by the plugin.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
geom	POLYGON	Polygon geometry for a 1-D layer.

user_bc_lines

Table of data for the boundary control polylines in the user layers. Polyline features that define an inflow or outflow boundary control.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
type	TEXT	Inflow or outflow type.
geom	LINESTRING	Polyline geometry for an inlet or outlet feature.

user_bc_points

Table of data for the boundary control points in the user layers. Point features that define an inflow or outflow boundary control. This data is schematized to the BC Cells layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
type	TEXT	Inflow or outflow.
geom	POINT	Point geometry for an inlet or outlet feature.

user_bc_polygons

Table of data for the boundary control polygons in the user layers. Polygon features that define an inflow or outflow boundary control. This data is schematized to the BC Cells layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
type	TEXT	Inlet or outlet.
geom	POLYGON	Polygon geometry for an inlet or outlet feature.

user_blocked_areas

Blocked areas table data for the Blocked Areas layer in the User Layer. This layer is used to calculate the Area and Width Reduction Factors. The polygons in this layer are typically building outlines.

Field Name	Field Type	Description
fid	INTEGER	Unique id field not associated with the grid field.
collapse	INTEGER	Building collapse switch
calc_arf	INTEGER	ARF reduction factor. A coefficient to reduce any ARF value generated by the plugin.
calc_wrf	INTEGER	WRF reduction factor. A coefficient to reduce any WRF value generated by the plugin.
geom	POLYGON	Polygons that represent buildings or other blocked features.

user_chan_n

Table of data that joins a natural cross section to a channel element. The data is saved and schematized to the Channel Tables. This table is edited by many processes:

- RAS imported
- Cross section editor
- Channel left bank layer
- Converter schematic to user
- Schematize user data
- Interpolation processes

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
user_xs_fid	INTEGER	Id of a cross-section feature to join to channel feature.
nxsecnum	INTEGER	Id of a channel cross section to join the data from the cross-section table to the channel element.
xsecname	TEXT	Cross section name.

user_chan_r

Table of data that stores channel geometry and joins a rectangular cross section to a channel element. The data is saved and schematized to the Channel Tables. This table is edited by many processes:

- Cross section editor
- Channel left bank layer
- Converter schematic to user
- Schematize user data

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
user_xs_fid	INTEGER	Id of a cross-section feature to join to channel feature.
bankell	REAL	Left bank elevation.
bankelr	REAL	Right bank elevation.
fcw	REAL	Cross-section width.
fcd	REAL	Cross-section depth.

user_chan_t

Table of data that stores channel geometry and joins a trapezoidal cross section to a channel element. The data is saved and schematized to the Channel Tables. This table is edited by many processes:

- Cross section editor
- Channel left bank layer
- Converter schematic to user
- Schematize user data

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
user_xs_fid	INTEGER	Id of a cross-section feature to join to channel feature.
bankell	REAL	Left bank elevation.
bankelr	REAL	Right bank elevation.
fcw	REAL	Cross-section bottom width.
fcd	REAL	Cross-section depth.
zl	REAL	Left bank side slope.
zr	REAL	Right bank side slope.

user_chan_v

Table of data that stores channel geometry and joins a variable cross section to a channel element. The data is saved and schematized to the Channel Tables. This table is edited by many processes:

- Cross section editor
- Channel left bank layer
- Converter schematic to user
- Schematize user data

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
user_xs_fid	INTEGER	Id of a cross-section feature to join to channel feature.
bankell	REAL	Left bank elevation.
bankelr	REAL	Right bank elevation.
fcd	REAL	Cross-section depth.
a1	REAL	Coefficient for variable area.
a2	REAL	Exponent for variable area.
b1	REAL	Coefficient for variable wetted perimeter.
b2	REAL	Exponent for variable wetted perimeter.

c1	REAL	Coefficient for variable top width.
c2	REAL	Exponent for variable top width.
excdep	REAL	Limiting depth for upper replacement curves.
a11	REAL	Upper coefficient for variable area.
a22	REAL	Upper exponent for variable area.
b11	REAL	Upper coefficient for variable wetted perimeter
b22	REAL	Upper exponent for variable wetted perimeter
c11	REAL	Upper coefficient for variable top width
c22	REAL	Upper exponent for variable top width

user_elevation_points

Table of data assigned to the Elevation Points layer. This layer is used to define elevation of levee crests or correct elevations for specific grid elements. This data is called by the Levee editor and the Correct Grid Elevation tools. Data processing is saved to the Levee and Grid layers.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Feature name.
elev	REAL	Elevation.
correction	REAL	Correction value + will add elevation correction and – will subtract correction.
membership	TEXT	All, Grid or Levee. Elevation or correction is applied to grid layer or levee feature based on membership.
geom	POINT	Geometry is a point representing a point of know elevation.

user_elevation_polygons

Table of data assigned to the Elevation Polygons layer. This layer is used to define elevation of levee crests or correct elevations for specific grid elements. This data is called by the Levee editor and the Correct Grid Elevation tools. Data processing is saved to the Levee and Grid layers.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the feature.
elev	REAL	Elevation.
correction	REAL	Correction value + will add elevation correction and – will subtract correction.
membership	TEXT	All, Grid or Levee. Elevation or correction is applied to grid layer or levee feature based on membership.
geom	POLYGON	Geometry is a polygon representing an area of know elevation.

user_fpxsec

Table of data for the floodplain cross section user layer. This data is schematized to the Floodplain Cross Sections and Floodplain Cross Sections Cells layers.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
iflo	INTEGER	Flow direction.
name	TEXT	Cross-section name.
geom	LINESTRING	Geometry polyline.

user_infiltration

Table of data for the infiltration user layer. This is a polygon layer digitized by the user to define spatially Green-Ampt, SCS curve number or Horton infiltration. The data from this layer is schematized to the Infiltration tables and layers.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of the polygon.
green_char	TEXT	C for channel F for floodplain.
hydc	REAL	Hydraulic conductivity.
soils	REAL	Capillary suction.
dtheta	REAL	Soil moisture deficit.
abstrinf	REAL	Initial abstraction.
rtimpf	REAL	Percent impervious.
soil_depth	REAL	Soil limiting depth.
hydconch	REAL	Hydraulic conductivity channel.
scsn	REAL	Curve number.
fhorti	REAL	Horton initial infiltration.
fhortf	REAL	Horton final infiltration.

deca	REAL	Horton decay coefficient.
notes	TEXT	Notes.
geom	POLYGON	Polygon feature outlines variable infiltration areas.

user_left_bank

Data table for the left bank line. This data is schematized to the Channel Segments layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Channel segment name.
depinitial	REAL	Initial depth.
froudc	REAL	Channel limiting Froude.
roughadj	REAL	Roughness adjustment.
isedn	INTEGER	Sediment transport equation.
rank	INTEGER	Segment rank.
notes	TEXT	Notes
geom	LINESTRING	Geometry is a polyline.

user_levee_lines

Table of variables for the levee lines in the user layer. It is also coupled to the Elevation Points layer to create 3-D center lines of levee data. The Levee tool uses data from this layer to schematize the Levees layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Levee name.
elev	REAL	Crest elevation.
correction	REAL	Elevation correction.
Geom	LINESTRING	Geometry is a polyline.

user_model_boundary

Table of data assigned to the Computational Domain layer. Computational domain layer is used to outline the project boundary and set the cell size. This layer is intersected to the grid array to define the location of the grid elements in row and column form. The plugin defines the elements in column, row order. Element number 1 is the first cell of column 1 on the left. The numbering is by column top to bottom.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
cell_size	REAL	Grid element size.
geom	POLYGON	Polygon of the boundary.

user_reservoirs

Table of values that stores the data to be assigned as a reservoir node. This data is schematized to the Reservoirs layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Name of reservoir point.
wsel	REAL	Water surface elevation.
notes	TEXT	Notes.
geom	POINT	A point feature representing any location within the banks of the reservoir.

user_right_bank

A layer that can be used to create a right bank defined by a polyline.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
chag_seg_fid	INTEGER	Id of a specific channel segment.
notes	TEXT	Notes.
geom	LINESTRING	Polyline feature used to intersect grid elements for a right bank.

user_roughness

Table of data assigned to the Roughness layer. This layer can be used to set the roughness variable to individual cells or blocks of cells in the grid layer. It is not necessary to assign roughness data to this layer. The tool will calculate it from any polygon layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
n	REAL	Manning's n.
code	TEXT	Notes.
geom	POLYGON	Polygon features of spatially variable roughness data.

user_spatial_froude

A layer used to create spatially variable limiting Froude polygons.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
Froude (froudefp)	REAL	Manning's n.
code	TEXT	Notes.
geom	POLYGON	Polygon features of spatially variable roughness data.

user_spatial_shallown

A layer used to create spatially variable shallow n polygons.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
n {shallown}	REAL	Shallow Manning's n.
code	TEXT	Notes.
geom	POLYGON	Polygon features of spatially variable spatial shallow n data.

user_spatial_tolerance

A layer used to create spatially variable tolerance or LID polygons.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
tolerance (tol)	REAL	Shallow Manning's n.
code	TEXT	Notes.
geom	POLYGON	Polygon features of spatially variable spatial shallow n data.

user_streets

Table of data used to define the global data of street segments. This data is schematized to the Streets layer.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
name	TEXT	Street name.
n_value	REAL	Street Manning's n value.
elevation	REAL	Street elevation.
curb_height	REAL	Curb height.
street_width	REAL	Street width.
notes	TEXT	Notes.
geom	LINESTRING	Polyline that represents a single street segment.

user_struct

Table of data used to define hydraulic structure polylines. The polylines sole purpose is to define the inlet node and outlet node. All other data is stored in Hydraulic Structures tables. These tables are not visible to the user. They are edited via the Structure Editor widget.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
geom	LINESTRING	Polyline used to define a straight line between the inlet and outlet of a hydraulic structure. It does not reflect the exact location of the structure.

user_swmm

The user layer that stores storm drain inlet, junction and outfall data. This data is written to the schematic layers.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
sd_type	TEXT	Storm drain inlet type.
name	TEXT	Storm drain name.
intype	INTEGER	Inlet type.
swmm_length	REAL	Feature length.
swmm_width	REAL	Feature width.
swmm_height	REAL	Feature height.
swmm_coeff	REAL	Weir coefficient.
flapgate	INTEGER	Flapgate switch.
curbheight	REAL	Curb height.
max_depth	REAL	Max inlet or junction depth.
invert_elev	REAL	Invert elevation.
rt_fid	INTEGER	Rating table ID.

outf_flo	INTEGER	Outfall flow condition switch.
invert_elev_inp	REAL	Invert elevation from swmm.inp.
max_depth_inp	REAL	Max depth from swmm.inp.
rim_elev_inp	REAL	Rim elevation from inp.
rim_elev	REAL	Rim elevation.
ge_elev	REAL	Grid element elevation.
difference	REAL	Grid element to rim elevation difference.
notes	TEXT	Notes
geom	POINT	Inlet or junction point.

user_xsec_n_data

User cross section data including cross section number and station elevation pairs.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
chan_n_nxsecnum (nxsecum)	INTEGER	Channel cross section number.
xi	REAL	Cross section station.
yi	REAL	Cross section elevation.

user_xsections

Table of data assigned to Cross Sections layer. These cross sections are schematized to the Channel Cross Sections layer. The data in this layer is used by the User Cross Sections Editor to define the location of cross sections and assign them to the left bank elements.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
fcn	REAL	Manning's n.
type	TEXT	Natural, Rectangular, Trapezoidal, Variable Area.
name	TEXT	Cross section name.
notes	TEXT	Notes.
geom	LINESTRING	A polyline that represents the location of a cross section.

wstime

Table of data assigned to the Calibration Data layers. This data is imported from and exported to the WSTIME.DAT file.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid	INTEGER	Grid element id of the cell.
wselev	REAL	Water surface elevation.
wstime	REAL	Time at which the elevation occurs.
geom	POINT	Point feature reflecting a known location of elevation of water.

wsurf

Table of data assigned to the Calibration Data layers. This data is imported from and exported to the WSURF.DAT file.

Field Name	Field Type	Description
Fid	INTEGER	Unit fid is unique and not associated with the grid id.
grid_fid	INTEGER	Grid element id of the cell.
wselev	REAL	Max water surface elevation.
geom	POINT	Point of known water surface elevation.

xsec_n_data

Cross section data for the schematic data. This data is written to the XSEC.DAT file when the project is exported.

Field Name	Field Type	Description
fid	INTEGER	Unit fid is unique and not associated with the grid id.
chan_n_nxsecnum	INTEGER	Channel cross section number.
xi	REAL	Cross section station.
yi	REAL	Cross section elevation.

Appendix B FLO-2D Plugin Error Codes

Errors

Type	Code	Message Details
ERROR	110618.1828	Could not save FLO-2D parameters!
ERROR	110618.1816	Could not save FLO-2D parameters!!
ERROR	101218.1535	exporting CONT.DAT or TOLER.DAT failed!
ERROR	101218.1541	exporting MANNINGS_N.DAT or TOPO.DAT failed!
ERROR	101218.1542	exporting INFLOW.DAT failed!
ERROR	101218.1543	exporting OUTFLOW.DAT failed!
ERROR	101218.1543	exporting RAIN.DAT failed!
ERROR	101218.1558	exporting RAINCELL.DAT failed!
ERROR	101218.1559	exporting INFIL.DAT failed!
ERROR	101218.1544	exporting EVAPOR.DAT failed!
ERROR	101218.1623	exporting CHAN.DAT failed!
ERROR	101218.1607	exporting XSEC.DAT failed!
ERROR	101218.1608	exporting HYSTRUC.DAT failed!
ERROR	101218.1609	exporting STREET.DAT failed!
ERROR	101218.161	exporting ARF.DAT failed!
ERROR	101218.1611	exporting MULT.DAT failed!
ERROR	101218.1539	exporting TOLSPATIAL.DAT failed!
ERROR	101218.1612	exporting SED.DAT failed!
ERROR	101218.1614	exporting LEVEE.DAT failed!
ERROR	101218.1613	exporting FPXSEC.DAT failed!
ERROR	101218.1616	exporting BREACH.DAT failed!
ERROR	101218.1617	exporting FPFROUDE.DAT failed!
ERROR	101218.1901	exporting SHALLOWN_SPATIAL.DAT failed!
ERROR	101218.1618	exporting SWMMFLO.DAT failed!
ERROR	101218.1619	exporting SWMMFLORT.DAT failed!
ERROR	101218.162	exporting SWMMOUTF.DAT failed!
ERROR	101218.1621	exporting WSURF.DAT failed!
ERROR	101218.1622	exporting WSTIME.DAT failed!
ERROR	170618.0611	construction of INP dictionary failed!
ERROR	170618.0701	couldn't create a [LOSSES] group from storm drain .INP file!
ERROR	170618.0704	couldn't create a [XSECTIONS] group from storm drain .INP file!
ERROR	170618.07	couldn't create a [OUTFALLS] group from storm drain .INP file!

ERROR	170618.0701	couldn't create a [JUNCTIONS] group from storm drain .INP file!	
ERROR	060319.1604	Evaluation of ARFs and WRFs failed! Please check your Blocked Areas User Layer.	
ERROR	060319.1606	Evaluation of ARFs and WRFs failed! Please check your Blocked Areas User Layer.	
ERROR	051218.2035	Green-Ampt infiltration failed\n	while intersecting soil layer with grid.'
ERROR	51218.2001	Green-Ampt infiltration failed!	
ERROR	140119.1715	Green-Ampt infiltration failed!	
ERROR	40319.1921	Adding features to Storm Drain Nodes failed!	
ERROR	21019.0629	update of Breach Global Data failed!	
ERROR	40219.2015	update of Individual Breach Data failed!"	
ERROR	130219.0755	update of fragility curves failed!	
ERROR	200618.0707	assignment of value failed!	
ERROR	200618.0705	assignment of value from conduits users layer failed!	
ERROR	200618.0631	assignment of value failed!	
ERROR	310718.1942	error populating control variables dialog.	
ERROR	110618.1806	Could not save FLO-2D parameters!	
ERROR	130618.165	Hazus layers loading failed!	
ERROR	130618.1715	Hazus layers loading failed!	
ERROR	80618.0456	Uniformization of field values failed!	
ERROR	150618.0235	Error while computing buildings statistics!	
ERROR	80618.0456	Uniformization of field values failed!	
ERROR	40219.2015	update of Individual Breach Data failed!	
ERROR	20219.0812	couldn't save inlets/junction into User Storm Drain Nodes!	
ERROR	100618.0846	error while loading outfalls components!	
ERROR	210618.1702	error assigning outfall values!	
ERROR	40319.1915	Converting Schematic SD Inlets to User Storm Drain Nodes failed!	
ERROR	51218.1146	couldn't load point or/and line layers!	
ERROR	51218.0559	there are not defined or visible point layers to select ‘inlets/junctions’ components!	
ERROR	51218.06	there are not defined or visible point layers to select outfall components!	
ERROR	51218.0601	there are not defined or visible line layers to select conduits components!	
ERROR	70618.0451	creation of Storm Drain Nodes (Inlets) layer failed!	
ERROR	70618.0454	creation of Storm Drain Nodes (Outfalls) layer failed!	
ERROR	70618.05	creation of Storm Drain Conduits User layer failed!	
ERROR	290718.1934	error while displaying elevation of cell ' + fid	
ERROR	60319.1607	Assigning grid elevation aborted! Please check your input layers.	

ERROR	60319.1608	Evaluation of ARFs and WRFs failed! Please check your Blocked Areas User Layer.	
ERROR	60319.1609	Replacing duplicated ARFs and WRFs failed!	
ERROR	110618.1818	Could not read infiltration global parameters!	
ERROR	271118.1638	error schematizing infiltration!	
ERROR	51218.1839	Green-Ampt infiltration failed! Please check data in your input layers.	
ERROR	40219.2004	assignment of Individual Breach Data failed!	
ERROR	210119.0626	assignment of Breach Global Data failed!	
ERROR	40219.2004	assignment of Individual Breach Data failed!	
ERROR	130219.0746	Saving of Fragility Curve Data failed!	
ERROR	100219.0646	assignment of Individual Multiple Channels Data failed!	
ERROR	310818.0824	error populating export storm drain INP dialog.	
ERROR	80618.0448	reading SWMM input file failed!"	
ERROR	60319.161	Creating Storm Drain Nodes layer failed!\n	+ ""Please check your SWMM input data.\nAre the nodes coordinates inside the computational do-main?
ERROR	50618.1804	creation of Storm Drain Conduits layer failed!	
ERROR	70618.0851	error while exporting [JUNCTIONS] to .INP file!	
ERROR	70618.1619	error while exporting [OUTFALLS] to .INP file!	
ERROR	70618.162	error while exporting [CONDUITS] to .INP file!	
ERROR	70618.1621	error while exporting [XSECTIONS] to .INP file!	
ERROR	70618.1622	error while exporting [LOSSES] to .INP file!	
ERROR	70618.1623	error while exporting [COORDINATES] to .INP file!	
ERROR	160618.0634	couldn't export .INP file!	
ERROR	130718.0831	schematized dialog failed to show!	
ERROR	60319.1611	Schematizing left bank lines failed!	
ERROR	280718.1054	Schematizing right bank lines failed!	
ERROR	101218.1607	exporting XSEC.DAT failed!	
ERROR	260618.0416	couldn’t read CHANBANK.DAT or reassign right bank coordinates!	
ERROR	50818.0618	couldn’t process HYCHAN.OUT!	
ERROR	240718.0359	Couldn't join left and right banks!	
ERROR	80618.0456	couldn't update the inlets/junctions component using [SUBCATCHMENT] group from storm drain .INP file!	
ERROR	60319.1631	Interpolation of channel n-values failed!	

Warnings

Type	Code	Message	Details
WARNING	060319.1831	Levee user lines required!	
WARNING	060319.1806	Assigning values aborted! Please check your crest elevation source layers.	
WARNING	060319.1808	File DEPFP.OUT is needed for the Hazus flooding analysis. It is not in the current project directory:\n	+ project_dir)
WARNING	060319.1810	Please choose at least one conversion source!	
WARNING	060319.1811	Please choose at least one conversion source!	
WARNING	060319.1612	Can't import channels!.\n	CHAN.DAT doesn't exist.
WARNING	060319.1632	Can't import channels!.\n	CHANBANK.DAT doesn't exist.
WARNING	010219.0742	Import channels failed!. Check CHAN.DAT and CHANBANK.DAT files. Import channels failed!.\n	Maybe the number of left bank and right bank cells are different.
WARNING	060319.1613	Export to ""GUTTER.DAT"" failed!	
WARNING	060319.1615	Assignment of building areas to building polygons. Not implemented yet!'	
WARNING	060319.1633	You need at least 2 cross-sections crossing left bank line!	
WARNING	060319.1618	Error while creating schematic Left banks!	
WARNING	220718.0741	Error while creating schematic Right banks!	
WARNING	180319.1431	Schematizing of inflow aborted!	
WARNING	180319.1434	Schematizing of outflows aborted!	
WARNING	060319.1641	Element "" + elem + "" has a cross section of type 'R' without data!	
WARNING	060319.1624	Element "" + elem + "" has a cross section of type 'V' without data!	
WARNING	060319.1625	Element "" + elem + "" has a cross section of type 'T' without data!	
WARNING	060319.1626	Element "" + elem + "" has a cross section of type 'N' without data!	
WARNING	060319.1627	Probing grid elevation failed! Please check your raster layer.	
WARNING	060319.1629	Cell size must be positive. Change the feature attribute value in Computational Domain layer.	
WARNING	060319.1630	Cell size must be positive. Change the feature attribute value in Computational Domain layer or default cell size in the project settings.	

WARNING	060319.1632	Assignment of building areas to building polygons. Not implemented yet!	
WARNING	060319.1650	Evaluation of buildings adjustment factor failed! Please check your Building Areas (Schematic layer).	
WARNING	060319.1612	Please choose at least one crest elevation source!')	
WARNING	060319.1653	Couldn't create new database {}"".format(gpkg_path)	
WARNING	060319.1822	Error processing geometry of inlet/junction '"" + name	
WARNING	060319.1656	Inlet/junction "" + name + "" is faulty!	
WARNING	060319.1657	The following inlets/junctions are outside the computational domain!\n	+ outside_inlets
WARNING	060319.1658	Error processing geometry of outfall'"" + name	
WARNING	060319.1659	Outfall "" + name + "" is faulty!	
WARNING	060319.1700	The following outfalls are outside the computational domain!\n	+ outside_outfalls
WARNING	060319.1701	Error processing geometry of conduit '"" + conduit_name	
WARNING	060319.1702	Conduit "" + name + "" is faulty!	
WARNING	060319.1703	+ str(no_in_out) + "" conduits have no inlet and/or outlet!	
WARNING	060319.1705	Process failed on schematizing floodplain cross-sections!	
WARNING	060319.1706	Cell size must be positive. Change the feature attribute value in Computational Domain layer.	
WARNING	060319.1707	Cell size must be positive. Change the feature attribute value in Computational Domain layer or default cell size in the project settings.'	
WARNING	060319.1709	Creating grid aborted! Please check Computational Domain layer.	
WARNING	060319.1710	Probing grid elevation failed! Please check your raster layer.	
WARNING	060319.1712	Calculating grid elevation aborted! Please check elevation points layer.	
WARNING	060319.1713	Calculating sampling of grid field aborted! Please check grid layer or input points layer.	
WARNING	060319.1714	Please choose at least one elevation source!	
WARNING	060319.1715	There are no roughness polygons! Please digitize them before running tool.	
WARNING	060319.1716	Assigning roughness aborted! Please check roughness layer.	

WARNING	060319.1717	Evaluation of spatial Froude failed! Please check your Froude Areas (Schematic layer).	
WARNING	060319.1719	Evaluation of spatial shallow-n failed! Please check your Shallow-n Areas (Schematic layer).	
WARNING	060319.1720	Evaluation of spatial gutter failed! Please check your Gutter Areas (Schematic layer).	
WARNING	060319.1721	Selection of no-exchange cells failed! Please check your No-xchange Cells (Tables layer).	
WARNING	060319.1724	Calculating SCS Curve Number parameters failed! Please check data in your input layers.'	
WARNING	060319.1835	Importing Rainfall Data failed! ({0})	{1}"".format(e.errno, e.strerror)
WARNING	060319.1726	Probing grid elevation failed! Please check your raster layer.	
WARNING	060319.1727	Cell size must be positive.	Change the feature attribute value in Computational Domain layer.
WARNING	060319.1728	Cell size must be positive.	Change the feature attribute value in Computational Domain layer or default cell size in the project settings.'
WARNING	060319.1729	SWMM input file\n	"" + swmm_file + "" has no coordinates defined!
WARNING	060319.1730	SWMM input file\n	"" + swmm_file + "" has no coordinates defined!
WARNING	060319.1731	Storm Drain point '"" + name + ""' outside domain!	
WARNING	060319.1732	The following conduit inlets were not found!\n	+ conduit_inlets_not_found
WARNING	060319.1733	The following conduit outlets were not found!\n	+ conduit_outlets_not_found
WARNING	060319.1734	+ str(no_in_out_conduits) + "" conduits have no inlet and/or outlet! The value '?' was assigned to them.\	
WARNING	060319.1736	Schematizing of streets aborted! Please check Street Lines layer.	
WARNING	060319.1742	Schematizing failed while creating cross-sections!	
WARNING	060319.1743	Schematizing failed while processing attributes!	

WARNING	060319.1745	Schematizing failed while preparing interpolation table!	
WARNING	060319.1746	There are no user cross sections defined.	
WARNING	060319.1747	CHANRIGHTBANK.EXE execution is disabled!	
WARNING	060319.1748	Can't import channels!.\n	CHAN.DAT doesn't exist
WARNING	060319.1749	There are no user cross sections defined!	
WARNING	060319.1751	Right bank cells selection failed!	
WARNING	060319.1752	Right bank cells calculated	
WARNING	060319.1756	Interpolation of cross-sections values failed!	
WARNING	060319.1757	Channel n-values interpolated into CHAN.DAT file!	
WARNING	060319.1758	Interpolation of channel n-values could not be performed!	
WARNING	060319.1759	Interpolation of channel n-values failed!	

Info Dialogs

Type	Details
show_info	("Files read by this project:\n\n" + self.files_used + "\n\nFiles not found or empty:\n\n" + self.files_not_used)
show_info	("Files exported:\n\n" + self.files_used)
show_info	('Values assigned to the Schematic Levees layer!')
show_info	('Converting User Layers to Schematic Layers finished!)
show_info	('gutter globals is empty')show_info,('gutter globals filled')show_info,('head')show_info,"('globals width%, height%, n_value%' % (head[0], head[1], head[2]))
show_info	('after rows')
show_info	('opened')
show_info	("fid %s, width %s, height %s , heign_value %s, direction %s" % (fid, width, height, n_value, direction))
show_info	('next line')
show_info	("WARNING 040319.0521:\n\nThe following cell(s) with inlet/junction of type 4 " +
show_info	("Inflows schematized!")
show_info	("Outflows schematized!")
show_info	("Run 0.4 min debug")
show_info	('Calculating elevation finished!')
show_info	('Spatial tolerance values calculated!')
show_info	('Perform average grid elevation interception.')
show_info	('Perform elevation from shapefile.')
show_info	('Flow depths were calculated.')
show_info	('Perform sample from raster.')
show_info	('Perform interpolate from DTM points.')
show_info	('Compute from area reduction factors.')
show_info	("Buildings statistics can be seen in 'Buildings Statistics' table.\n\n" +
show_info	('Connection!')
show_info	('TABLE CHANGED in ' + str(I) + ' ' + str(J))
show_info	("WARNING 020219.1836:\n\nThe following " + str(no_rt) +
show_info	('Connection!')
show_info	('Sampling done.')
show_info	('Sampling done.')
show_info	("Importing Storm Drain nodes and conduits data finished!\n\n" +
show_info	("Importing Storm Drain conduits data finished!\n\n" +
show_info	("Importing Storm Drain nodes data finished!\n\n" +
show_info	("Floodplain cross-sections schematized!")

show_info	('Grid created!')
show_info	('Calculating elevation finished!')
show_info	("Sampling of grid field '" + grid_field + "' finished!")
show_info	('Assigning grid elevation finished!')
show_info	('Assigning roughness finished!')
show_info	('ARF and WRF values calculated!')
show_info	('Spatial tolerance values calculated!')
show_info	('Spatial Froude values calculated!')
show_info	('Spatial shallow-n values calculated!')
show_info	('Spatial gutter values calculated!')
show_info	('No-exchange areas selected!')
show_info	("WARNING 150119.0354 Calculating Green-Ampt parameters finished, but \n"
show_info	('Calculating Green-Ampt parameters finished!')
show_info	('Calculating SCS Curve Number parameters finished!')
show_info	('Importing Rainfall Data finished!')
show_info	('Exporting Rainfall Data finished!')
show_info	('Importing predefined time series finished!')
show_info	("Schematizing of Storm Drains finished!\n\n" +
show_info	("No nodes or conduits were defined in file\n\n" + swmm_file)
show_info	("Importing Storm Drain data finished!\n\n" +
show_info	(swmm_file + "\n\nfile saved with:\n\n" +
show_info	("Inlets saved to 'Storm Drain-Inlets' User Layer!\n\nSchematize it before saving into SWMMFLO.DAT.")
show_info	("Streets schematized!")
show_info	('Importing Storm Drain input data finished!')
show_info	('Updating SWMM input data finished!')
show_info	('Left Banks, Right Banks, and Cross Sections schematized!')
show_info	("Files CHAN.DAT and XSEC.DAT saved.")
show_info	('Interpolation of cross-sections values finished!')
show_info	('Confluences schematized!')

Bar Warning

Type	Message
bar_warn	Could not run simulation under current operation system!
bar_warn	Running simulation failed!
bar_warn	Could not find TOPO.DAT file! Importing GDS files aborted!', dur=3
bar_warn	Could not read HEC-RAS file!
bar_warn	There is no grid layer to identify.
bar_warn	There is no schematic cross-section data to display!
bar_warn	There is no evaporation data to display!
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	WARNING 060319.1809 There are not any polygon layers selected (or visible)!
bar_warn	Could not compute Hazus Flooding Analysis!
bar_warn	Reading coordinates from SWMM input data failed!
bar_warn	Reading conduits from SWMM input data failed!
bar_warn	No time series fid for current outflow is defined.
bar_warn	No time series fid for rain defined.
bar_warn	Define a database connections first!
bar_warn	No data series for this inflow.
bar_warn	No time series data defined for that inflow.
bar_warn	No data series for this type of outflow.
bar_warn	Couldn't find outflow fid={} and type={}'.format(fid, typ).
bar_warn	Schematized Channel Editor populated!
bar_warn	Schematized Channel Segments (left bank) Layer is empty!
bar_warn	Schematized Channel Segments (left bank) Layer is empty!
bar_warn	Could not save Channels data! Please check it
bar_warn	There are no Schematized Channel Cross Sections!
bar_warn	Schematized Channel Segments (left bank) Layer is empty!
bar_warn	There are no Schematized Channel Cross Sections!
bar_warn	There are not any polygon layers selected (or visible)
bar_warn	There are not any polygon layers selected (or visible)
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There are no raster layers in the project!
bar_warn	WARNING 060319.1628 There is no grid! Please create it before running tool.
bar_warn	WARNING 060319.1631 There is no grid. Please, create it before evaluating the tolerance values.
bar_warn	No inlets defined in 'Storm Drain Nodes' User Layer!

bar_warn	No rating table defined!
bar_warn	Could not import 3D levee lines data!
bar_warn	There are not any point layers selected (or visible)
bar_warn	Creating User Layers failed on Grid to Computational Domain conversion!
bar_warn	Creating User Layers failed on Grid to Roughness conversion!
bar_warn	Creating User Layers failed on Boundary Conditions conversion!
bar_warn	Creating User Layers failed on 1D Domain elements conversion!
bar_warn	Creating User Layers failed on Levees conversion!
bar_warn	Creating User Layers failed on Floodplain cross-sections conversion!
bar_warn	Creating User Layers failed on Infiltration conversion!
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	No data was selected!
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no any user floodplain cross sections!
bar_warn	There is no Computational Domain! Please digitize it before running tool.
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	WARNING 060319.1711 There is no grid! Please create it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There are not any point layers selected (or visible)
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no grid. Please, create it before evaluating the reduction factors.
bar_warn	There is no any blocking polygons in ""Blocked Areas"" layer! Please digitize them before running tool.
bar_warn	There is no grid. Please, create it before evaluating the tolerance values.
bar_warn	There is no grid. Please, create it before evaluating the Froude values.
bar_warn	WARNING 060319.1718 There is no grid. Please, create it before evaluating the shallow-n values.
bar_warn	There is no grid. Please, create it before evaluating the shallow-n values.
bar_warn	There is no grid. Please, create it before evaluating the no-exchange cells.
bar_warn	Please define global infiltration method first!
bar_warn	Please define global infiltration method first!
bar_warn	Please define global infiltration parameters first!
bar_warn	Please define global infiltration method first!
bar_warn	Please define global infiltration method first!
bar_warn	Please define global infiltration method first!
bar_warn	Schematizing of infiltration failed! Please check user infiltration layers.

bar_warn	Importing Rainfall Data from ASCII files failed! Please check your input data.\nIs the .RFC file missing?
bar_warn	There is no h5py module installed! Please install it to run export tool.
bar_warn	Exporting Rainfall Data failed! Please check your input data.
bar_warn	Importing predefined time series failed! Please check your input data.
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	Vertical inlet opening is not allowed for {}!'.format(inlet_type))
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There are no storm drain components (inlets/outfalls) defined in layer Storm Drain Nodes (User Layers"
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	User Layer ""Storm Drain Nodes"" is empty! Import components from .INP file or shape-file, or schematize Storm Drains.
bar_warn	No oulets defined in 'Storm Drain Nodes' User Layer!
bar_warn	Could not save outfalls! Please check if they are correct.
bar_warn	User Layer ""Storm Drain Nodes"" is empty! Import components from .INP file or shape-file, or schematize Storm Drains.
bar_warn	No inlets defined in 'Storm Drain Nodes' User Layer!
bar_warn	Could not save Inlets! Please check if they are correct.
bar_warn	User Layer ""Storm Drain Conduits"" is empty! Import components from .INP file or shape-file, or schematize Storm Drains.
bar_warn	Could not save conduits! Please check if they are correct.
bar_warn	User Layer ""Storm Drain Conduits"" is empty!
bar_warn	There is no computational domain! Please digitize it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	Storm drain components not saved!
bar_warn	No rating table defined!
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no any user streets to schematize! Please digitize them before running tool.
bar_warn	Vertical inlet opening is not allowed for {}!'.format(inlet_type))
bar_warn	Schematizing of Storm Drains failed! Please check user Storm Drains Points layer.
bar_warn	Recalculation of Max Depth failed!

bar_warn	Importing Storm Drain input data failed! Please check your SWMM input data.
bar_warn	Updating SWMM input data failed! Please check Storm Drain data.
bar_warn	No rating table defined!
bar_warn	Too many columns to paste.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There are no User Left Bank lines! Please digitize them before running the tool.
bar_warn	There are no User Cross Sections! Please digitize them before running the tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There are no User Right Bank lines! Please digitize them before running the tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There are no Schematized Channel Segments (Left Banks) to export.
bar_warn	There are no Schematized Channel Cross Sections to export.
bar_warn	Could not run interpolation under current operation system!
bar_warn	Could not run CHANRIGHTBANK.EXE under current operation system!
bar_warn	CHANRIGHTBANK.EXE failed!
bar_warn	WARNING 060319.1754 There is no grid! Please create it before running tool.
bar_warn	WARNING 060319.1755 There are no cross-sections! Please create them before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	There is no grid! Please create it before running tool.
bar_warn	Could not run 'CHAN N-VALUE INTERPOLATOR.EXE' under current operation system!
bar_warn	There is no grid! Please create it before running tool.
bar_warn	WARNING 060319.1801 There is no grid! Please create it before running tool.
bar_warn	WARNING 060319.1802 There are no any user left bank lines! Please digitize them before running the tool.
bar_warn	WARNING 060319.1803 There are no any user cross sections! Please digitize them before running the tool.
bar_warn	All changes to this layer can be overwritten by changes in the User Layer.
bar_warn	ERROR 12117.0602
bar_warn	ERROR 121117.0544

Bar Error

Type	Message
bar_error	ERROR 060319.1604 Cell size is 0 - something went wrong! Does TOPO.DAT file exists or is empty?
bar_error	{} is NOT a GeoPackage!.format(gpkg_path)
bar_error	{} is NOT a GeoPackage!.format(self.gutils.path)
bar_error	ERROR while saving storm drain components from hydraulic layers!
bar_error	ERROR 280318.0530 Cross sections interpolation dialog could not be loaded!
bar_error	ERROR 280318.0528 Cross sections interpolation failed!

Bar Info

Type	Message
bar_info	Simulation started!, dur=3
bar_info	Loading last model cancelled, dur=3
bar_info	Import cancelled, dur=3
bar_info	Flo2D model imported, dur=3
bar_info	Flo2D model exported, dur=3
bar_info	HEC-RAS geometry data imported!
bar_info	Parameters saved!, dur=3
bar_info	Hazus Flooding Analysis performed
bar_info	Converting Schematic Layers to User Layers finished!
bar_info	Not implemented...
bar_info	Channel Profile tool not implemented for selected features.
bar_info	There is no inflow defined in the database...
bar_info	There is no outflow defined in the database...
bar_info	Channel data saved!, dur=3
bar_info	3D levee lines data imported!
bar_info	GeoPackage {} is OK .format(gpkg_path)
bar_info	GeoPackage {} is OK .format(self.gutils.path)
bar_info	No data was selected
bar_info	Schematizing of infiltration finished!
bar_info	There aren t cells with levees defined
bar_info	Individual Breach Data saved.
bar_info	Saving of Individual Breach Data failed!.
bar_info	Breach Global Data saved.
bar_info	Saving of Breach Global Data failed!.

bar_info	There aren t individual breach cells
bar_info	Individual Breach Data saved.
bar_info	Saving of Individual Breach Data failed!.
bar_info	Fragility curve data saved.
bar_info	Saving of Fragility Curve Data failed!.
bar_info	Individual Multiple Channels Data saved.
bar_info	Saving of Individual Multriple Channels Data failed!.
bar_info	Outfalls saved to Storm Drain-Outfalls User Layer!\n\nSchematize it before saving into SWMMOUTF.DAT.
bar_info	Conduits saved to Storm Drain-Conduits User Layer!\n\nSchematize it before saving into SWMMOUTF.DAT.
bar_info	Storm drain components (inlets, outfall, and/or conduits) from hydraulic layers saved.
bar_info	Schematizing of Storm Drains finished!
bar_info	Recalculation of Max Depth finished!
bar_info	CHAN.DAT file exported to + outdir, dur = 5
bar_info	CHAN.DAT file exported to + outdir, dur = 5
bar_info	XSEC.DAT model exported to + outdir, dur=5
bar_info	xsec.dat model exported to + outdir, dur=5
bar_info	HYCHAN.OUT file imported. Channel Cross Sections updated with max. surface water elevations and peak discharge data.
bar_info	Action cancelled, dur=3