Yunex Traffic Map2X

User Guide V.1.2.0

YUNEX TRAFFIC

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1. Map2 Overview

V2X technologies play a pivotal role to provide enough information to connected vehicles that allow these to intelligently plan their routes in an autonomous way.

Map2x tool allows the creation of MAP messages for V2X system. It has two parts:

1.1. Project Manager

Project manager can automatically manage files of a MAP project, allow the user to manage MAP messages (CRUD) and Intersection/Road Segments (CRUD). It can also execute plausibility checks on project MAP messages automatically, when selecting save, or on-demand. Project manager allows the user to export MAP messages based on MAP message definitions and intersection data.

1.2. Intersection Editor

Intersection editor allows a user to create data for an intersection. Intersection editor also provides users with a graphical area for editing intersection data visually and other means to edit intersection data textually. Textually editing of intersection data helps fine-tune intersection properties.

2. Installation

2.1. System Requirements

- Windows 7 or newer
- .NET 4.7.2 runtime environment or newer

2.2. Installation Steps

To install the application, perform the following steps:

- Run Map2xSetup.msi file.
- Choose a language and click the **OK** button.

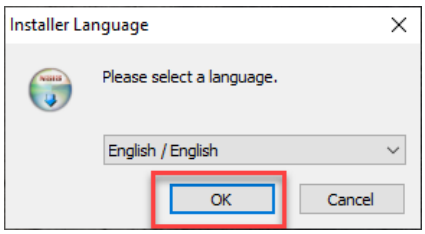


Figure 1: Choose a language to install

- Click the **Next** button

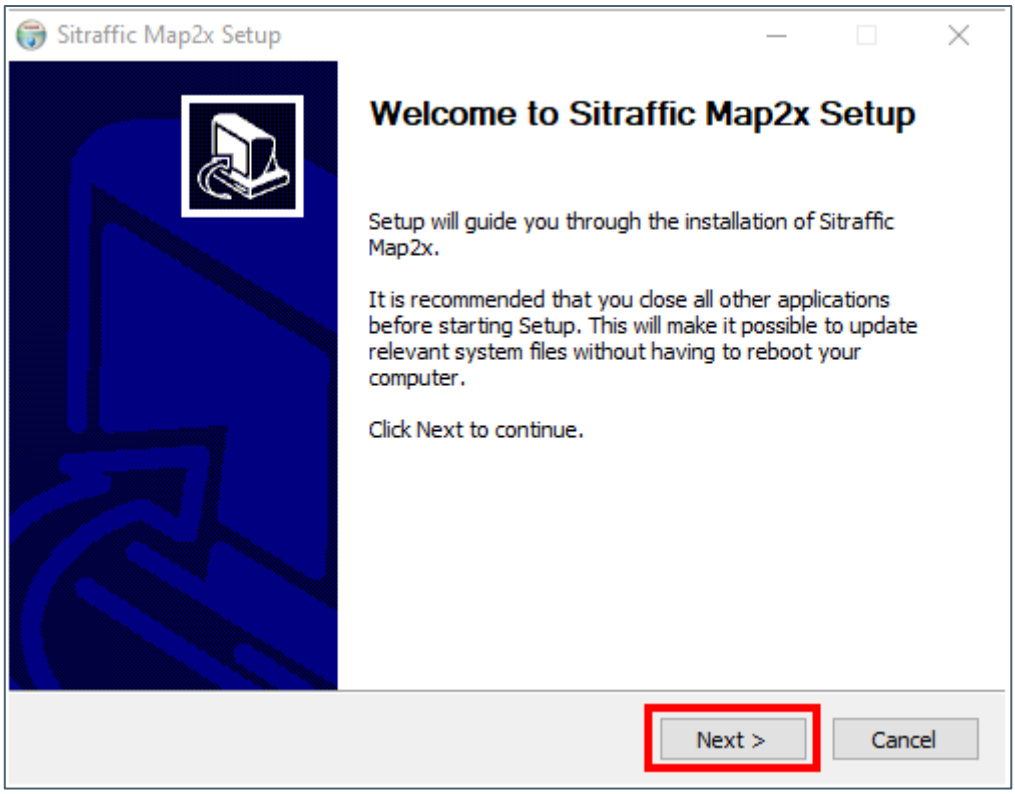


Figure 2: Continue to install Map2x tool

- Accept the License Agreement.
- Click the **Next** button

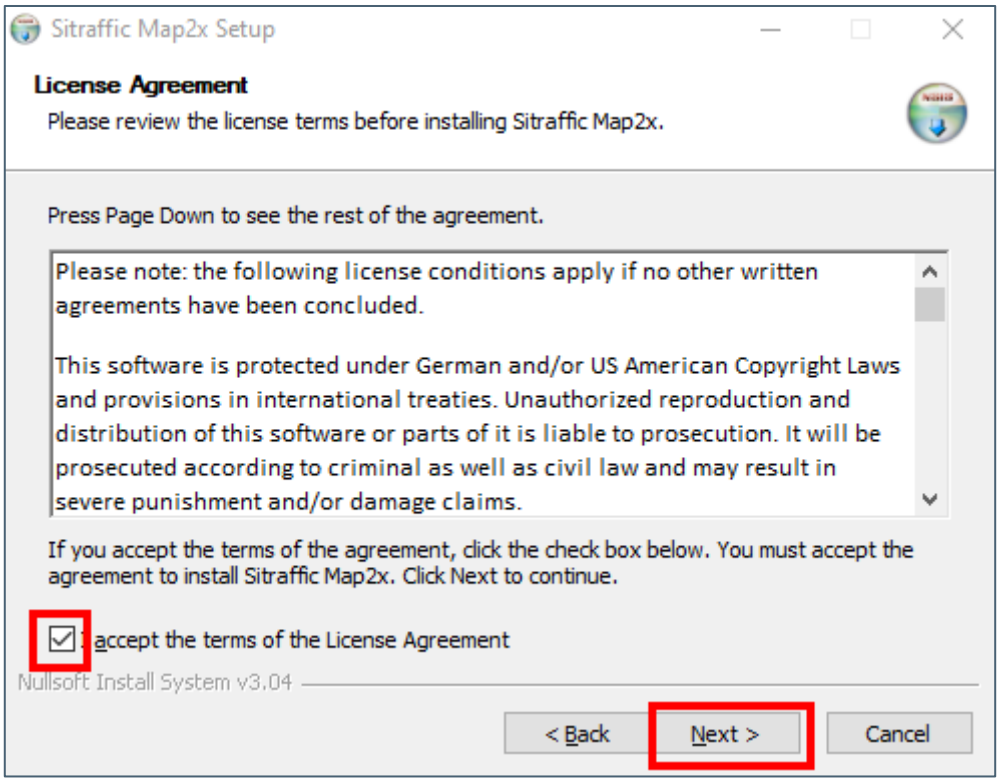


Figure 3: Accept the license

- Choose the destination folder to install the application.
- Click the **Install** button.

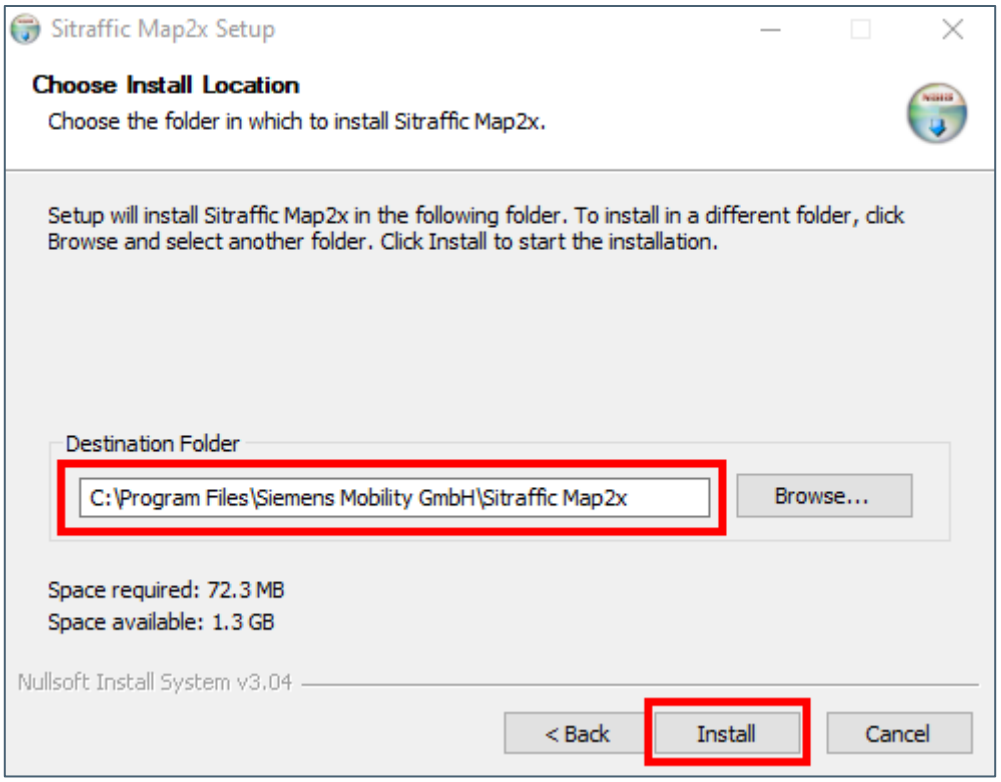


Figure 4: Choose a location to install Map2x tool

- Wait for the application to finish installing.
- Click the **Finish** button to complete the installation.

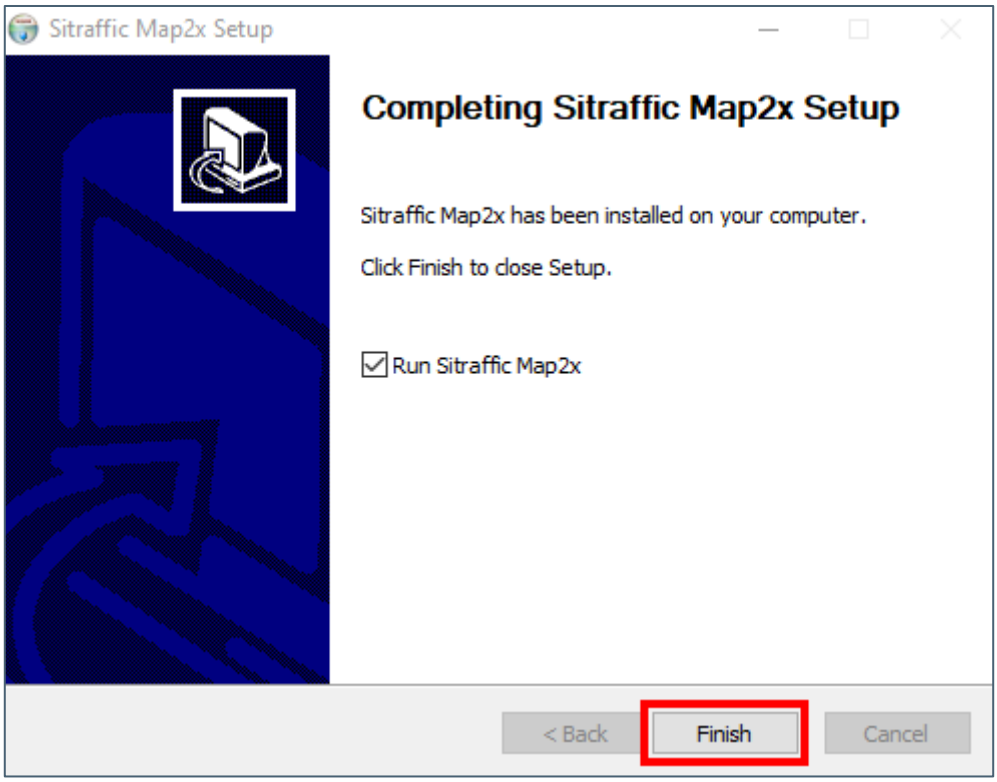


Figure 5: Finish to setup Map2x

2.2.1. Import License file

- After installation, users need to have a valid license file. In the 1.2. release, users are allowed to start Map2x without a license. In this case a dialog will pop up asking users whether they want to import a license file. If the license file is valid and not expired, the application will start and load the main window.

3. Project Management

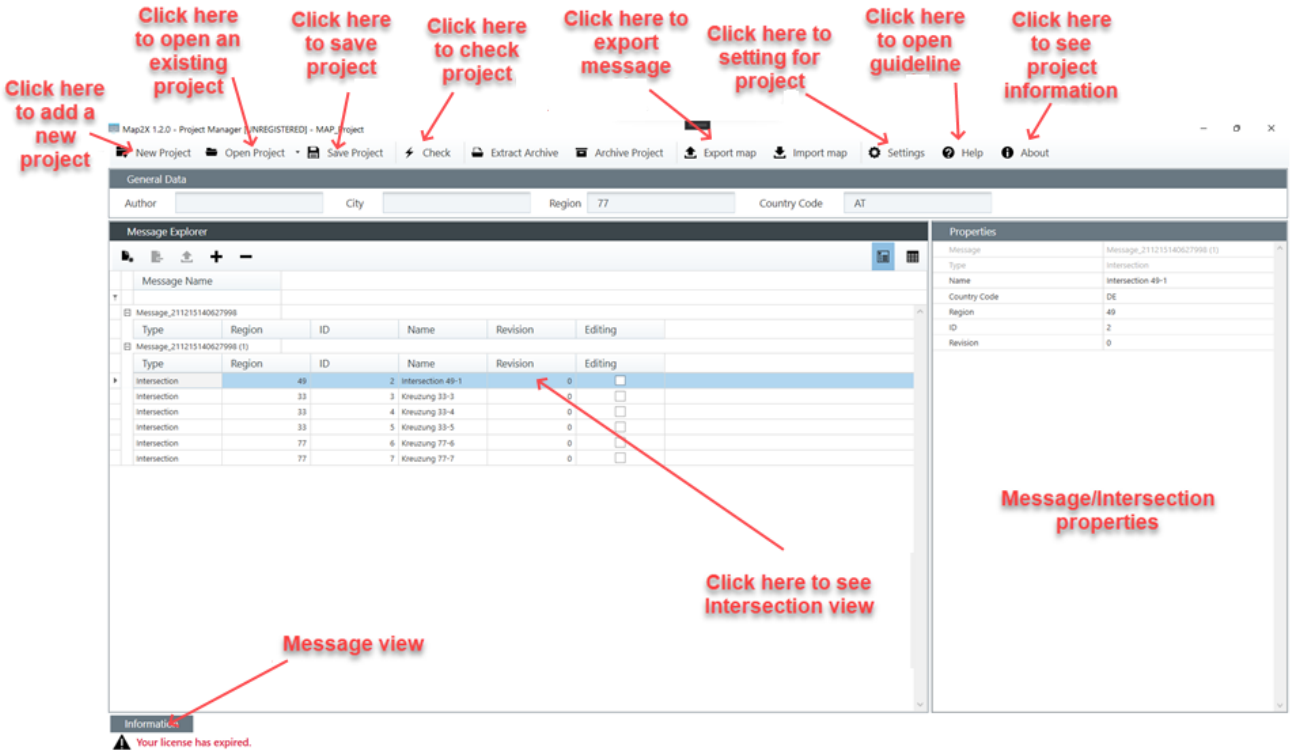


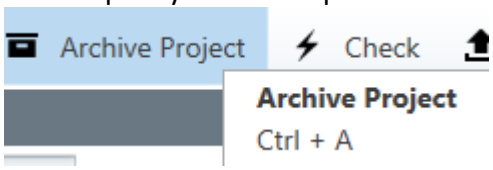
Figure 6: Project Management Overview

3.1. Project

- This function allows a user to create a new project (See the detailed steps here), open an existing project and/or save a project.
- To open an existing project, the user must choose a .m2x file ([ProjectName].m2x).

3.2. Archive Project

- The option “Archive Project” allows to save the project as a zip file so that it is easier to be sent via email. To do so, users needs to click on the “Archive Project” button, and specify the zip folder to save the compressed project file.



3.3. Import Project

- The option “Import Project” allows to open an archived the project as a zip file. All messages in the archived project will become part of the current project.

3.4. Message

- This function allows a user to create a new message (See the detail steps at here), edit message properties and/or manage intersection(s).

- Messages can be sorted, by name, in the project manager dialog.
- When a message is deleted, all the intersections in this message are also deleted.

3.5. Intersection

- This function allows a user to create a new intersection (See the detail steps here) and edit intersection properties.
- Each intersection will open a new Intersection Editor window to enter data.
- When an intersection is deleted, all the intersection data is removed.

3.6. Switch View

- There are two ways to view project data: **Message view** and **Intersection view**.
- To view project data in the **Message view**, click on icon.

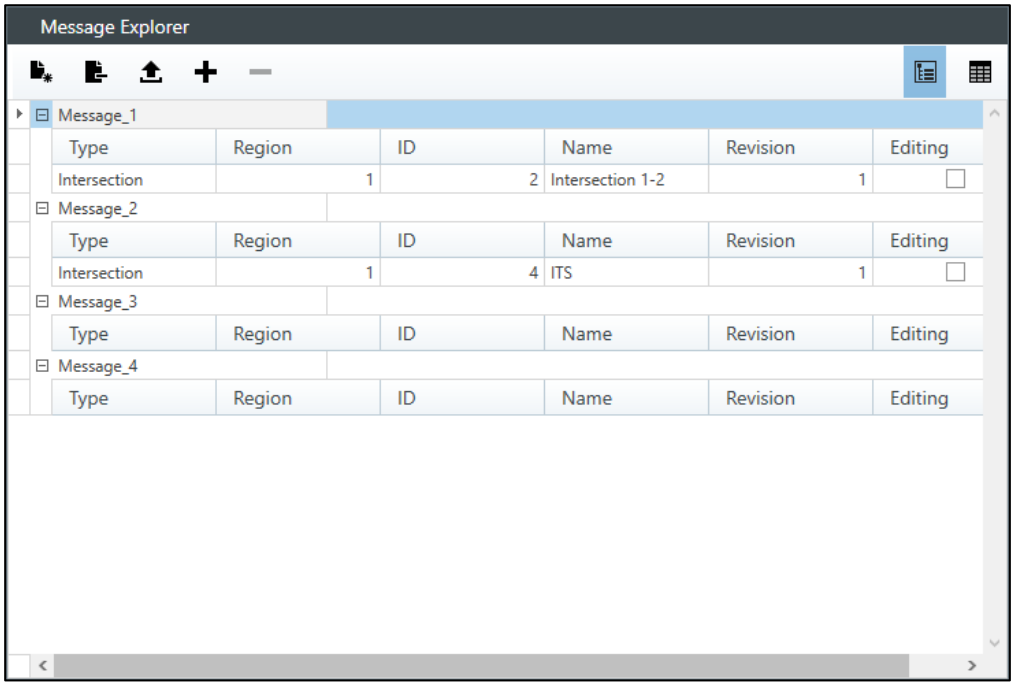


Figure 7: Message View

To view project data in the **Intersection view**, click on icon.

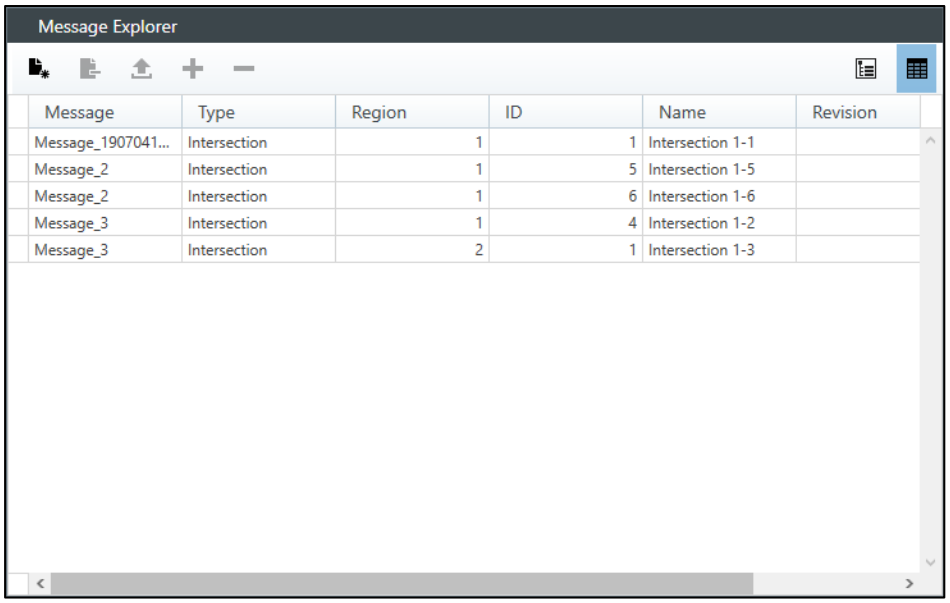


Figure 8: Intersection view

3.7. Settings

The **Settings** dialog allows a user to select a language, change lane color and set the Map service setting.

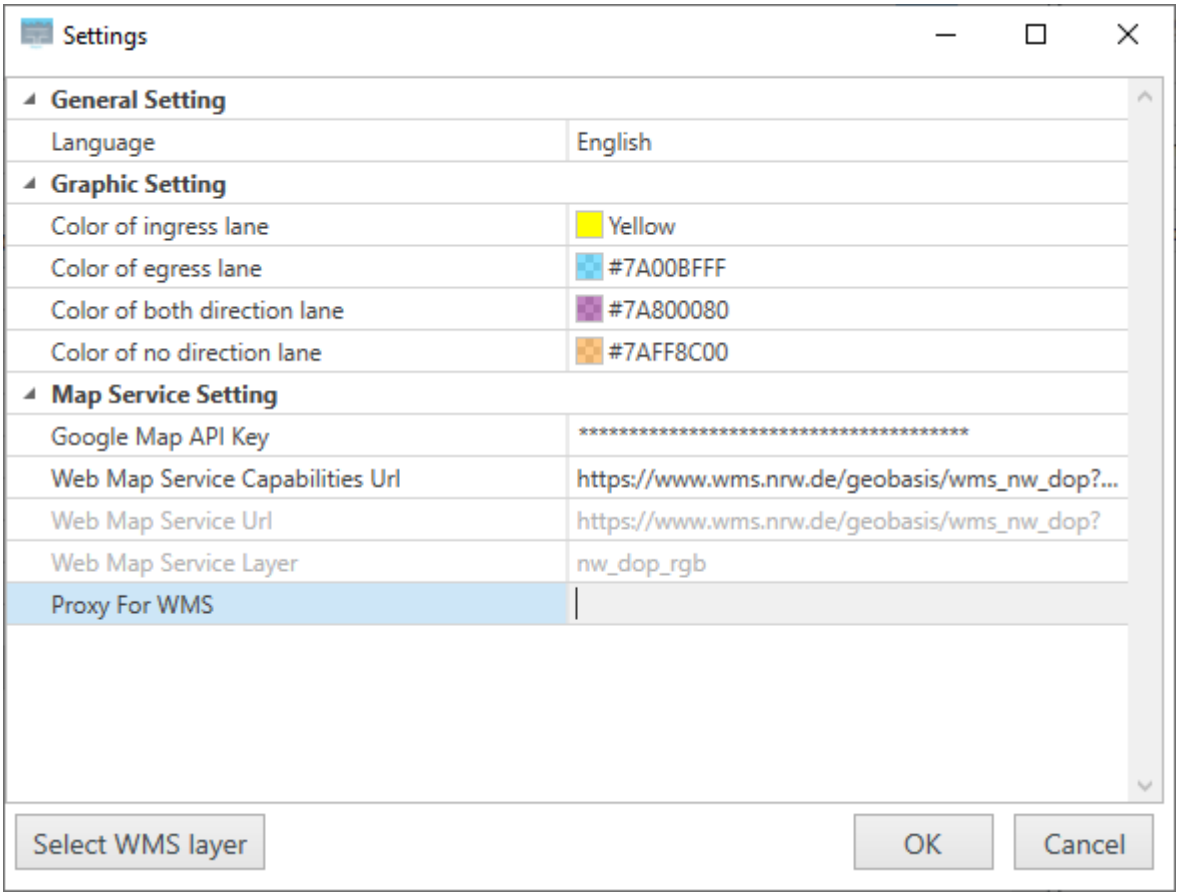


Figure 9: Settings

- To change the language, perform the following steps:
  - Click the **Settings** button on the toolbar.
  - Select language: **English** or **German**.
  - Click the **OK** button.
- NOTE: After changing the language, the user must restart the application to apply the setting.
  - To change the color of the lane, perform the following steps:
- Click the **Settings** button on the toolbar.
- Choose the color used when editing a lane.
- Click the **OK** button.

NOTE: After changing the lane color, the user must restart the application to apply the setting.

- To set the map service, perform the following steps:
- For Google Map:
  - Put the key value in the **Google Map API.**
  - For Web Map Service:
    - Put the URL of the projection in the **Web Map Service Capabilities URL** field

- Select the corresponding layer

NOTE: If these values are blank or invalid, the background in the Intersection Editor is not shown.

3.8. Plausibility Check

- This function validates intersection data. To use the plausibility check:
  - Click on the **Check** button on the toolbar.
  - If all the data is correct, a message will be launched informing the user that the project data is well-formed.

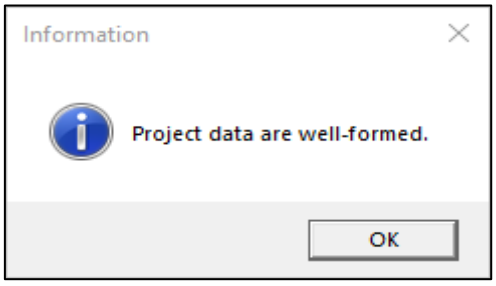


Figure 10: Project Well-Formed

- If the data is not correct, a message informing the user that that data is not well-formed will be launched.

Figure 11: Project Not Well-Formed

- To see the important messages, open the Information tab in the lower-left corner of the project window.

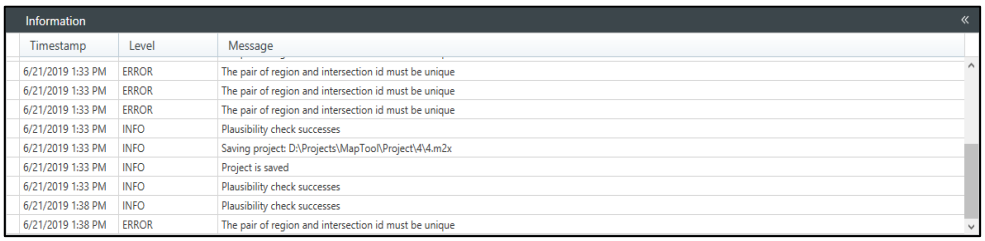


Figure 12: Information

3.8.1. Update overview in Warning view

- The warning messages are grouped by messages of similar type:

Level	Message
Type: Connection Direction invalid	
ERROR	IntersectionGeometry (49:1)\LaneList\Connection (ID=1, des=1): Connection must be between a lane with ingress path attribute and a lane with egress path attribute
Type: Diverge or Merge Point missing	
WARNING	IntersectionGeometry (49:1)\LaneList: Diverge or merge point should have attribute divergePoint or mergePoint
Type: Ingress missing	
WARNING	IntersectionGeometry (49:1)\GenericLane (1): Missing ingress approach value for unidirectional lane.
WARNING	IntersectionGeometry (49:1)\GenericLane (2): Missing ingress approach value for unidirectional lane.
WARNING	IntersectionGeometry (49:1)\GenericLane (3): Missing ingress approach value for unidirectional lane.

3.9. Help

- The help function will launch the user guideline. To open the user guideline:
- Click the **Help** button on the toolbar.

3.10. About

- The About function will launch project information. To launch project information:
    - Click the **About** button on the toolbar.

Figure 13: Tool Information

    - Click **OK** to close the form

3.11. General Data

- Author: Author of the Map2x file
- City: City of the Map2x intersections
- Region: Default region for the intersections. When a user specifies a region, Map2x will auto-populate the region field with this value for new intersections.

4. Intersection Editor

Intersection Editor allows a user to create data for one intersection. It provides a photo or image of the area for editing intersection data.

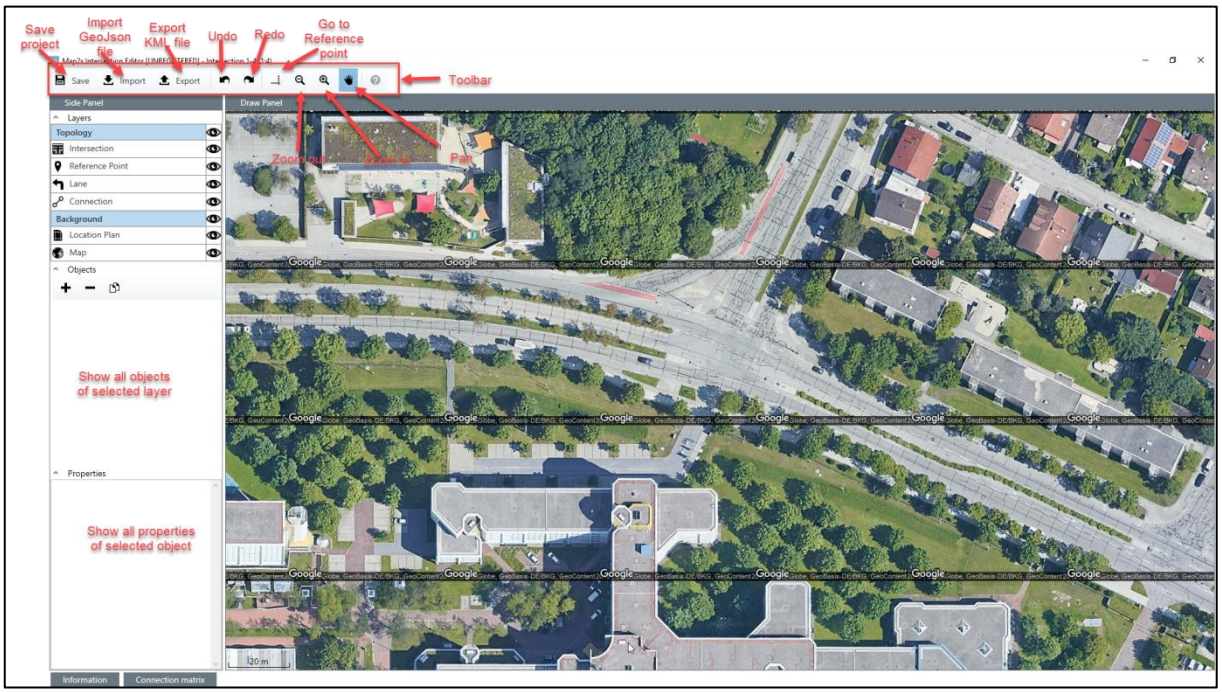


Figure 14: Intersection Overview

4.1. Object actions

4.1.1. Select object(s)

- Reference point
  - Click on the **Reference point** button in the **Layers** section.
- Lane
  - Click on the **Lane** button in the **Layers** section in the left panel.
    - Click on a lane object in the **Object** section (below the Layers section).
    - Or
    - Click on an existing lane on the background image/map.

  To select multiple lanes, perform the following steps:
  - Click on the **Lane** button in the **Layers** section in the left panel.
  - Select the **Ctrl** key, on the keyboard, and select existing lanes on the background image/map.

To select all lanes, perform the following steps:
  - Click on the **Lane** button in the **Layers** section in the left panel.
  - Select **Ctrl + A** key on the keyboard.
- Node
  - Click on the **Select Node** button on toolbar.

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- Click on an existing node on the lane.

- Connection button in the Layers section in the left panel and then:
  - Click on a connection object in the **Object** section (below the **Layers** section).
  - Or
  - Click on the **Select Connection** button on the toolbar.
  - Click on an existing connection on the background image/map.
- Approach
  - Click on an approach object in the **Object** section (below the **Layers** section).
  - Or
  - Click on the **Select Approach** button on the toolbar.
  - Click on an existing approach on the background image/map.

4.1.2. Parallel editing of Connections and Lanes

- When there are multiple lanes and connections in the map, then the respective layer will be selected automatically when users click on objects in the map. E.g. the Lane layer will be selected when users click on a lane or node within a lane. The connection layer will be selected automatically when a connection is selected.

4.1.3. Create new object(s)

- While in Lane, Reference Point, Connection or Approach layers, a new object can be added:
  - Click on the Add Object button on the toolbar.
  - A '+' symbol will appear next to the mouse 
  - Left click on the map to place the object to the map.

4.1.4. Move object(s)

- Move lane(s)
  - Left click and hold the mouse on one of the selected lane(s) and then move the mouse to change its/their position.
    - Multiple lanes can be selected and moved by using CTRL + Left click. This allows all selected lanes to be moved together.
  - Release the left mouse to place the selected lane(s) at a new position.
- Move node(s)
  - Left click and hold the mouse on one of the selected node(s) and then move the mouse to change its/their position.
  - Release the left mouse to put the selected node(s) at a new position.
- Move approach(es)
  - Left click and hold the mouse on one of the selected approach(es) and then move the mouse to change its/their position.
  - Release the left mouse to put the selected approach(es) at a new position.
- Move control point
  - Some objects, like connections and approaches, have control points to adjust the figure.
  - Left click and hold the mouse on one of the selected control points and then move the mouse to change its position.

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- Release the left mouse to put the selected control point at a new position.

4.1.5. Copy objects(s)

Users can make a copy of a lane. To duplicate a lane, perform the following steps:

- Choose a lane.
- Click on the **Duplicate** icon.

A new/duplicate lane is successfully created and has the same properties as the original lane (lane path, lane type, shared with, name...) except lane ID.

Users can also make a copy of an approach. To duplicate an approach, perform the following steps:

- Choose an approach.
- Click on **Duplicate** icon.

A new/duplicate approach is successfully created and has the same properties as the original approach except the approach ID.

4.1.6. Delete object(s)

- Select an object.
- Click the **Remove** icon.

NOTE:

- Users cannot remove the Reference point.
- If the lane is removed, all the nodes and connections, that belong to this lane, are also removed.

4.1.7. Show/Hide object(s)

- Click the **Eye** icon near the object in the Layers to show/hide objects on the map.

4.1.8. Connection Matrix

Shows all the connection information. Click on the Connection matrix tab, at the bottom of the Intersection window, to open this form.

Connection matrix

Connection	From Lane	To Lane	Signal Group
Connection (Lane 4; SG 1)	Vehicle: Lane (1)	Vehicle: Lane (4)	1
Connection (Lane 3; SG 2)	Vehicle: Lane (2)	Vehicle: Lane (3)	2
Connection (Lane 133; SG 3)	Crosswalk: Lane (5)	Crosswalk: Lane (133)	3
Connection (Lane 133; SG 4)	Crosswalk: Lane (5)	Crosswalk: Lane (133)	4
Connection (Lane 5; SG 3)	Crosswalk: Lane (133)	Crosswalk: Lane (5)	3
Connection (Lane 5; SG 4)	Crosswalk: Lane (133)	Crosswalk: Lane (5)	4

Figure 15: Connection Matrix

4.1.9. Shortcut keys

- Ctrl + S: Save
- Ctrl + J: Import GeoJson
- Ctrl + P: Plausibility check
- Ctrl + Z: Undo

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- Ctrl + Y: Redo
- Ctr + I: Import
- Ctrl + E: Export
- Ctrl + N: New project
- Ctrl + O: Open Project
- Ctrl + Y: Open selected Intersection
- Ctrl + R: Go to Reference point
- Ctrl + “+”: Zoom in
- Ctrl + “-”: Zoom out
- Arrow keys (left, right, up, down): move map
- In all modes (except drawing mode), right-click (and hold) enables pan-zoom mode. This allows a user to move around the map. When in pan-zoom, the mouse cursor is changed to Hand icon.
- Select pan-zoom tool
    - Scroll middle mouse down: zoom in
    - Scroll middle mouse up: zoom out
- To highlight an Object Layer:
    - Ctrl + “1” for ‘Intersection’
    - Ctrl + “2” for ‘Reference Point’
    - Ctrl + “3” for ‘Lane’
    - Ctrl + “4” for ‘Connection’
    - Ctrl + “5” for ‘Approach’
    - Ctrl + “6” for ‘Location Plan’
    - Ctrl + “7” for ‘Map’
- switch between Layers Toolbar buttons (i.e. ‘Create new Node and Create New Ingress Lane):
    - Select one of the layers
    - Press the space bar

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5. Basic Workflow

Below are basic steps for creating a message with one intersection geometry:

5.1. Open recent project

- When Map2x is started, and the user has previously opened projects, a dialog that allows a user to select one of the most recent projects (up to 5) will appear.
    - To launch the project, the user can double-click or click on the “Open Project” button.
    - To create a new project, or to launch a project not listed, the user can click on “Cancel” to launch the Project Manager window.

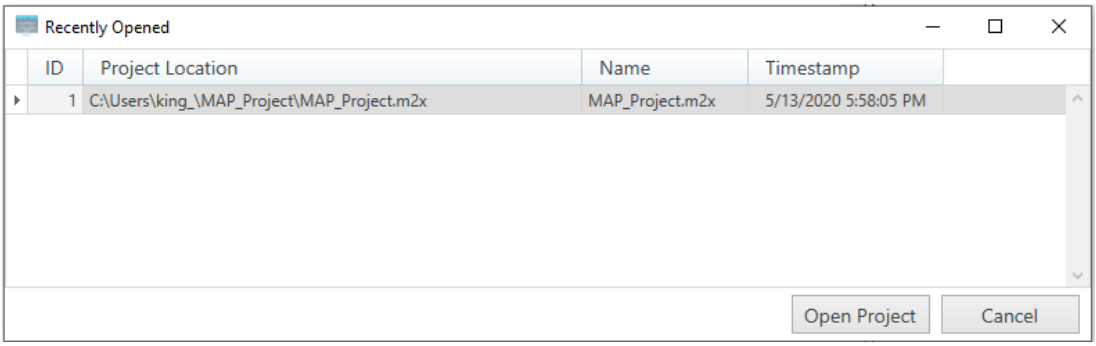

Figure 16: Recent project view

5.2. Open MAP project

- When Map2x is started, a user can also double-click on a “.m2x” file to open it with the Map2x tool.

5.3. Create a new project

- To create a new project, perform the following steps:
    - Click on **New Project** icon on the toolbar.

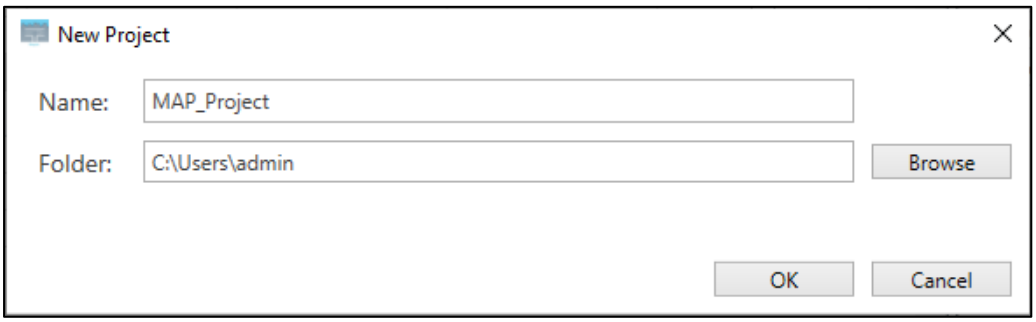

Figure 17: Create New Project

    - Input the project name in the **Name** field.
    - There are two ways to select the location for the project:
        - Click on the **Browse** button and select the location.

Or

        - Input the path directly in the **Location** field.
    - Click the **OK** button.

- The project will be created, and the name will be displayed at the top of the window.
- When a new project is created, it will also create a default message and intersection.

5.4. Add a new message to a project

- Click on the  icon on the **Message Explorer** form.
  - A new message is automatically created.
- Input message properties

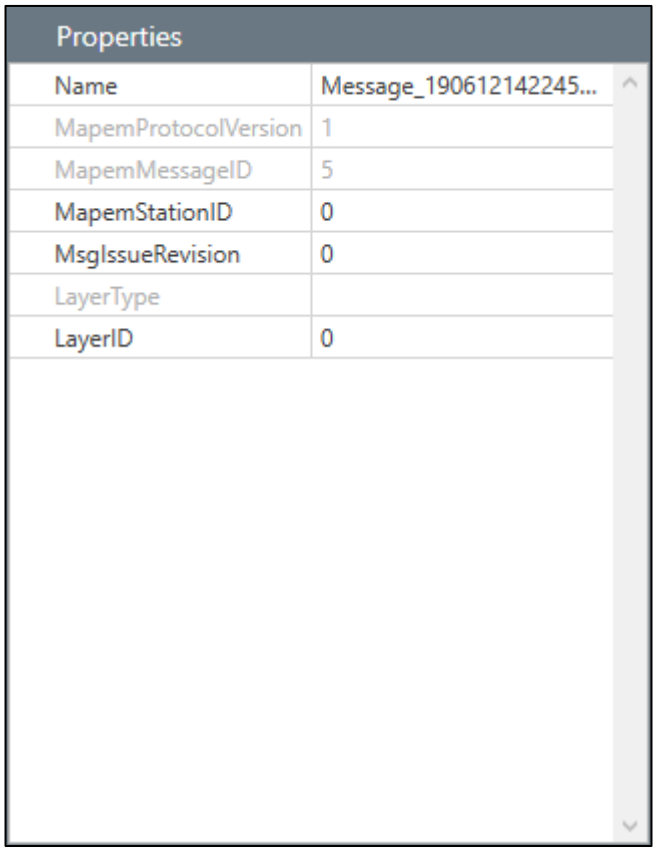

Figure 18: Message Properties

  - Input a new value in the **Name** field.
  - Input values in the **MapemStationID**, **MsgIssuseRevision,** and **LayerID** fields.

5.5. Add a new intersection to a message

- Select a message.
- Click on the  icon on the **Message Explorer** form.
- Input intersection properties.

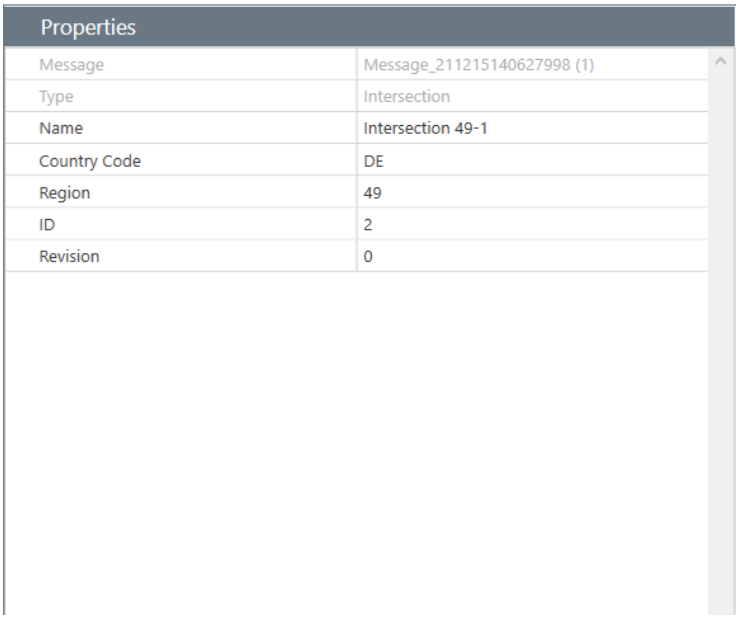

Figure 19: Intersection Properties

- Input a value in the **Region** field.
- Input a value in the **ID** field.

Note: The pair value of Region and ID must be unique.

- input a value in the **Name** field.
- Input a value in the **Revision** field.

5.6. Open intersection in Intersection Editor

Double click on the intersection that you want to edit in the project manager window. It is possible to open multiple intersection editors for different intersections.

5.6.1. Editing layers

In the Intersection Editor, there can be many objects of several categories. Therefore, objects are categorized in several layers or editing modes. When a user selects a layer (or editing mode), they can only modify objects that belong to that layer.

The layers are:

- **Intersection**: There is always one intersection object, in this layer, which contains general information about the intersection. Available properties of this intersection object correspond to the structure of the IntersectionGeometry dataframe. There is no graphical representation of the intersection object.
- **Reference Point**: This layer can contain only one Reference Point object. Properties of the Reference Point object correspond to the structure of the Position3D dataframe.
- **Lane**: This layer contains lane objects and their node objects. A lane object corresponds to a GenericLane dataframe. A node object corresponds to a NodeXY dataframe.
- **Connection**: This layer contains the intersection connection objects. A connection object corresponds to a Connection dataframe. The connection objects are grouped based on the lane objects in which they are contained.

NOTE: In J2735, each Connection dataframe is contained in a GenericLane dataframe.

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- **Approach**: This layer contains the intersection approach objects. An approach is a four-point polygon that describes entry and exit points.

NOTE: In J2735, there is no definition for approach.

- **Location Plan**: This layer can only contain one location plan object which is used when editing an intersection.
- **Map**: This layer does not contain any objects, but a user can select the type of map in the background and navigate via Navigation panel.

5.6.2. Project interlocks

Map2x is designed so that a user can simultaneously work with the Project Manager window and several instances of the Intersection Editor window (each with one specific intersection). To guarantee data integrity, when the user opens the intersection editor, the intersection is “locked” in the Project Manager. If an intersection is locked, its properties cannot be changed in the Project Manager window. Intersections are unlocked automatically when their corresponding editing windows are closed.

5.7. Editing an intersection

To configure properties of intersection, perform the following steps:

- Select Intersection properties

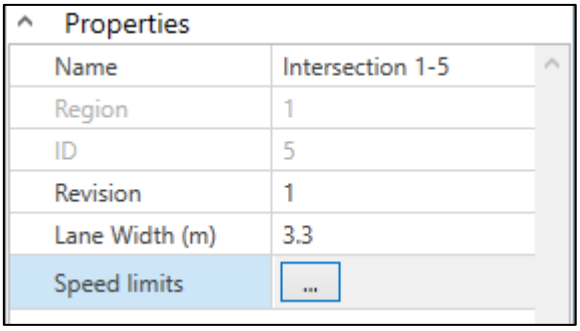

Figure 20: Intersection Properties

  - Input a value in the **Name** field.
  - Input a value in the **Revision** field.
  - Input a value in **Lane Width** field.

Note: All new nodes will use this value for Lane Width.

- Edit speed limits

  To add speed limits, perform the following steps:

  - Click on the button next to Speed Limits

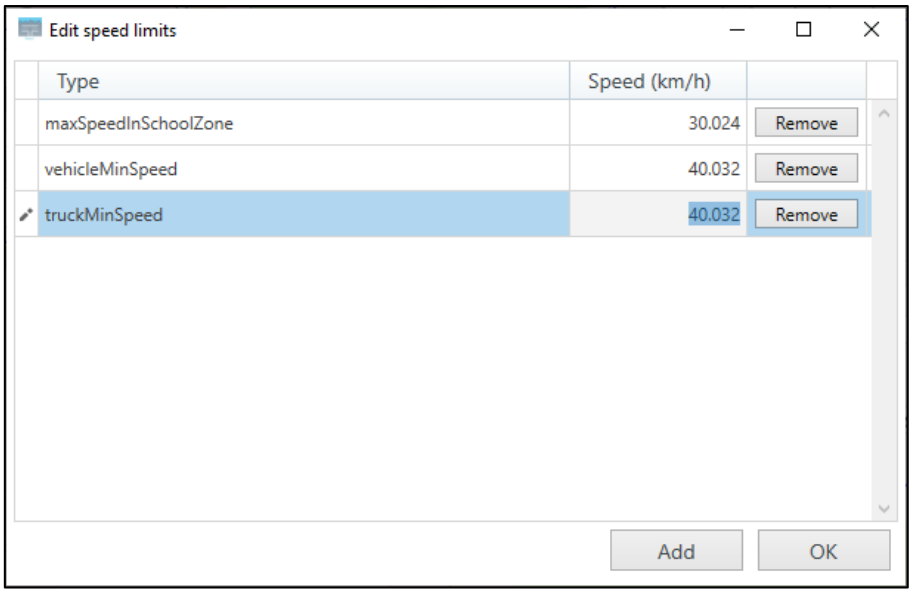

Figure 21: Speed Limits

- Click the **Add** button. By default, the speed limit type is **Unknown,** and the speed is 0.
  - Click on **Unknown** text and choose the speed limit type
  - Change the value of the speed.

5.7.1. Set reference point

- Add Reference Point by toolbar:
  - Click on the **Reference point** button in the **Layers** section.
  - Click on the **Add** icon on the toolbar.
- Click on the background image/map.

  Note: A user can only create one Reference point in the Intersection.
- Add Reference Point by Object Browser:
  - Click on the **Reference point** button in the **Layers** section.
  - Click on the **Add** icon on the Object Browser.

  Note: User can create only one Reference point in the Intersection.

NOTE: Reference point is a mandatory object of an intersection. Removing it removes all the other objects of the intersection. When an intersection geometry is imported (e.g. from GeoJson file), a new reference point is created, and all previously created objects will be removed.

The coordinates of a Reference Point are calculated, based on their placement, by using the OpenStreetMap geo-coordinate system. It is recommended that the user enter, when available, precise coordinates in the verified coordinates property boxes. If not entered, there is a possibility that the street map or satellite photos, from imagery services, will not be precise. This could result in inaccurate placement of the Reference Point if the satellite photo does not have the exact coordinates. Upon exporting of MAP message, these verified coordinates will be used instead of automatically obtained coordinates.

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- Moving reference point
    - In Map2x v1.0, a user could not move the reference point after it had been placed. In this version, there are two options to move the reference point:
        - To move only the reference point, while keeping all the objects unchanged, select icon
        - To move the reference point and all other objects select icon.

Figure 22: Toolbar buttons to set and move reference point

5.7.2. Map navigation

Use this function to display the background image/map

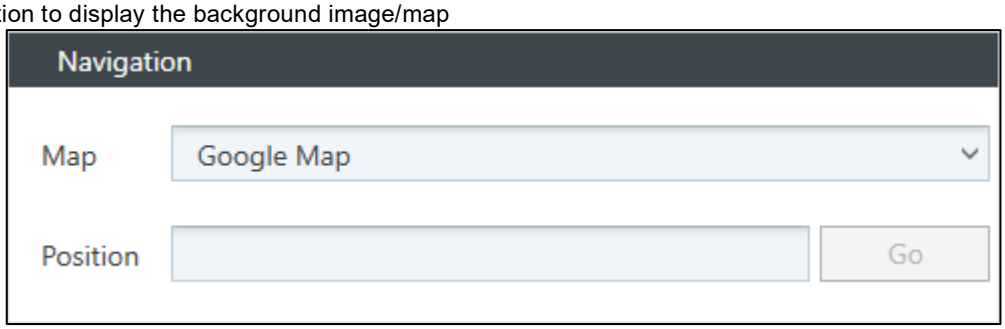

Figure 23: Navigation

- Click on the **Map** in the **Layers** section.
- Select the **Map** service: **Open Street Map**, **Google Map** or **Web Map Service**.

Open Street Map is displayed by default.

- For Web Map Service, a user needs a working URL and to select a layer. (A proxy server may also be necessary).
- Some web map services have many layers with images from different years. The user should select the appropriate layer.

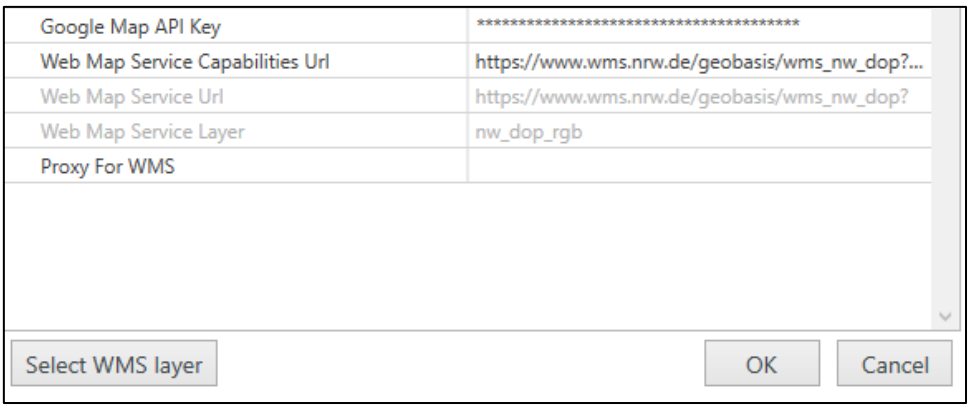

Figure 24: Settings of Web Map Service URL

- Input the street name or the Lat/Long value in the **Position** field.
- Click on the **OK** button.

5.7.3. Set a location plan

To assist the creation of a MAP message, a user can add an image of intersection/location plan. Supported image formats include PNG, JPEG, BMP, GIF.

Some properties of the location plan which can be adjusted:

- **Offsets** from Reference Point (X Offset and Y Offset): These offsets are X and Y distances from location plan center to Reference Point.
- **Dimensions**: Logical (real field) width and height of the location plan, in meters.
- **Rotation**: The angle of which the location plan image is rotated to match real field. A positive angle corresponds with clockwise rotation. Angle units are in degrees.
- Keep image **ratio**: If this property is set to true, the image texture will not be stretched to fill the field area specified width and height.

To add a location plan, perform the following steps:

- Select Location Plan in Layers section.
- Click on the Add button, under Objects, in the left panel.

  Note: Location plan is placed relatively to the Reference Point. Therefore, Reference Point must be added before a user can add a location plan.
- Click on the Browse button to select the image file.
- Input the X Offset, Y Offset relative to Reference Point.
- Input the value in the Width, Height fields.

  Note: These values are real field dimensions.
- Input the value in the Rotation (degrees) field (if any). The center of rotation is the center of the image.
- Click on the OK button.

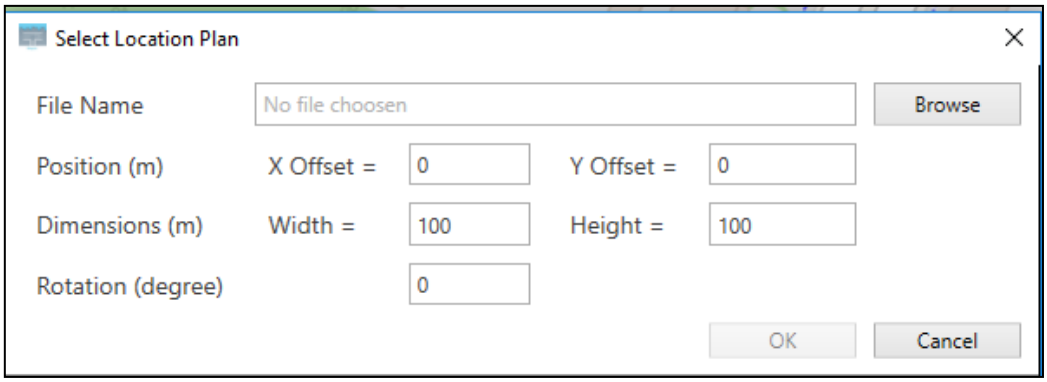

Figure 25: Location Plan

5.7.4. Move a location plan

A location plan can be automatically moved to the targeted location. To move the location plan, follow these steps:

- Specify two points in the location plan via left click and select “Select 1st point” or “Select 2nd point” on the pop-up.

Figure 26: Select points in a Location Plan

- After selecting a point, click on it to enter a point's Latitude and Longitude
- When two points in the location plan have their coordinate set, left click on the location plan image and select "Move". The location plan will then be moved (and rotated) to the points in the entered coordinate.

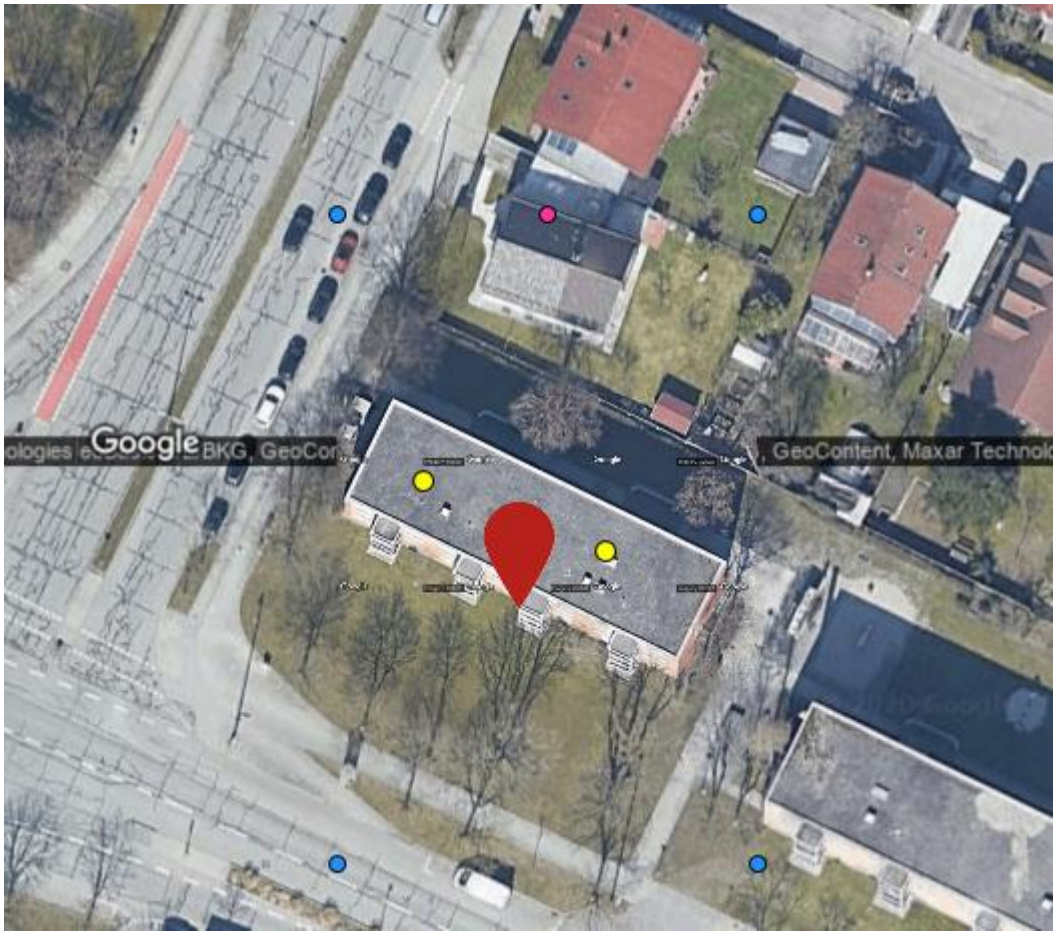

Figure 27: Moved Location Plan

5.7.5. Add lanes to intersection

To add a new lane, a Reference point must be created. Without Reference point, other graphical objects cannot be created.

- Add a new ingress and egress lane by using the toolbar
  - Click on the **Lane** button in the **Layers** section in the left panel.
  - Click on the **Create New Ingress Lane/Create New Egress Lane** icon in the toolbar
  - Click on the background image/map to place the first node of the new lane.

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- Left click, on the background image/map, where you want the new intersection to begin.
- To add additional nodes, left click on the map where each node will be placed.

Note: A lane should not have more than 18 nodes.

- To finish creating a lane, right click on the mouse.
- To cancel creating a lane, press the **Esc** key on the keyboard.

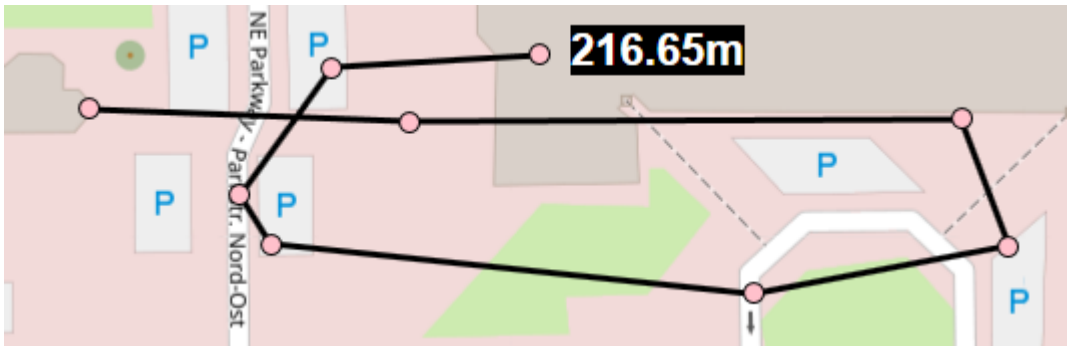
- Add new lane by Object browser
  - Click the **Lane** button in the **Layers** section of the left panel.
  - Click the **Add** icon under Objects in the left panel.
  - A new lane is automatically created with the default lane path as Ingress lane.
- Add new lane by duplication
  - Click the **Lane** button in the **Layers** section in the left panel.
  - Select a lane.
  - Click the **Duplicate** button under **Object** in the left panel.
- A user can drag lanes and nodes to change their positions.
  - Left click on the **Lane** on the map.
  - Left click and hold, while moving the lane to the desired location on the map.
  - The same steps can be used to drag an individual node.
- Bind/Unbind node

  To bind nodes, do the following steps:
  - Click on one node in the lane
  - Drag this node and drop it to a different node
  - Click **OK** on the confirm message

  To unbind nodes, do the following steps:
  - Right click on the node that has been bound, select **Unbind**

5.7.6. Measurement of length

Click the “Draw Ruler” icon in the Layers to start measuring a distance on the map. Then users need to click on 2 or multiple points on the map to create a poly line. The total length of the poly line will be displayed near the last point of the line. Users can finish drawing by right-click on the map view.



5.7.7. Properties of lanes and nodes

- Lane properties

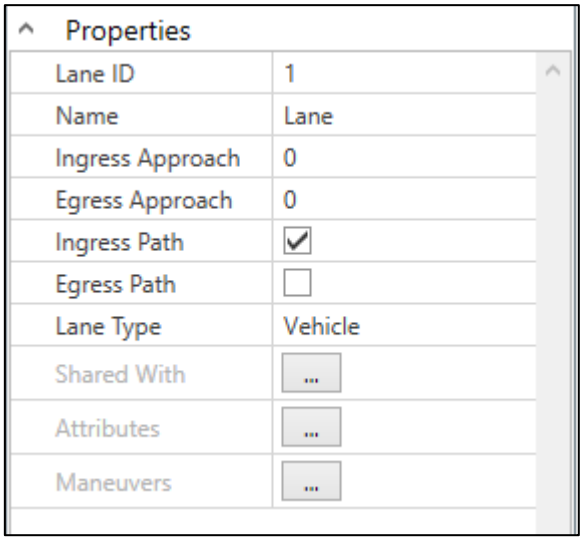


Figure 28: Lane Properties

- **Lane ID**. The Lane IDs must be unique. The lane ID is in the intersection editor between the 1st and 2nd Node of the lane.
- Put a value in **Ingress Approach**/ **Egress Approach** field.
- Choose the lane path. There are 2 paths: Ingress path and Egress path. A user can choose each, both or neither lane path.
- Choose the lane type in the list.
- Choose the Lane attributes. Each lane type has its own attributes.
  - Click the button in the **Attributes**.

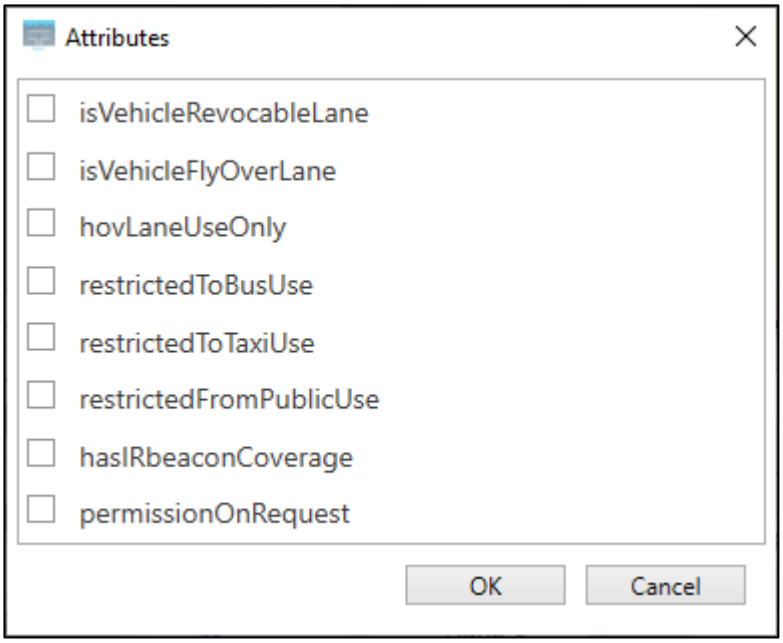


Figure 29: Lane Attributes

- Select the attributes.
- Click the OK button.

- Lane sharing
  - Click on the button in the **Shared With** dialog.

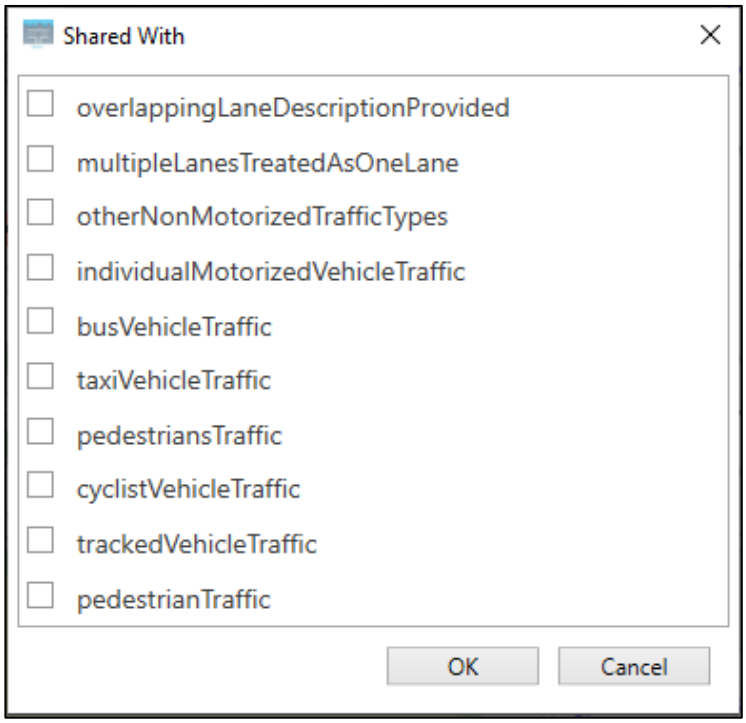


Figure 30: Lane Sharing

  - Choose an element(s).
  - Click the **OK** button.

- Maneuvers
  - Select one or more items in **Maneuvers**.

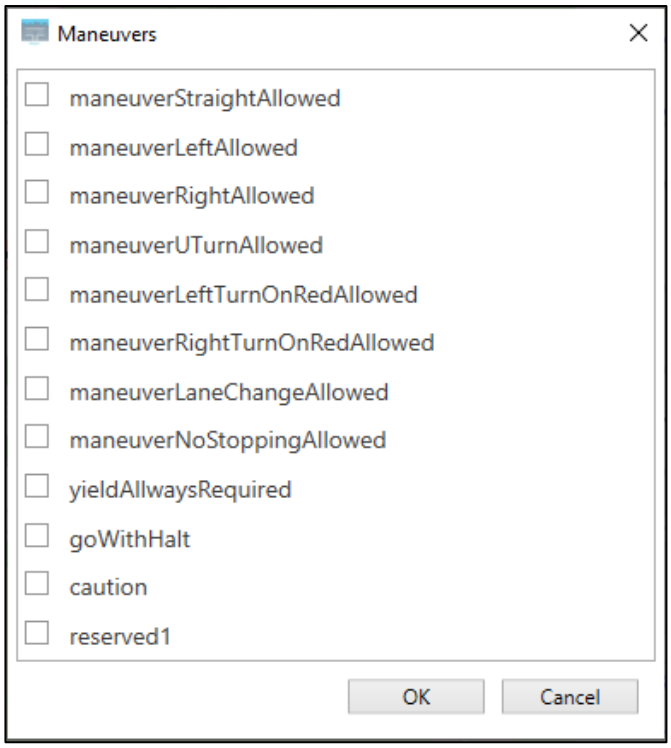


Figure 31: Maneuver

- Choose an element(s).
- Click the **OK** button.

- Node properties

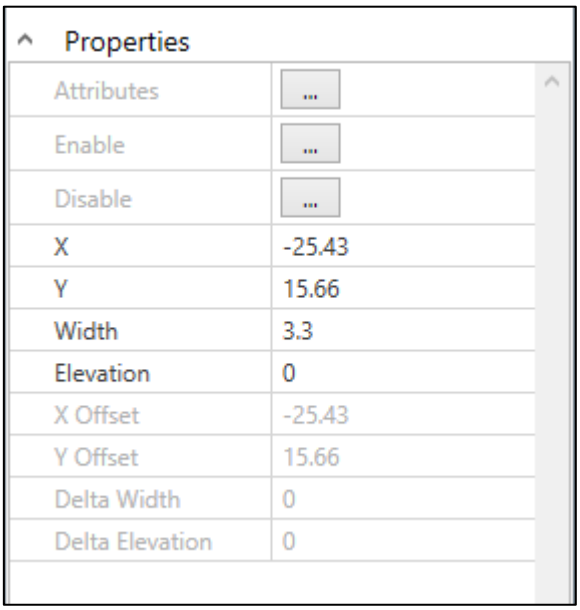


Figure 32: Node Properties

- The first node is marked in green to indicate it is the start of a lane.

The first node is the starting point of a lane. Typically, this is located on the stop line for approaches. Safety applications can use this to identify their stop line without having to consult the Intersection Message. For egresses, the first node indicates where the outbound lane begins.

- Basic properties: Each X, Y point is referred to as a Node Point. The straight-line path between these points are referred to as a Segment. Each single selected node is computed as an X and Y Offset from the prior node point.
- Lane width
  - Lane width depends on the width of each node. Each single selected node width is computed as delta width from the prior node.
  - To change the lane width, the user can put the value in the **Width** field or drag the points on the corner of the lane.
- Elevation: determine the absolute position.
  - Each single selected node elevation is computed as delta elevation from the prior node.
  - To change the node elevation, put the value in the **Elevation** field.
- Node attributes
  - Click on the button under **Attributes** in the left panel.

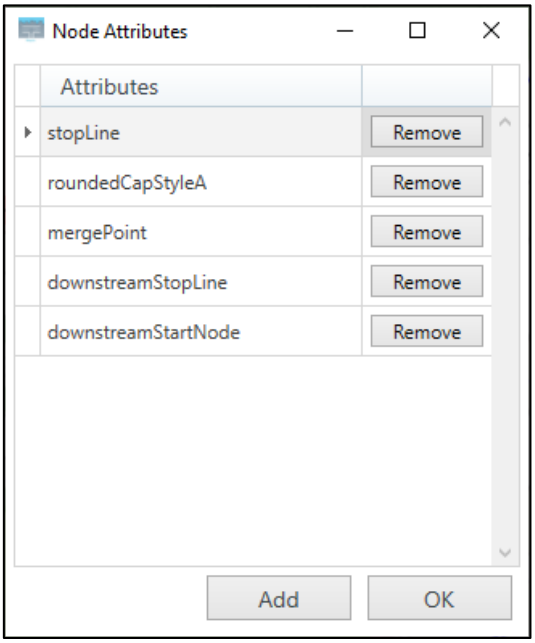


Figure 33: Node Attribute

  - Click the **Add** button.
    - By default, the value of the attribute is **Reserved.**
  - Change the value by clicking on the default value and choose an attribute on the list.
  - Click the **OK** button.
- Enable/Disable
    - Click on the button under **Enable/Disable** in the left panel.

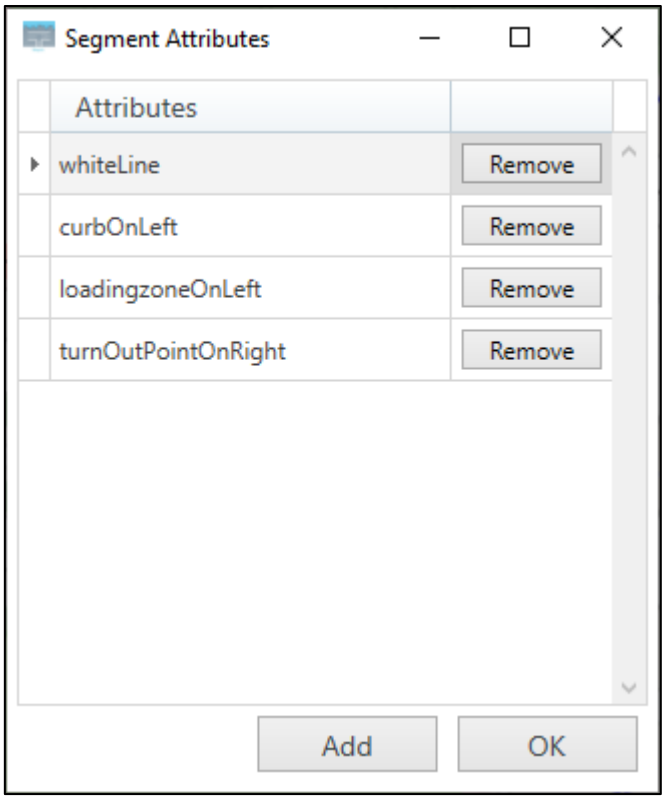


Figure 34: Segment Attributes

- Click on the **Add** button.
  - By default, the value of the attribute is **Reserved.**
- Change the value by clicking on the default value and choose an attribute on the list.
- Click the **OK** button.

5.7.8. Add connections between lanes

- Add connection by toolbar
  - Click on the **Connection** button in the **Layers** section in the left panel.
  - Click on the **Create New Connection** icon on the toolbar.
  - Click on the start node of a lane.
  - Move the mouse to the start node of the other lane.
- Adding a curve connection
  - Click on the **Connection** button in the **Layers** section in the left panel.
  - Click on the **Create New Connection** icon on the toolbar.
  - Click on the start node of a lane.
  - Click on another position on the map
    - The curve created is determined by the selected points.
  - Click on the start node of the other lane.
  - For a curve connection, the connection trajectory can be exported as a poly line that consists of 10 points. They will still be imported as 4 points.

- Add connection by Object Browser
  - Click on the **Connection** button in the **Layers** section in the left panel.
  - Click the **Add** icon on the **Objects.**

Figure 35: Create New Connection

  - Select Source Lane and Destination Lane.
  - Click the OK button.
- Adding a remote connection
  - Click on the **Connection** button in the **Layers** section of the left panel.
  - Click on **Add** icon on the **Objects.**
  - Click on **Remote** checkbox.

Figure 36: Remote Connection

  - Select Source Lane.
  - Input a value for Destination Lane.
  - Input a value for Region and ID of Remote Intersection.
  - Click the OK button.
- Connection properties

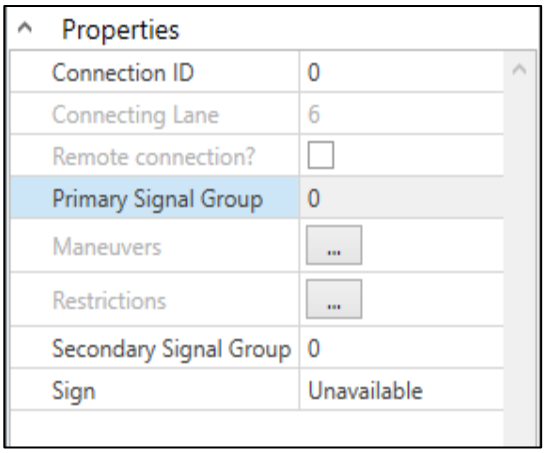


Figure 37: Connection Properties

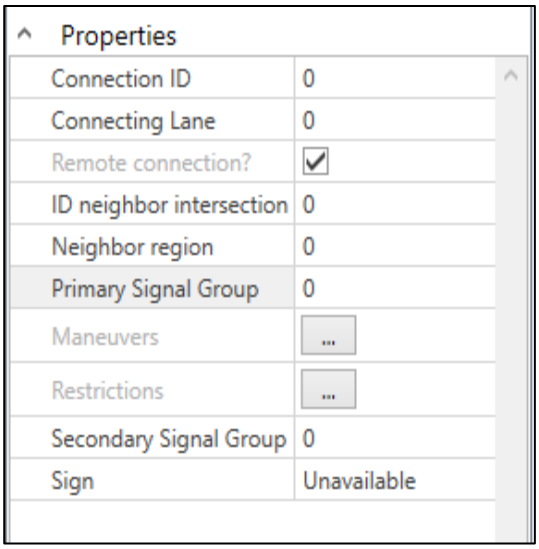


Figure 38: Remote Connection Properties

- Input a value in the **Connection ID** field.
- Connection IDs are not necessarily unique.
- Input a value in the **Connecting Lane, RemoteIntersectionID** and **RemoteRegion** field (for Remote Connection).
- Input a value in **Primary Signal Group** and **Secondary Signal Group**.
- Select the **Sign**.
    - Currently, there are 5 signs: Unavailable, Stop Then Proceed, Permissive Movement Allowed, Protected Movement Allowed and Caution Conflicting Traffic.
- Maneuvers

To add maneuvers, perform the following steps:

- Select a checkbox in the **Maneuvers** dialog.

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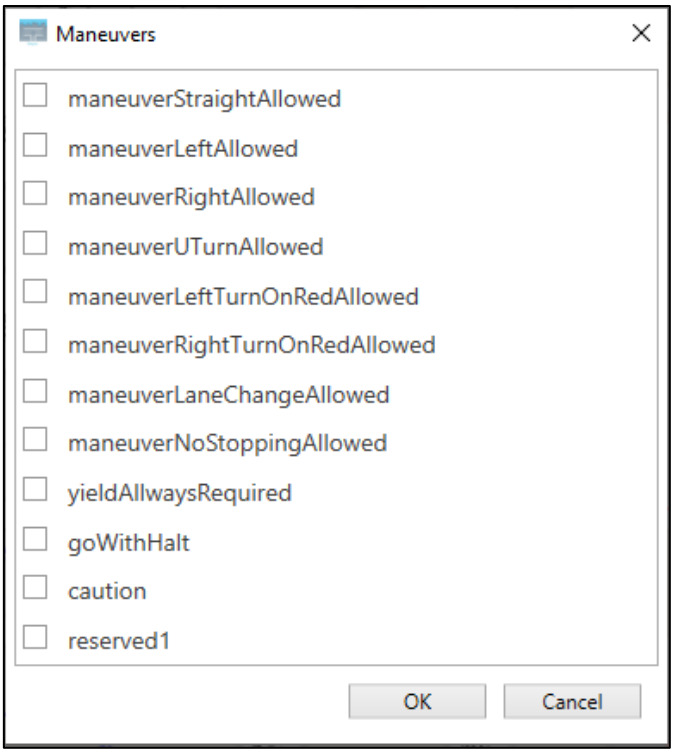

Figure 39: Maneuvers

- Select the maneuver properties.
- Click the **Ok** button.
- When no options for maneuvers are selected, it will not be exported.

- Restrictions

To add the restrictions, perform the following steps:

- Under **Connections properties**, click on the button near the **Restrictions** field.

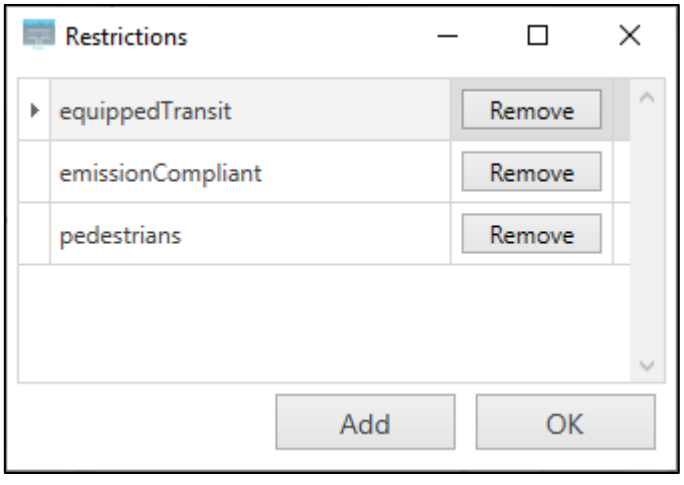

Figure 40: Restrictions

- Click the **Add** button.
  - By default, the restriction value is **none**. Click on this text and select the restriction properties in the list.

- Click the **OK** button.

NOTE: Originally, the connection dataframe in J2735 contained a user class ID, which refers to a list of restrictions defined in MapData dataframe. For user convenience, Map2x allows a user to specify restrictions directly, in each connection, without selecting a user class ID. Upon exporting, combinations of restrictions will be aggregated to MapData and the corresponding user class ID will be generated and assigned to each Connection dataframe. The resulting MAP message will totally conform with J2735 standard.

5.7.9. Add a connection between intersections

- It is possible to create a connection from the last point of an egress lane to last point of an ingress lane. This allows the connection of partial intersections.
- The connection is visualized by a purple line

5.7.10. Add a graphical object to define approach

- The user can draw a box of 4 points to create and visualize one approach. To do this, first select the Approach layer and then click on the “Create new approach” icon in the Map2x toolbar.
  - An approach is defined by exactly 4 points.
- After an approach is created, all lanes that have the first node inside the approach will have the approach id equal to the id of the approach object. If the user changes the approach object’s id, then the id within the lanes will be updated.
- Furthermore, if after an approach object is defined, any new lanes created with the first node inside it will also have the same approach id as the approach object. When the lane is moved out of an approach, the approach id of the lane will be removed.

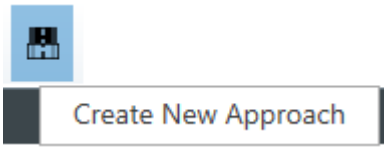

Figure 41: Toolbar icon to create approach object

5.7.11. Import intersection geometry from GeoJson

- Click on the **Import** button on the toolbar.

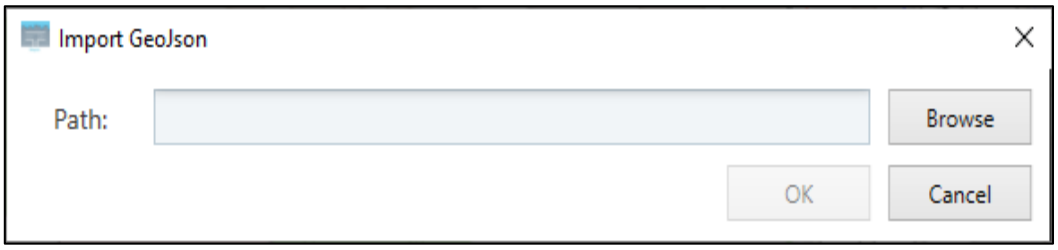

Figure 42: Import GeoJson

- Input a value in the **Path** field.
- Click on the **OK** button.
- Click **OK** on confirm message.

NOTE: All existing objects are removed

When users import a GeoJson into an existing intersection, a merge operation will be executed. Map2x will try to detect the changes from the new GeoJson file and merge them with existing modifications on the intersection. New lanes and connections will be added- Coordinates of the Map2x application will be kept in favor of those from the GeoJson file, if the object exists in both files.

5.8. Import/Export messages

5.8.1. MAPEM

- Open Project Manager window.
- For Export:
  - Click on the **Export** button on the toolbar.

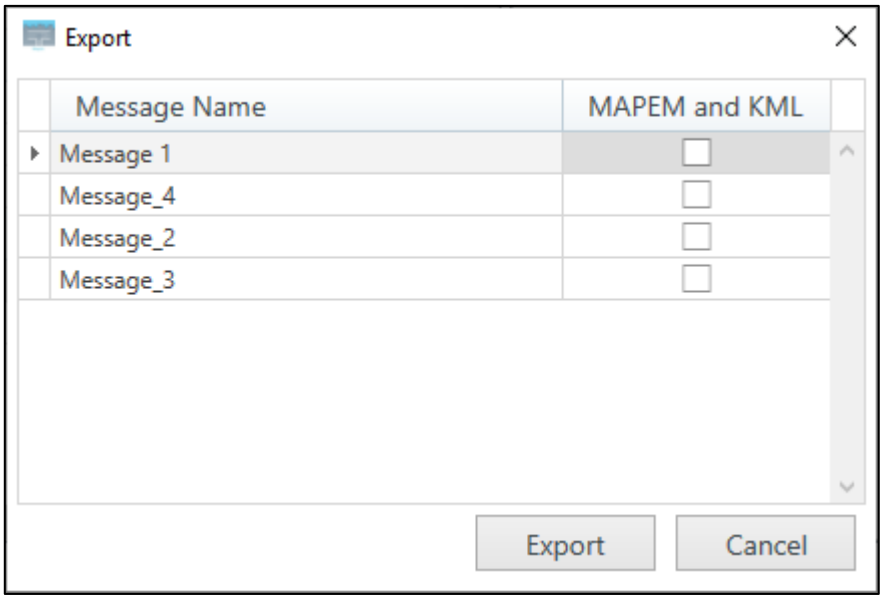

Figure 43: Export form

  - Select the desired message or all the messages with the exported type is MAPEM and KML.
  - Click on the **Export** button. The exported message(s) are stored in the project folder.
  - The MAPEM type has format: [MessageName].mapem.xer.
  - The KML type has format: [IntersectionName].kml.
- For Import:
  - Click on the **Import** button on the toolbar.
  - Navigate to the location and select the message (.xer) file. One or more message files can be selected for import

5.8.2. KML

- Open **Intersection** window.
- Click **Export** button on the toolbar. The intersection is exported with format [IntersectionName].kml and stored on the project folder.
- To read KML file, perform the following steps:
  - Open link: https://earth.google.com/web/ in a Chrome browser.
  - Open Menu and select My Place.
  - Import .kml file.
- The data in 'Google Earth' is the same as the data in the Map2x tool.

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5.8.3. Note on TrafficStreams

In MAPEM encapsulation, the <trafficStreams> node with the extension was introduced on the same level as the <map> node. The <map> node still complies with the SAE J2735 specification.

Traffic streams are generated automatically by exporting a MAPEM message based on Connection objects. Some extended properties are added to the Connection object compared to original dataframe in J2735; this supports the generation of traffic streams.

Notes related to the generation:

- In J2735, one GenericLane can contain up to 16 Connection dataframes. This means, there can be up to 16 connections from one lane to another.
- Each Connection object will generate one <TrafficStreamConfigData>.
- It's possible to create two or more Connection objects between two specific lanes. However, a TrafficStream is identified by the pair of source lane ID and destination lane ID. There will be warnings for duplicated TrafficStream identifiers (pair of lane IDs). In this case, it's the responsibility of user to explicitly remove redundant connections.
- Each connection between lanes is unique and has a unique id within one intersection. A warning message will appear if there are 2 or more lanes with the same connection Id.

5.9. Convert messages from XER encoding to UPER encoding

Map2x supports exporting MAP messages to the MAPEM structure in XER encoding.

To generate a message file in UPER encoding, a separate tool is required.

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6. List of figures

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