

# VS Scene Builder

Mechanical Simulation Corporation offers a variety of tools to integrate with the core software of VS Products: CarSim, TruckSim, and BikeSim. As of version 2018.0, a tool has been developed to assist in rapidly building scenes from pre-built tiles with integrated pathing information. The ease of assembly of scenes greatly streamlines the process of setting up a simulation, and saves time on this step, so you have more time to focus on running simulations.

The purpose of this document is to walk you through the process of locating and accessing the tool, and then will walk you through functionality of the VS Scene Builder. Next, you will be shown the various types of commands and methodology for building a scene, and finally, how to output a scene to a VS product. You will need to have at least version 2018.0 of CarSim, TruckSim, or BikeSim installed. The scene builder tool does not work with earlier versions.

## Accessing the Tool

The VS Scene Builder can be accessed through **Tools > VS Scene Builder** (Figure 1).

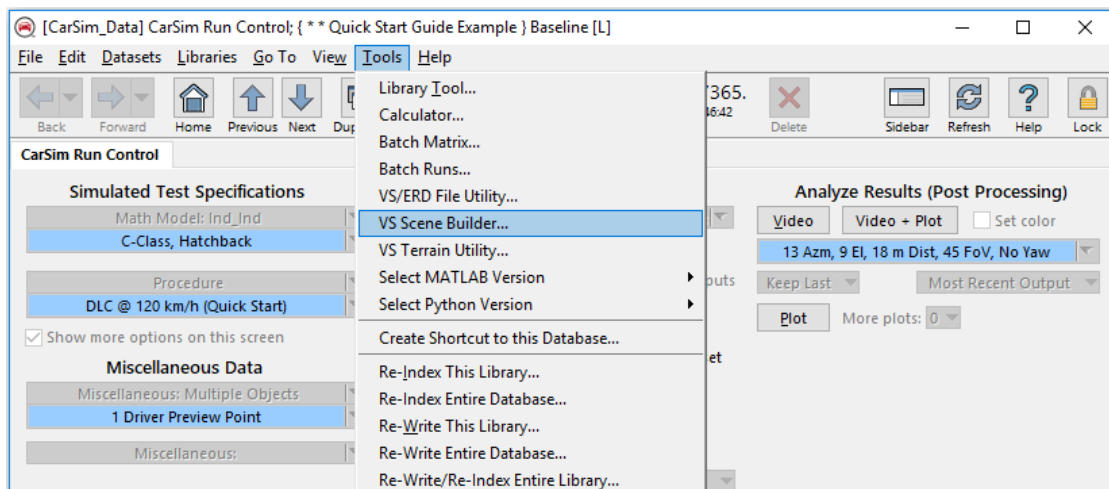


Figure 1. Launching the VS Scene Builder.

## Using the VS Scene Builder

### Introducing the Tile and Props

You will see **Tiles** mentioned a lot in this document. A tile is a pre-packaged set of assets available in the **VS Scene Builder** that contains a thumbnail, visual assets for use with **VS Visualizer**, and embedded pathing information for quickly generating paths within the scene you're creating.

Tiles can be placed in the scene and snapped together however you desire.

The **VS Scene Builder** comes pre-packaged with several sets of tiles useful for building different types of environments. Also provided are several “transition” tiles, that can connect to different tile types on each end. For example, there is a transition tile that can be used to smoothly connect a group of Urban tiles to a group of Highway tiles.

**Props** are scenery furniture, such as signs and barriers, that can be dropped into any scene. The props are categorized to help find the desired prop quickly.

Mechanical Simulation also provides instructions and example material for end users to make their own assets, provided they have the capability to do so.

## Using the Item Palette and Scene

When you launch the VS Scene Builder, you will notice three vertical sections to the application (Figure 2).

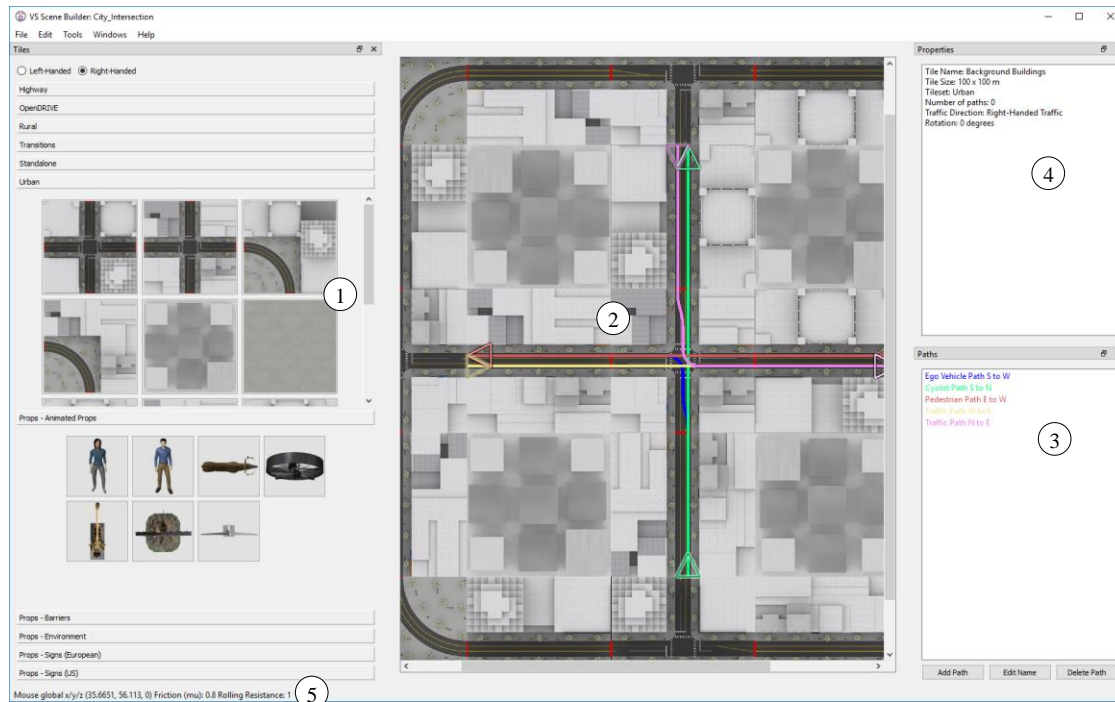


Figure 2. The VS Scene Builder

- 1 On the left is the **Item Palette**, which are visual representations of each tile and prop available to build a scene with. The items are grouped by type. Clicking on the horizontal tabs will switch between item categories. The tile window is separated into two sections; scene tiles and props tiles. A toggle for right-hand traffic and left-hand traffic tiles is at the top of the window and will switch between right and left-handed tile sets.

- ② The center area of the application is the **Scene**, which is the build area which will be exported for use in a VS Product.
- ③ The **Path List** contains the names of all defined paths. Clicking on a path will highlight it in the scene and provide further information in the properties pane. Double-click on a path to center the scene view around the extents of the path.
- ④ The right side of the application is the **Properties Pane**, which will give information on the object the mouse is currently hovered over. It gives information about things in the **Scene**, as well as the **Item Palette** and **Path List**.
- ⑤ The mouse cursor's position in the scene is displayed in the lower left of the application in the status bar. It will display the x, y, z, friction, and rolling resistance of the point directly under the cursor.

## Functionality

The following are the interface actions to control what happens in the scene builder.

- Drag and Drop tiles from the **Tile Palette** onto the scene.
- Double-Clicking a tile moves and rotates the tile by 90 degrees.
- Double-Clicking a prop will rotate it by 45 degrees. Holding Shift while double-clicking will rotate the prop by 15 degrees.
- Mouse scroll wheel will zoom in or out of the scene. Hotkeys **I** and **O** will also zoom.
- Right mouse button click and drag will pan the scene. **Arrow keys** can also pan around the scene if nothing is selected.
- When a path is selected, click and drag to see the lateral offset from the path. The S, L is listed in the bottom-left of the scene builder application.
- You can select tiles by dragging a box around items or holding **CTRL** while left-clicking multiple objects to form a selection group.
- Delete selected tiles with the **DEL** button.
- Copy selected tiles using **CTRL+C**, cut them using **CTRL+X**. Paste using **CTRL+V**.
- Undo an action with **CTRL+Z**, redo an action with **CTRL+Y**. You can view the undo command list by pressing **`**.
- Hit **ESC** to de-select scene items.
- Holding **CTRL + SHIFT** will lock the mouse cursor to move directly along the x or y axes until you release the keys. This can be helpful to draw aligned path segments.
- Dragged tiles can snap to other tiles with compatible edge points. When a snap is occurring, the tile being dragged will turn green to indicate the compatible edges are being automatically aligned.

- Dragged tiles can snap to the 100-meter grid drawn in the background in light gray. The scene origin is indicated by the dark red grid lines. This can be turned off in **Tools > Options... > Allow tiles to snap to grid**
- When dragging a tile, or group of tiles, hold **CTRL** to avoid snapping to other tiles or the 100-meter grid.
- When making a path, hold **CTRL** and left click to avoid snapping to selectable path points.

### *Context Menu*

- Right-click anywhere in the **Scene** and select **Zoom to scene** to fit the viewing area to encompass all objects.
- Right-click on any scene tile and select **Zoom to Tile(s)** to fit the viewing area to the specified tile or selected tiles.
- Right-click on any scene object and select **Push to the back of its draw layer** to make other objects of its type that it intersects with be rendered first.
- Right-click any prop and select **Set height offset for selected props...** to offset its standard Z coordinate when it renders in the visualization software. If you have a group selection it will apply this offset for all props within the group.
- Right-click to **Set Origin** or **Set Origin Exact**. This will shift the entire scene around the new scene origin.
- Right-click to **Set Origin** or **Set Origin Exact**. This will shift the entire scene around the new scene origin.
- Right-click to **Delete** the selected tiles.

### **Creating a path**

You can add a path by clicking the **Add Path** button. If you have tiles in the scene, all entry points for embedded pathing information will show up as highlighted triangles.

If you click these triangles you can quickly create a path using the embedded tile paths. When you are creating a path in this mode, only the next valid selections will be highlighted. If you click elsewhere you will enter **Manual Path Mode**, and you can click anywhere. This can be useful when using tiles such as the Concrete Square in the Urban tile set, which has no embedded path information.

|             |  |
|-------------|--|
| <b>Note</b> | Holding <b>CTRL</b> and left clicking will place a point with a straight line from the previous point without snapping to any selectable points. This can be useful on tiles when the start and end points of paths do not match. This behavior can create a straight-line path to the next point when you expect it to follow the curves of the path. The tile may need an update or use <b>CTRL + Left click</b> to manually draw the path between the points. |
|-------------|--|

When the **Add Path** button is pressed, it changes to an **End Path** button which can be pressed to finish a path after adding path points. The path name should be rendered in the same color that the path line is drawn over the tiles in the scene. You can use undo (CTRL+Z) to remove an errant click. In the **End Path** window, you can edit the path name and press **Ok** to complete the path or press **Cancel** to continue editing the path.

### Editing a path name

Selecting an existing path and clicking the **Edit Name** button will allow you to rename a path that you have previously created.

### Deleting a path

If you select a path in the path pane, you can then click the **Delete Path** button to remove it from the list. The highlight of the path, displayed as a matching line in the scene, will also disappear.

## File Menu

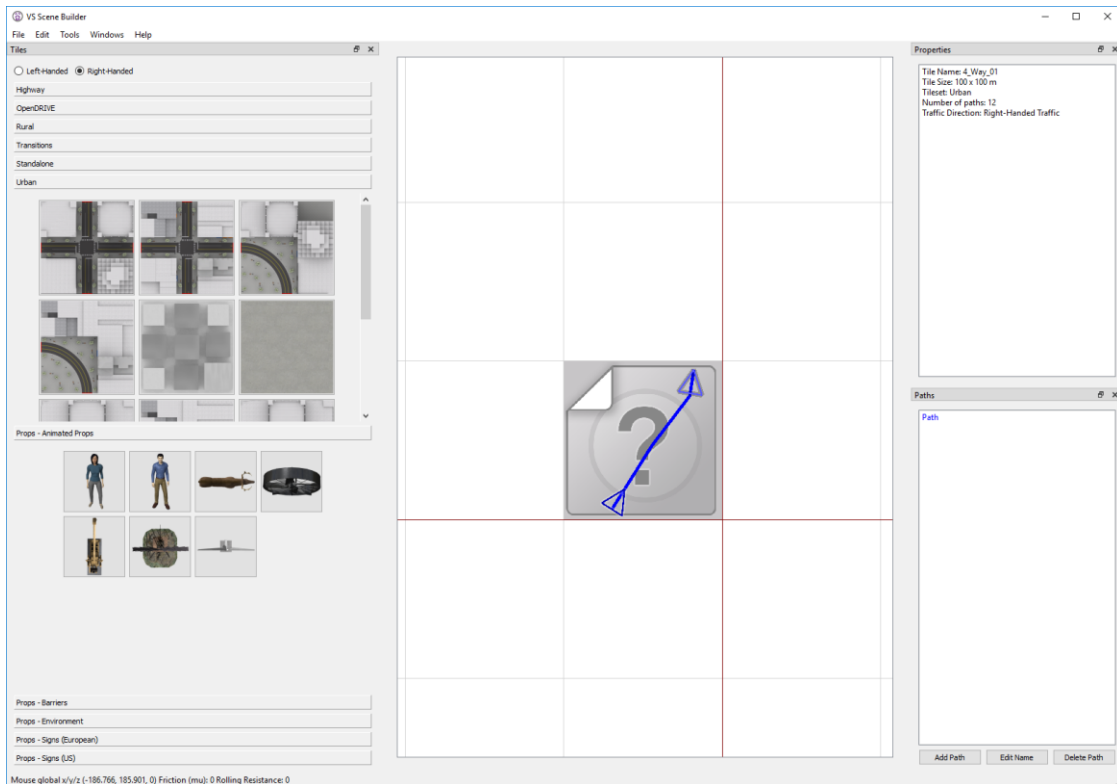
### New... (CTRL+N)

This will discard all objects from the scene and clear the undo history.

### Load... (CTRL+O)

This command can be used to restore a previously saved file for a scene you were working on.

Please note that if you have loaded a file that contains source tiles not available on your PC, the tile will be replaced with a small cyan tile and notify you that it is invalid when you hover the mouse over it. This can happen when you've used a custom tile and subsequently removed it from the VS Scene Builder. Restoring the source data and reloading VS Scene Builder should correct this issue.



*Figure 3. A tile invalid or missing source.*

## Save (CTRL+S)

This command will save the scene you're working on to its last saved location.

## Save As... (CTRL+ALT+S)

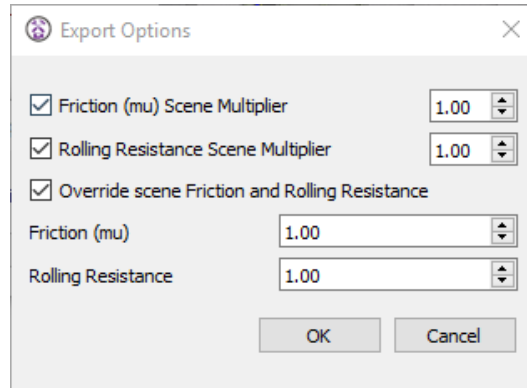
This command will save the scene you're working on to a specified location.

## Import OpenDRIVE... (CTRL+I)

Import OpenDRIVE files (\*.xodr) into the Scene Builder as a tile. Importing a file will copy the file into the Resources OpenDRIVE TileSets directory, procedurally generate a thumbnail, and an FBX (3D Asset) for VS Visualizer. All Imported OpenDRIVE tiles will be added to the OpenDRIVE tile directory when the file is done being processed.

## Export... (CTRL+ALT+E)

The export command will output files necessary to use your scene in a VS Product.



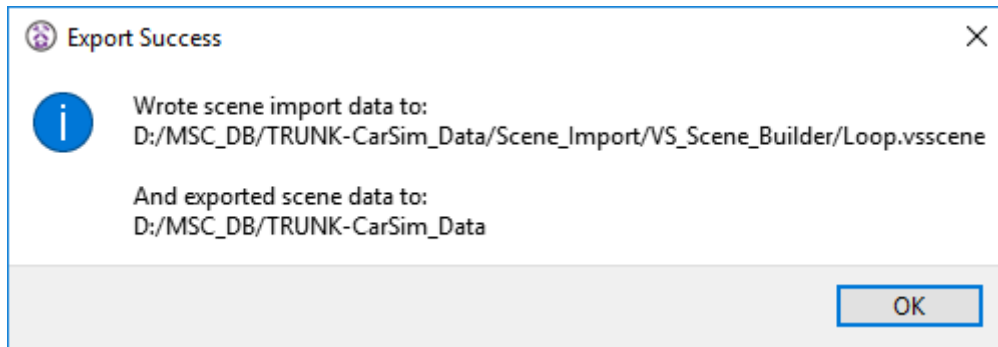
*Figure 4. Export override scene road properties.*

The Export process has the option to scale the friction and rolling resistance for existing VS Terrain used to create the scene VS Terrain file. There is also an option to override the friction and rolling resistance used in the VS Terrain file for the entire scene. The override values will also be multiplied if the Scene Multiplier values are used.

It is recommended that you save your exported VSSCENE file in the database which you intend to use the data with. Doing so will also update the animation shapes in the database needed to render the tiles.

If you save your VSSCENE file outside of a database, you will also be prompted to locate a VS Product database to ensure the animation shapes are current.

After a successful export, you will be given an export message outlining what was written (Figure 5).



*Figure 5. Export success message.*

**Note** All exported scenes will link to a consolidated VS Terrain file. This is created using the tiles that were added to the scene. If a tile does not have its own VS Terrain file, a flat VS Terrain bounding box will be created matching the extents of the tile.

### **Re-export... (CTRL+E)**

This will quickly export the scene again to the last export location.

### **Exit (ALT+F4)**

This will exit the application. Any unsaved work will be lost.

## **Edit Menu**

### **Delete Items (Del)**

This will delete all selected tiles and props.

### **Cut Items (CTRL+X)**

This will delete the selected tiles and props and add them to the clipboard.

### **Copy Items (CTRL+C)**

This command will make copies of the selected tiles and props on the clipboard.

### **Paste Items (CTRL+V)**

This will paste any items in the clipboard to the scene.

### **Undo... (CTRL+Z)**

Removes the last user action to the scene.

### **Redo... (CTRL+Y)**

This will reenact the last action that was removed via the **Undo** command.

### **Toggle Command List (\)**

Displays the command list that makes up the stack of actions that can be undone or redone.

## **Tools Menu**

### **Options**

The options dialog, shown in Figure 6, allows the user to modify some standard behavior of the application. The Options menu also includes the ability to edit how OpenDRIVE tiles are imported and generated.



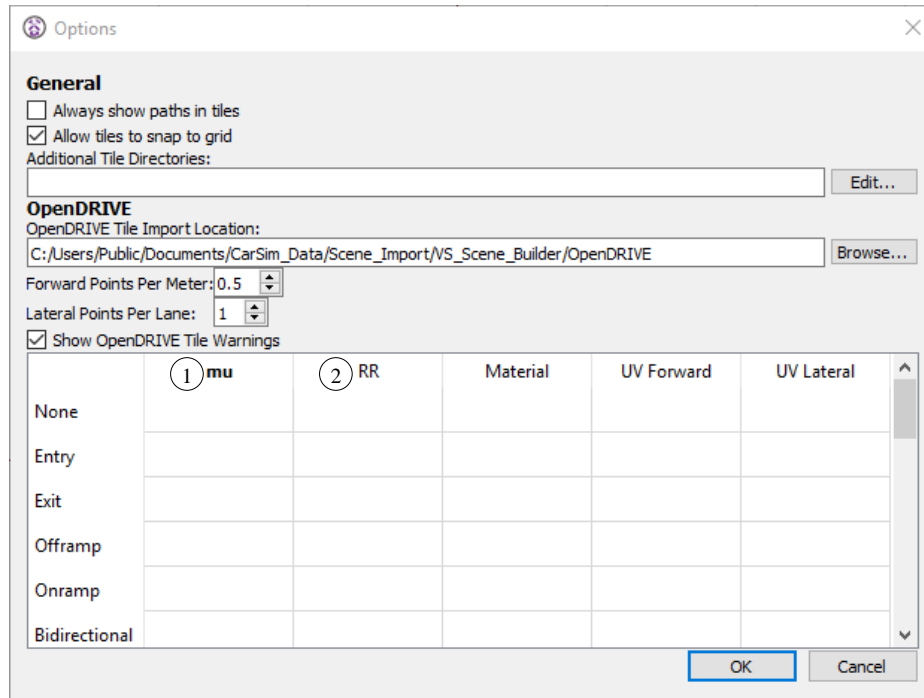


Figure 6. VS Scene Builder Options Menu.

- **Always show paths in tiles** will enable lines to always be drawn representing the built-in paths in the tiles. If not selected, these will only be drawn when the tile is in the current selection group.
- **Allow tiles to snap to grid** is on by default and draws a light-gray 100m grid in the background. This grid allows for tiles to snap into place at these intervals. The scene origin (0, 0) is indicated with dark red lines.
- **OpenDRIVE Tile Import Location** is the directory where imported OpenDRIVE files are copied and the associated thumbnail and FBX are generated. This directory will always generate an Icons and Mesh directory for the supplementary Scene Builder and VehicleSim files. Changing the directory will require a restart of the Scene Builder to load any files that may exist in the new location. If no directory is defined, the Scene\_Import folder for the current VehicleSim database will be used.
- **Additional Tile Directories** is a list of directories separated by semi-colons (;) for additional tiles maintained by the user. Clicking **Edit...** will open a new window where the directories can be added and removed to the list of directories. Scene Builder will also load any props present in the additional tile directories.
- **Forward Points Per Meter** is the points per meter(ppm) of the path in the forward direction. The number of points may be rounded based on the point density and length of the path. All paths will have a minimum of 4 points. Increasing the ppm will GREATLY increase the size of the FBX 3d asset file.
- **Lateral Points Per Lane** is a fixed value for the number of lateral cross sections in each lane. All Lanes will have a minimum of 1 point (the lane edge). Increasing the Points Per Lane will GREATLY increase the size of the FBX 3d asset file.

- **Show OpenDRIVE Tile Warnings** is on by default and will warn users if the OpenDRIVE tile has potential issues. This can be disabled for tile warnings. Tile Errors will always show. Tile errors are found when the tile does not adhere to the OpenDRIVE specification.
- **OpenDRIVE Lane Settings** is a table used to set the driving surface properties as well as the Material settings for the VS Terrain and generated FBX. Empty cells will use the default values. Default  $\mu$  (0.8) <sup>①</sup> and RR (1.0) <sup>②</sup> for every lane type other than None and Median. None and Median are treated like grass by default  $\mu$  (0.6) and RR (0.8). Lane type Special3 is reserved for Lane Edge Markings and uses the same  $\mu$  and RR as Driving. The Material and UV settings use a small set of basic materials for asphalt, grass, and paint markings for basic FBX generation.

## Windows Menu

### Tiles

Re-opens the Tile window.

### Paths

Re-opens the Paths window.

### Properties

Re-opens the Properties window.

### Scene Items

The Scene Items window is not open by default. This window will display a list of all tiles and props. Double click items in the list to focus the scene view on the selected item.

### Layouts

The sub windows in Scene Builder can be docked. For example, the Tiles window can be dragged out of the primary Scene Builder window. The Windows menu option can change between a few set layouts and reopen any sub windows that were closed.

## Help Menu

### VS Scene Builder Manual

Displays this manual.

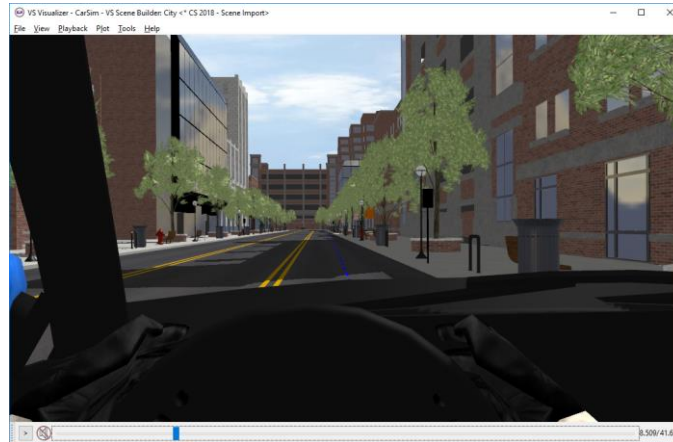
### About

Displays the version of the program.

## Using the VS Scene Builder output in a VS Product

For details on how to use the output **VSSCENE** file, please reference the technical memo for the **Scene External Import** library.

Once imported, you can setup your procedure as you would any other scene you've created with the VS Browser (Figure 7).



*Figure 7. A scene created with the VS Scene Builder.*

## More Information

### Version Notes: 2019.0+

- All exported scenes generate and link to a VS Terrain file within the `vsscene` file. If the run includes a VS Terrain file, all VS Roads will not be used. In 2019.1, the solver will show a warning if a VS Road is included with a VS Terrain.

### Version Notes: 2018.1

- The exported animation data has changed structure slightly to accommodate scene props. The **Resources** folder now diverges into a **Props** and **Tilesets** folder, whereas the old structure was setup just for tiles. The path to the **Urban** collection changes from `Data\Animator\3D_Shape_Files\VS_SceneBuilder\Resources\Urban` to `Data\Animator\3D_Shape_Files\VS_SceneBuilder\Resources\Tilesets\Urban`. If you're updating an old database to the newer version and re-export your scenes, you may end up with some duplicated data in both above locations.

## OpenDRIVE Tiles

OpenDRIVE tiles are creating using the OpenDRIVE format files version 1.4. The initial focus of the OpenDRIVE file is constructing a 3D road asset with selectable paths that can be exported into VehicleSim. Elements such as Objects, and others listed below, in the OpenDRIVE file will not be loaded into the Scene Builder tile and will not be exported into VehicleSim.

## Importing new OpenDRIVE files

There are two methods for importing OpenDRIVE files into the Scene Builder. The first method is mentioned above using the **File > Import OpenDRIVE...** option. This method will copy the OpenDRIVE file into the Scene Builder OpenDRIVE tile directory defined in the Options menu. Users can also copy their files directly into the OpenDRIVE directory. When Scene Builder launches it will search the OpenDRIVE directory and construct the tile for use automatically. For faster launch speed of the Scene Builder, the tile meta data files (thumbnail, mesh, and VS Terrain data) will not be regenerated if they already exist. If the OpenDRIVE file has changed users can import the FBX directly, then the tile meta data will be re-generated.

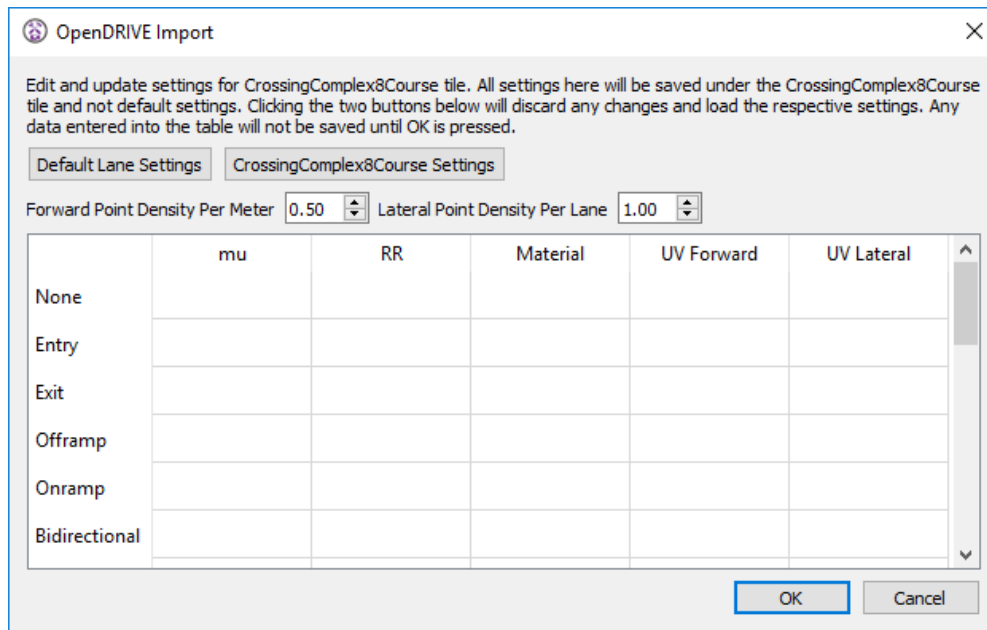


Figure 8: OpenDRIVE Import options.

Users can set road driving surface properties and rendering properties from the import dialog. The same table is available in the Options menu to edit the default lane settings. The mu (surface friction) and RR (rolling resistance) will change how the vehicle drives on each OpenDRIVE lane type. The Material, UV Forward and UV Lateral will change how the lanes are rendered.

When editing the table cells on the import menu take note that any changes are not saved until the **OK** button is pressed. If any edits are made to the cells, clicking the **Default Lane Settings** or **[Tile] Settings** will discard the table contents and load what is saved for selected setting. Any changes made here when committed by pressing **OK** will save the settings only to the **[Tile] Settings**. If you load and edit the default lane settings and press **OK**. The default settings will not change, only the **[Tile] Settings** will be updated. To update the **Default Lane Settings**, open the **Tools > Options...** menu and edit the Lane Settings table.

**Note** Each OpenDRIVE Tile when imported has a tile ID constructed from the relative path of the tile beginning with its parent directory. For

example, if the tile directory is C:\SceneBuilder\OpenDRIVE and the tile is C:\SceneBuilder\OpenDRIVE\figure8scene.xodr, then the tile ID will be OpenDRIVE\figure8scene.xodr. If the scene is saved and the name of the OpenDRIVE directory changes, then the tile will not be found. See Figure 3, a missing tile will be shown as a cyan tile.

## OpenDRIVE Tile Paths

OpenDRIVE files do not directly define paths. When the Scene Builder creates a tile, paths are generated from drivable surfaces. Scene Builder interprets the following Lane Types as drivable surfaces `ENTRY`, `EXIT`, `OFFRAMP`, `ONRAMP`, `BIDIRECTIONAL`, and `DRIVING`. Path placement is determined by the lane edge and the width of the lane. For most paths this will place the path in the center of the lane. In the case of merging lanes, Scene Builder will interpolate from one lane's center line into the other lane's center line along the length of the path.

### *Traffic Driving Side*

OpenDRIVE tiles will default to interpreting the driving side of the road to be the Right-Hand side. If the OpenDRIVE Tile was built as a Left-Hand driving side road network, the OpenDRIVE file will need an update to the header element. Adding `drivingSide="LHT"` to the heading element will reverse the driving direction for left and right-handed lanes.

```
1 <?xml version="1.0" standalone="yes"?>
2 <OpenDRIVE>
3   <header revMajor="1" revMinor="4" drivingSide="LHT">
4     </header>
```

*Figure 9: OpenDRIVE file updated header tag for Left-Handed traffic.*

## User made OpenDRIVE FBX files

Users can replace the generated FBX files with their own assets. Overwrite the generate FBX file within the generated assets folder. Use the same name as the `xodr` file. The new FBX file will then be exported into the VehicleSim database for use. If the textures are not defined in the FBX file, the texture images will need to be copied to the Database animator assets folder manually.

## Unsupported OpenDRIVE Elements

- Objects
- Signals
- Surface
- Railroad
- Station
- Logic used by Controllers, Junctions, Junction Groups.

**Note** The nested file include feature from OpenDRIVE v1.5 is available to use in the Scene Builder. The Right and Left-handed driving feature is indirectly supported by designating the whole file as Right or Left-handed as described in the section above.