

RWR 4013

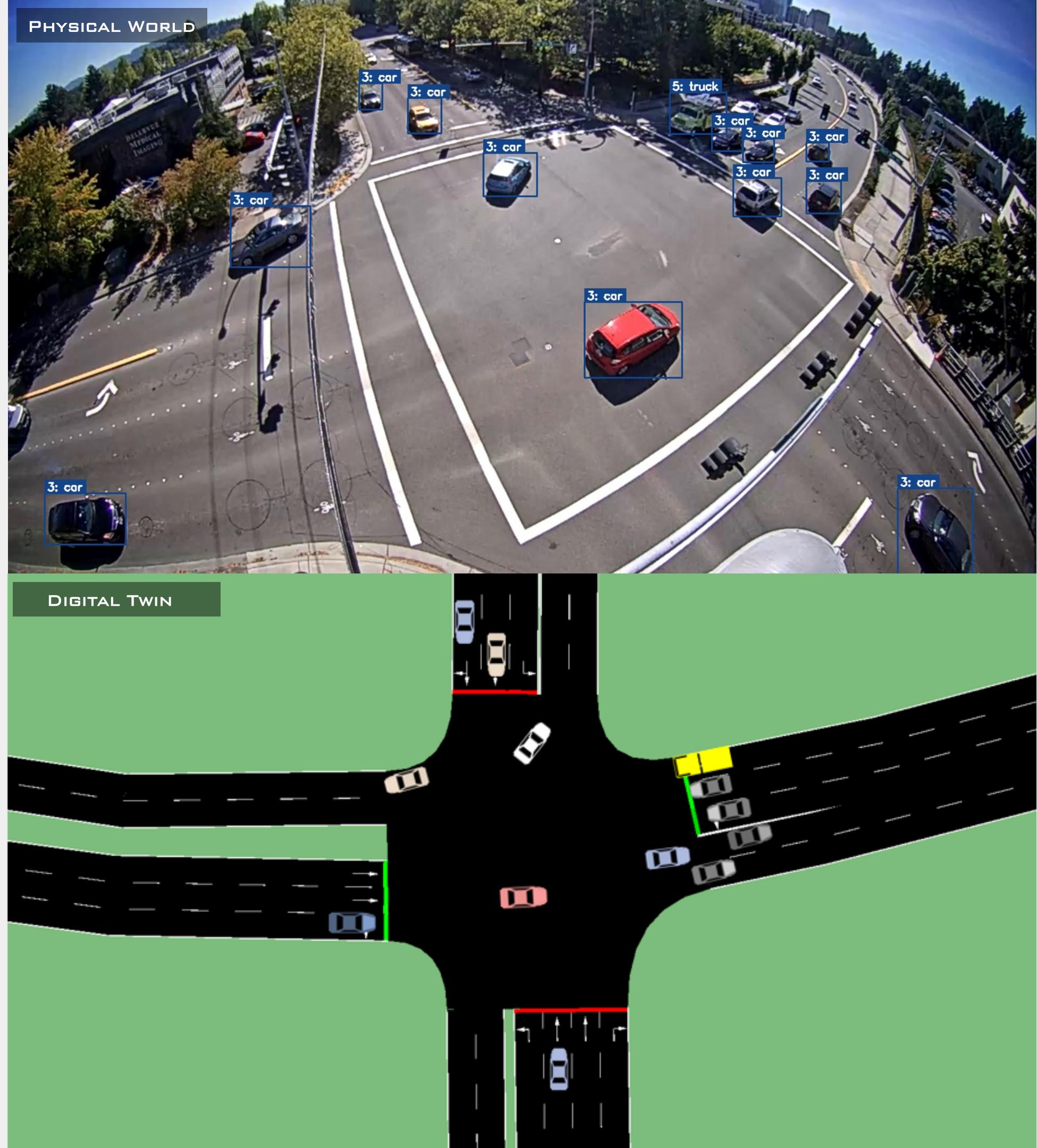
Digital Twins for Smart Cities

Dr. Ahmad Mohammadi

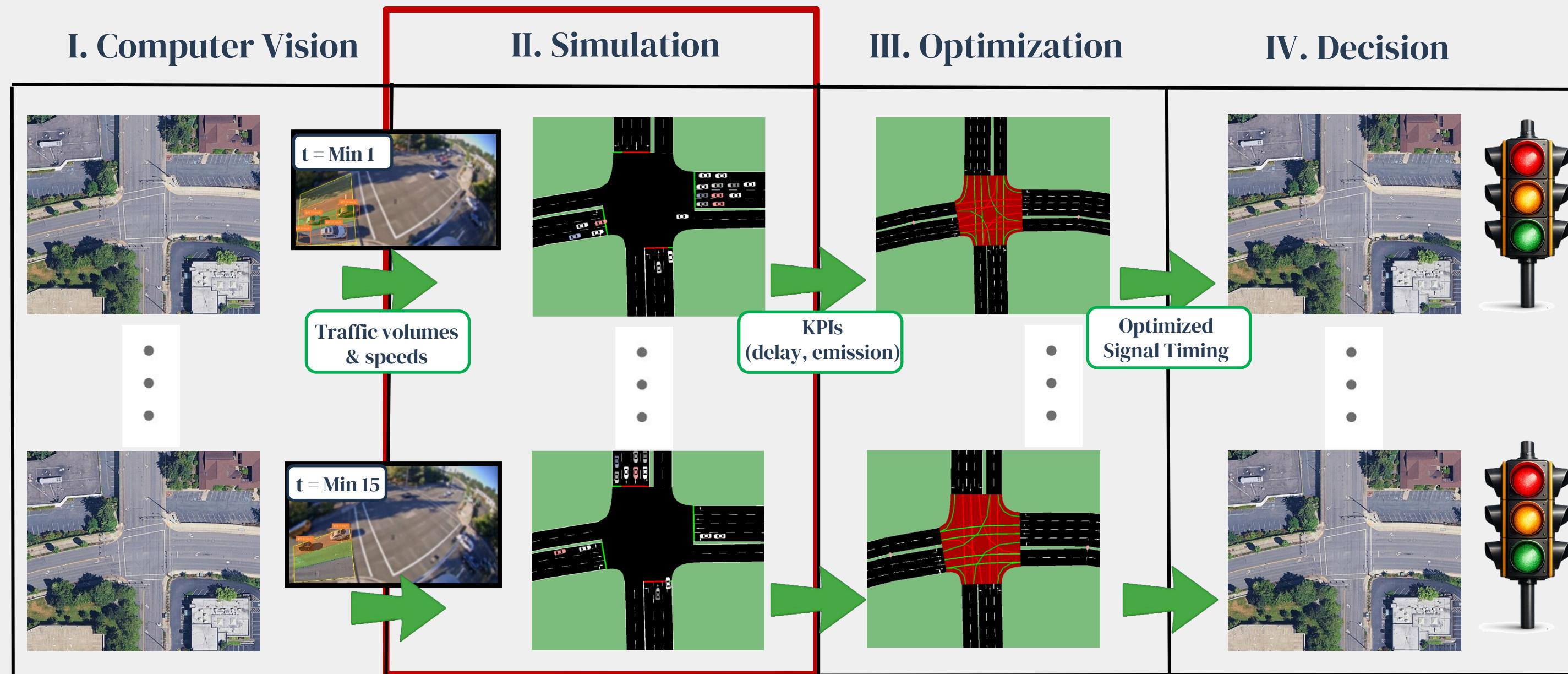
Week 5 | Session 2:
Digital Road Network
Modelling with GIS

Fall 2026

RoadwayVR

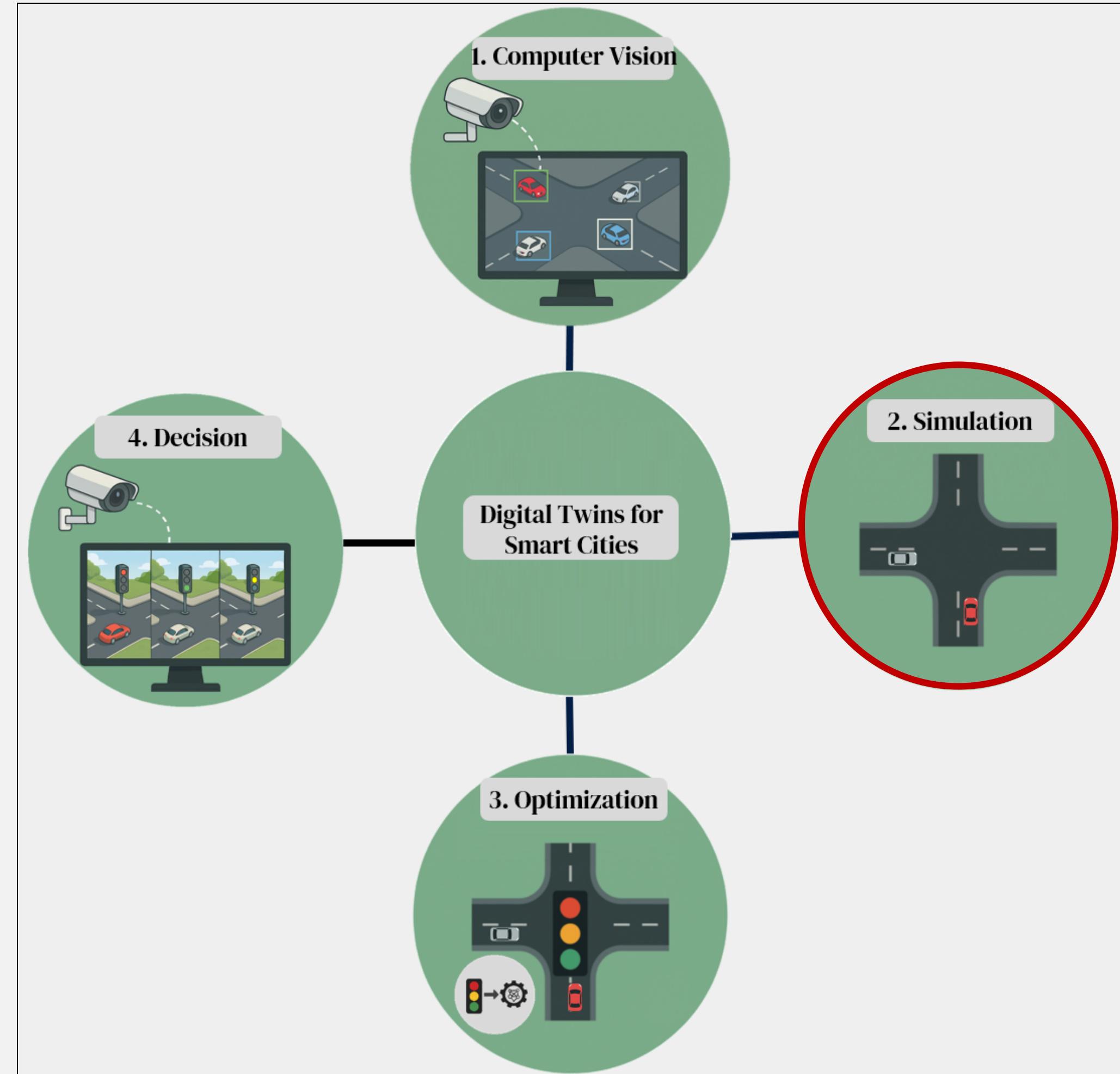


Overview of Course Syllabus in One Shot

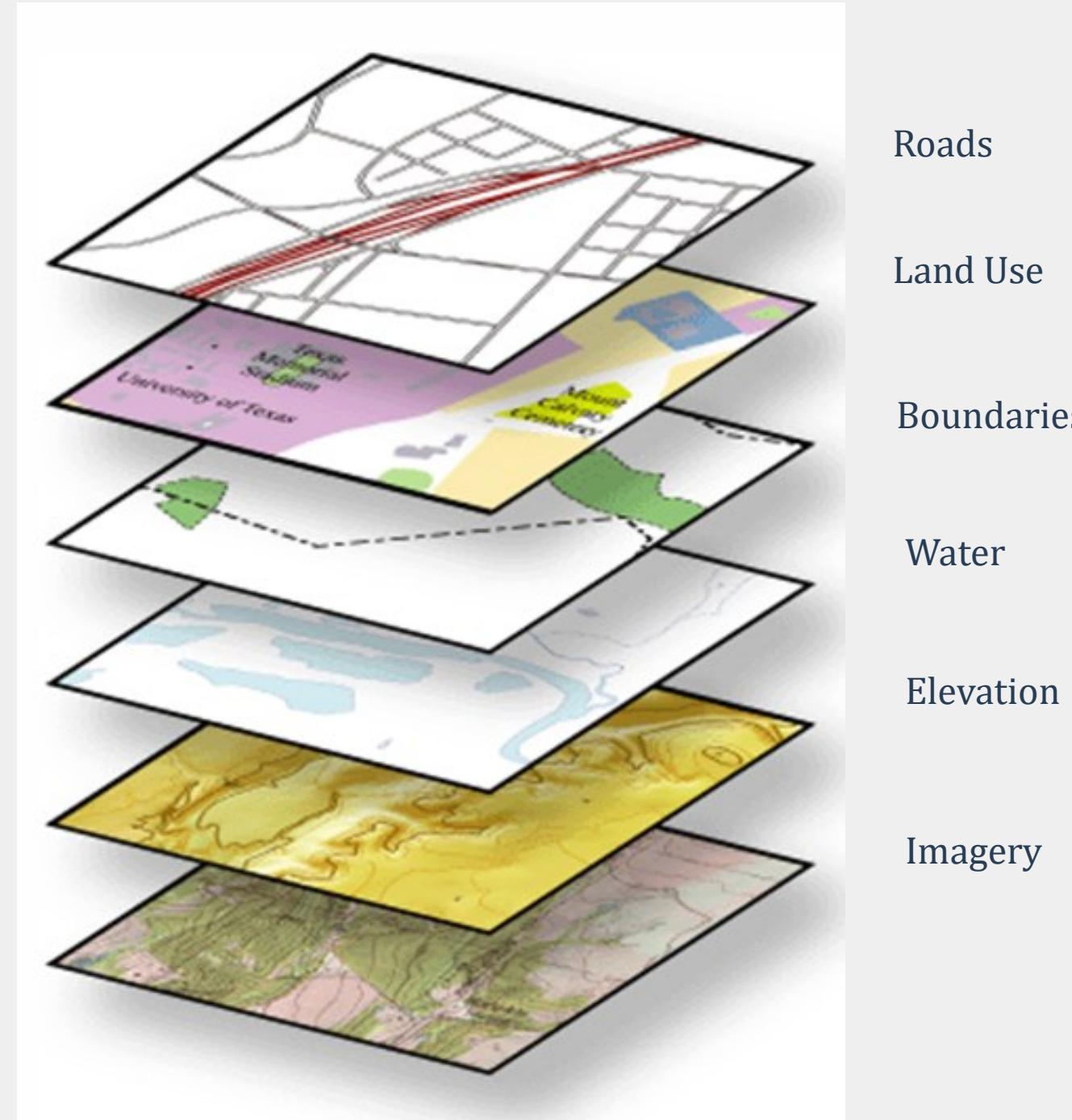


Agenda

- ❑ Network Modelling with GIS
- ❑ GIS Software
- ❑ Download and Installing QGIS Software
- ❑ Map Services
- ❑ Imagery Map and Georeferencing
- ❑ Import a GIS Map into Simulation



Network Modelling with GIS



Reference:

<https://desktop.arcgis.com/en/arcmap/latest/map/projections/what-are-map-projections.htm>

Example: Network Modelling Study

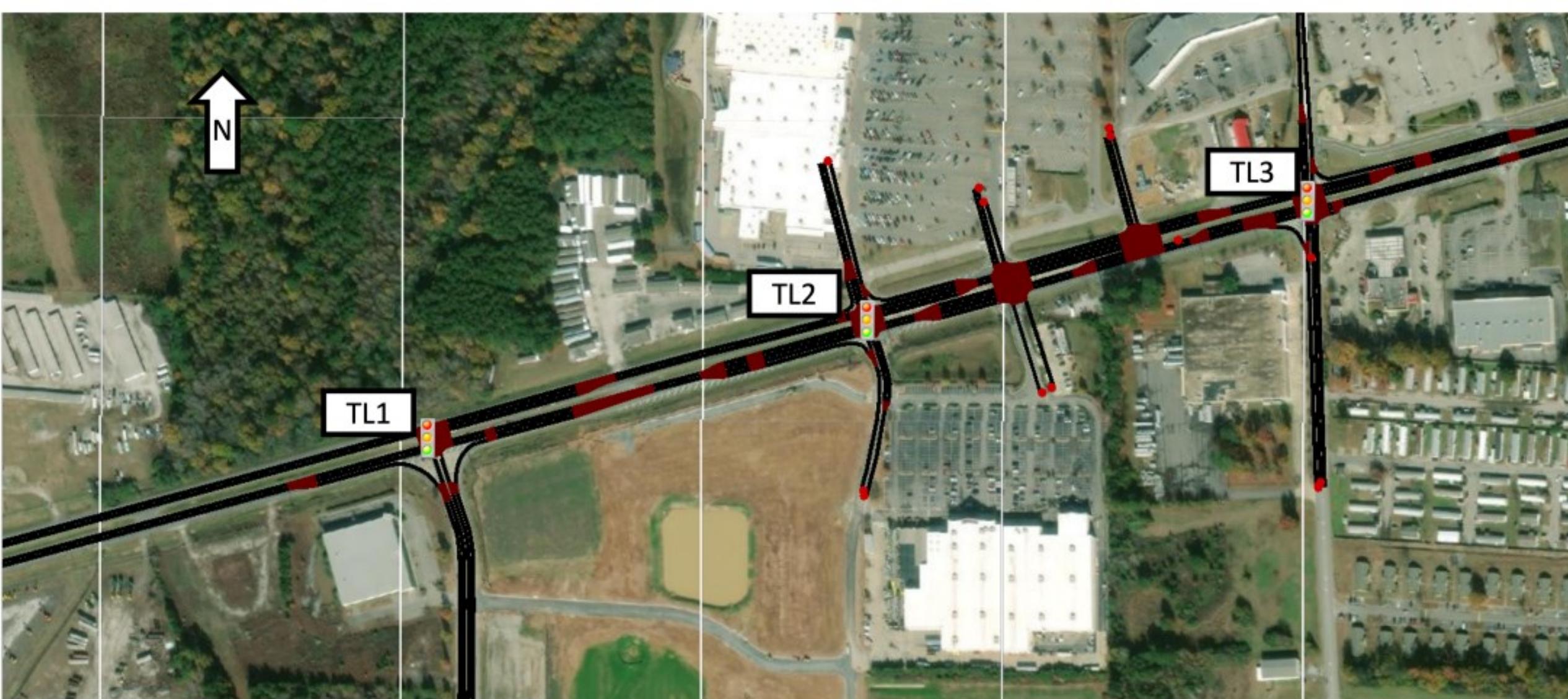


Figure 2.1: SUMO model of the simulated network including three intersections.

GIS Software



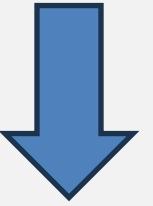
ArcGIS Pro



QGIS



Google Earth Pro



Open Source and Free

Installing QGIS

1. QGIS.ORG and Download

2. Skip It and Go to Download

3. Long Term Version for Windows

The screenshot shows the QGIS website homepage. At the top right, there is a red box around the "Download" button, which is highlighted with a red circle labeled "1". Below the header, the main banner features the text "Spatial without Compromise" and "Spatial visualization and decision-making tools for everyone". A large green "QGIS" logo is on the right. In the center, there are two "Download" buttons: one green one labeled "Available on Windows, Mac, Linux" and one smaller white one. At the bottom, there's a donation section with "One-Time" and "Monthly" options and a "Donate" button. A red box labeled "2" highlights the "Skip it and go to download" link. Another red box labeled "3" highlights the "Long Term Version for Windows (3.40 LTR)" option under the "Offline (Standalone) installers:" heading.

1

2

3

QGIS

Project ▾ Community ▾ Resources ▾

News: New QGIS Map Gallery

Free and Open Source DPG

Spatial without Compromise

Spatial visualization and decision-making tools for everyone

Download Available on Windows, Mac, Linux

One-Time Monthly

€ 10.00 € 20.00 € 50.00

€ 100.00 € 250.00

Donate

2 Other methods, more info EUR ▾

Skip it and go to download

Offline (Standalone) installers:

3 Long Term Version for Windows (3.40 LTR)

Latest Version for Windows (3.42)

Latest Version for Windows (3.42) with Qt6 (experimental)

Long Term Version for Windows (3.40) with Qt6 (experimental)

Search

Donate

Map Services

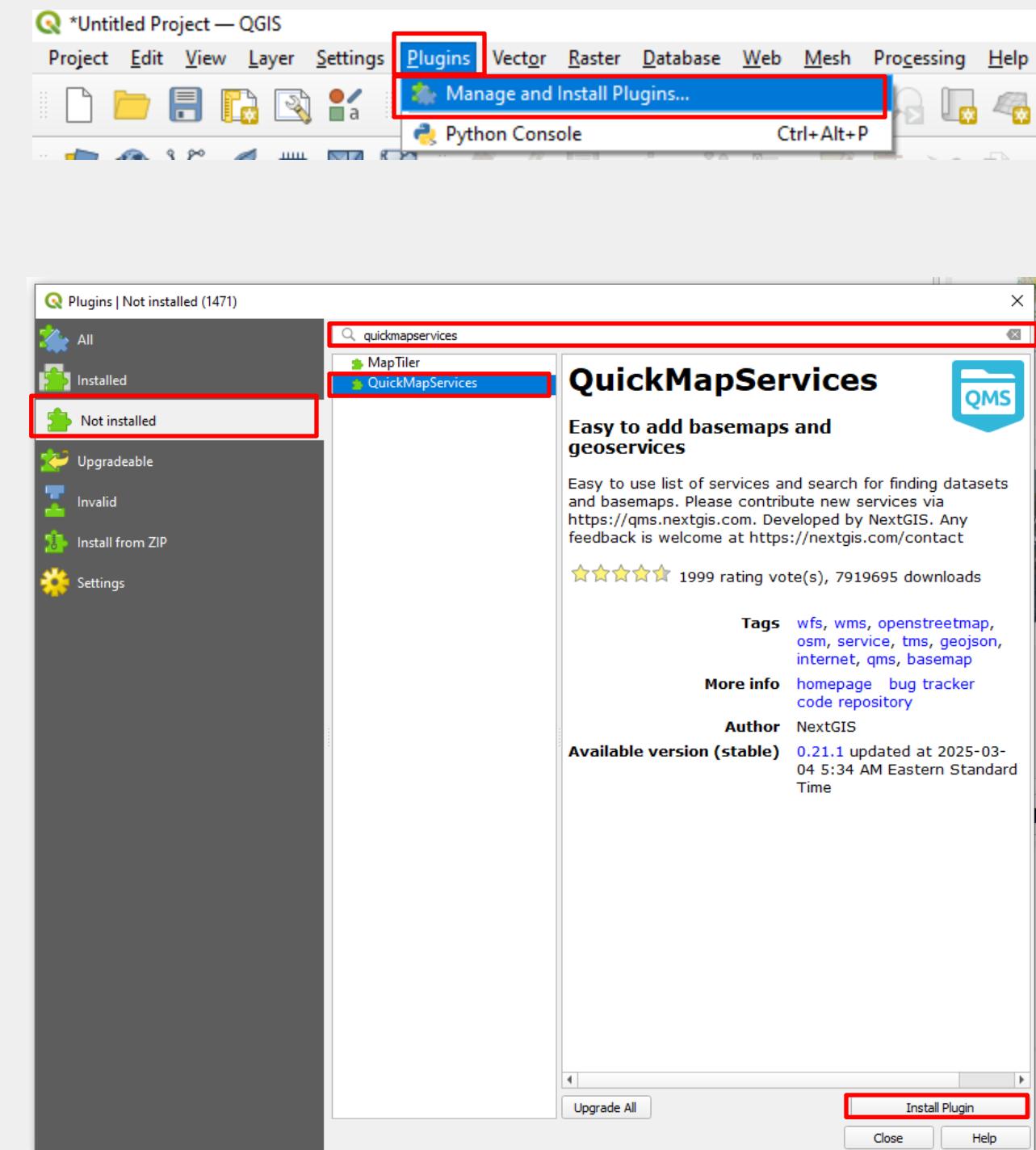
1. Menu bar → Plugins → Manage and Install Plugins

2. Not installed → on Search Bar → QuickMapServices →

Install Plugin

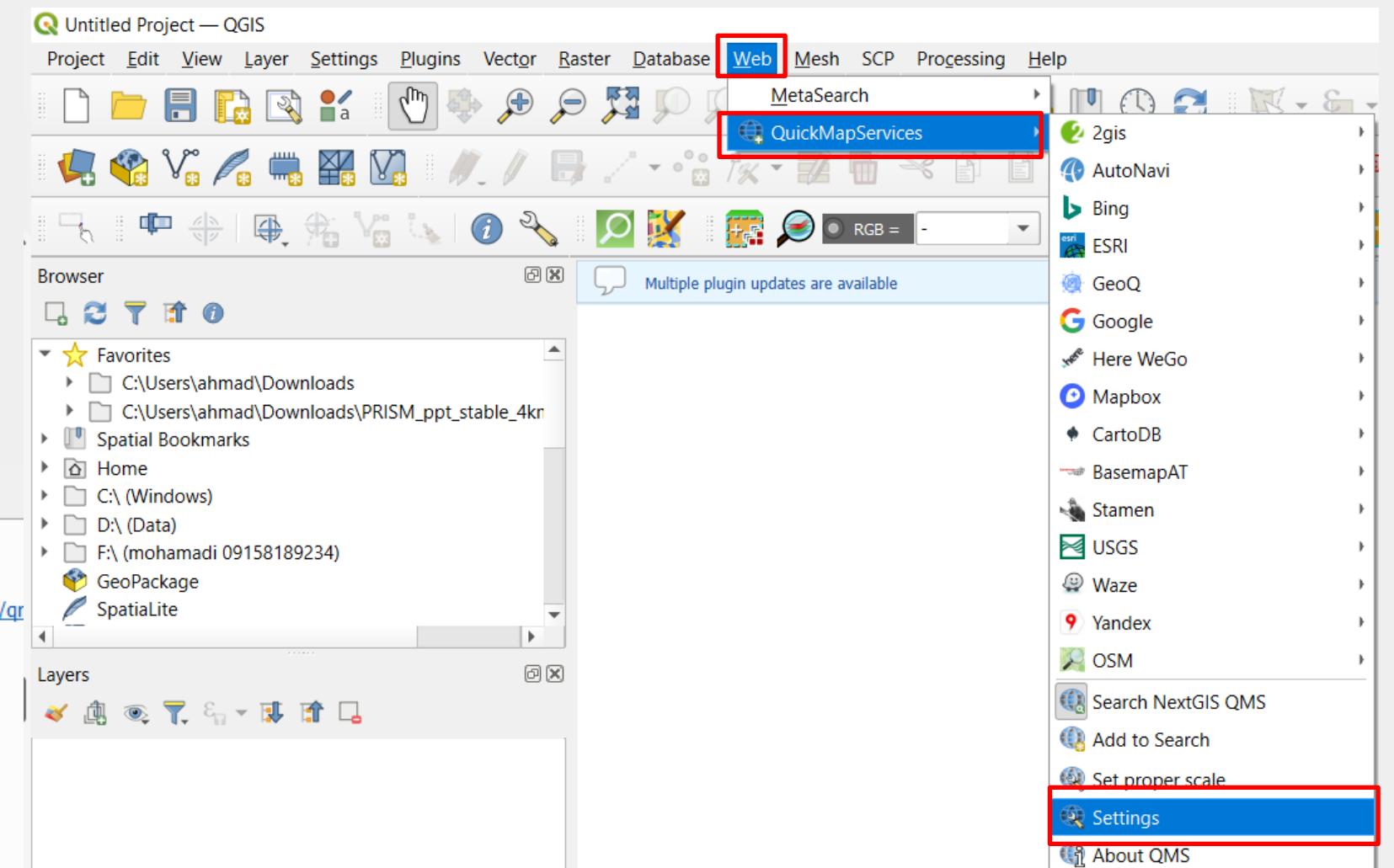
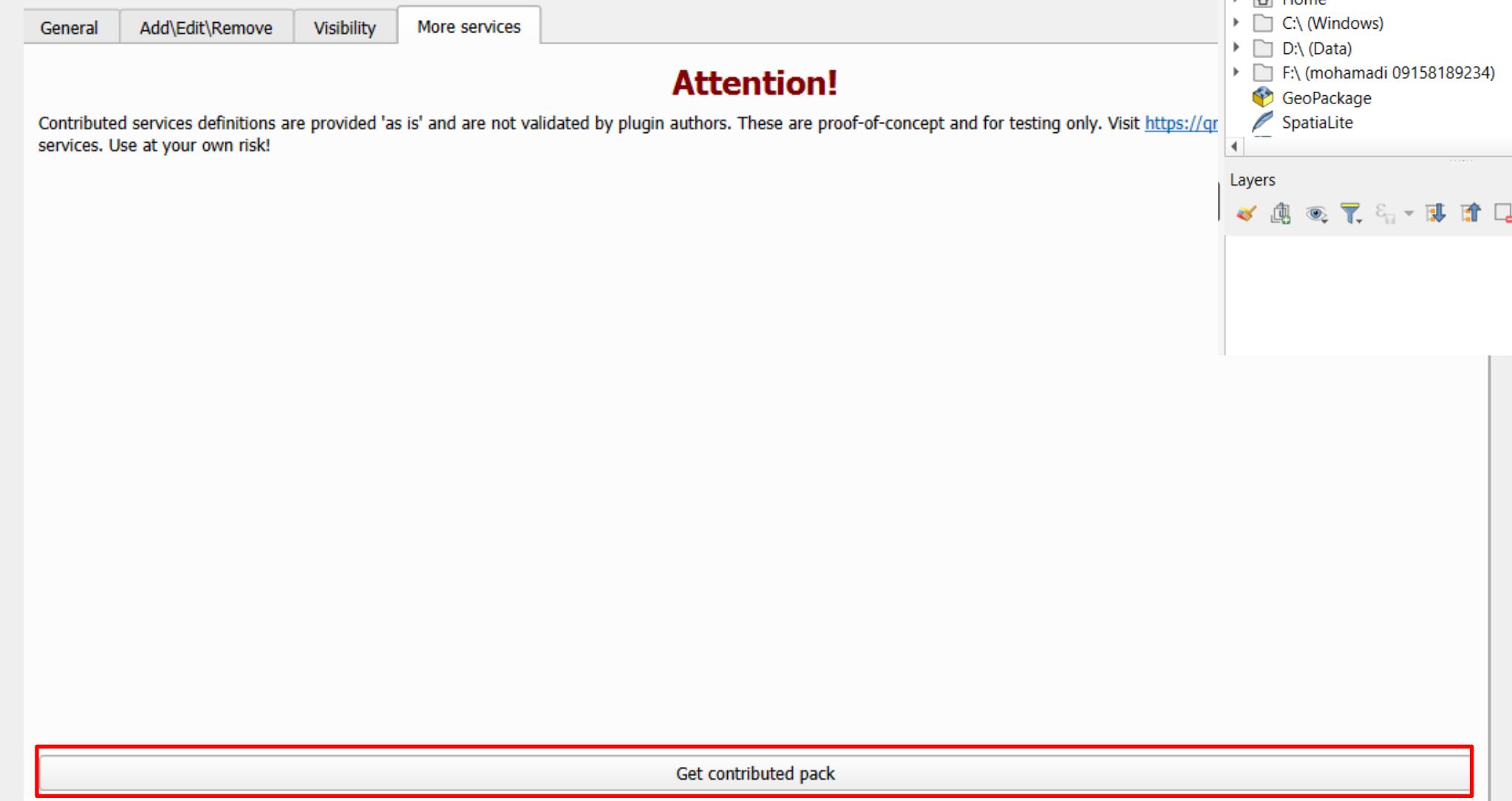
3. Not installed → on Search Bar → QuickMapServices →

Install Plugin



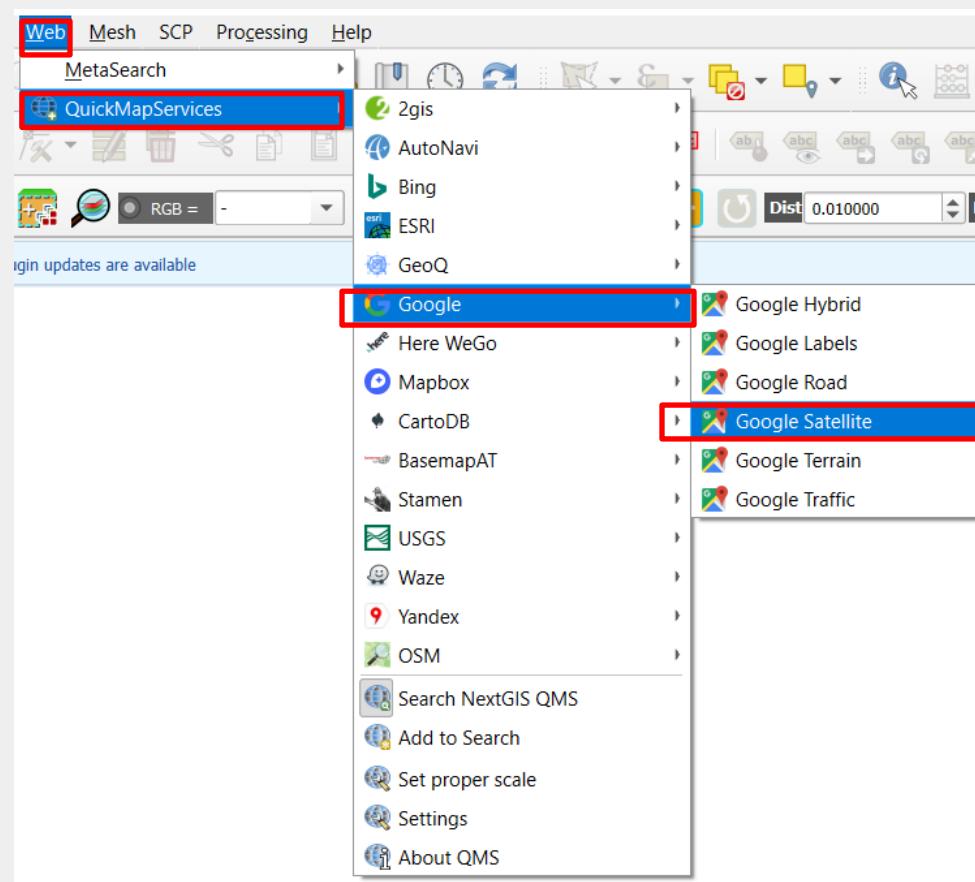
Map Services

4. Web → QuickMapServices → Settings



Map Services

6. Main Manu → Web → QuickMapServices → Google → Google Satelite

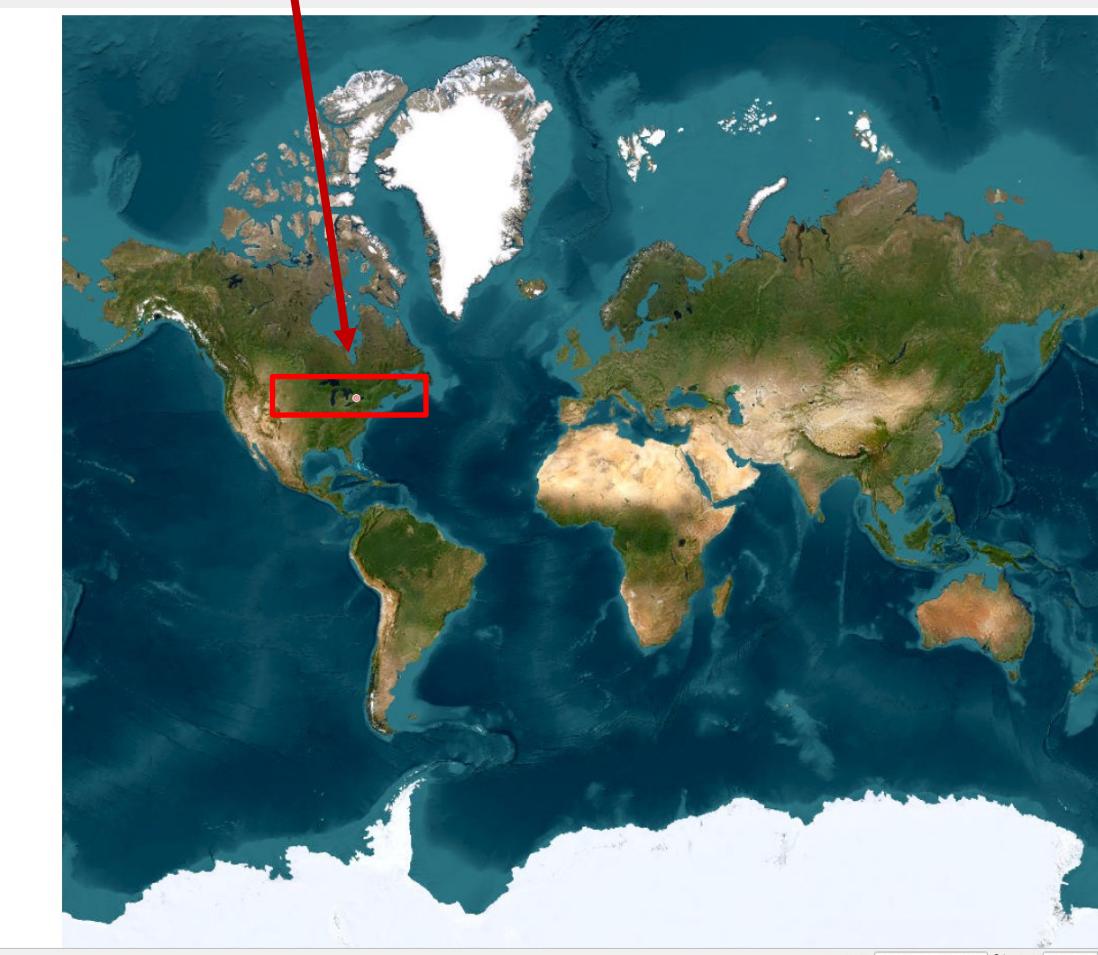
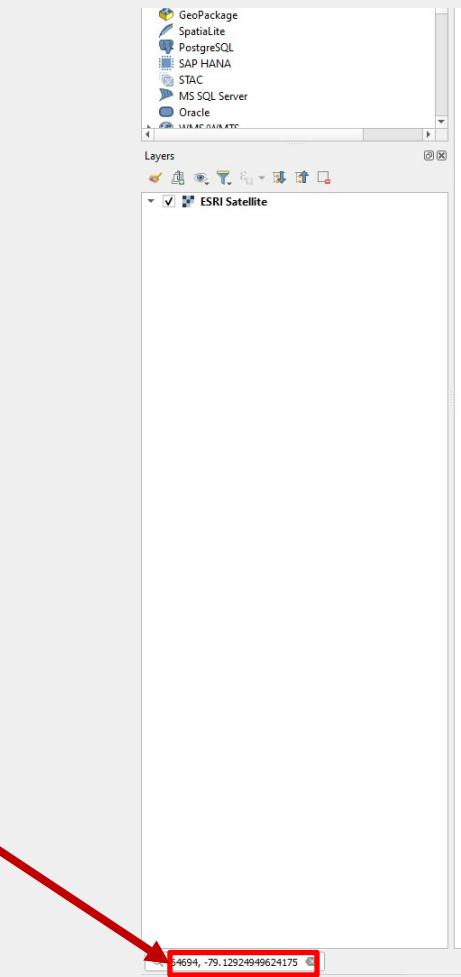
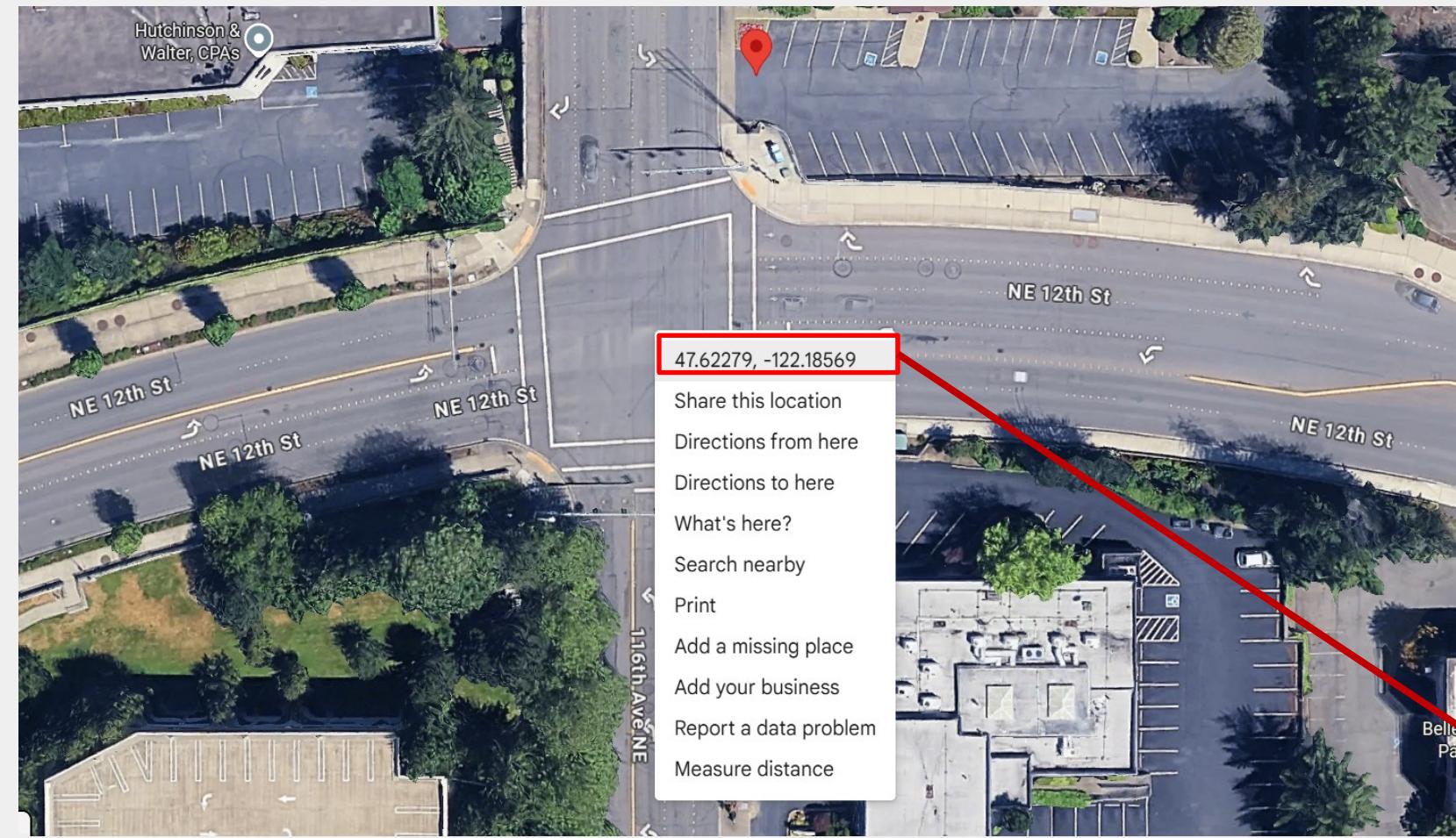


Imagery Map and Georeferencing

7. Find the Intersection in Google Map → Right Click → Copy and Paste the Coordinate into QGIS

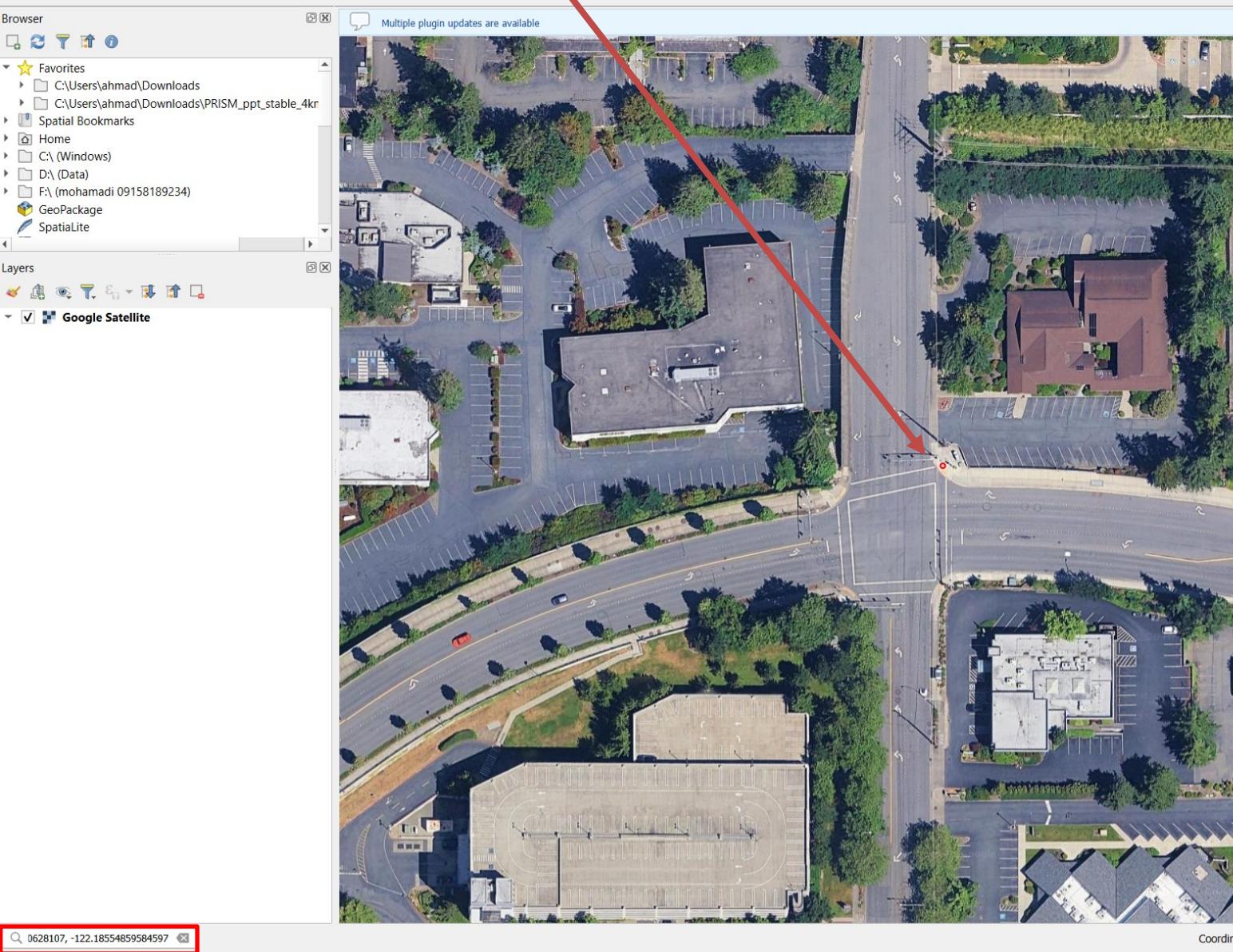
Status Bar → Type to Locate → Press “Enter”, It shows a Red Dot on Top of Map → Zoom In

✓ Coordinates: 47.62293830628107, -122.18554859584597



Imagery Map and Georeferencing

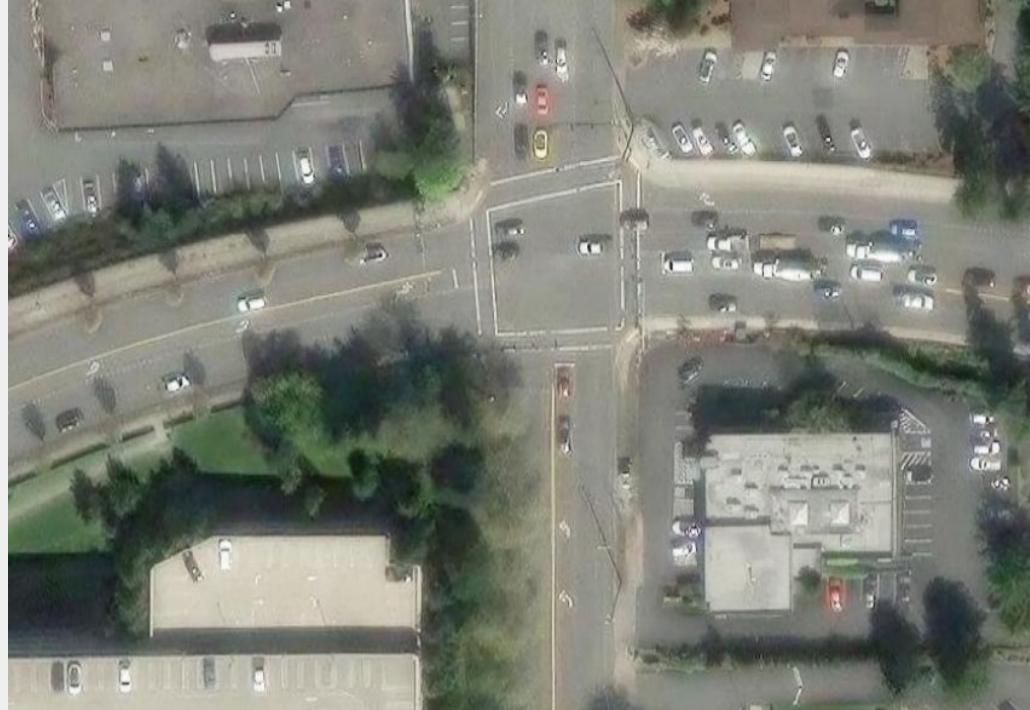
8. Select the Box and Press Enter to Reappear the Red Dot



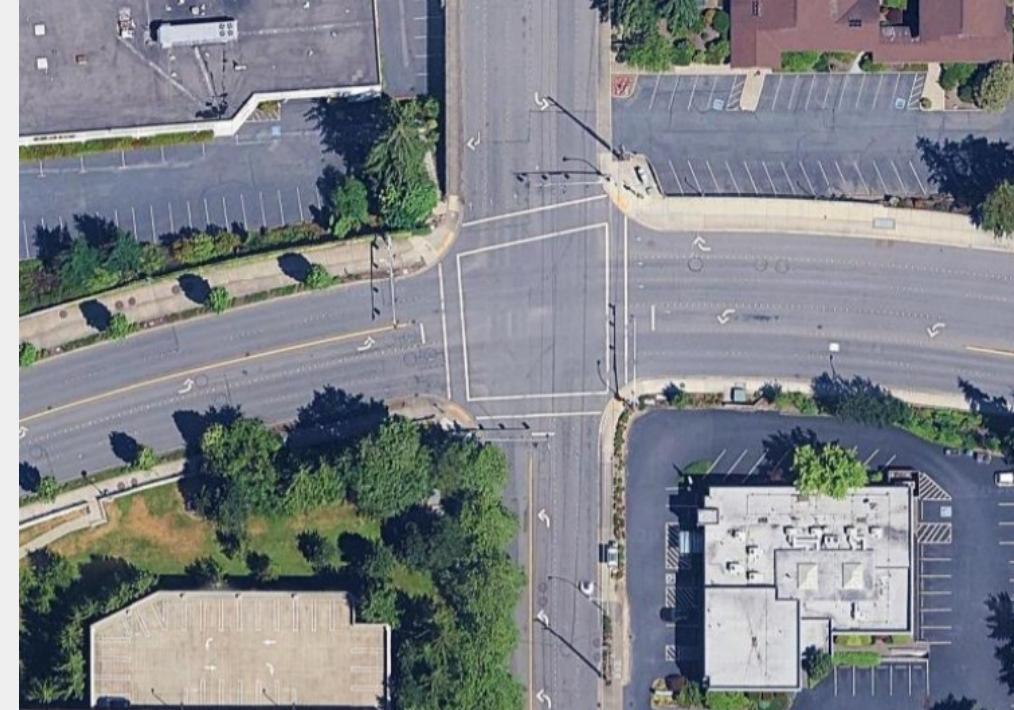
Imagery Map and Georeferencing

9. Try Different Map Provider like Google Map, Bing

ESRI



Google Map

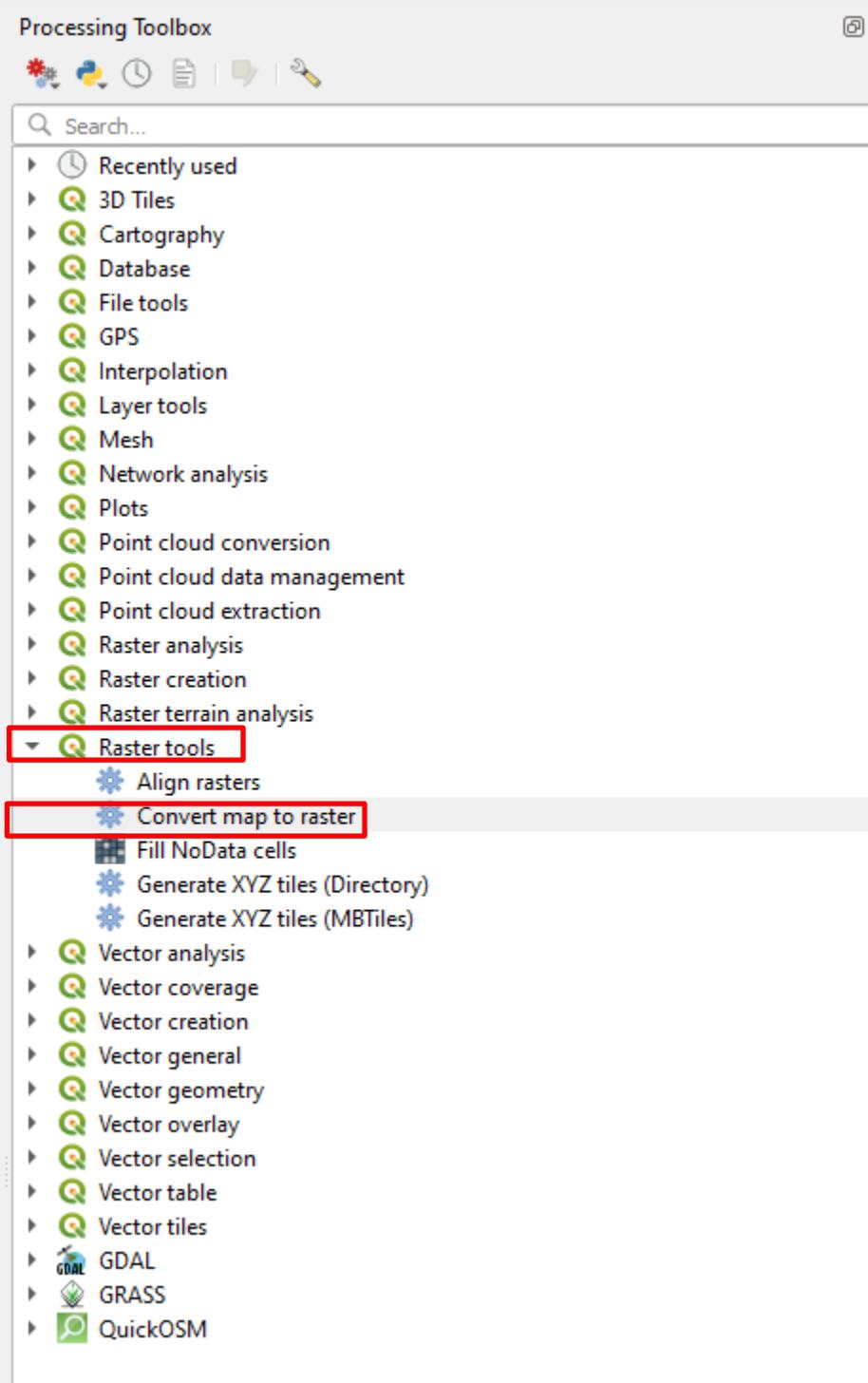


Bing

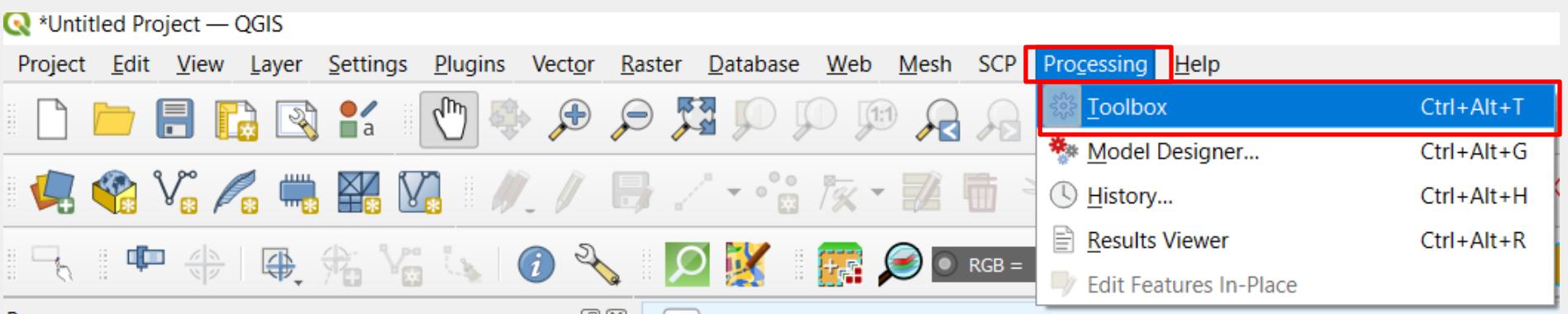


Imagery Map and Georeferencing

10. On The Right Side → Processing Toolbox → Convert Map To Raster



11. If you cannot find “Processing Toolbox”, it is in
MainMenu → Processing → Toolbox

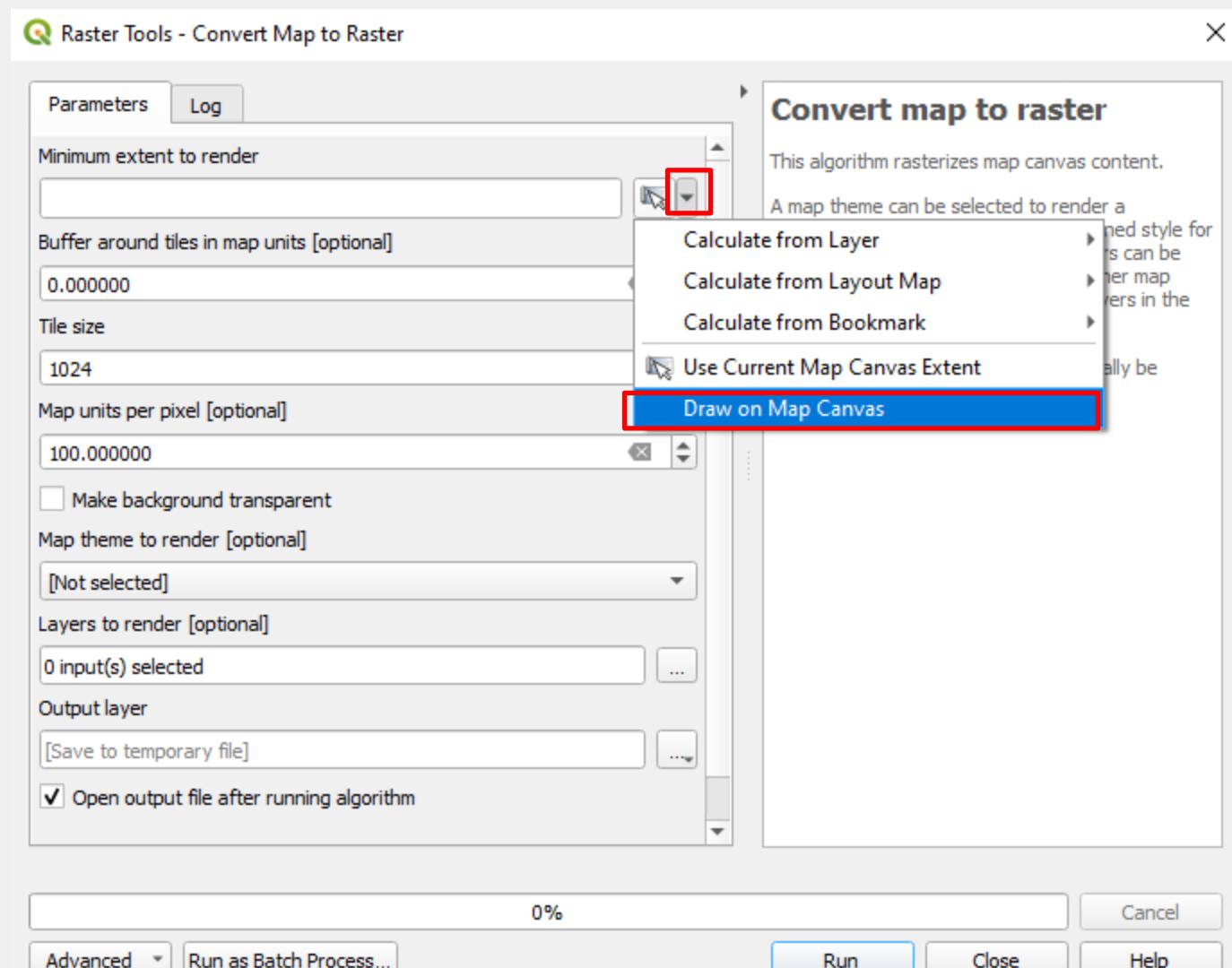


Imagery Map and Georeferencing

12. After selecting Convert Map To Raster in Processing Toolbox

13. Select Arrow → Click the Arrow → Select “Draw on Map Canvas”

14. Draw a Region of Interest (Holding Left Click and Dragging a Rectangle)



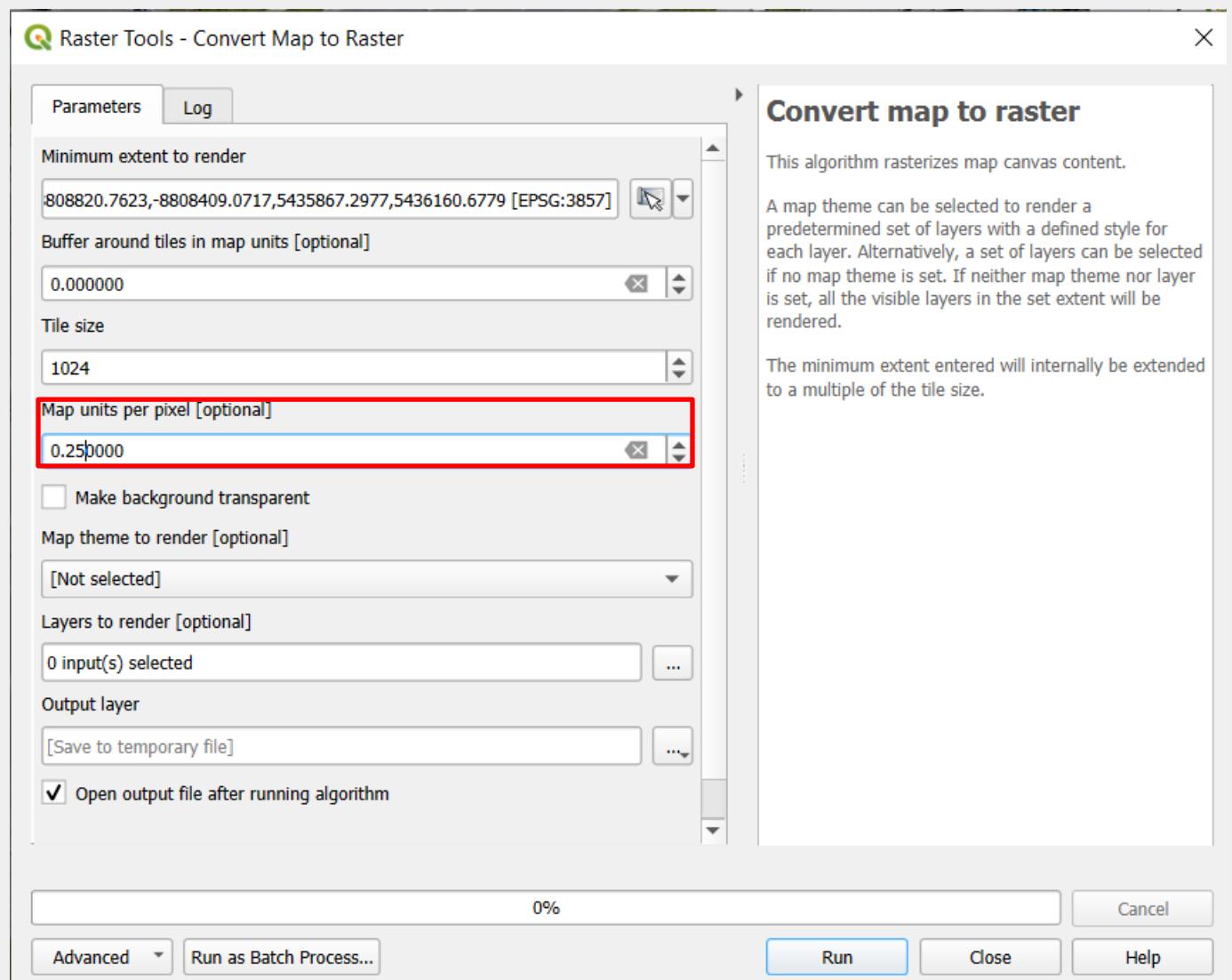
Imagery Map and Georeferencing

15. Change “Map units per pixel” from 100 to something small:

0.25 (\approx 25 cm/pixel, nice aerial detail)

0.5 (50 cm/pixel)

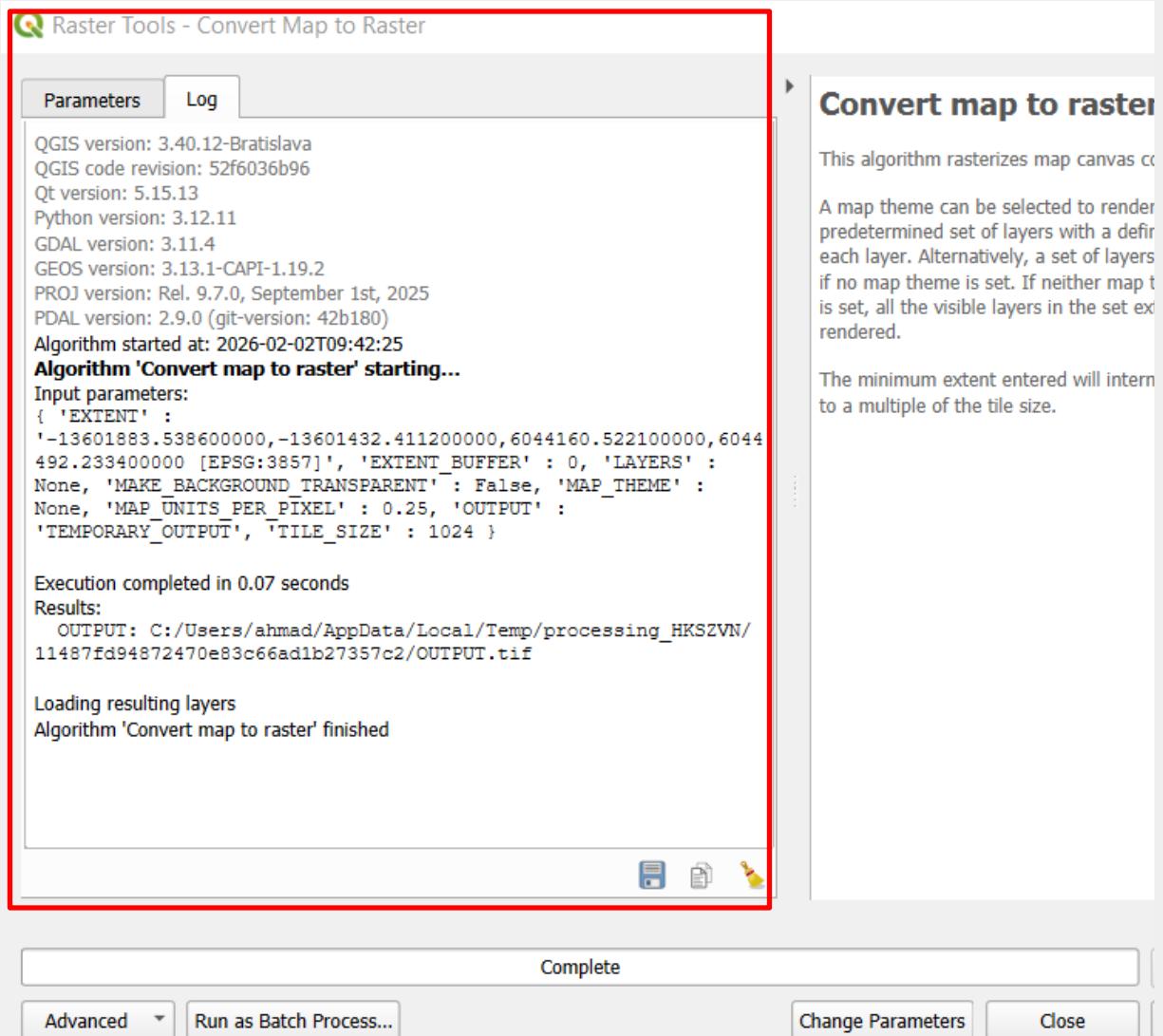
1.0 (1 m/pixel, lighter file)



Imagery Map and Georeferencing

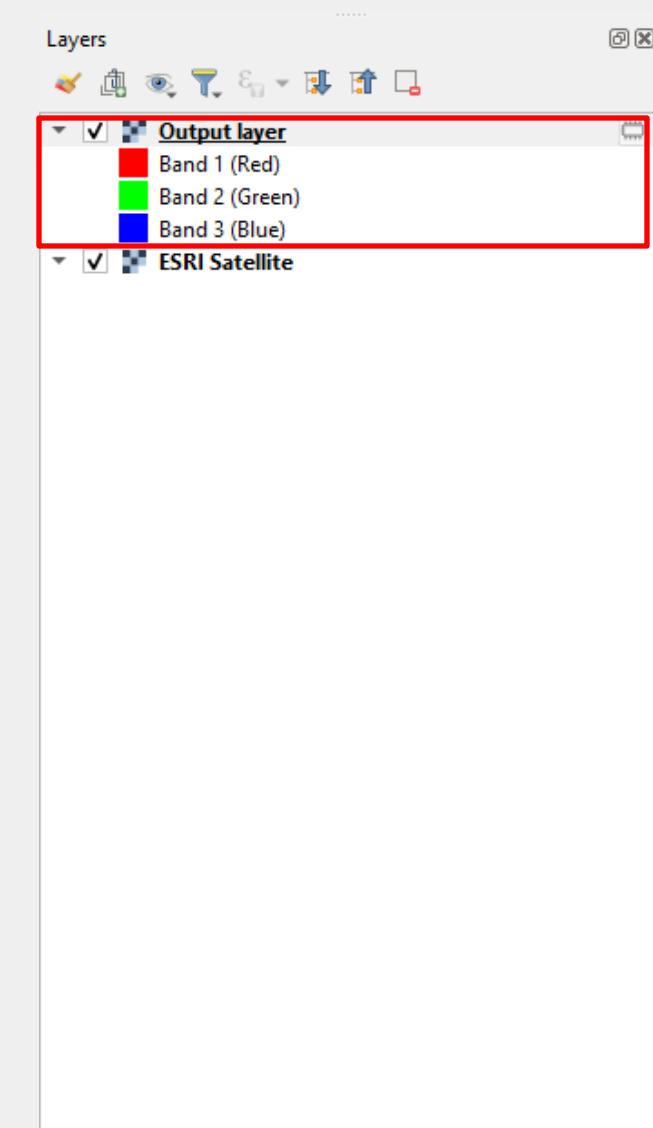
16. In the “Raster Tools” window

- You should see output similar to the screenshot on the left.



17. In the “Layers” panel

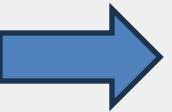
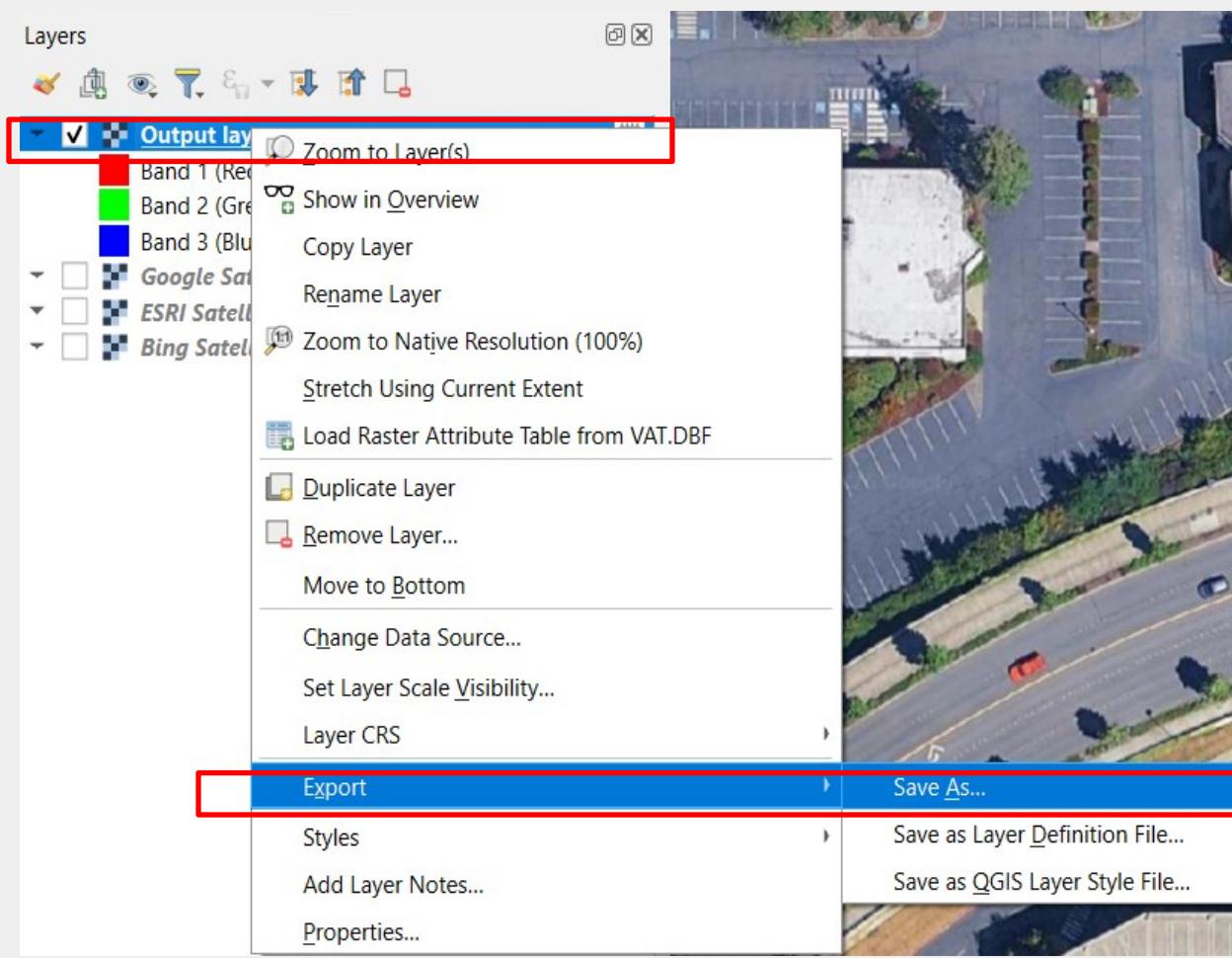
- You should see the resulting layers as shown on the right.



Imagery Map and Georeferencing

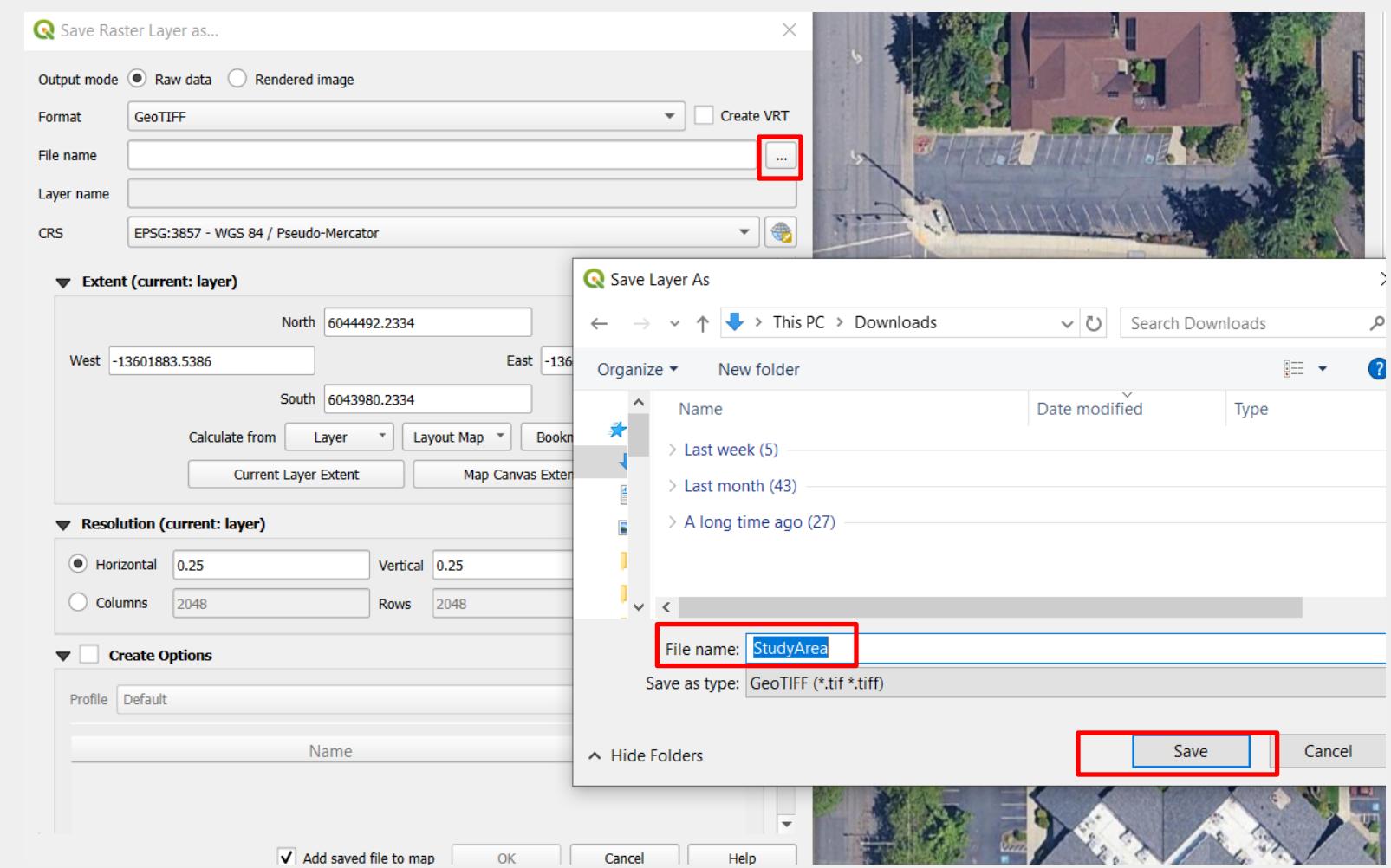
18. In the “Layers” panel

- Right Click on “Output Layer” → Export → Save As



19. Save Raster Layers as

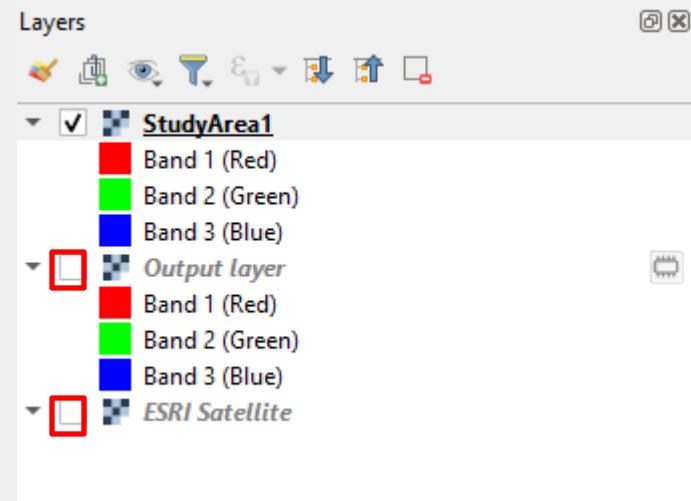
- Click Three Dots
- Pick a File Name and a Directory → Save



Imagery Map and Georeferencing

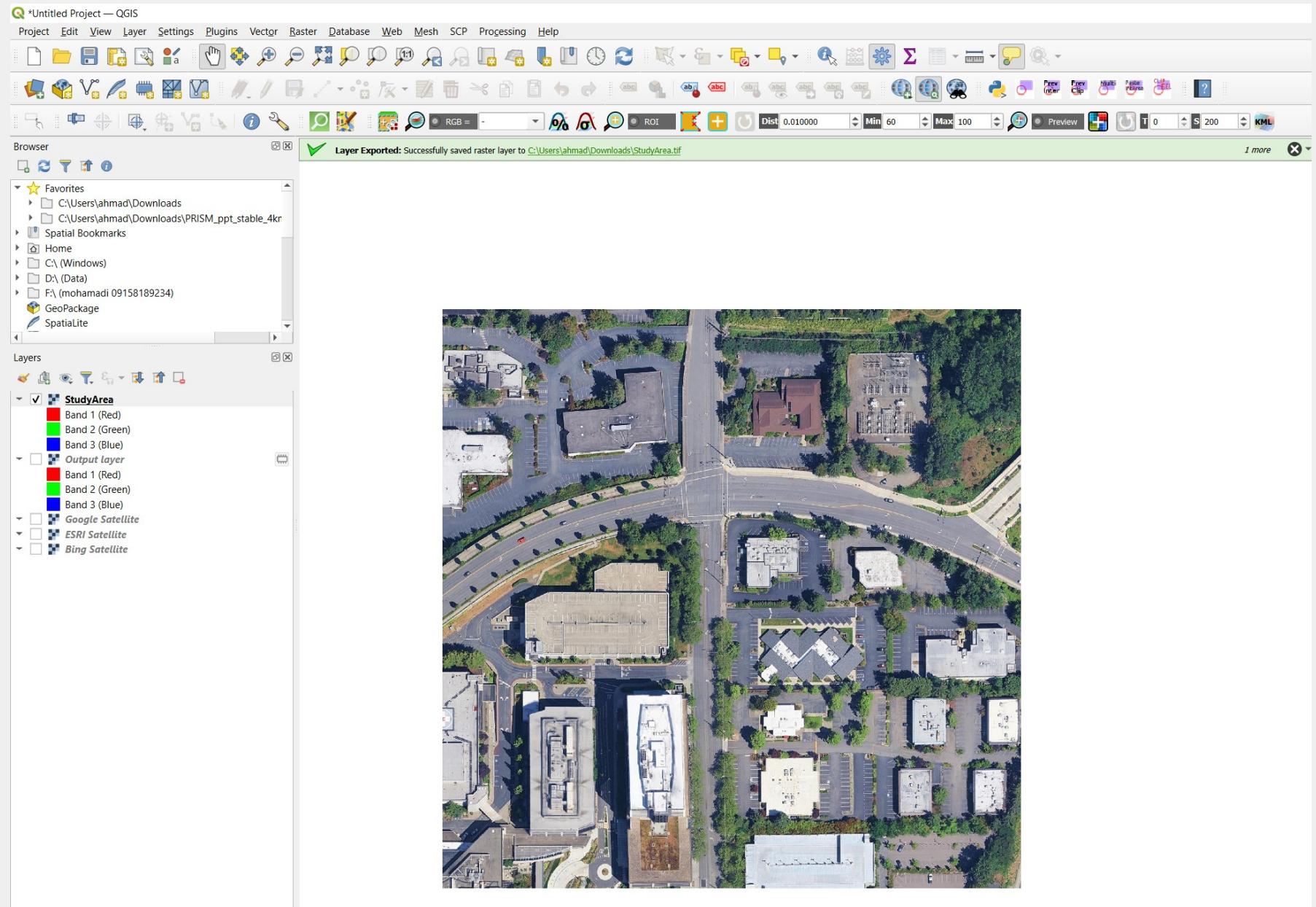
20. In the “Layers” panel

- Deselect Output layer and all other layers except StudyArea



21. Your Study Area is Just an Image Now ☺

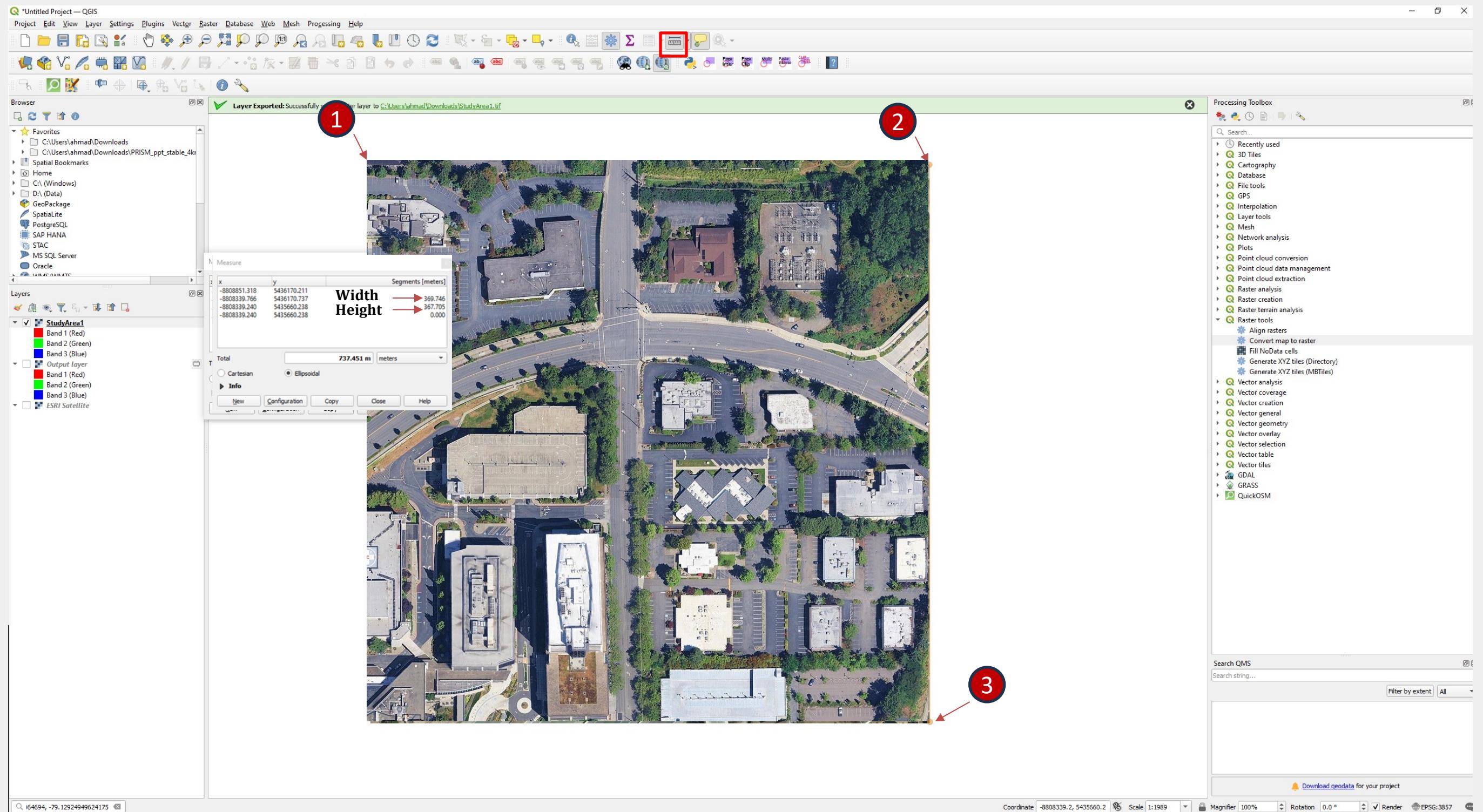
Zoom Out a Bit



Imagery Map and Georeferencing

22. Main Menu → Select “Measure”

□ Measure Width and Height of Image by Clicking on ① ② ③ → Record these measurements in a text file.

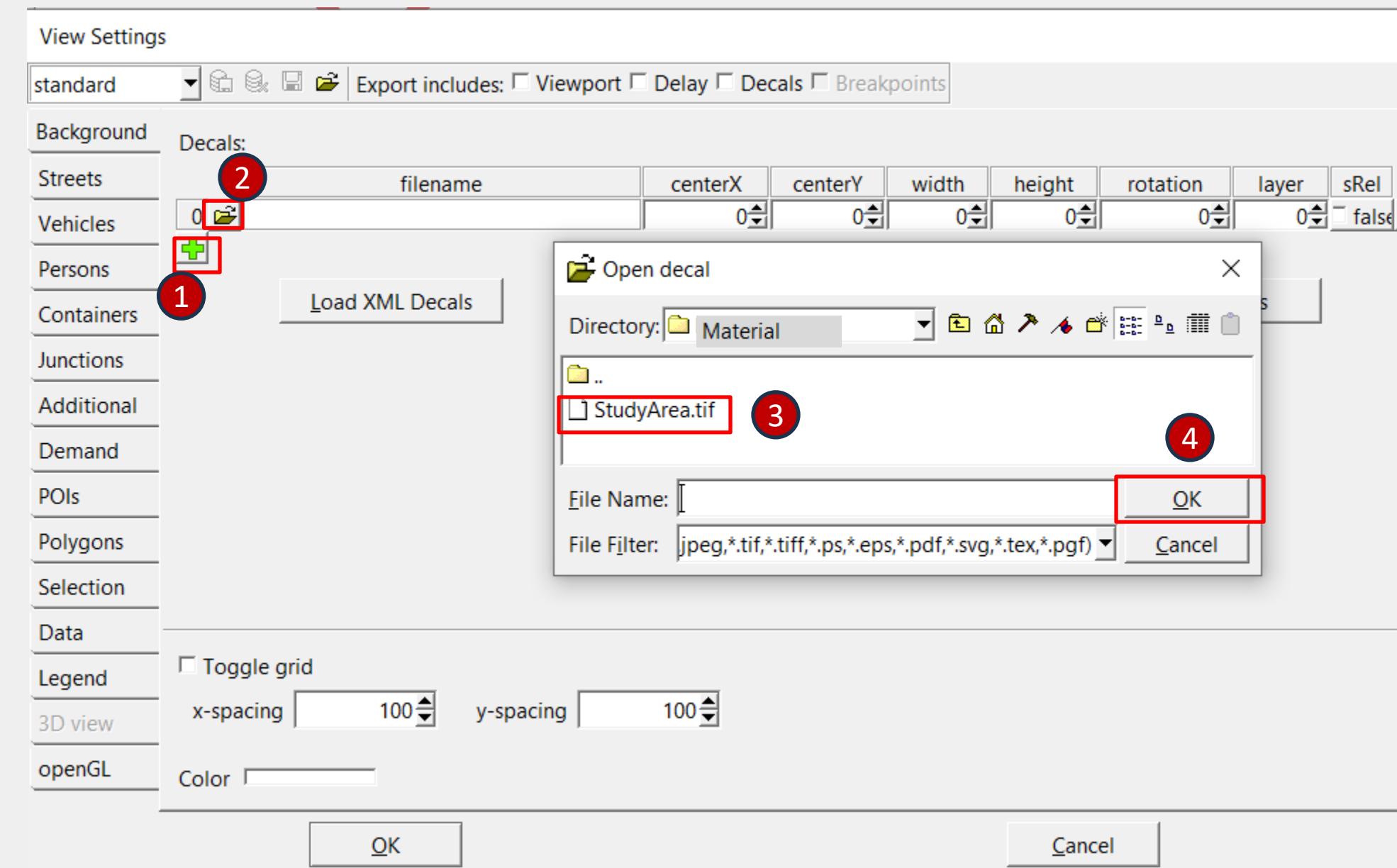


Import a GIS Map into Simulation

1. Opennedit → MainMenu → File → New Network

2. MainMenu → Edit → Edit Visualization → Select “plus” button → Select “Folder”

→ Select the StudyArea.tif → and Save it to a New Folder Called “Material” Select “Ok”



Import a GIS Map into Simulation

3. Enter the values of Width and Height recorded in QGIS

Decals:

	filename	centerX	centerY	width	height	rotation	layer	sRel
0	\Downloads\Material\StudyArea.tif	0	0	345	345	0	0	false

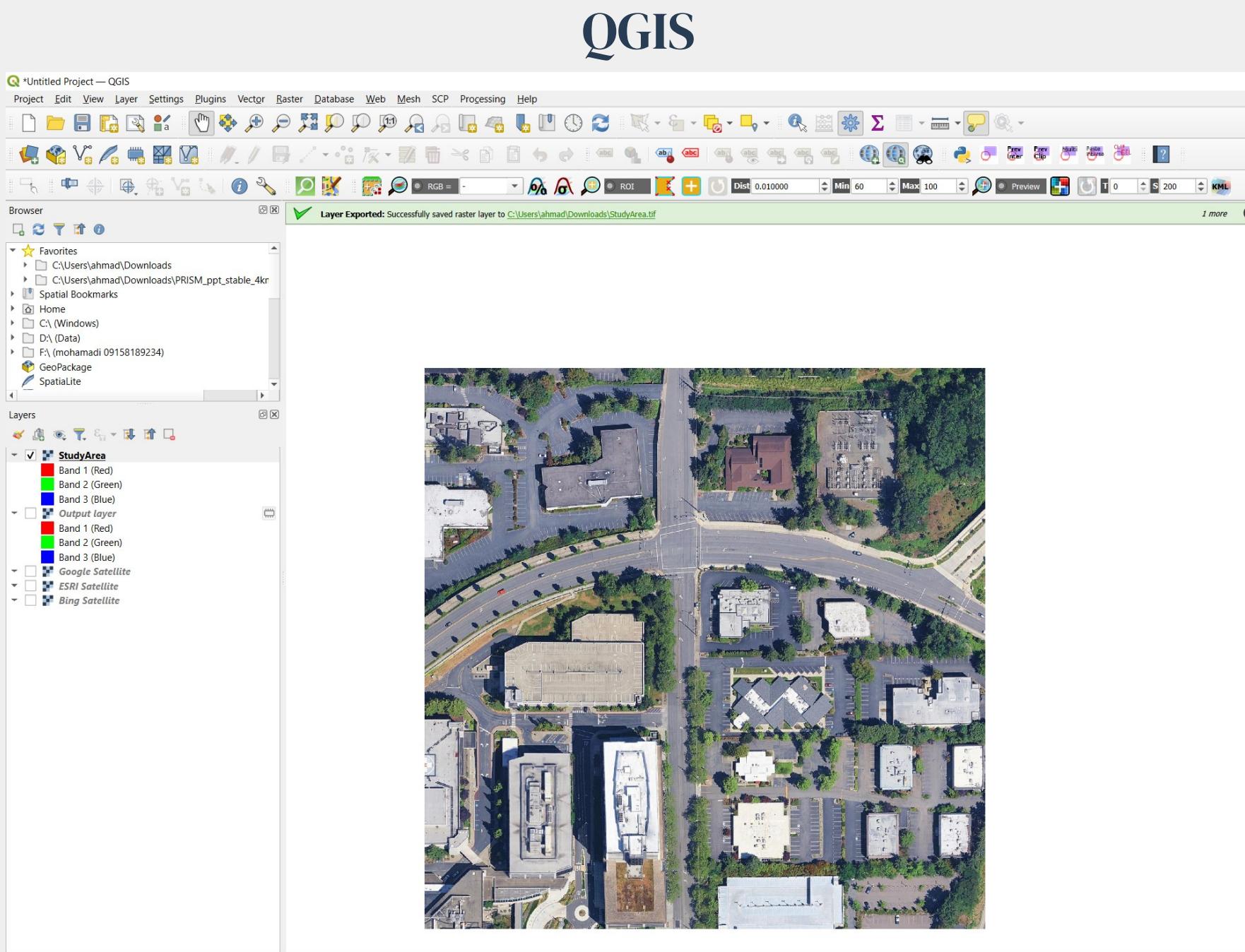
Load XML Decals **Save XML Decals** **Clear Decals**

4. This process is called “georeferencing”

Please listen to instructor explanation about Georeferencing

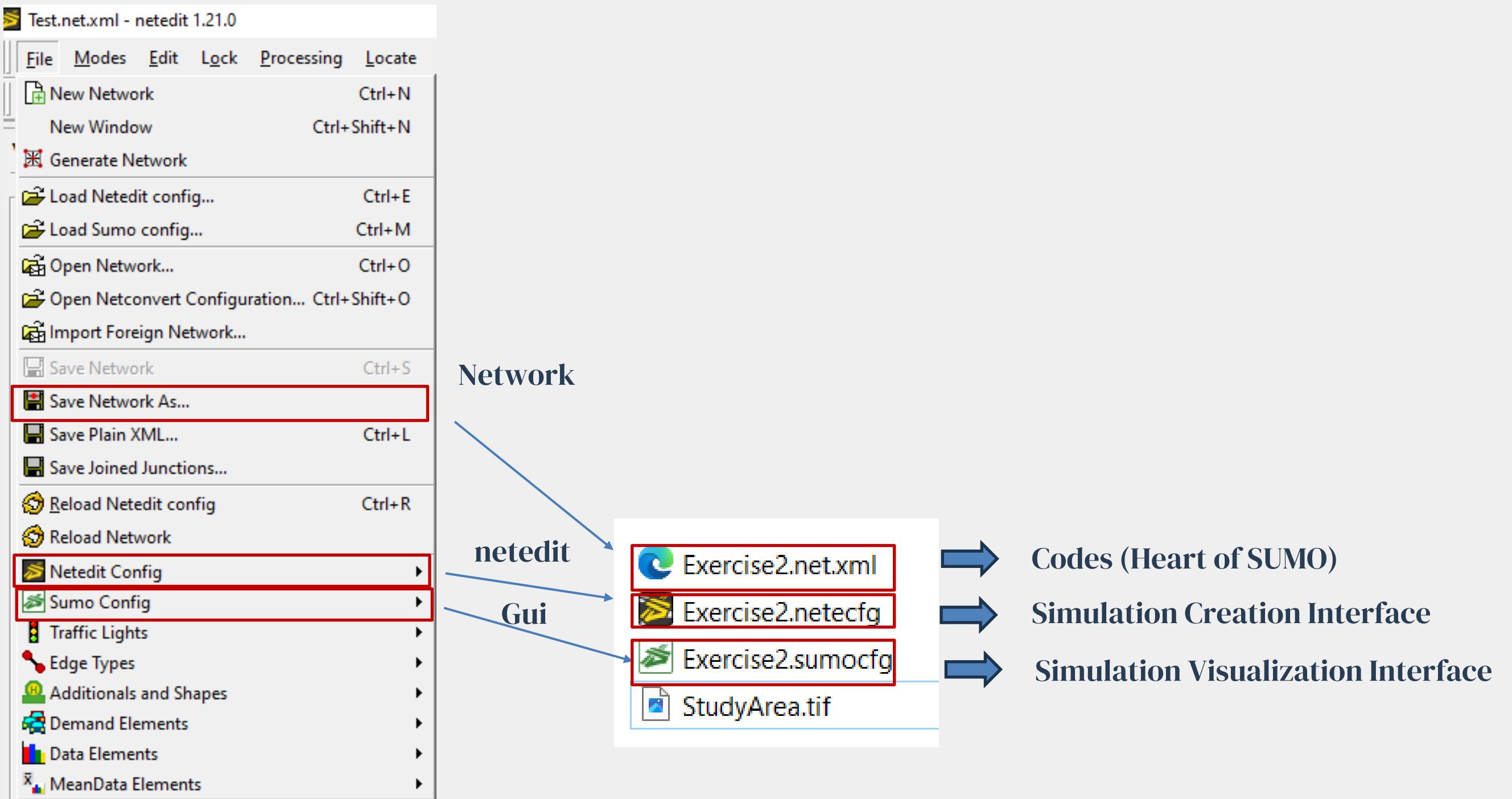
Import a GIS Map into Simulation

We successfully transferred QGIS map to SUMO



Import a GIS Map into Simulation

5. Save SUMO Files in the Folder “Material” as below (name each file as “Excercise2”)



Import a GIS Map into Simulation

6. Close NetEdit and reopen it.

7. Do you see an error message (e.g., “No nodes loaded”)?

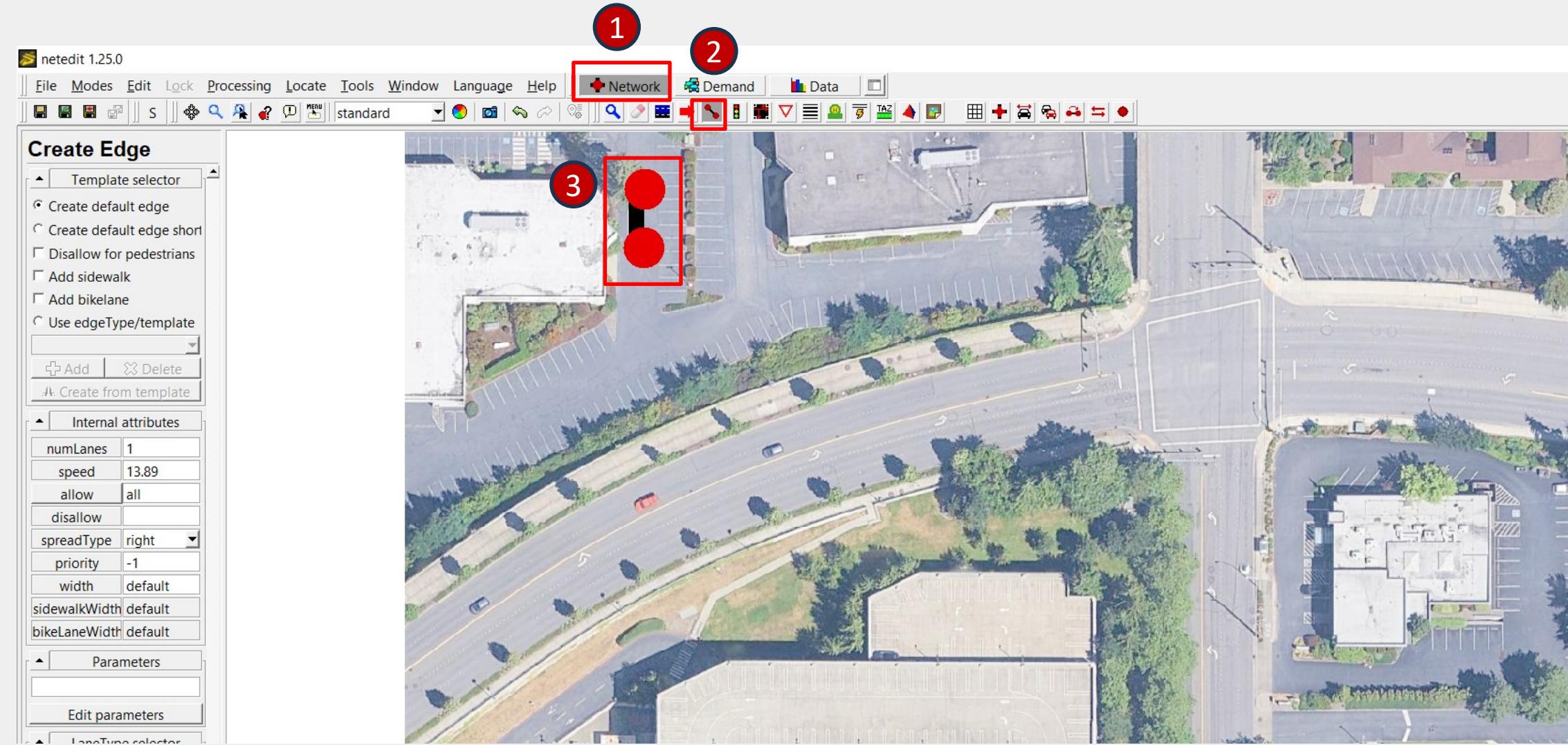
```
Parsing sumo-net from 'D:\OneDrive - York University\Business2\CodingPractical\Courses\DigitalTwinForSmartCities\Week6\Week6a.Material\Exercise2.net.xml' ... done (0ms).
Error: No nodes loaded.
Error: Failed to build network.
```

8. This happens because there is no road network yet, so the saved SUMO network file is empty (no nodes/edges).

9. To avoid this, create a small dummy road network (we won’t use it), then save the file.

Import a GIS Map into Simulation

10. Delete the existing SUMO files and repeat Slides 21–23.
11. Create a small (dummy) road network as shown below.
12. Save the SUMO files again (see Slide 24).



Import a GIS Map into Simulation

13. Close All SUMO Files and Reopen Netedit

Note: SUMO currently does not save the background image, so you need to reassign it after reopening.