



# 3DCityDB Tools

*for*

 QGIS

## Quick installation and user guide

Version 0.7.0 (February 2023)

Last update: 13 February 2023

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# Motivation

## Motivation

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### IDEA:

- **CityGML 3D City Database:** Why not letting users benefit from *directly* working with the 3DCityDB?
  - No need to work with files
  - Editing of features attributes could become way easier
  - SQL/relational model are rather well-known in and outside the GIS user community
  - Last but not least.... "3D city models belong best in a database" ☺



# Motivation

BUT:

- 3DCityDB structure is rather complex
  - Lots of nested tables, intricate structure
  - Data management is difficult, although some functions are provided (e.g. delete functions)
  - There can be multiple citydb schemas in the same database instance (aka "scenarios")
- CityGML does not follow the Simple Feature for SQL model (SFS)
  - Nested features
  - One feature can have multiple representations (multiple LoDs, multiple geometry types)
- The existing **Importer/Exporter** offers some functionalities, but its *raison d'être* is basically different (...as the name says!)

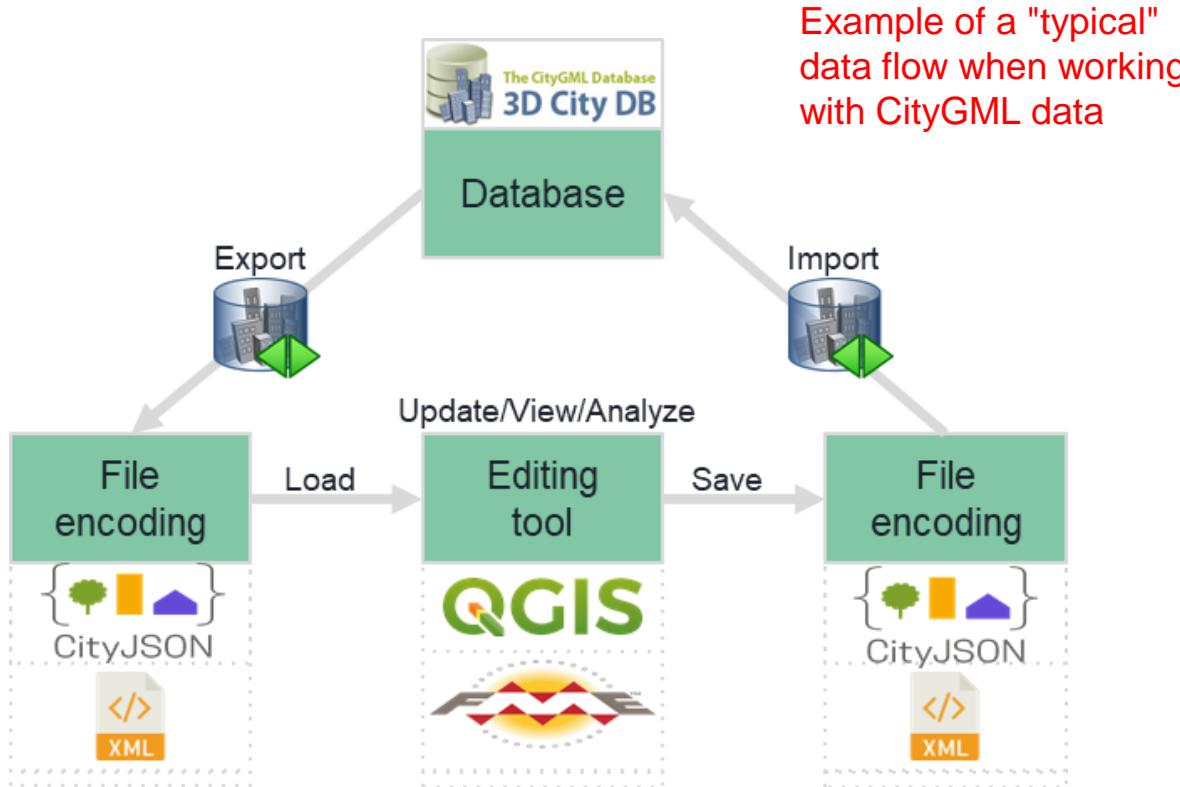
# Motivation

SO:

- Why not using **QGIS**?
  - Well-known and established open-source software
  - Rather mature, version 3.22 LTR released in autumn 2021, well documented
  - Native support for PostgreSQL/PostGIS, support also for Oracle Spatial
  - Has strong 2D and some (definitely less mature) 3D visualisation functionalities
  - Can be extended with Python-based plugins

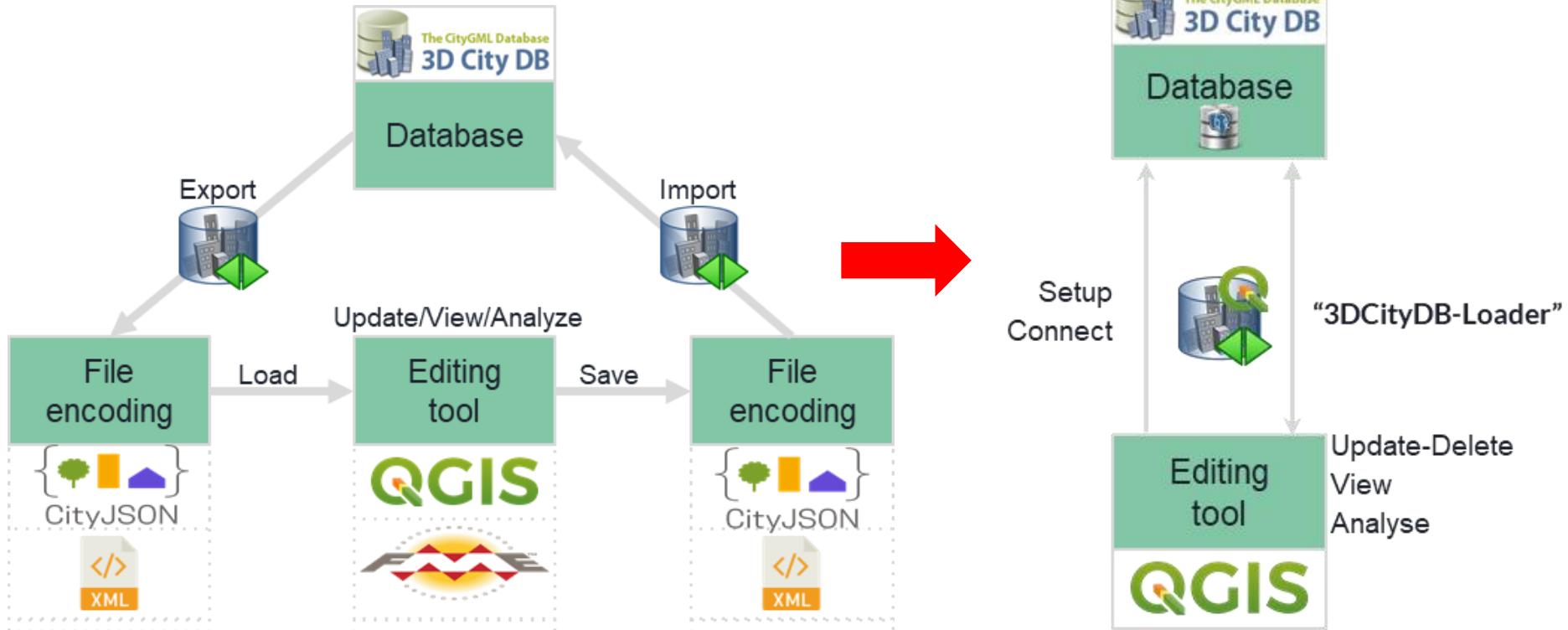


# Motivation



# Motivation

Vision / goal of the plugin



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# Plugin overview

## Main functionalities

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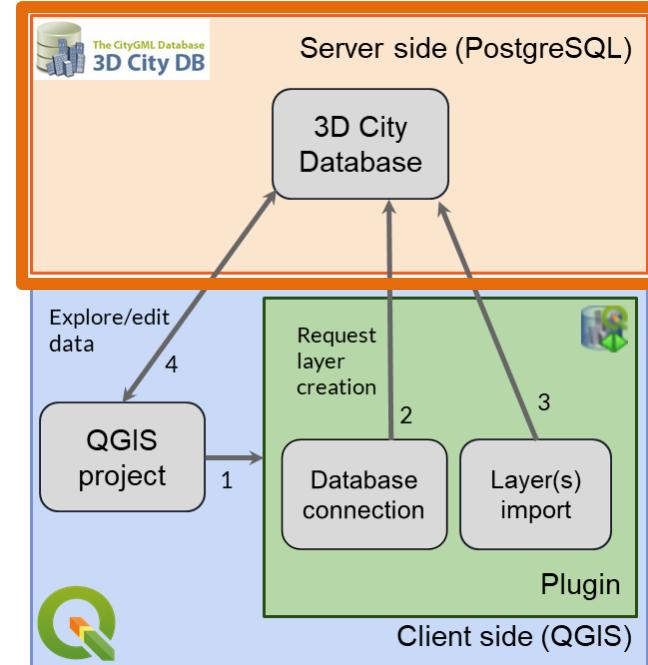
- Create "**SFS-like layers**" to hide 3DCityDB complexity when interacting with data
  - Deal efficiently with multi-LoD / different geometries / implicit representations
    - Up to ≈600 possible combinations in CityGML!
  - Merge all standard attributes of a CityObject into a single "table"
- **Deal with the possibly huge size of city models** stored in a database
- Support for **multiple citydb schemas** in the same 3DCityDB instance
- Support for **multiple users with different privileges** (read-only, read-write)
- **Editing of attributes:** possible (depending on user privileges)
- **Deletion of features:** possible (depending on user privileges)
- Editing of geometries: NOT possible

# Plugin overview

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## Server-side PostgreSQL "QGIS Package"

- Creates and manages layers as views (for attributes) linked to materialized views (for geometry) following the SFS model
- Manages
  - users and privileges
  - multiple citydb schemas
- Adds default users with ro & rw privileges



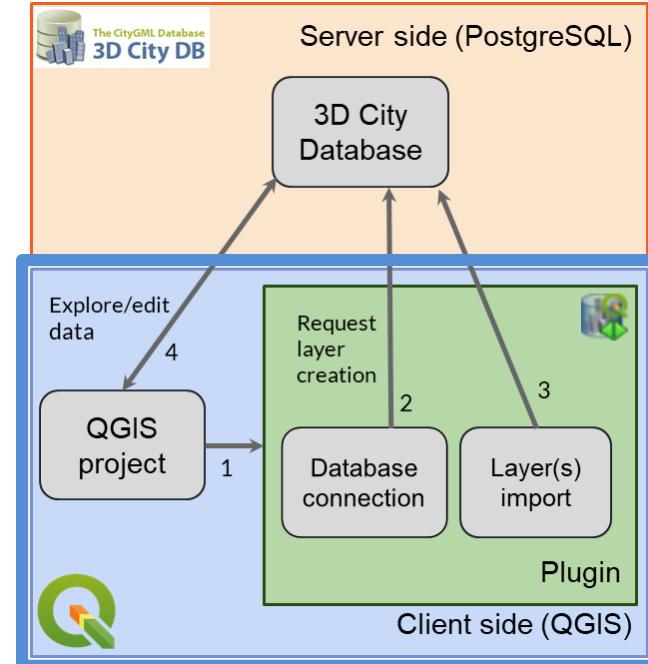
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## Client-side

### QGIS plugin “3DCityDB-Loader”

- Manages db connections + installation of the **QGIS Package**
- Allows for GUI-based
  - layer creation and management
  - management of multiple citydb schemas
  - editing of feature attributes
- GUI includes
  - support for children tables (e.g. generic attributes)
  - CityGML enumerations
  - (optionally) codelists
- Creates a hierarchical Table of Contents



# IMPORTANT NOTICE

The following slides assume that you are already familiar with the **3DCityDB Suite**

In particular you should:

- Have an already installed 3DCityDB database instance
- Be able to use the 3DCityDB Importer/Exporter
- Be able to import CityGML data into the 3DCityDB
- (Optionally) be able to create additional citydb schemas

Otherwise:

- Refer to the slides in "**3DCityDB\_Suite\_QuickInstall.pdf**" (also in the same folder of this file) and/or
- Follow the tutorial: <https://github.com/3dcitydb/tutorials>

Last but not least...

- You may profit from a basic knowledge of the main CityGML concepts 😊
- Otherwise, here a crash course for free: <http://www.urbangeobigdata.it/?p=195>

# Installation

## Software requirements

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- CityGML 3D City Database **v. 4.x or higher** for PostgreSQL
  - <https://github.com/3dcitydb/3dcitydb-suite/releases>
  - <https://3dcitydb-docs.readthedocs.io/en/latest/>
  - **BEWARE:** 3DCityDB v. 3.x and older are NOT supported!
- PostgreSQL **v. 10 or higher**, PostGIS **v. 2.0 or higher**
  - **BEWARE:** NOT compatible with older versions
  - <https://www.postgresql.org/download/>
- QGIS **v. 3.22 or higher**
  - **BEWARE:** NOT compatible with older versions
  - <https://qgis.org/en/site/forusers/download.html>
- PgAdmin (suggested, not required)
  - <https://www.pgadmin.org/download/>

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## 3DCityDB-Tools compatibility matrix

QGIS version	3DCityDB-Tools works?	Comments
QGIS 3.28 LTR	✓	Works
QGIS 3.26	✓	Should work, but not supported
QGIS 3.24	✓	Should work, but not supported
QGIS 3.22 LTR	✓	<b>Works. Reference version used for development</b>
QGIS 3.20	✗	May work, but not supported
QGIS 3.18	✗	"Import selected layers" button always disabled
QGIS 3.16 LTR	✗	User's GUI won't load. Issues with (outdated?) method QgsExtentGroupBox.setMapCanvas()

# Testing machines

Machines used for development and testing:

OS	Processor(s)	HD	RAM	PostgreSQL	PostGIS
Windows 10 21H2 64bit	Core i7-8650U 1.7 GHz	SSD 2 TB	32 GB	14, 64bit	3.2
Ubuntu 20.04.3 LTS 64bit	Intel i7-7500U (4) 3.500GHz	SSD 250 GB	8 GB	12, 64bit	3.1
Mac OS (11.6.2 64bit)	Core i9-9980HK	HDD 1TB	32 GB	14, 64bit	3.1
Ubuntu 18.4 LTS 64bit	Virtual Machine	HDD 2 TB	16 GB	10, 64bit	3.0
Windows 10 22H2 64bit	Core i7-8565U 1.8 GHz	SSD 250GB + HDD 1 TB	16 GB	15, 64 bit	3.1
Ubuntu 22.04 LTS 64bit	Virtual Machine	100 GB	8 GB	14, 64 bit	3.2

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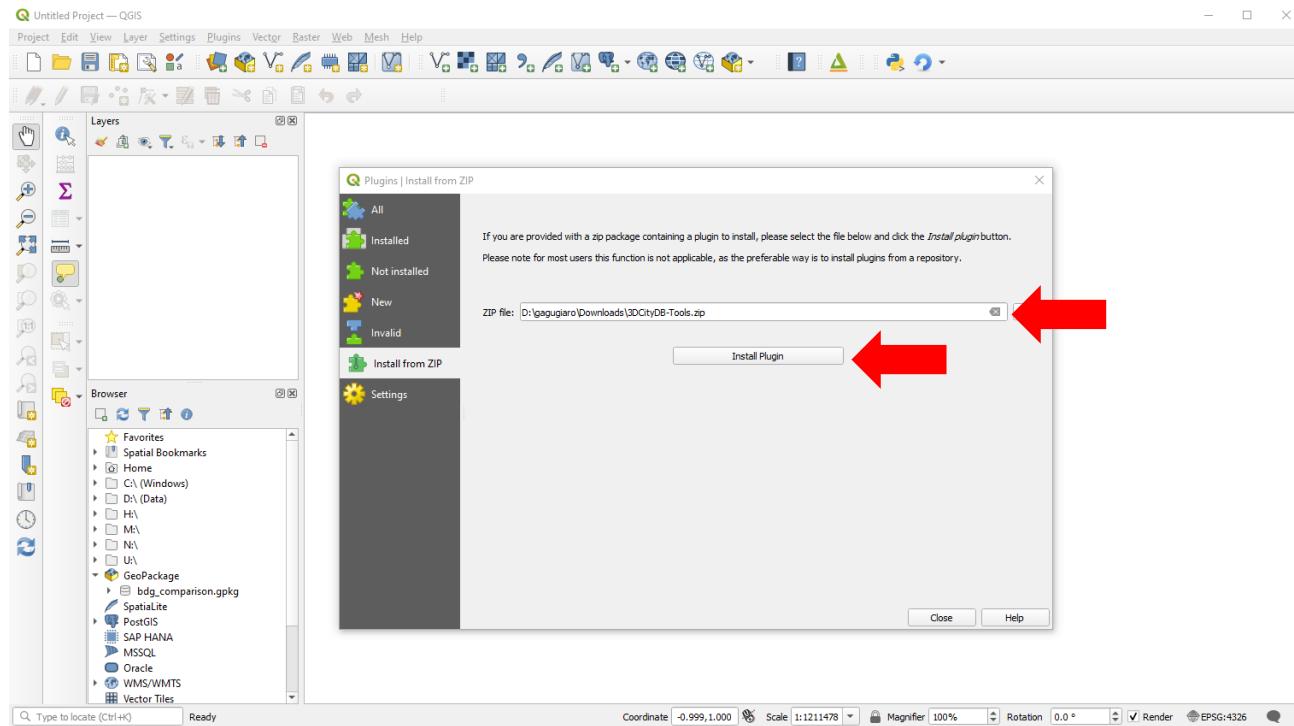
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# Front-end installation

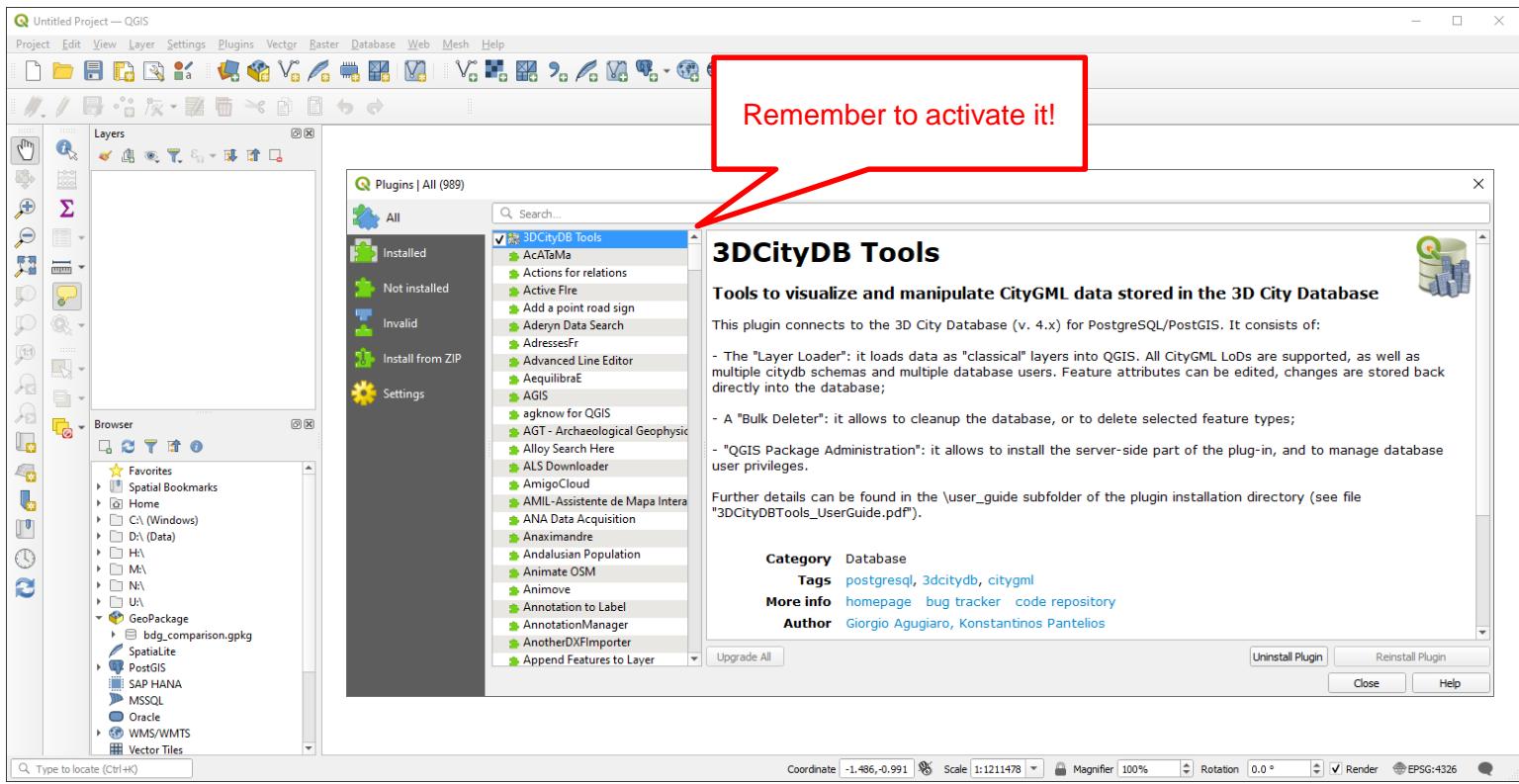
- The "**3DCityDB-Tools**" for QGIS is currently available as **zip file**
- In QGIS, open the Plugins\Manage and install plugins window, and choose "Install from ZIP". Select the provided zip file and click the "Install Plugin" button



# Front-end installation

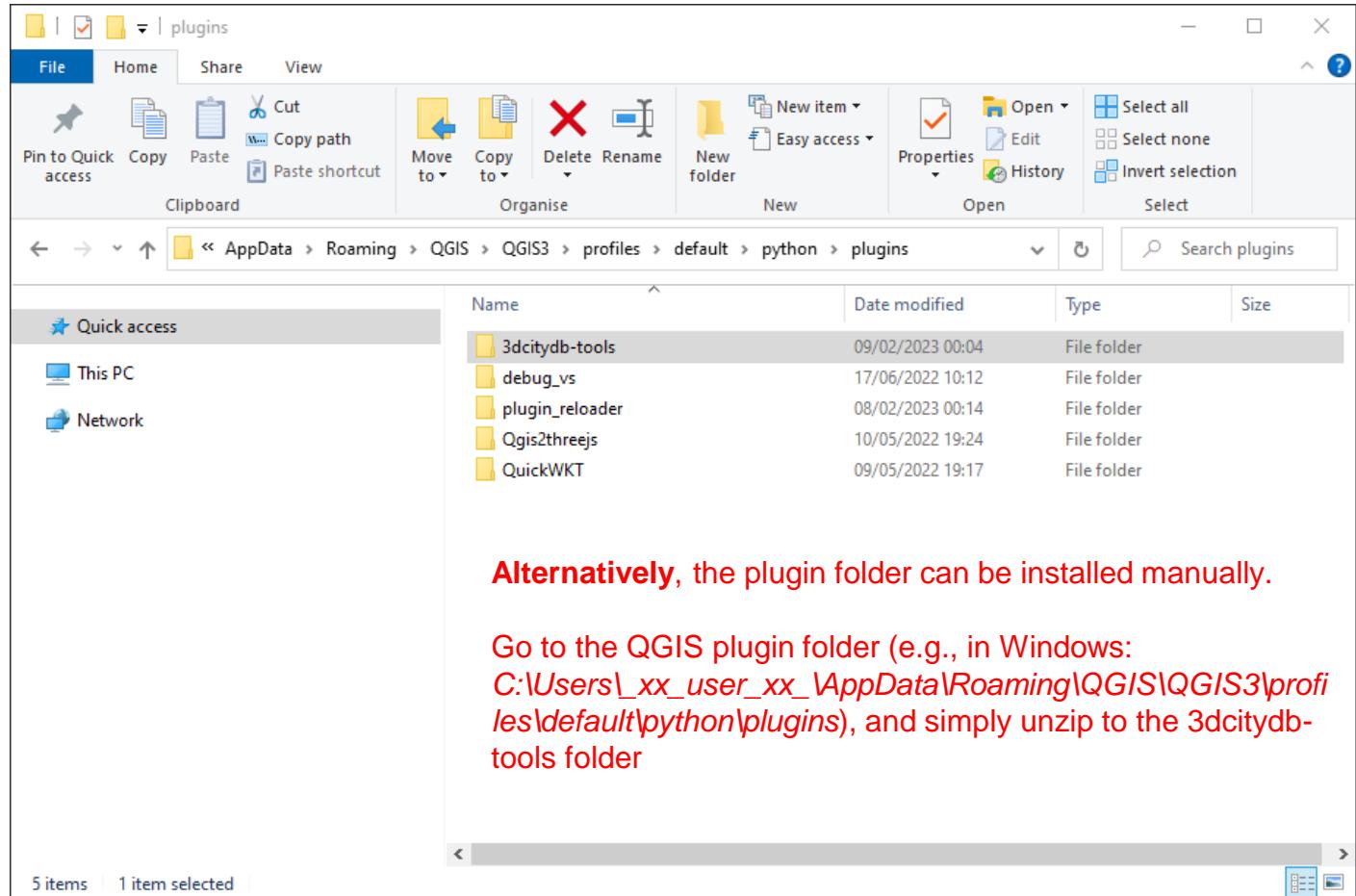
- Upon installation, you must activate the plugin

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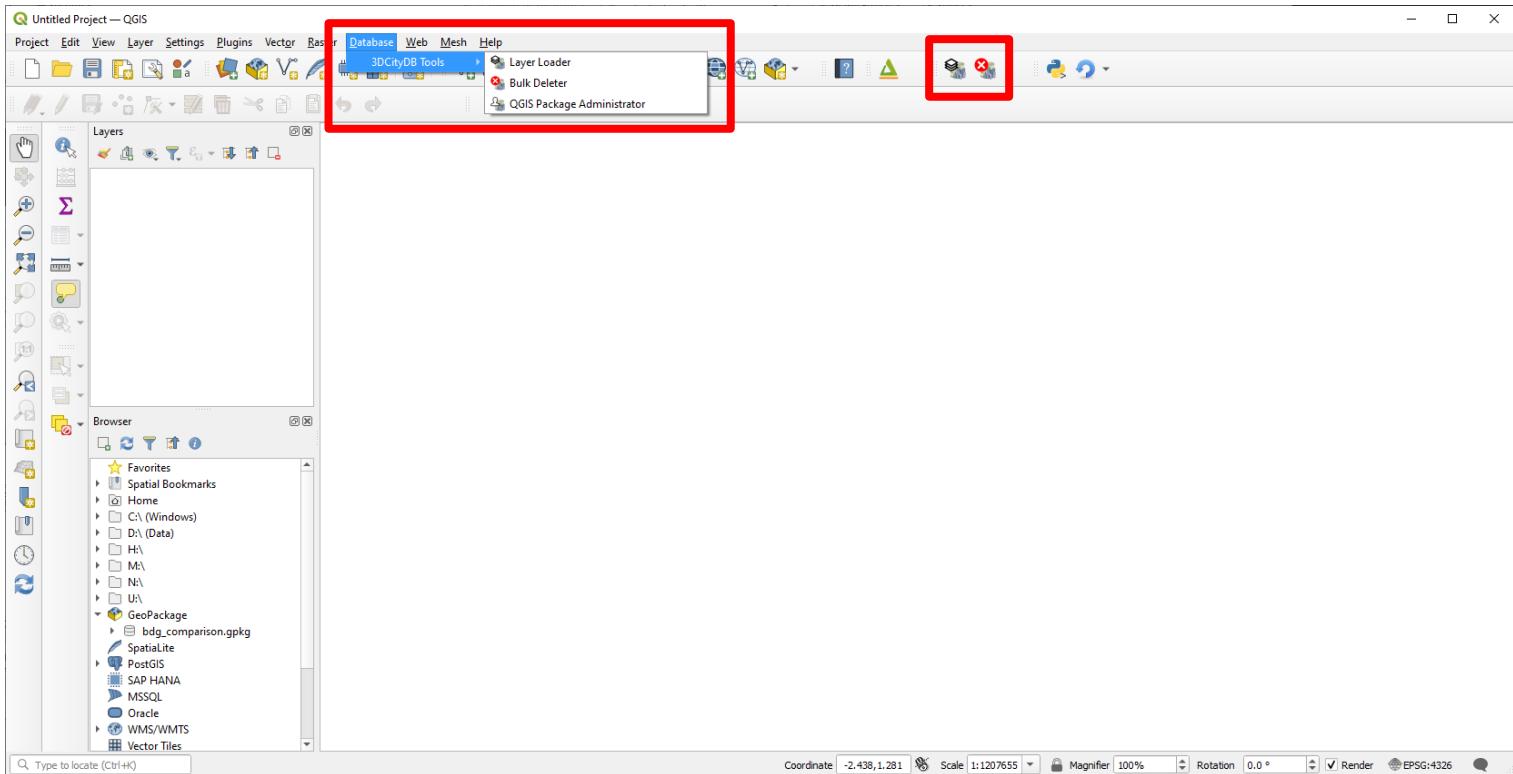
# Front-end installation

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# Front-end installation

The **Database menu** will now contain a new entry, and the icons will be visible in the database icon bar (if the icon bar is activated)



# Back-end installation

The back-end installation consists in installing the **QGIS Package** into a 3DCityDB instance. It can be carried out using the "QGIS Package Installation" GUI of the front-end. The **database administrator** is responsible for setting up in advance the server-side for *any* user.

In general, **4 steps** are necessary:

- a) Installation of the QGIS Package (i.e. the "qgis\_pkg" schema)
- b) Selection of the database users
- c) Creation of a user schema for each selected user (e.g. "qgis\_giorgio")
- d) Definition of the database privileges for each user and for each citydb schema (i.e. read-only, read & write, none)

It is possible to perform:

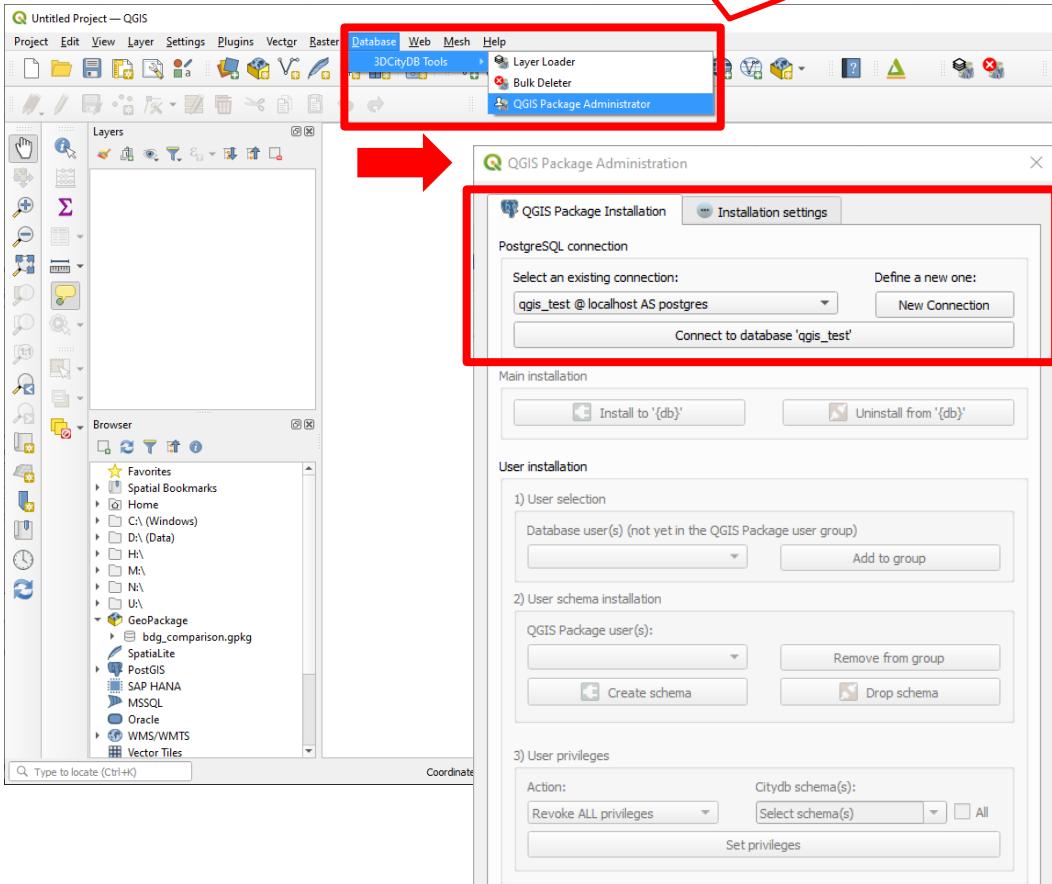
- A "**simplified installation**", which carries out all 4 operation at once and automatically installs 2 default users
- A "**normal installation**", where the administrator has complete control over each step

# Back-end installation

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As **database administrator**  
(e.g. "postgres"):

- 1) Create a new connection or use an existing one to the desired 3DCityDB instance (here: "qgis\_test")



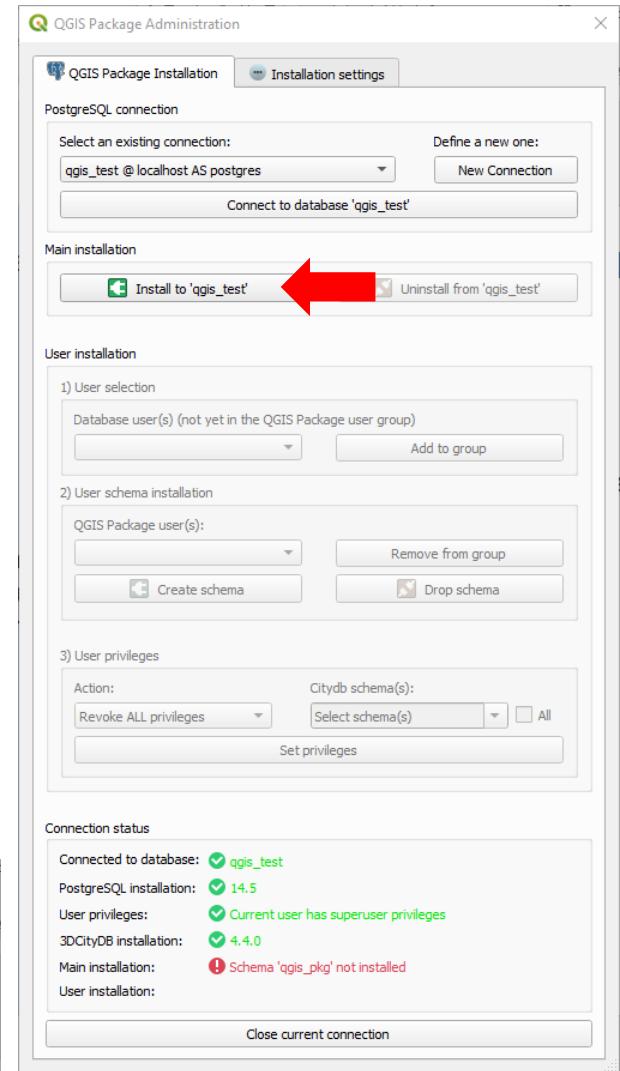
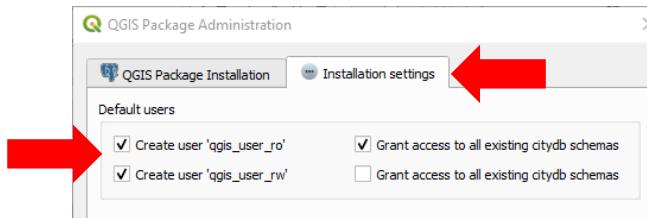
# Back-end installation

## 2.1) "Simplified" installation

The QGIS Package and up to two default users are installed at once:

- User "`qgis_user_ro`" with read-only privileges
- User "`qgis_user_rw`" with read & write privileges
- Both users have access to all citydb schemas in the database at the moment of the installation
- Note bene: Their privileges and access rules can be changed at *any* time after installation. See later in "normal" installation

Before clicking the Install button, go to the "Installation settings" tab and check the desired options

A screenshot of the "QGIS Package Administration" window, specifically the "QGIS Package Installation" tab. It shows a "PostgreSQL connection" section with a dropdown set to "qgis\_test @ localhost AS postgres" and a "Connect to database 'qgis\_test'" button. Below this is a "Main installation" section with "Install to 'qgis\_test'" and "Uninstall from 'qgis\_test'" buttons, with the "Install to" button highlighted by a red arrow. The window also includes sections for "User selection", "User schema installation", "User privileges", and "Connection status".

# Back-end installation

## 2.1) "Simplified" installation

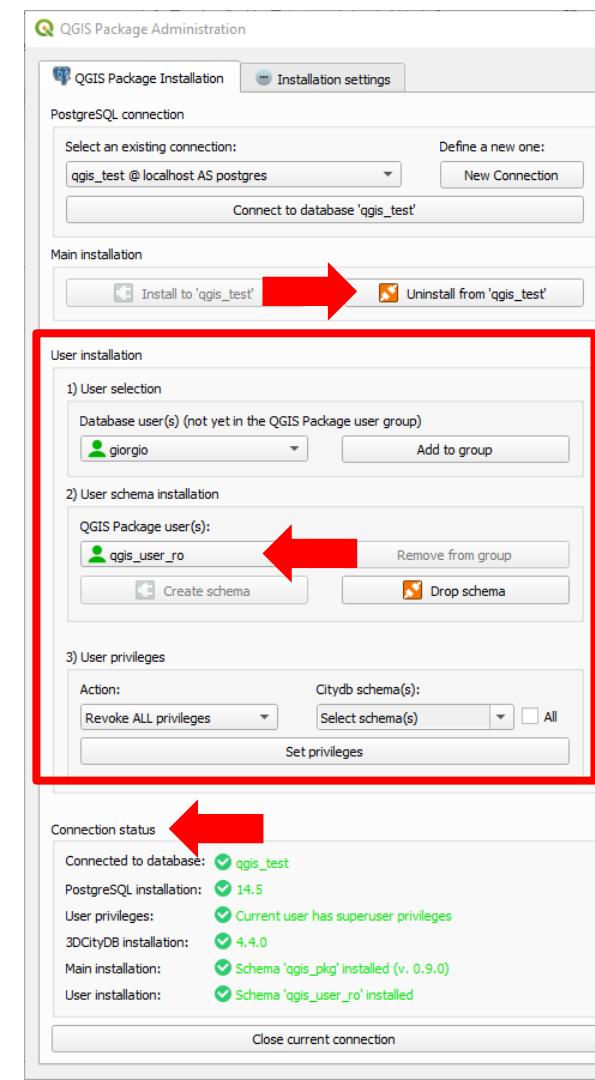
Upon successful installation:

- The **Uninstall button** is activated (in case you want to uninstall the QGIS Package)
- The **User Installation box** is activated
- You are notified in the **Connection status**

**Done!** 😊 Close the QGIS Package Administration GUI. You can now start using the plugin (e.g. the Layer Loader or the Bulk Deleter) using the credentials of one of the default users

Please observe that:

- The default user(s) are automatically added to the **QGIS Package user(s)**
- You can edit the privileges in the **User privileges box**, or leave them as they are



# Back-end installation

## 2.1) "Simplified" installation

In the 3DCityDB, the **qgis\_pkg** schema is added and, depending on the chosen options, the **qgis\_user\_ro** and/or the **qgis\_usr\_rw** schemas are created, too

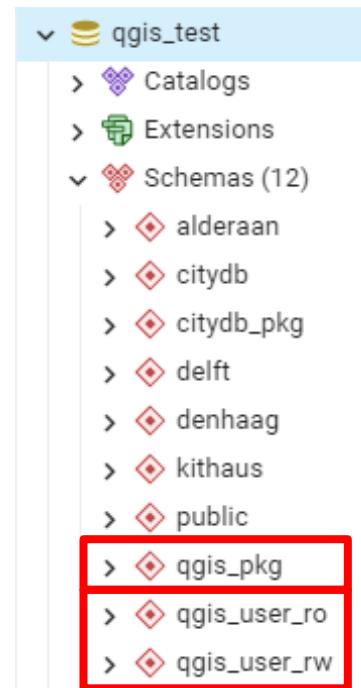
The credentials for the default users are:

### User "qgis\_user\_ro":

- user name: **qgis\_user\_ro**
- password: **qgis\_user\_ro**

### User "qgis\_user\_rw":

- user name: **qgis\_user\_rw**
- password: **qgis\_user\_rw**



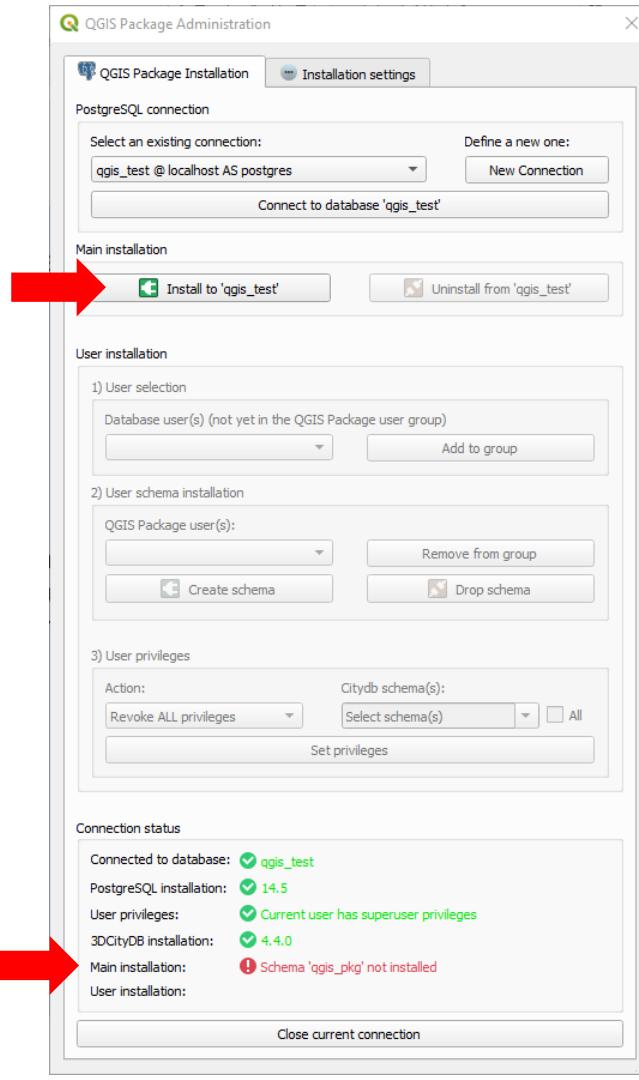
# Back-end installation

## 2.2) "Normal" installation

**Step a)** To install the GIS Package, click the **Install button** (here: install to database "qgis\_test")

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The **Connection status box** in the lower part of the dialog will keep you informed.



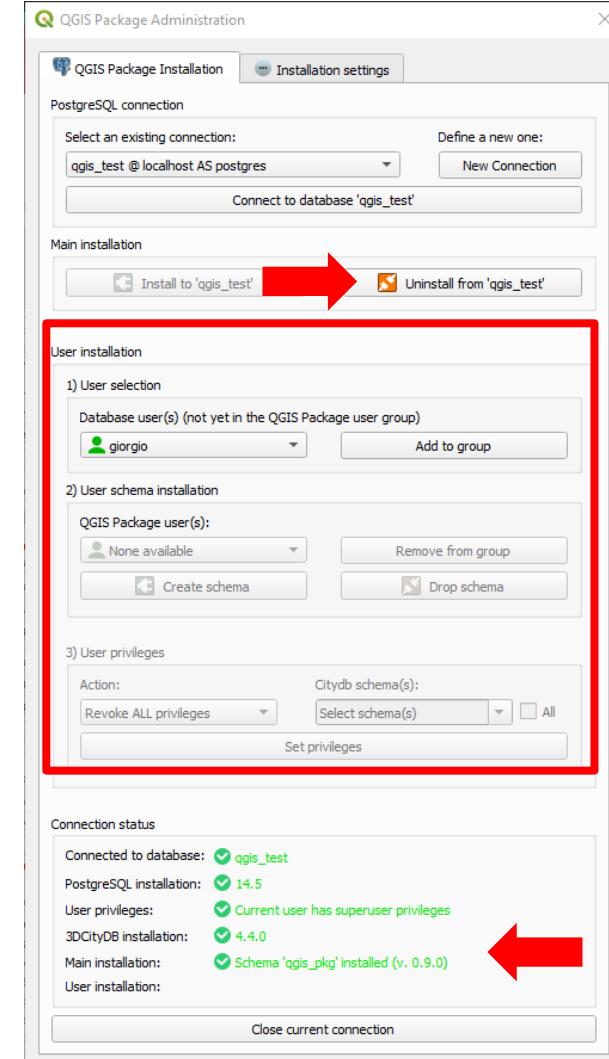
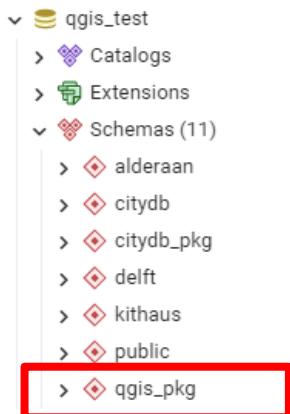
# Back-end installation

## 2.2) "Normal" installation

Upon successful installation:

- The **Uninstall button** is activated (in case you want to immediately uninstall)
- The **User Installation box** is activated
- You are notified in the **Connection status box**

The "**qgis\_pkg**" schema is created in the the selected current database



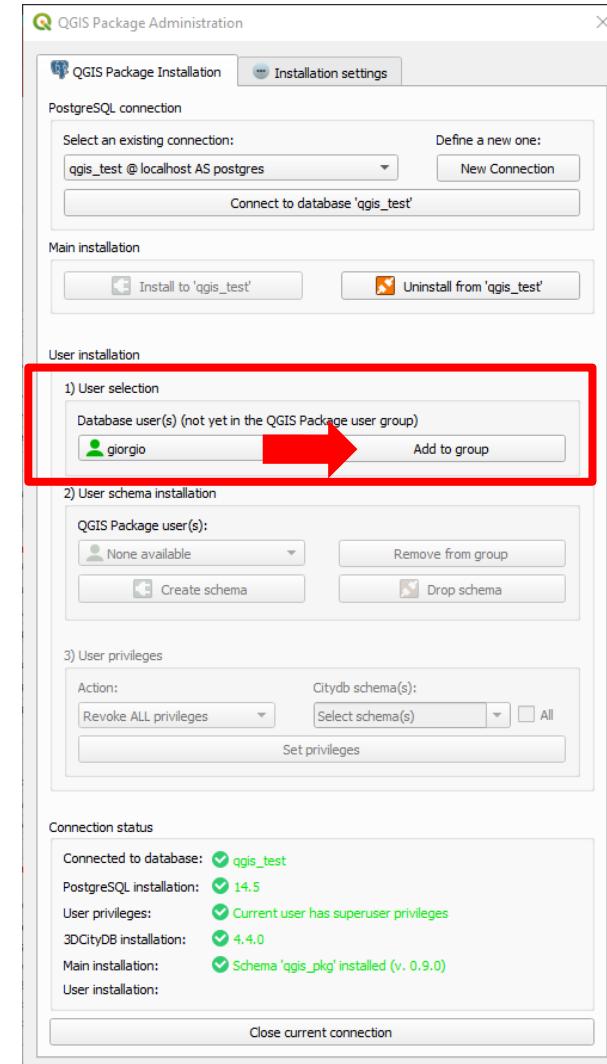
# Back-end installation

## 2.2) "Normal" installation

**Step b)** Choose from all database users the one(s) to add to the QGIS Package user group. Click the **Add to group** button



For each 3DCityDB there is a group named "**qgis\_pkg\_usrgroup\_**" + **database name** is created. It contains those users that will be allowed to interact with the database from the front-end.  
Example: for database "qgis\_test" there is a group called "qgis\_pkg\_usrgroup\_qgis\_test".

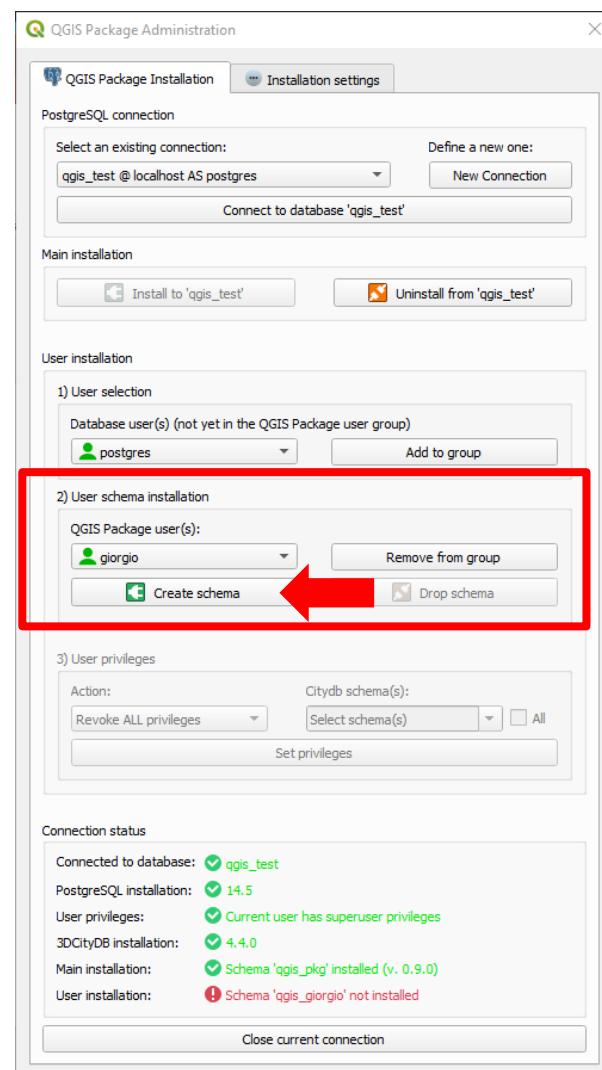
A screenshot of the QGIS Package Administration window. In the 'User selection' section, a user named 'giorgio' is listed in a dropdown menu. To the right of the dropdown is a red arrow pointing to a 'Add to group' button. The 'User selection' section is also highlighted with a red rectangular border.

# Back-end installation

## 2.2) "Normal" installation

**Step c)** Create the user schema for the selected user(s) belonging to the group

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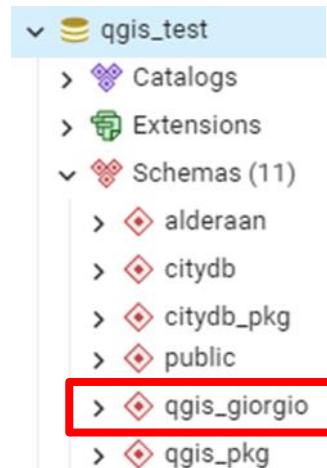


# Back-end installation

## 2.2) "Normal" installation

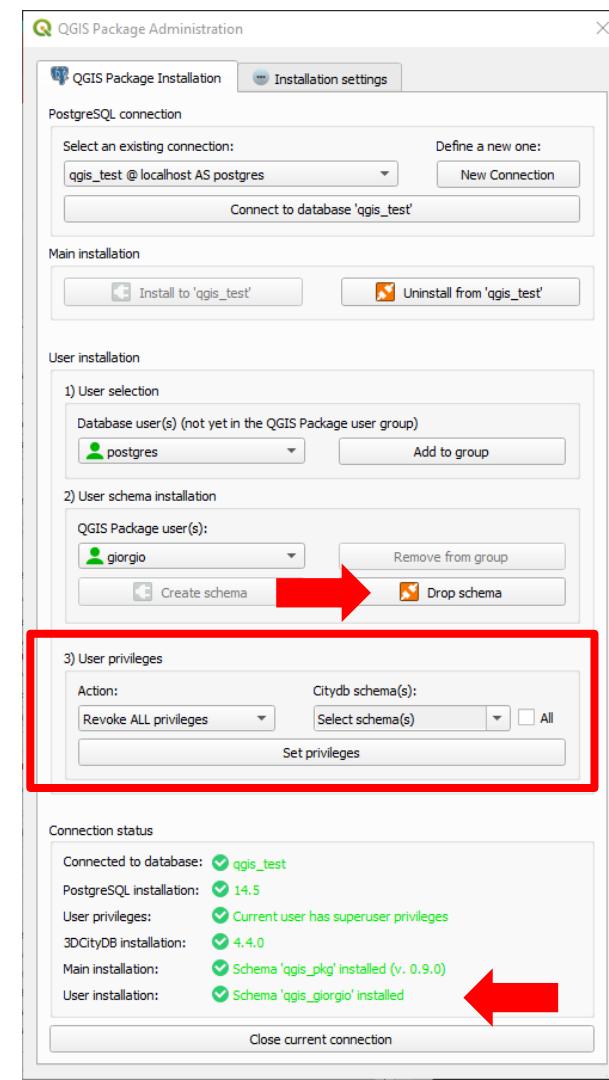
Upon successful creation of the user schema:

- The **Drop schema** button is activated (in case you want to drop the schema you just created)
- the **User privileges box** is activated
- You are notified in the **Connection status box**



A schema named "**qgis\_**" + **user name** is created.

Example: for user "giorgio", schema "qgis\_giorgio" will be created.



**QGIS Package Administration**

**PostgreSQL connection:**  
Select an existing connection: qgis\_test @ localhost AS postgres  
Define a new one: New Connection  
Connect to database 'qgis\_test'

**Main installation:**  
Install to 'qgis\_test' | Uninstall from 'qgis\_test'

**User installation:**

- 1) User selection:  
Database user(s) (not yet in the QGIS Package user group): postgres | Add to group
- 2) User schema installation:  
QGIS Package user(s): giorgio | Remove from group  
Create schema | **Drop schema** (highlighted by a red arrow)
- 3) User privileges:  
Action: Revoke ALL privileges | Select schema(s) | All  
Set privileges

**Connection status:**  
Connected to database: qgis\_test  
PostgreSQL installation: 14.5  
User privileges: Current user has superuser privileges  
3DCityDB installation: 4.4.0  
Main installation: Schema 'qgis\_pkg' installed (v. 0.9.0)  
User installation: Schema 'qgis\_giorgio' installed

**Close current connection**

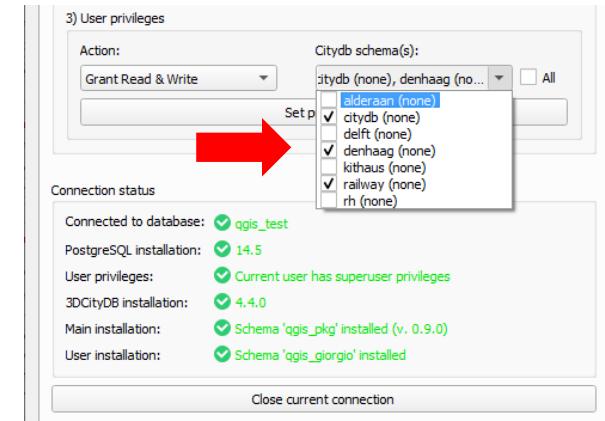
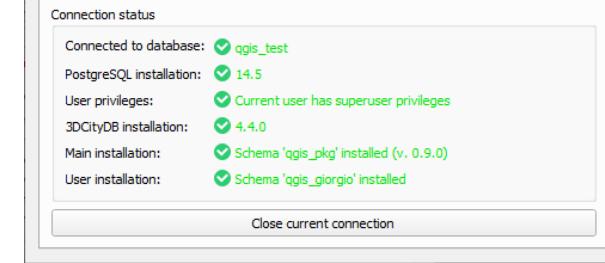
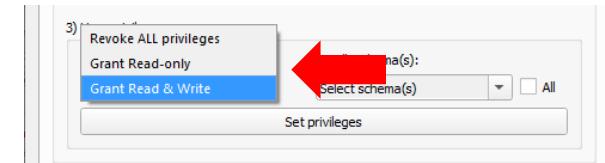
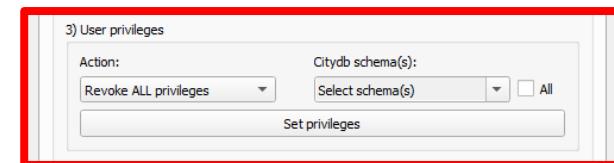
# Back-end installation

## 2.2) "Normal" installation

**Step d)** For the selected user, set the database privileges (read-only, read & write, none) for each of the existing citydb schemas.

You can assign different privileges to different citydb schemas – or revoke them.

Click the **Set privileges** button to apply the settings. The privileges status in the drop down menu will be updated accordingly.



# Back-end installation

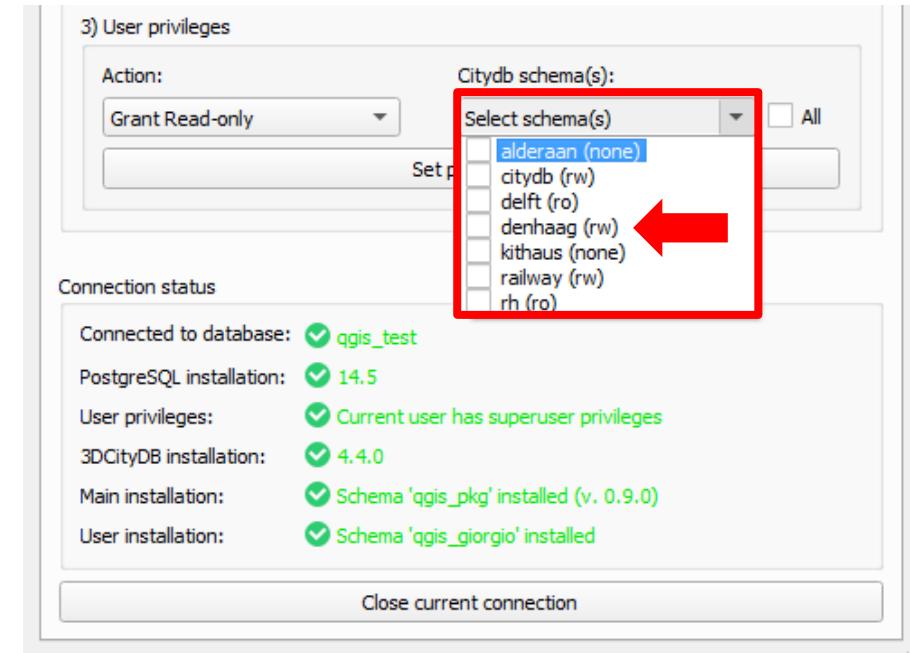
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Every time new privileges are set, the status in the drop down menu is updated with "ro" (read-only), "rw" (read & write) or "none".

Once you are done, close the current connection.

You can now use the Layer Loader or the Bulk Deleter.



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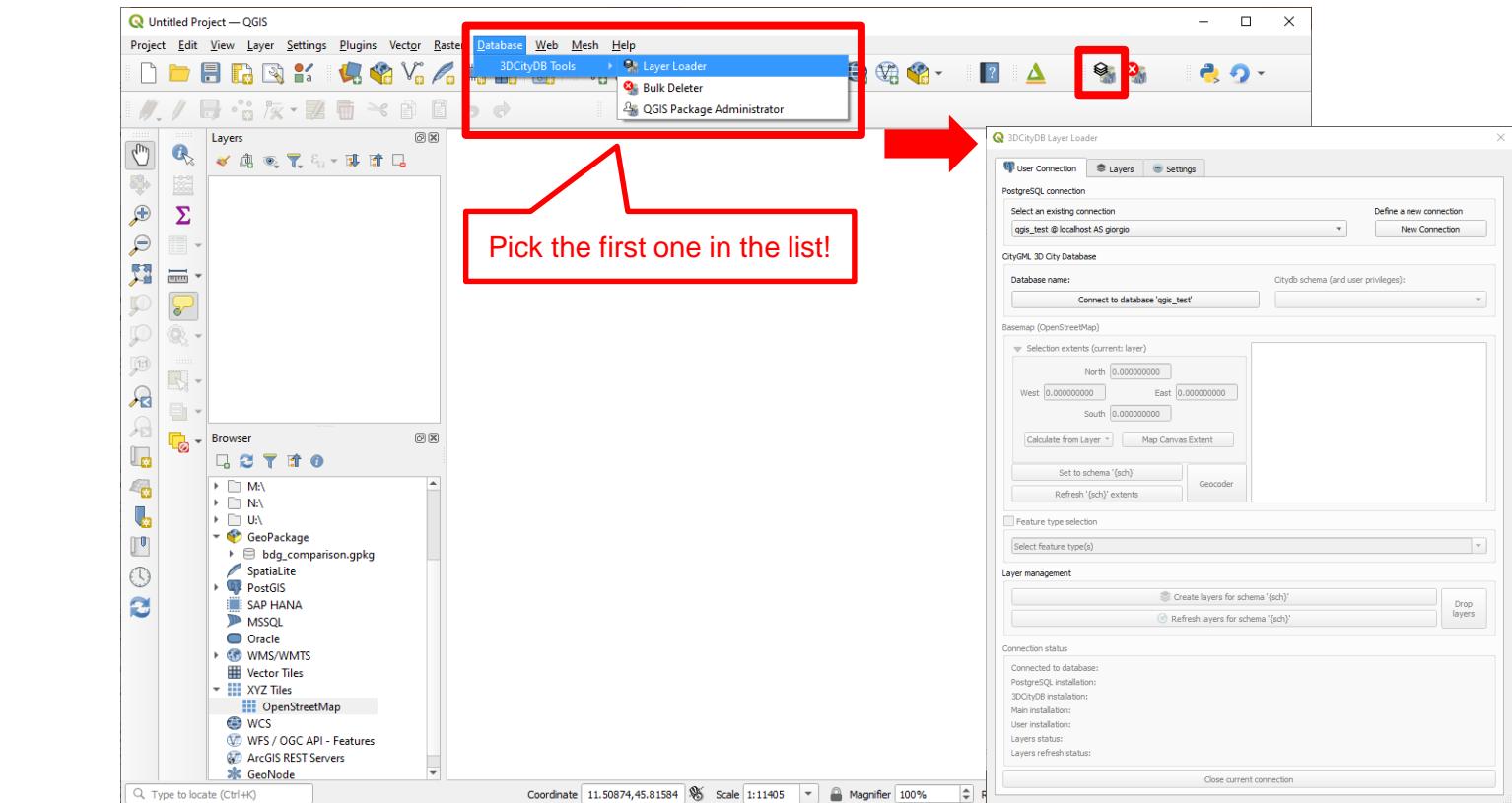
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# Layer Loader

Open the **Layer Loader** from the menu or by clicking on the icon

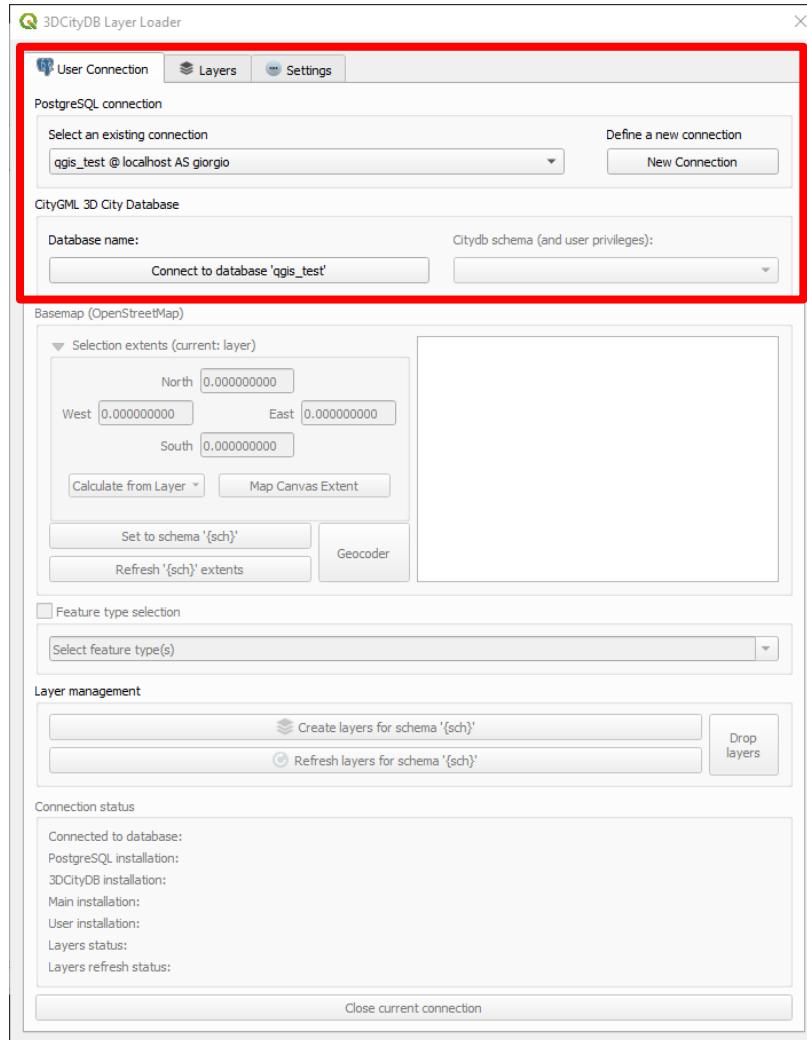
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# Layer Loader

In the "User Connection" tab

- 1) Create a new connection or use an existing one to the desired 3DCityDB instance (here: "qgis\_test")
  
- 2) Use the credentials of:
  - the default users **qgis\_user\_ro** or **qgis\_user\_rw** (if previously installed)
  - Your own credentials (if the administrator has set up your *usr\_schema* before)



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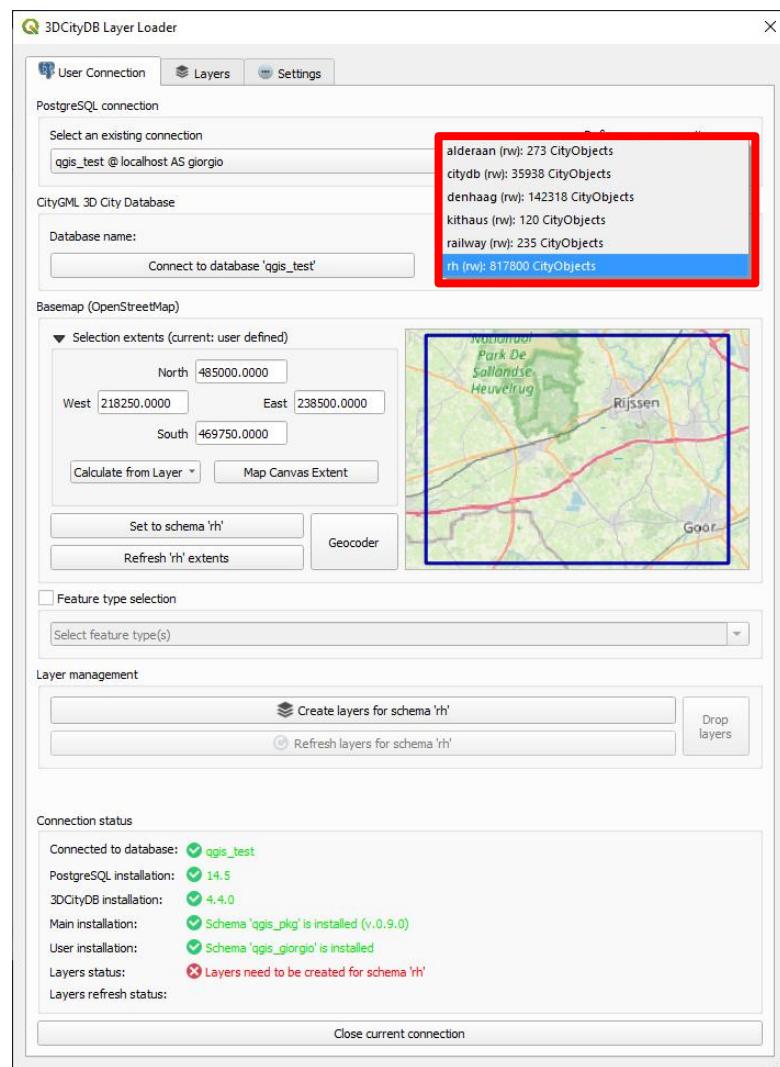
# Layer Loader

3) Once connected, choose one of the existing citydb schemas. If they contain CityGML data, they will be listed.

You will also see your privileges for that citydb schema ("ro" or "rw") and the number of CityGML CityObjects in that schema.

**Nota bene:** Generally, "**citydb**" is the default, and, very often, the only one citydb schema! Nevertheless, the next slides refer to the "**rh**" schema

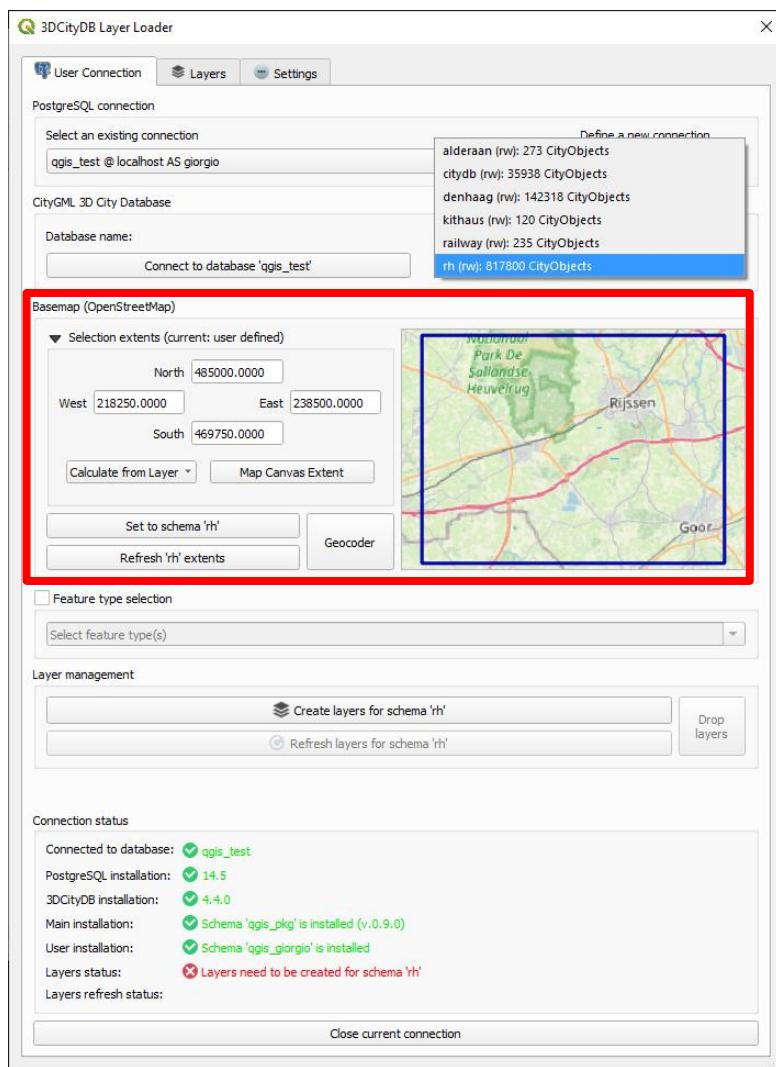
How to create additional citydb schemas  
<https://3dcitydb-docs.readthedocs.io/en/latest/3dcitydb/multi-schema.html>



# Layer Loader

4a) Upon selection of the citydb schema, you will see the extents of the dataset. They correspond to the extents of all currently loaded data in the selected citydb schema (here, for example, schema "rh")

**Please note:** the very first time you load a citydb schema, and depending on the size of the city model, it might take a while to load as the bounding boxes are being computed. From the second time onwards, it will load nearly instantly.

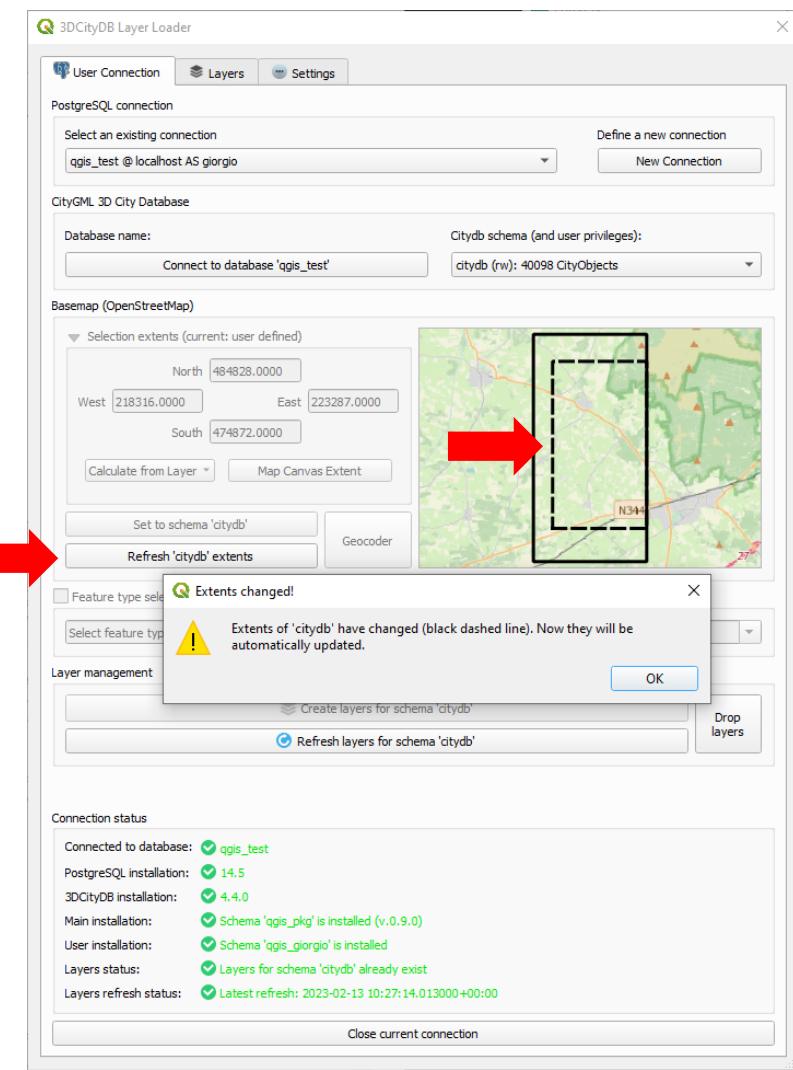


# Layer Loader

4b) If data has been added or removed in the current citydb schema, you can refresh the extents by pressing the **Refresh {cdb\_schema} extents button**.

The new extents will be temporarily shown with a **black dashed line**, before being updated.

**Note bene:** Depending on how the extents have changed, you may have to recreate, refresh and reload the layers in QGIS (see next slides)

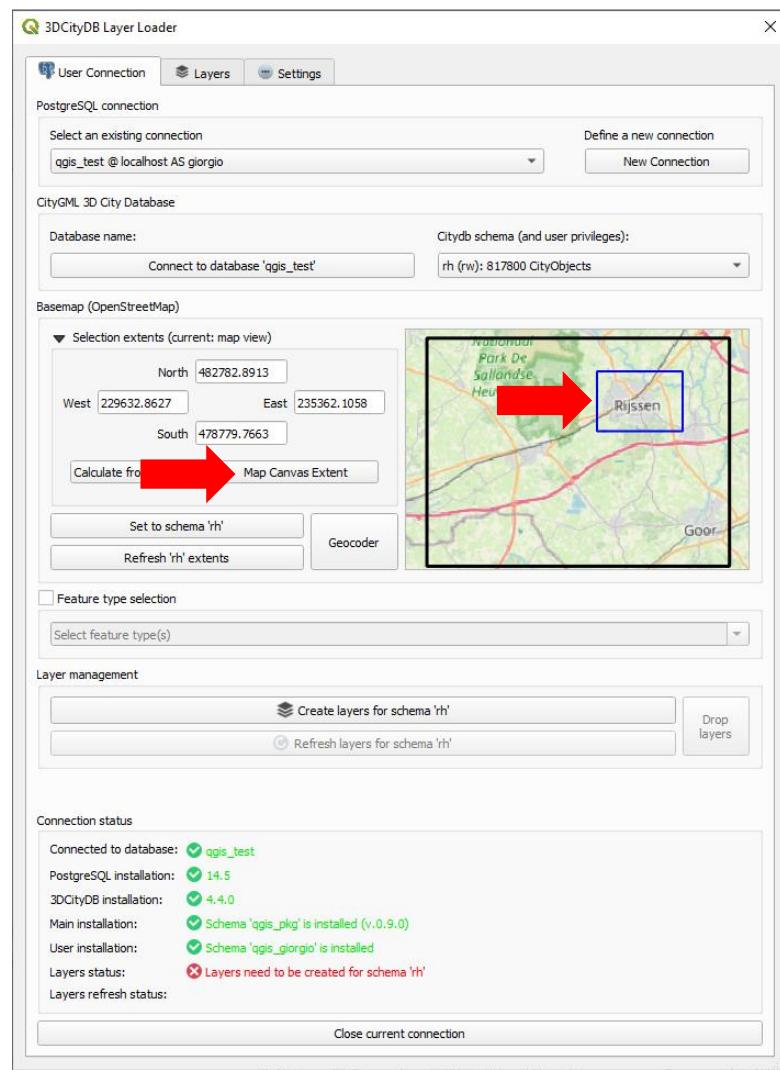


# Layer Loader

- 5) Depending on your needs, you can set the spatial extents of the study area for which the layers will be created
- Default: same size of the whole dataset
  - Otherwise: zoom in the map and choose your own area by clicking the **Map Canvas Extent button**. The **blue bounding box** shows the layers extents.

**Beware:** The bigger the size, the more time it will take to populate the layers!

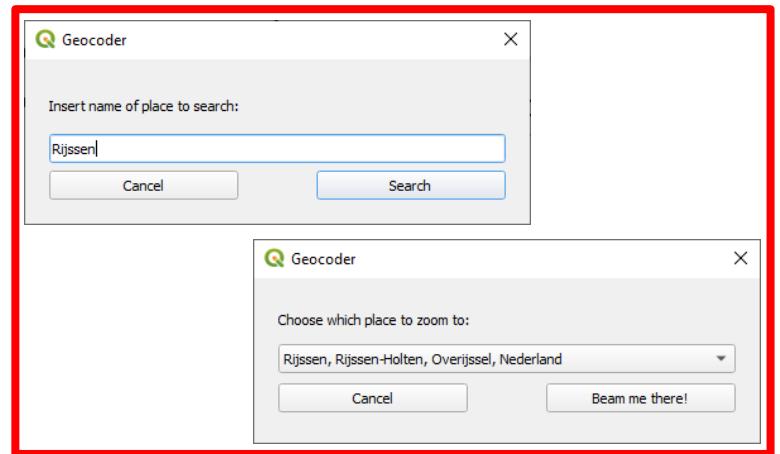
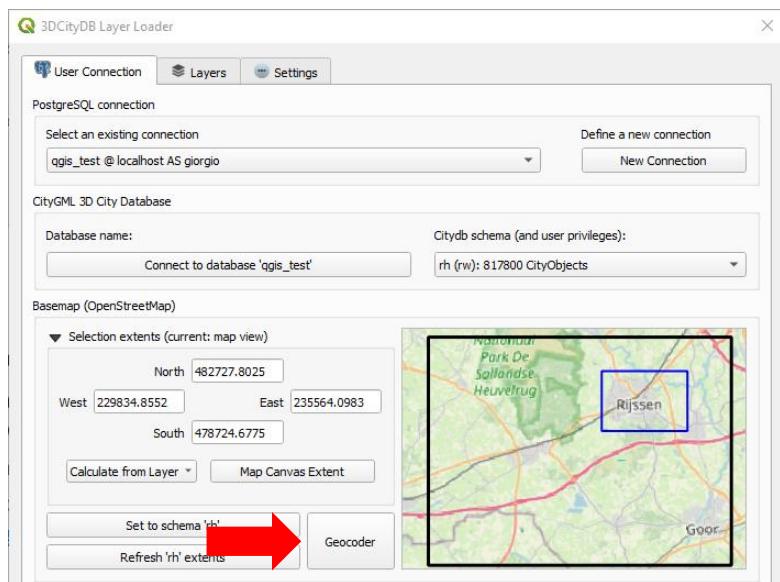
**Behind the scenes:** In the database, materialised views of the geometries will be generated according to the selected extents. In case of very large cities, it might take a long time (and a lot of space on the server)!



# Layer Loader

- 5) Depending on your needs, you can set the spatial extents of the study area for which the layers will be created
- Default: same size of the whole dataset
  - Otherwise: zoom in the map and choose your own area by clicking the **Map Canvas Extent button**. The **blue bounding box** shows the layers extents.

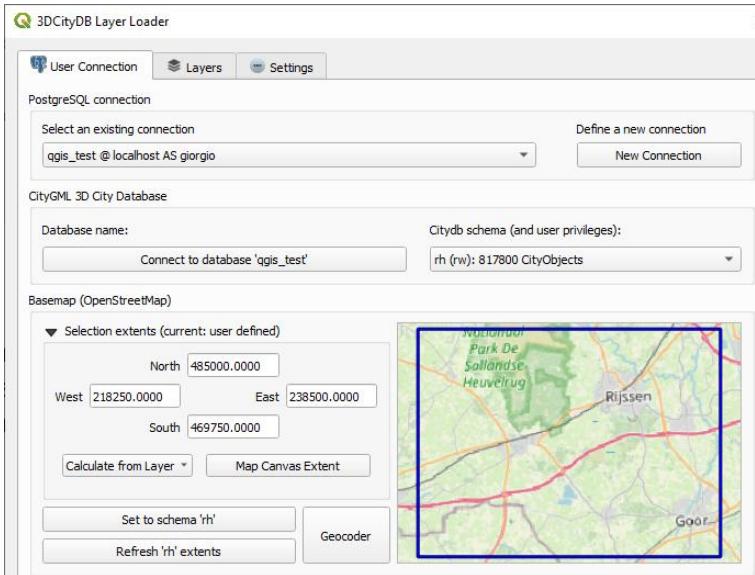
If you are looking for a specific place inside the citydb extents, you can also use the Geocoder that will zoom you directly there. Simply click the **Geocoder button**.



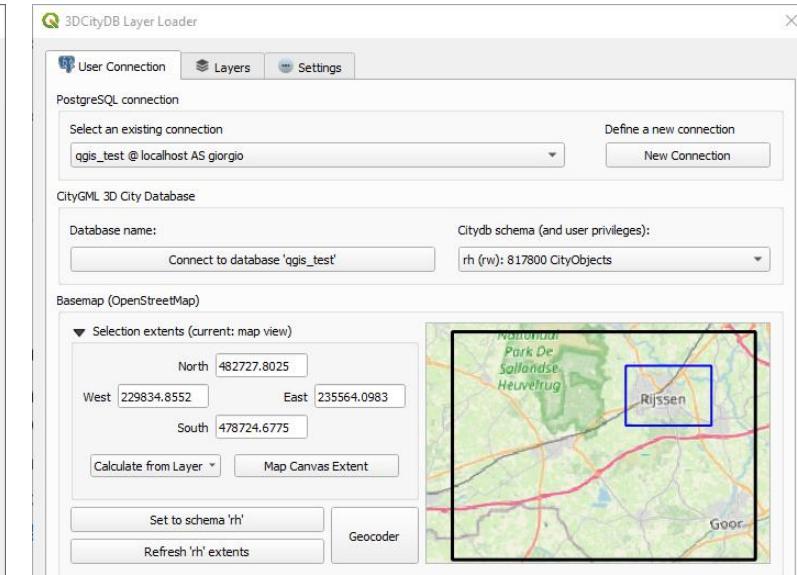
# Layer Loader

**Black:** database schema extents (i.e. extents of the whole city model/dataset)  
**Blue:** database-side layers extents (i.e. extents of the materialised views)

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Both areas coincide (default)



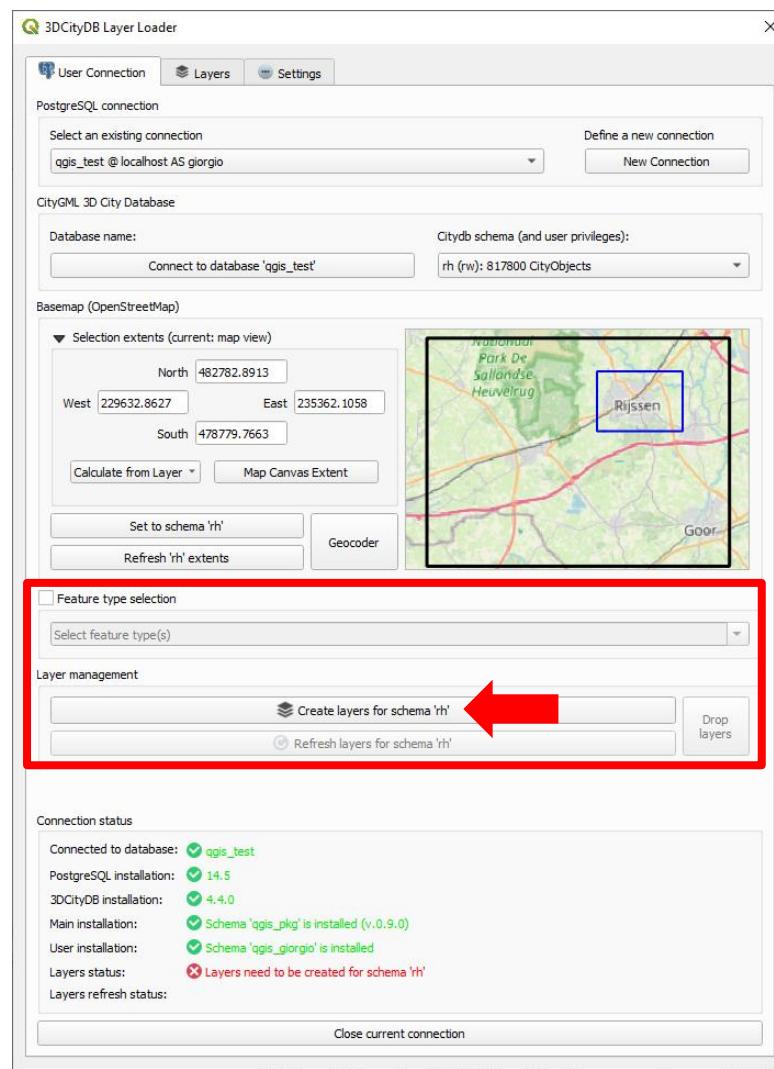
User-selected layers extents

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# Layer Loader

## 6a) Create the layers

Layers for all CityObjects available within the Layer extents will be created.



**Behind the scenes:** In the database, (empty) materialised views of the geometries and views will be created as layers.

Only layers for *existing* data will be created.

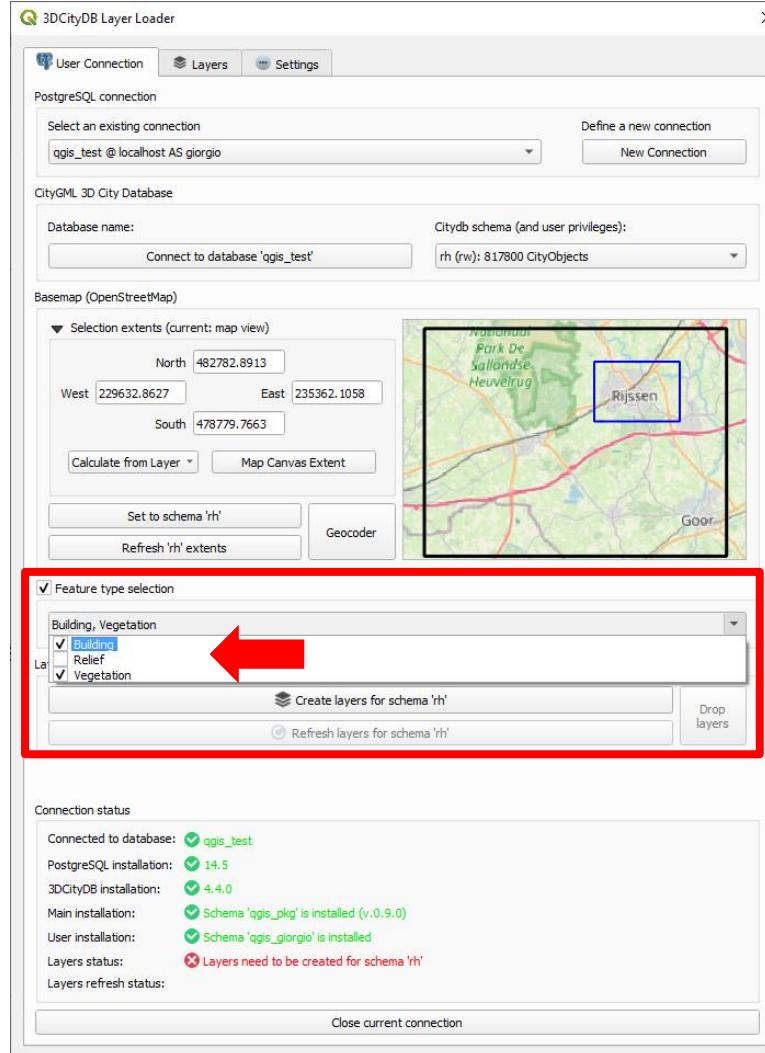
# Layer Loader

## 6a) Create the layers

Layers for all CityObjects available within the Layer extents will be created.

Optionally, you can further refine your selection and choose for which Feature Types the layers will be generated. Open the **Feature type selection box** and check the desired Feature types.

**Note bene:** Feature Types correspond to the CityGML modules (Building, Vegetation, Transportation, LandUse, Relief, etc.)

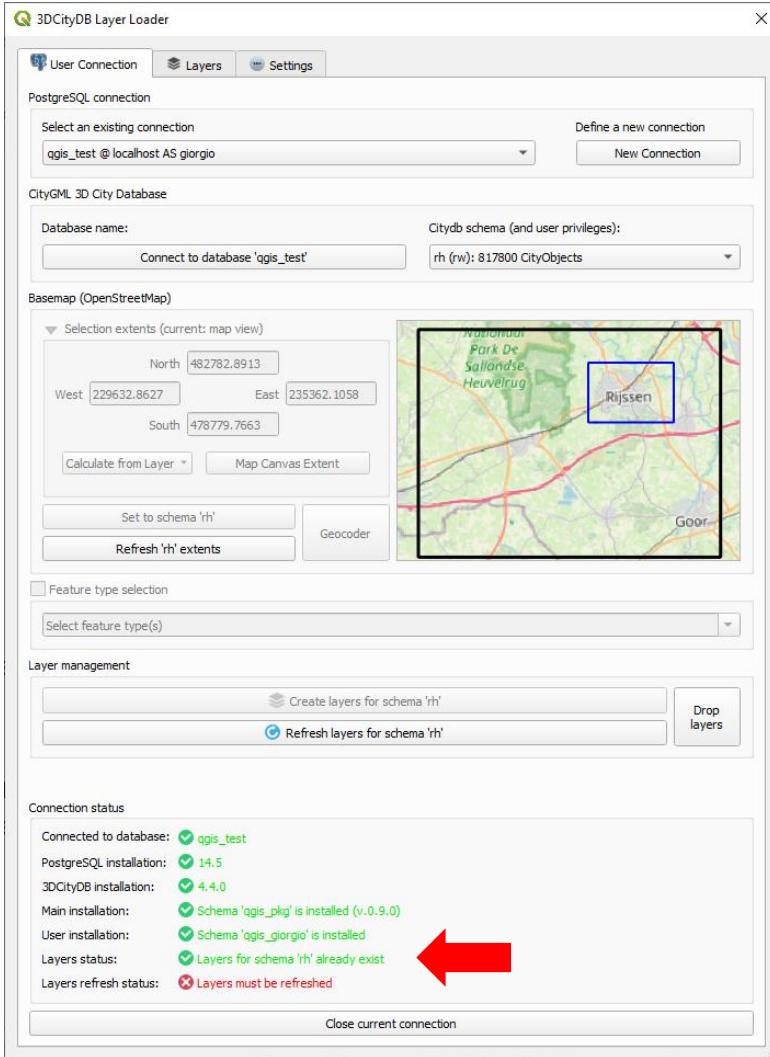


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## 6b) Create the layers

Upon successful creation of the layers,  
you will be notified in the **Connection  
Status box**



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# Layer Loader

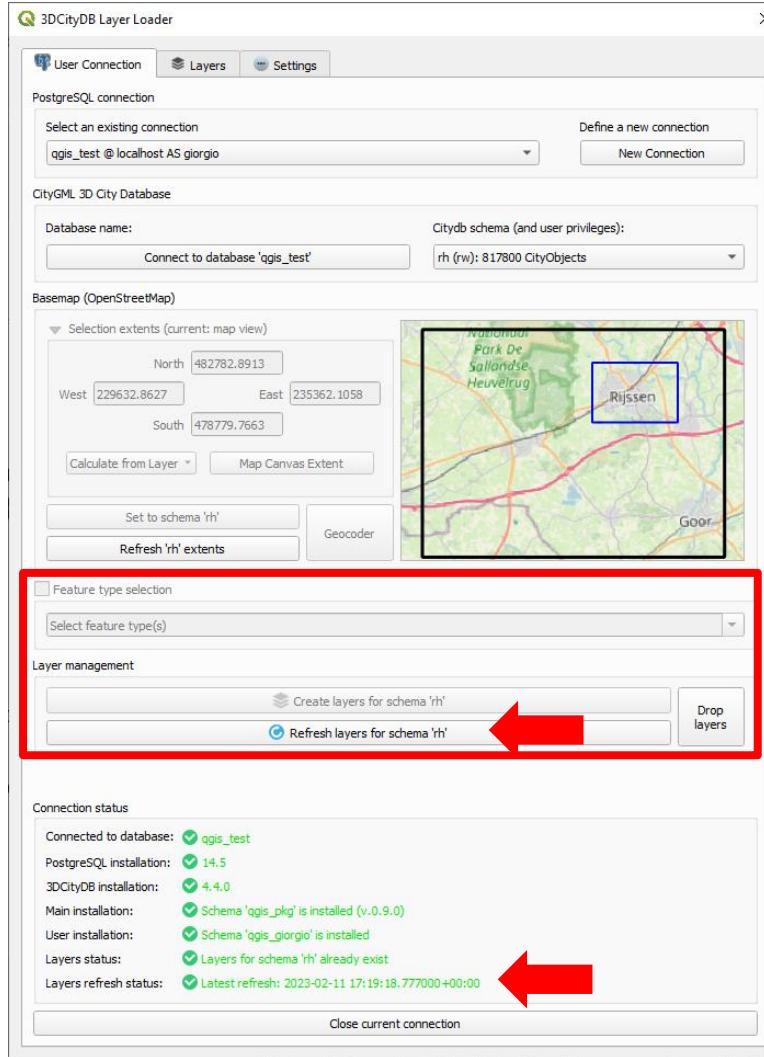
## 7) Populate/refresh the layers

Click on the **Refresh layers button**. Once the operation is complete, you will be notified in the **Connection status box**.

The following "Layers" tab is now activated and you can open it.

Alternatively, layers created in a previous session may be used (and/or refreshed again), or dropped.

**Beware:** Depending on the size of the selected area and the amount of data in the city model, this operation might take long.



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## Behind the scenes:

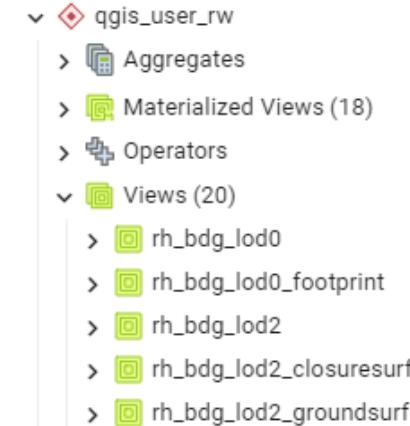
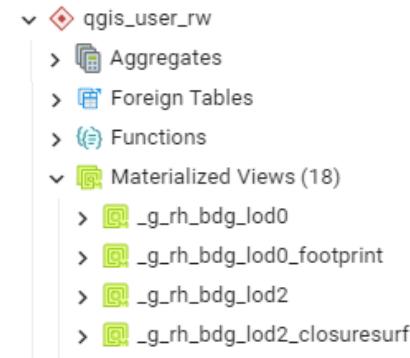
In the database user schema, both materialised views (containing the feature geometries) and the layers (as updatable views, containing the feature attributes linked to the corresponding geometries in the materialised views) can be accessed.

### Materialised views name coding:

- "\_g\_" prefix + citydb schema name + feature name + lidx + (optional) semantic details

### Views name coding:

- citydb schema name + feature name + lidx + (optional) semantic details
- Linked via column co\_id (PK and FK to the materialised views)

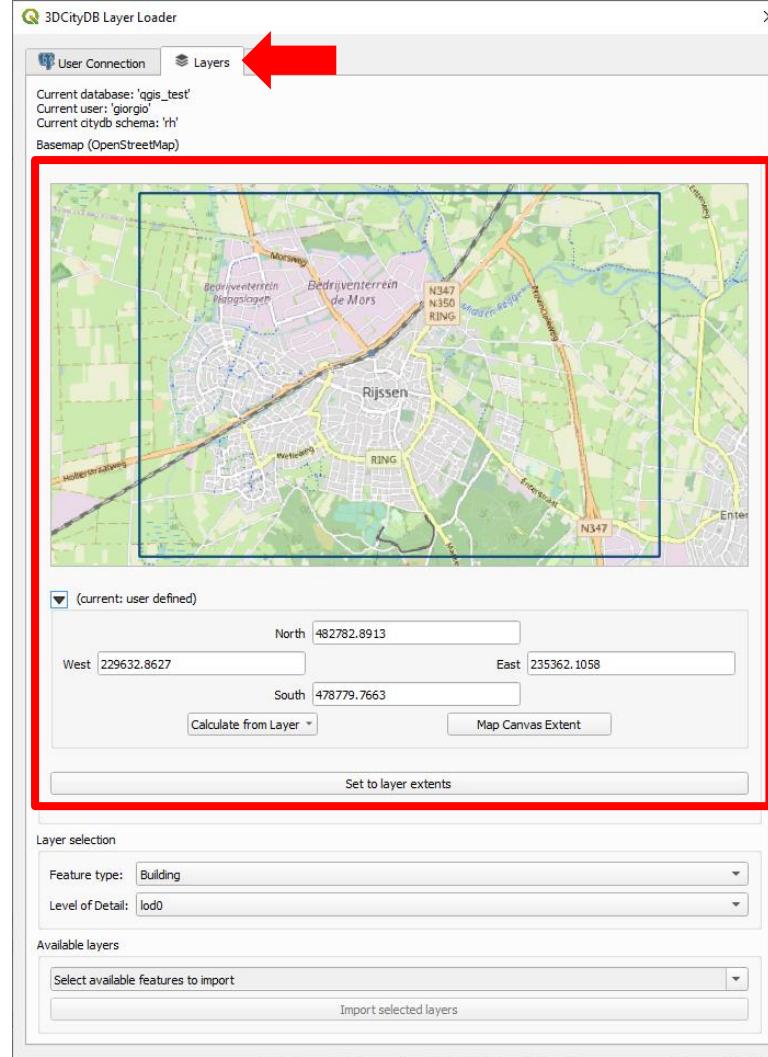


# Layer Loader

In the "Layers" tab

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8) You are now directly zoomed to the layers extents (**blue bounding box**)



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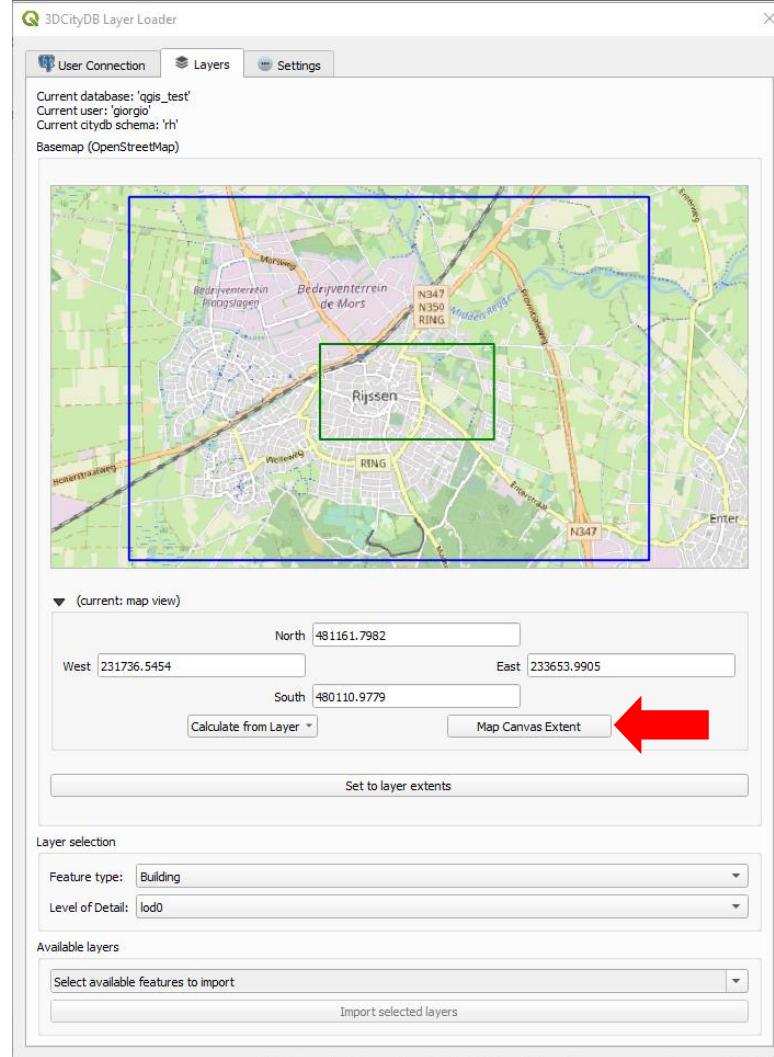
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# Layer Loader

9) Depending on your needs, you can further reduce the extents of the layers to be loaded into QGIS by pressing the **Map Canvas Extent button**. The new extents are represented by the **green bounding box**.

- Default: same size of the layer extents (**blue bounding box**)
- Otherwise: zoom in and choose your own area



# Layer Loader

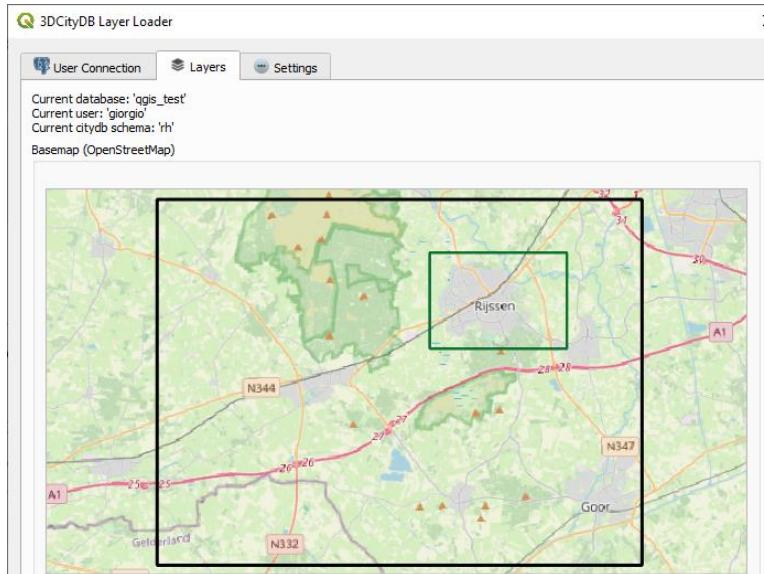
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**Black:** database schema extents (i.e. extents of the whole city model/dataset)

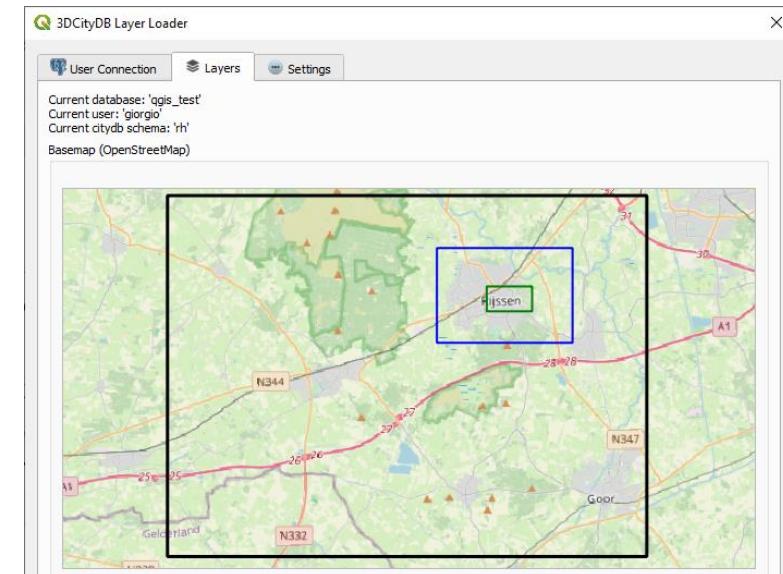
**Blue:** database-side layers extents (i.e. extents of the materialised views)

**Green:** QGIS-side layers extents (i.e. extents of the data loaded into QGIS)

Remember: **QGIS extents  $\subseteq$  Layers extents  $\subseteq$  City model extents**



Database- and QGIS-side extents coincide (default)



User-selected QGIS-layers extents

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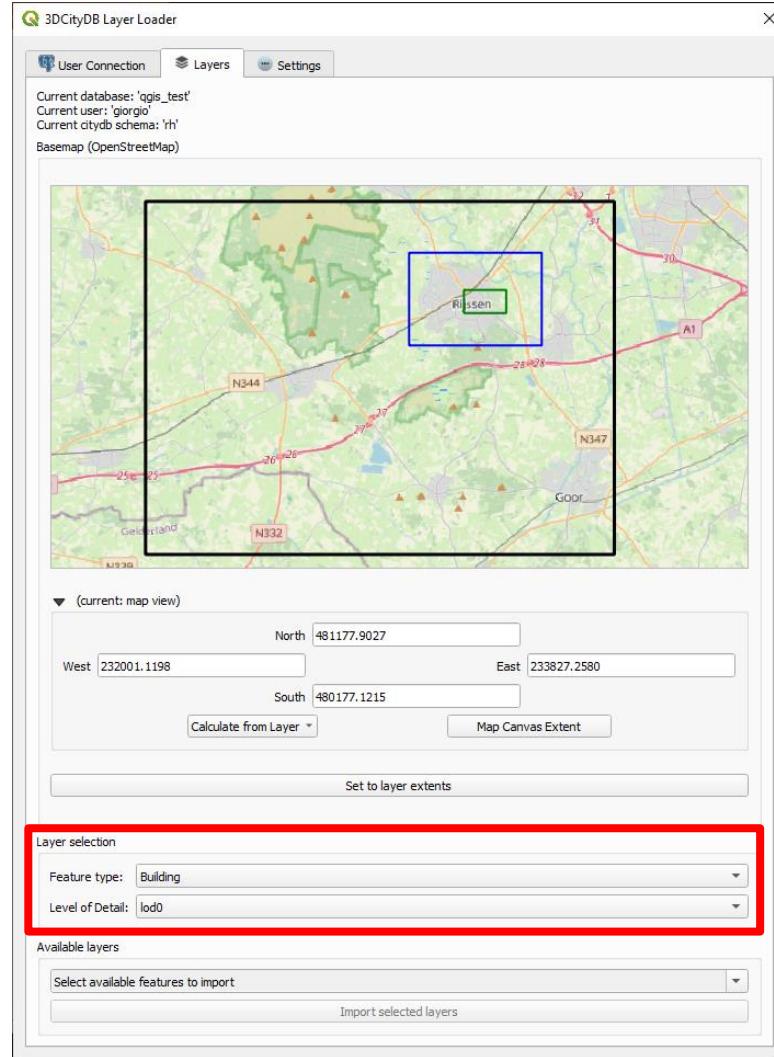
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# Layer Loader

- 10) Select available Feature type and LoD
- Layers are grouped according to the CityGML Feature Types (e.g. "Bridge", "Building", "Tunnel", "Relief", etc.)

**Behind the scenes:** The plugin shows only the available Feature types and LoDs of data *within* the QGIS extents (**green bounding box**).

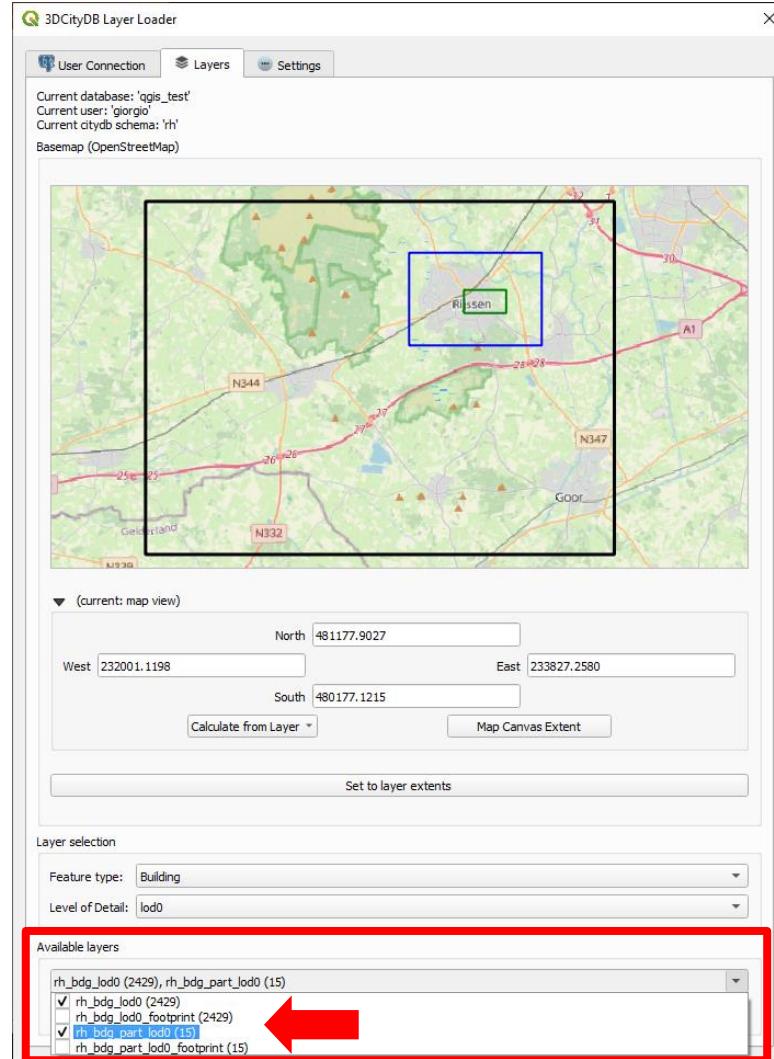


# Layer Loader

## 11) Select the layer(s) to import into QGIS

- The number of available features is shown next to the layer name

**Behind the scenes:** The plugin shows only the available Layers *within* the QGIS extents (**green bounding box**).



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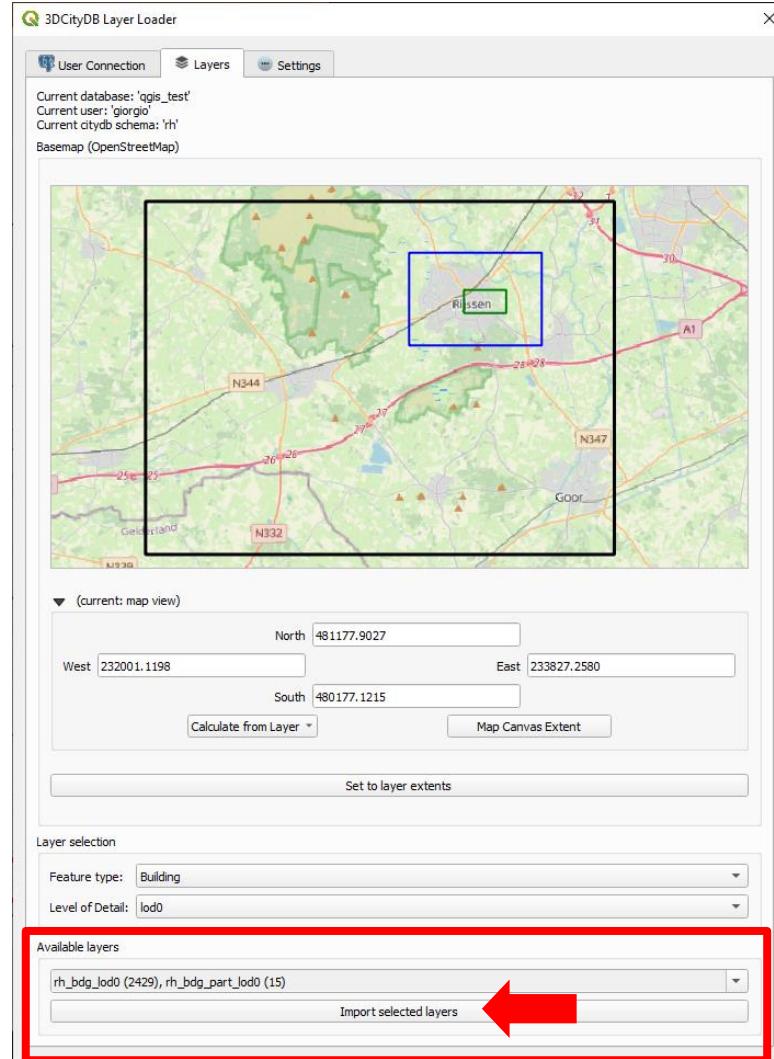
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# Layer Loader

12) Import the selected layers to QGIS by clicking on the **Import selected layers** button

- The import operation can be repeated with different layers
- The layers will be automatically added to the QGIS Layers Tree / Table of Contents
- The Plugin window can be closed, the connection parameters and settings will be kept until the connection is intentionally closed by the user (in the "User Connection" tab)

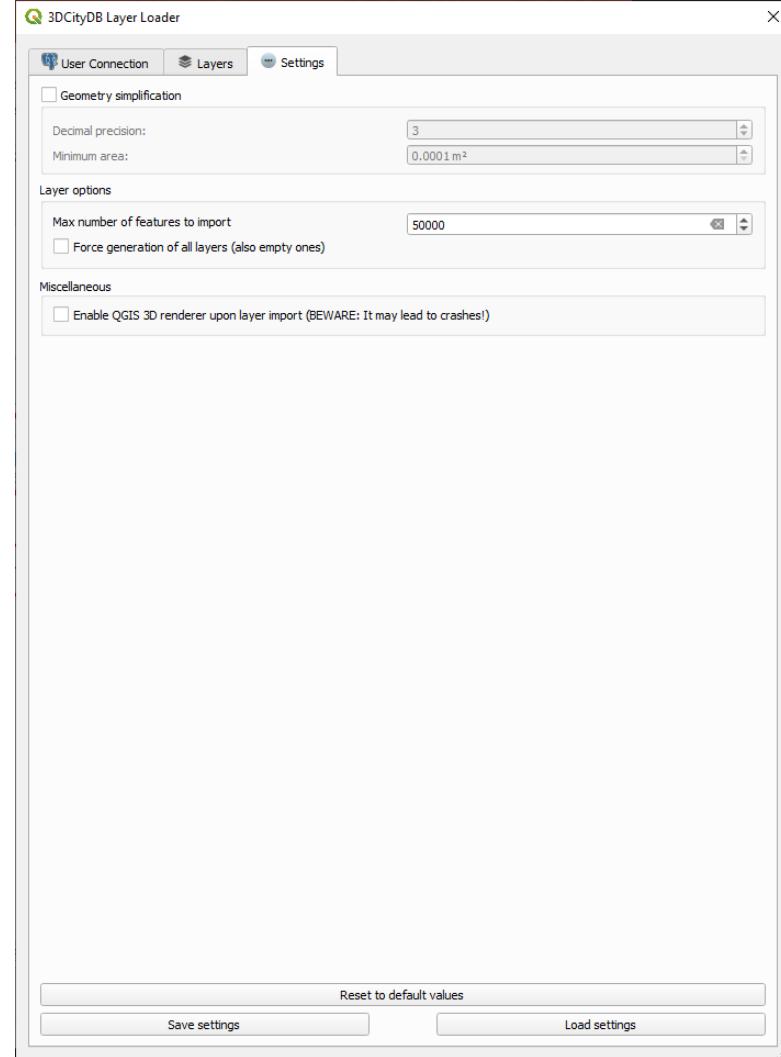
**Nota bene:** Layers that have already been loaded can be selected, but won't be loaded again.



# Layer Loader

The "Settings" tab allows to enable specific options.

- The **Geometry simplification box** contains details about the coordinates precisions and the minimum area of the geometries to be generated in the materialized views (see next slide)
- The **Layer options box** allows to set the maximum number of features to be imported in each import action and to force the generation of the empty layers
- In the **Miscellaneous box**, the user can force the 3D renderer to be enabled upon import of the selected layers, although this might lead to instabilities (see next slides)
- Settings can be saved, (re)loaded and reset to the default values.



# Geometry simplification

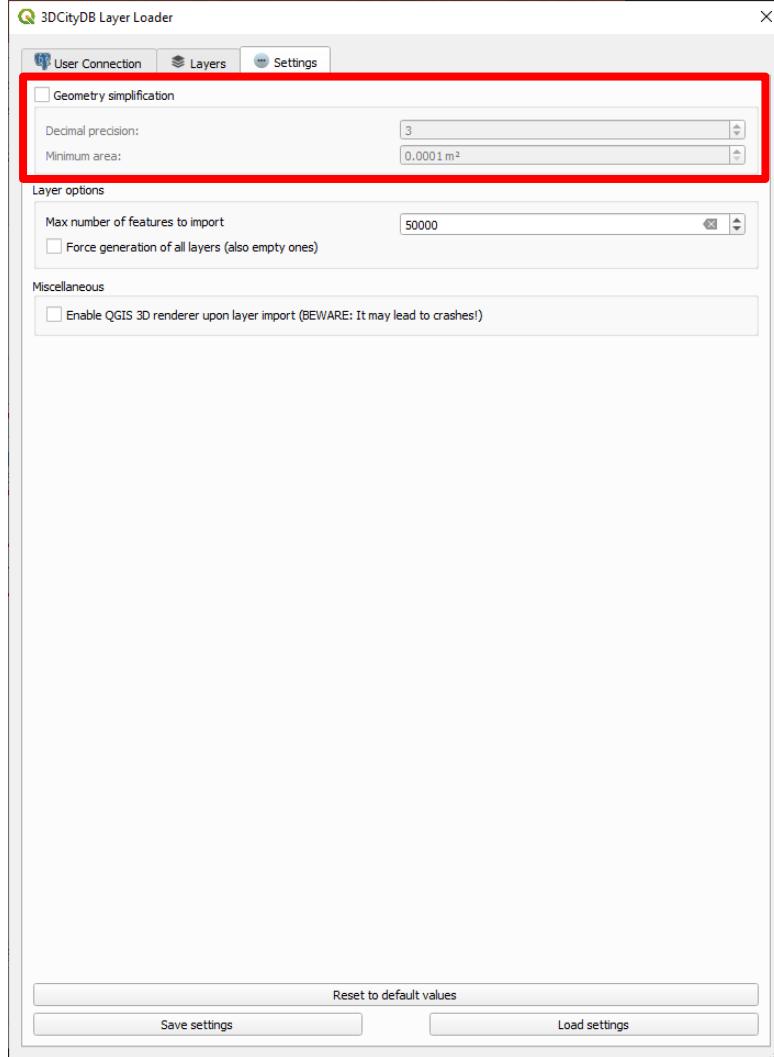
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In order to simplify geometries and (partially) cope with the 3D visualisation issues of the 3D View Map in QGIS, the user can set some simplification parameters *before* generating the layers.

All polygons composing the geometries will be checked. The user can set the number of decimal positions in the coordinates. Resulting degenerate geometries are filtered out. The second parameter filters out all polygons smaller than the chosen threshold.

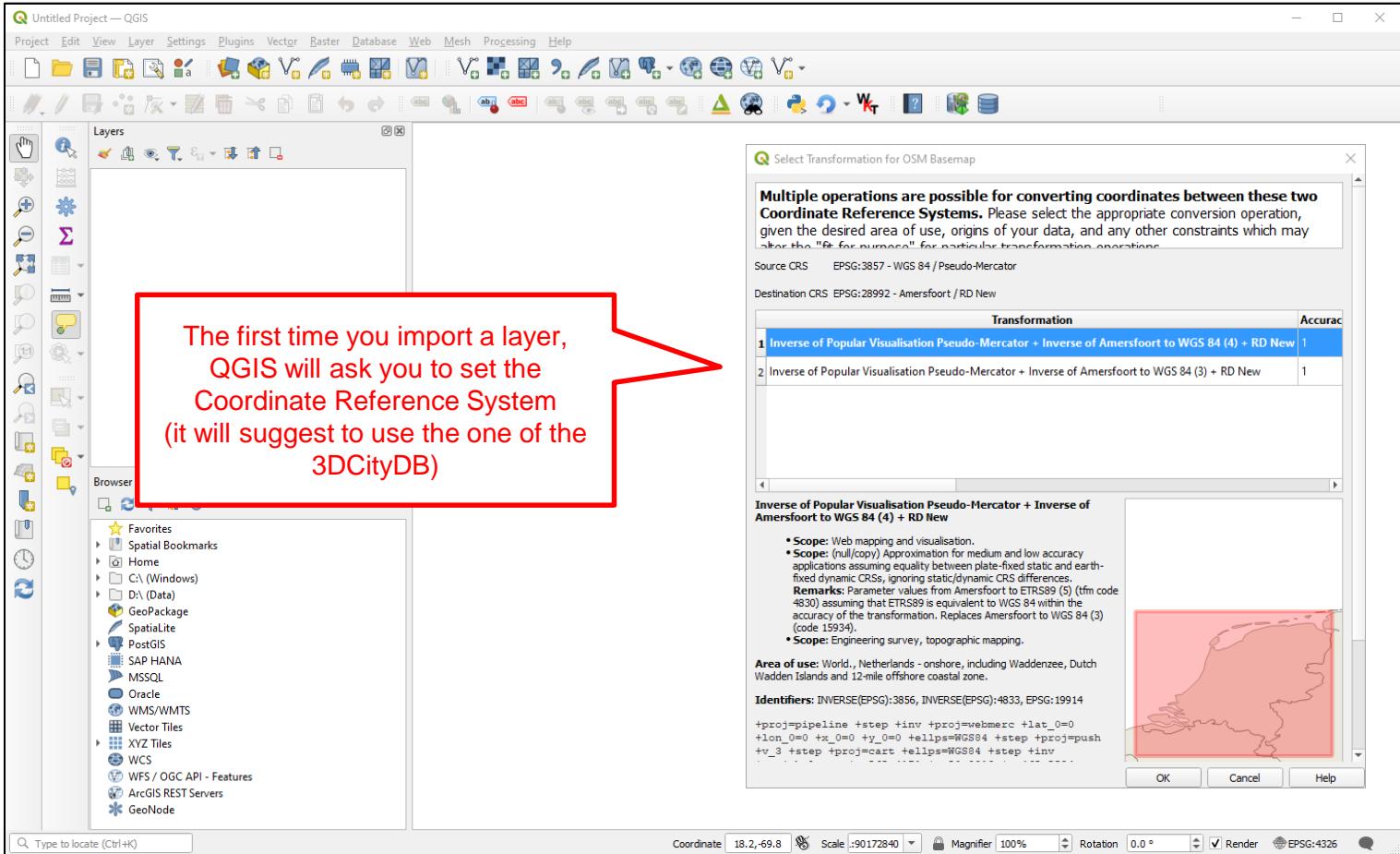
## **BEWARE** This operation

- can significantly increase the time needed to refresh the layers
- does NOT change the original data in the database!



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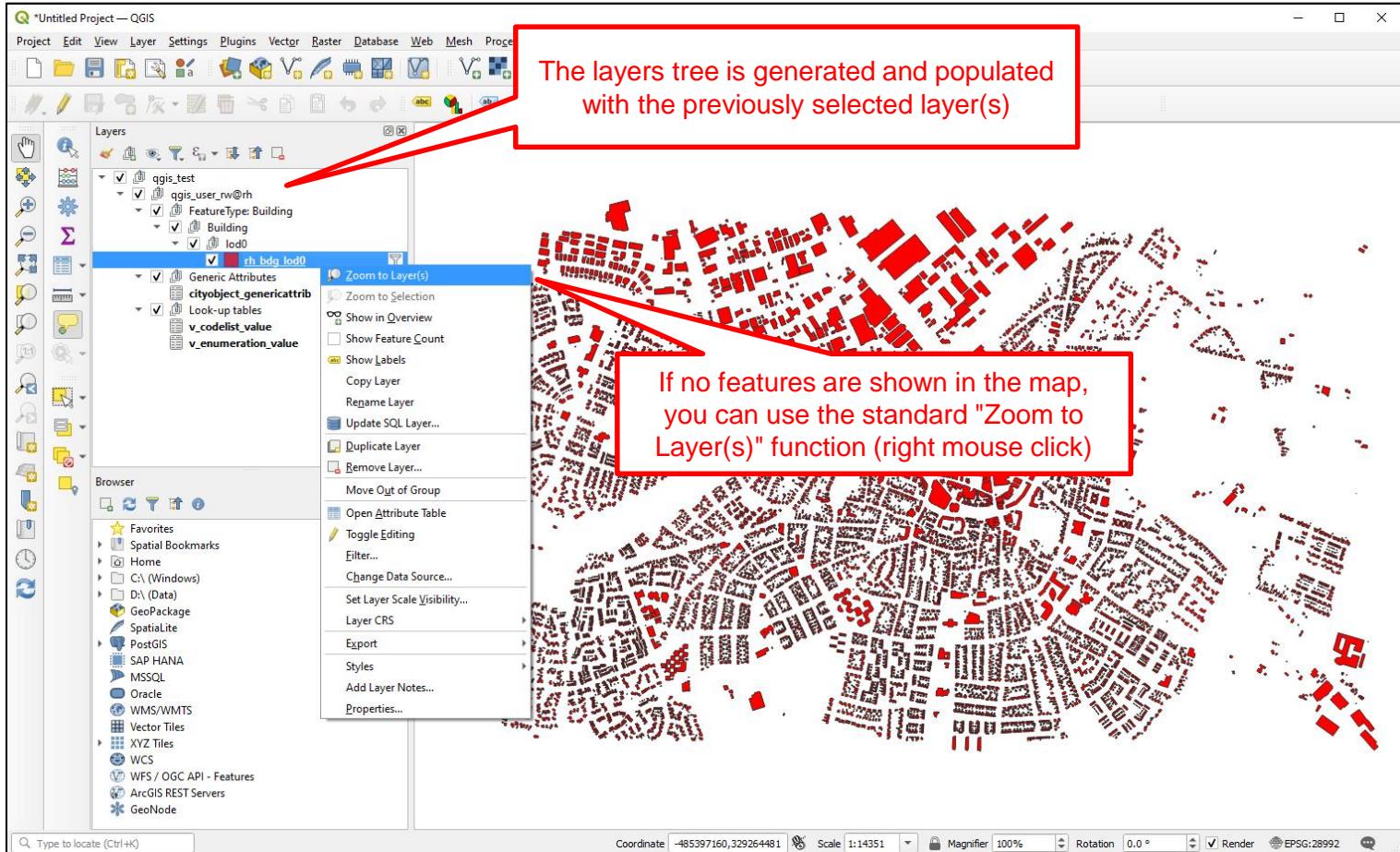


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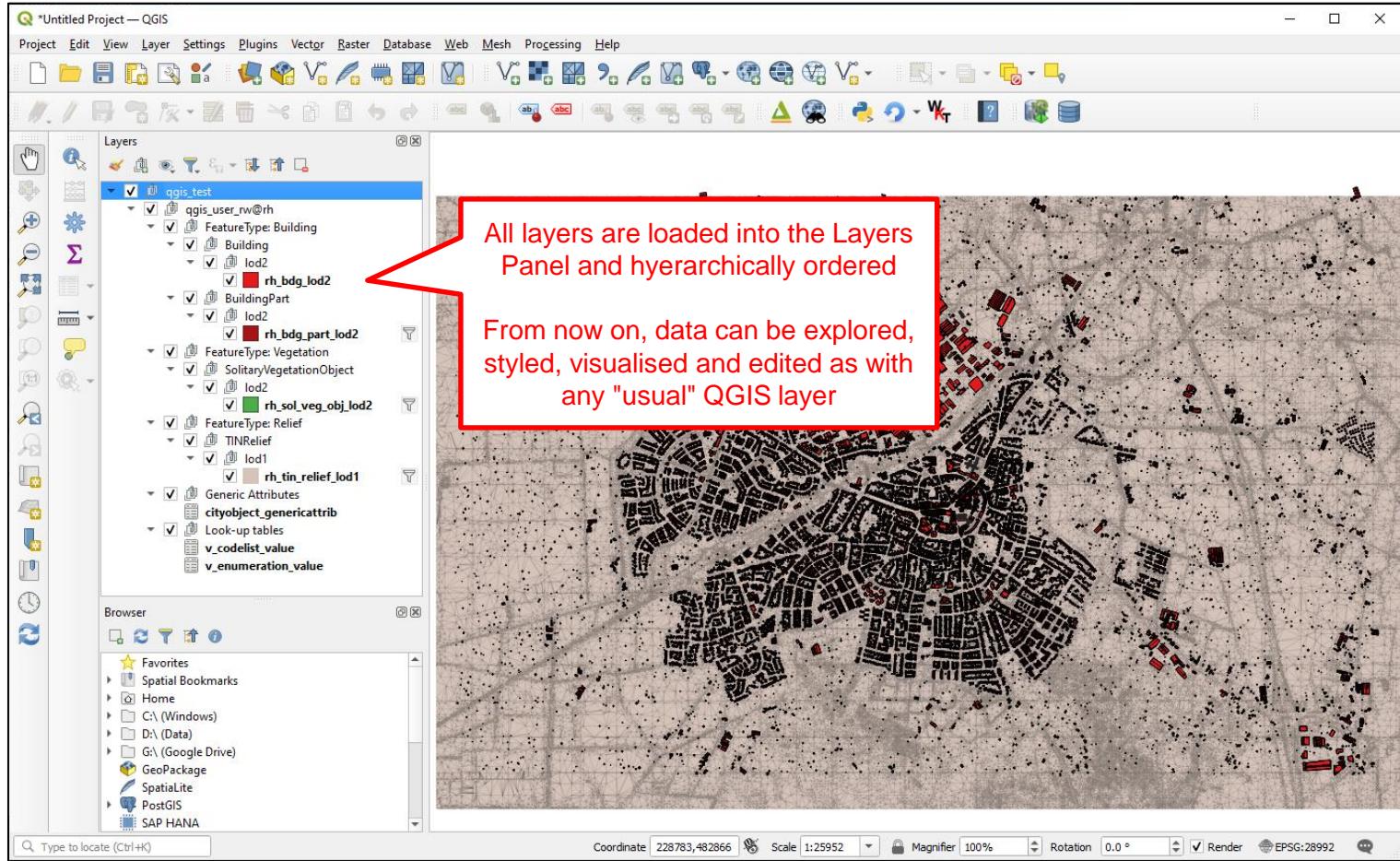


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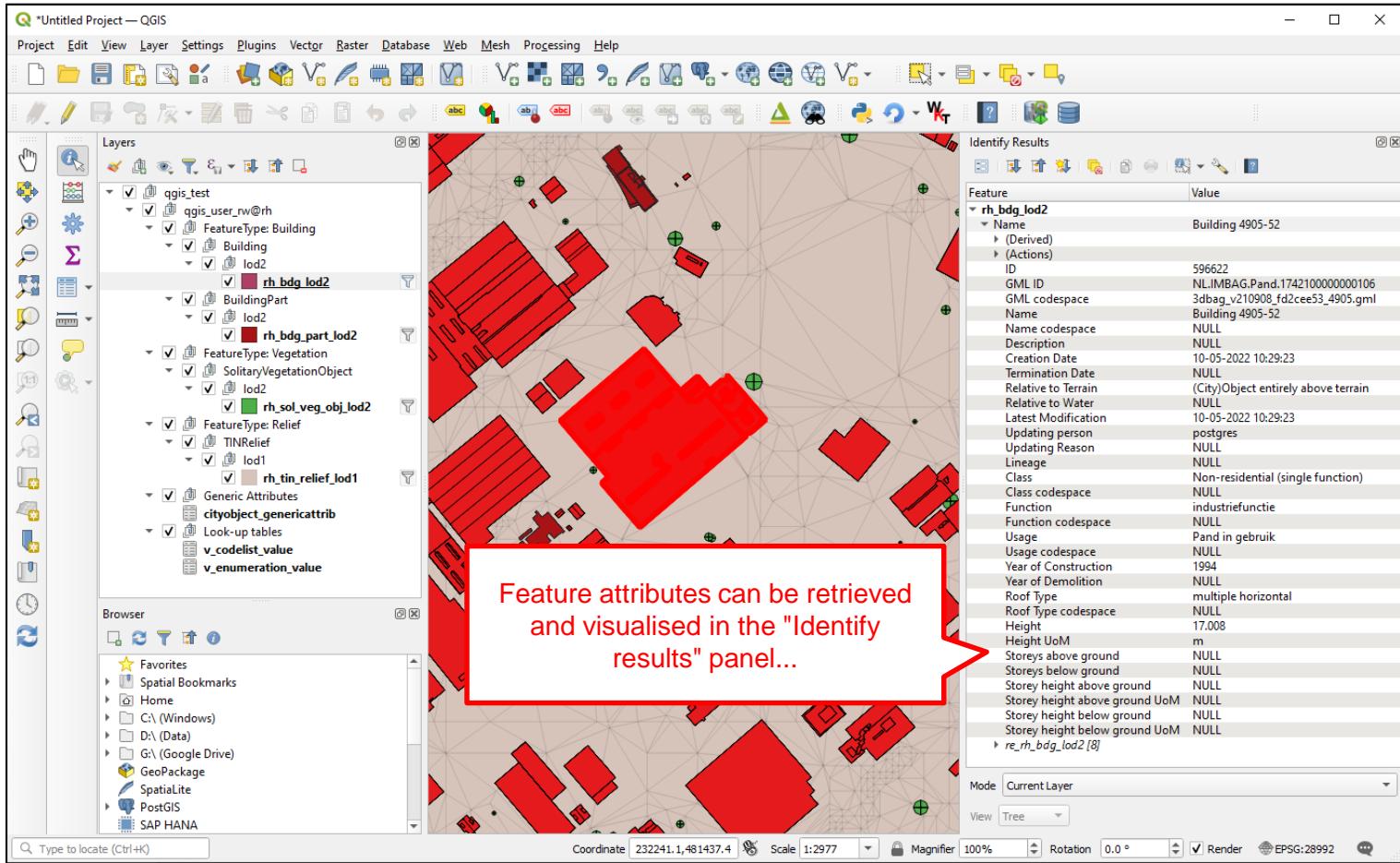
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The screenshot shows the QGIS interface with a map view containing several red polygonal features representing buildings. A specific building is highlighted with a green selection marker. To the right of the map, the 'Identify Results' panel is open, showing detailed attribute information for the selected feature.

Feature	Value
rh_bdg_lod2	Building 4905-52
Name	(Derived)
ID	596622
GML ID	NLIMBAG.Pand.174210000000106
GML codespace	3dbag_v210908_fd2ceef53_4905.gml
Name codespace	Building 4905-52
Description	NULL
Creation Date	NULL
Termination Date	10-05-2022 10:29:23
Relative to Terrain	NULL
Relative to Water	NULL
Latest Modification	10-05-2022 10:29:23
Updating person	postgres
Updating Reason	NULL
Lineage	NULL
Class	Non-residential (single function)
Class codespace	NULL
Function	industriefunctie
Function codespace	NULL
Usage	Pand in gebruik
Usage codespace	NULL
Year of Construction	1994
Year of Demolition	NULL
Roof Type	multiple horizontal
Roof Type codespace	NULL
Height	17.008
Height UoM	m
Storeys above ground	NULL
Storeys below ground	NULL
Storey height above ground	NULL
Storey height above ground UoM	NULL
Storey height below ground	NULL
Storey height below ground UoM	NULL
re_rh_bdg_lod2 [8]	

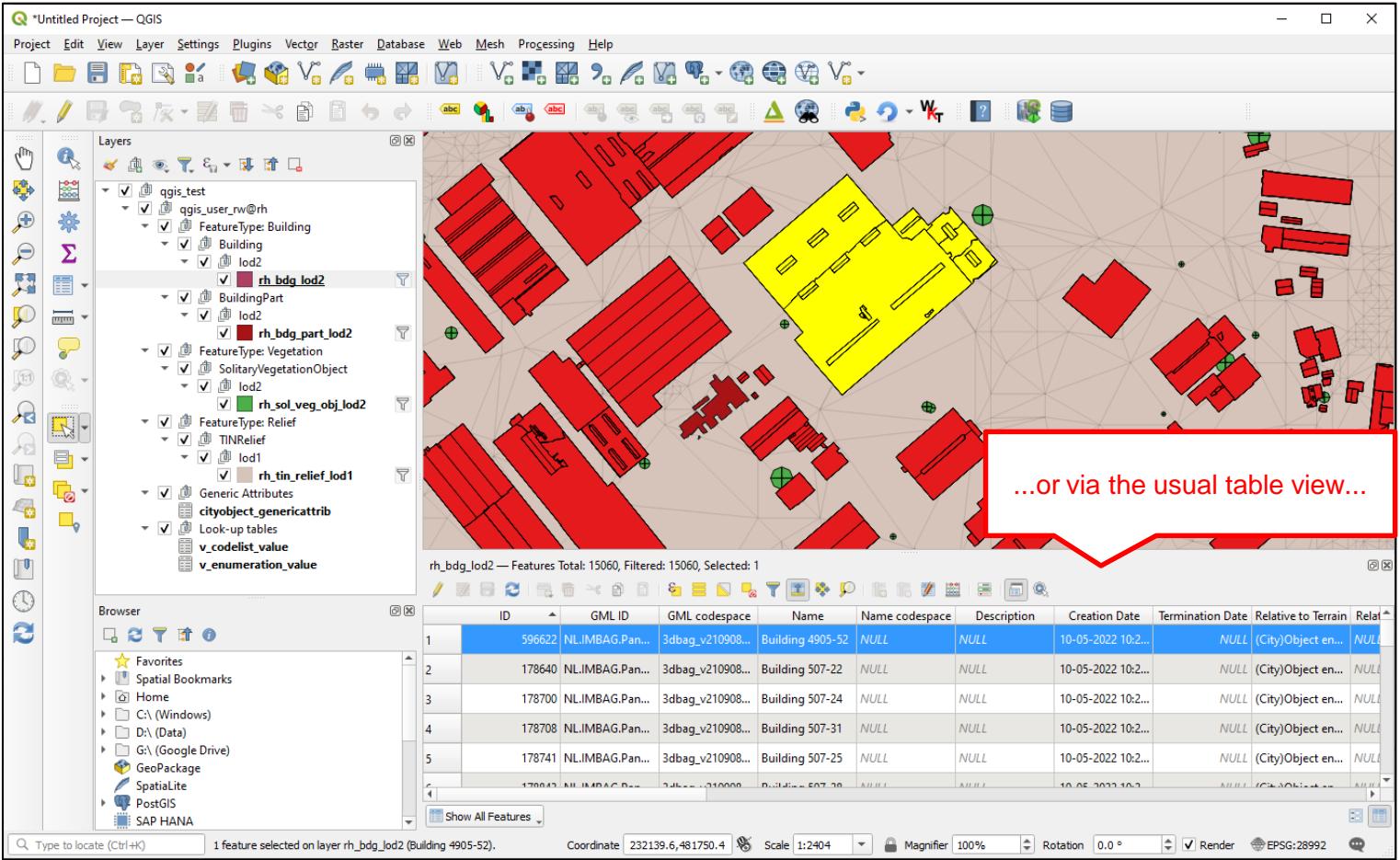
Mode: Current Layer  
View: Tree

Coordinate: 232241.1, 481437.4 Scale: 1:2977 Magnifier: 100% Rotation: 0.0° Render: EPSG:28992

Feature attributes can be retrieved and visualised in the "Identify results" panel...

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The screenshot shows a QGIS interface with the following elements:

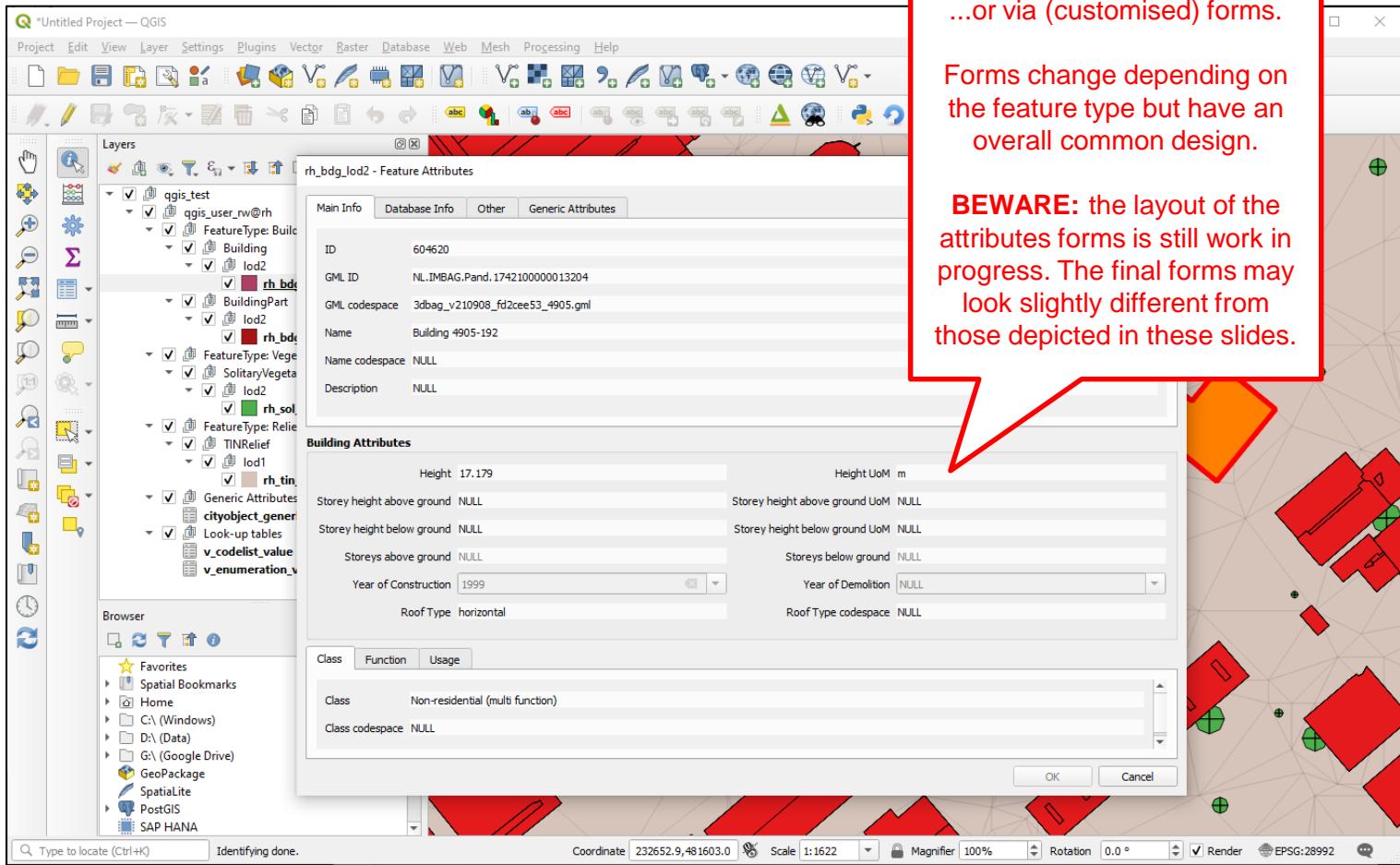
- Layers Panel:** Displays a tree view of layers. The 'qgis\_test' project contains several layers under 'qgis\_user\_rw@rh':
  - Building:** Contains 'lod2' and 'rh\_bdg\_lod2'.
  - Vegetation:** Contains 'lod2' and 'rh\_sol\_veg\_obj\_lod2'.
  - Relief:** Contains 'lod1' and 'rh\_tin\_relief\_lod1'.
  - Generic Attributes:** Contains 'cityobject\_genericattrib'.
  - Look-up tables:** Contains 'v\_codelist\_value' and 'v\_enumeration\_value'.
- Map View:** Shows a map with red buildings and a yellow polygon representing vegetation or a specific feature.
- Table View:** A red-bordered box highlights the table at the bottom right, which lists selected features from the 'rh\_bdg\_lod2' layer. The table has columns: ID, GML ID, GML codespace, Name, Name codespace, Description, Creation Date, Termination Date, Relative to Terrain, and Relative to Water.
 

ID	GML ID	GML codespace	Name	Name codespace	Description	Creation Date	Termination Date	Relative to Terrain	Relative to Water
1	596622	NL.1MBAG.Pan...	Building 4905-52	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
2	178640	NL.1MBAG.Pan...	Building 507-22	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
3	178700	NL.1MBAG.Pan...	Building 507-24	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
4	178708	NL.1MBAG.Pan...	Building 507-31	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
5	178741	NL.1MBAG.Pan...	Building 507-25	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
- Bottom Bar:** Includes a search bar ('Type to locate (Ctrl+K)'), coordinate information ('Coordinate 232139.6,481750.4'), scale ('Scale 1:2404'), magnifier ('Magnifier 100%'), rotation ('Rotation 0.0°'), and projection ('EPSG:28992').

...or via the usual table view...

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...or via (customised) forms.

Forms change depending on the feature type but have an overall common design.

**BEWARE:** the layout of the attributes forms is still work in progress. The final forms may look slightly different from those depicted in these slides.

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rh\_bdg\_lod2 - Feature Attributes

Main Info Database Info Other Generic Attributes

Creation Date 10-05-2022 10:29:26

Termination Date NULL

Latest Modification 10-05-2022 10:29:26

Updating person postgres

Updating Reason NULL

Lineage NULL

Data is further organised in tabs.  
Additional related tables are connected (e.g. Generic Attributes)

rh\_bdg\_lod2 - Feature Attributes

Main Info Database Info Other Generic Attributes

**Surface Relation**

Relative to Terrain (City)Object entirely above terrain

Relative to Water (no selection)

rh\_bdg\_lod2 - Feature Attributes

Main Info Database Info Other Generic Attributes

**Generic Attributes**

Expression

3dbag\_tile  
bag\_net\_internal\_area  
footprint\_area  
is\_single\_part  
lod2\_volume

id	2892542
parent_genattrib_id	NULL
root_genattrib_id	2892542
attrname	3dbag_tile
datatype	

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rh\_bdg\_lod0\_footprint - Feature Attributes

Main Info Database Info Other Generic Attributes

ID	634298
GML ID	NL.IMGAG.Pand.1742100000001632
GML codespace	3dbag_v210908_fd2cee53_4906.gml
Name	Building 4906-363
Name codespace	NULL
Description	NULL

**Building Attributes**

Height	20.765	Height UoM	m
Storey height above ground	NULL	Storey height above ground UoM	NULL
Storey height below ground	NULL	Storey height below ground UoM	NULL
Storeys above ground	NULL	Storeys below ground	NULL
Year of Construction	1914	Year of Demolition	NULL
Roof Type	slanted	Roof T	

Class Function Usage

Function	Value
bijeenkomstfunctie	
onderwijsfunctie	
overige gebruiksfunctie	

Function codespace

OK Cancel

Attributes containing [..\*] entries (e.g. function, usage, etc.) are presented as lists.

External codelists can also be visualised as look-up tables (see **Advanced options** later on)

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Untitled Project — QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help

Layers

rh\_bdg\_lod2 - Feature Attributes

	Main Info	Database Info	Other	Generic Attributes
ID	604620			
GML ID	NL.IMBAG.Pand.1742100000013204			
GML codespace	3dbag_v210908_fd2ce53_4905.gml			
Name	Building 4905-192			
Name codespace	NULL			
Description	How cool! I can now directly edit the attributes like this one!!			

Building Attributes

Height	17.179	Height UoM	m
Storey height above ground	NULL	Storey height above ground UoM	NULL
Storey height below ground	NULL	Storey height below ground UoM	NULL
Storeys above ground	NULL	Storeys below ground	NULL
Year of Construction	1999	Year of Demolition	NULL
Roof Type	horizontal	Roof Type codespace	NULL

Class Function Usage

Class	Non-residential (multi function)
Class codespace	NULL

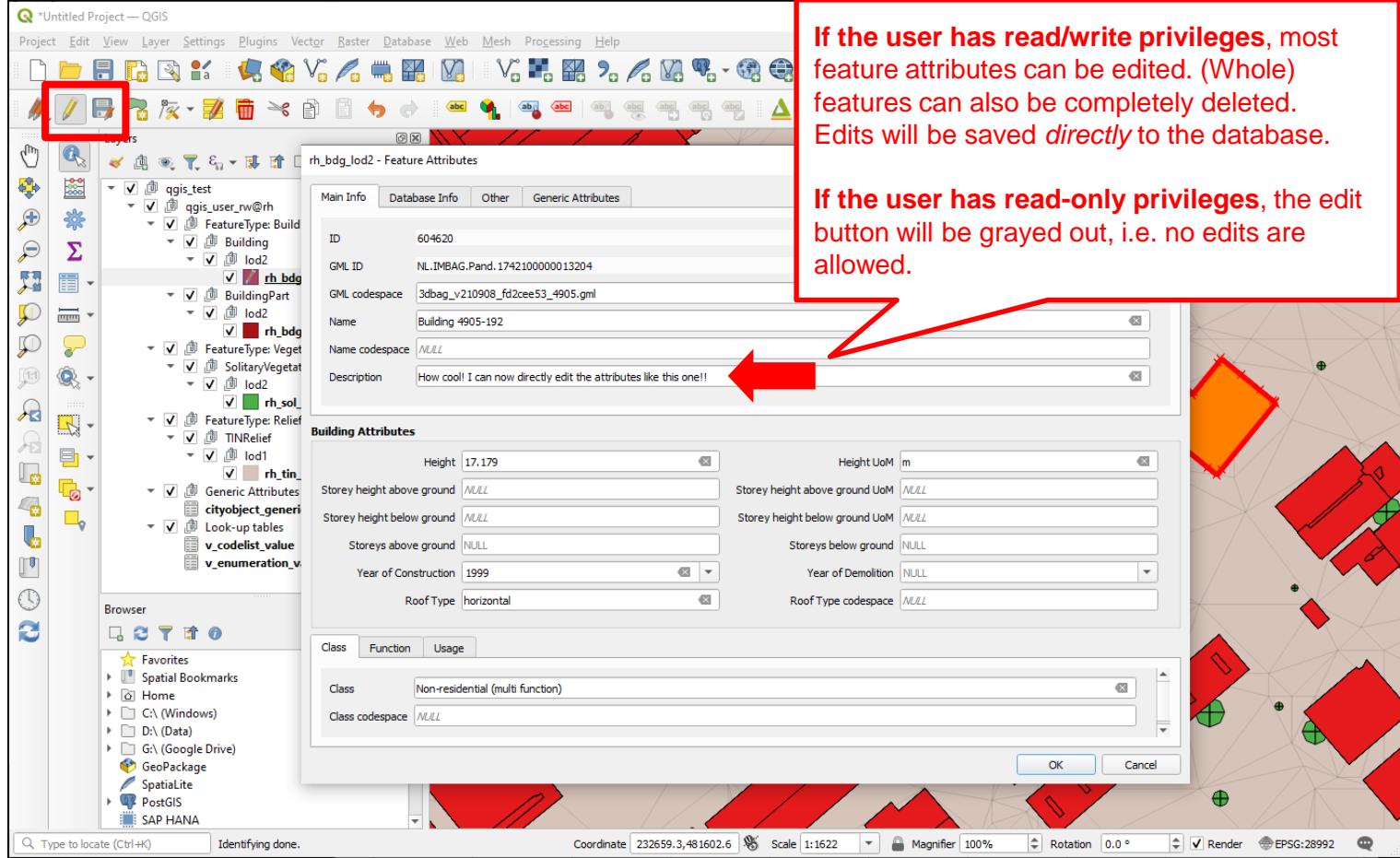
OK Cancel

Type to locate (Ctrl+K) Identifying done.

Coordinate 232659.3, 481602.6 Scale 1:1622 Magnifier 100% Rotation 0.0° Render EPSG:28992

If the user has **read/write privileges**, most feature attributes can be edited. (Whole) features can also be completely deleted. Edits will be saved *directly* to the database.

If the user has **read-only privileges**, the edit button will be grayed out, i.e. no edits are allowed.

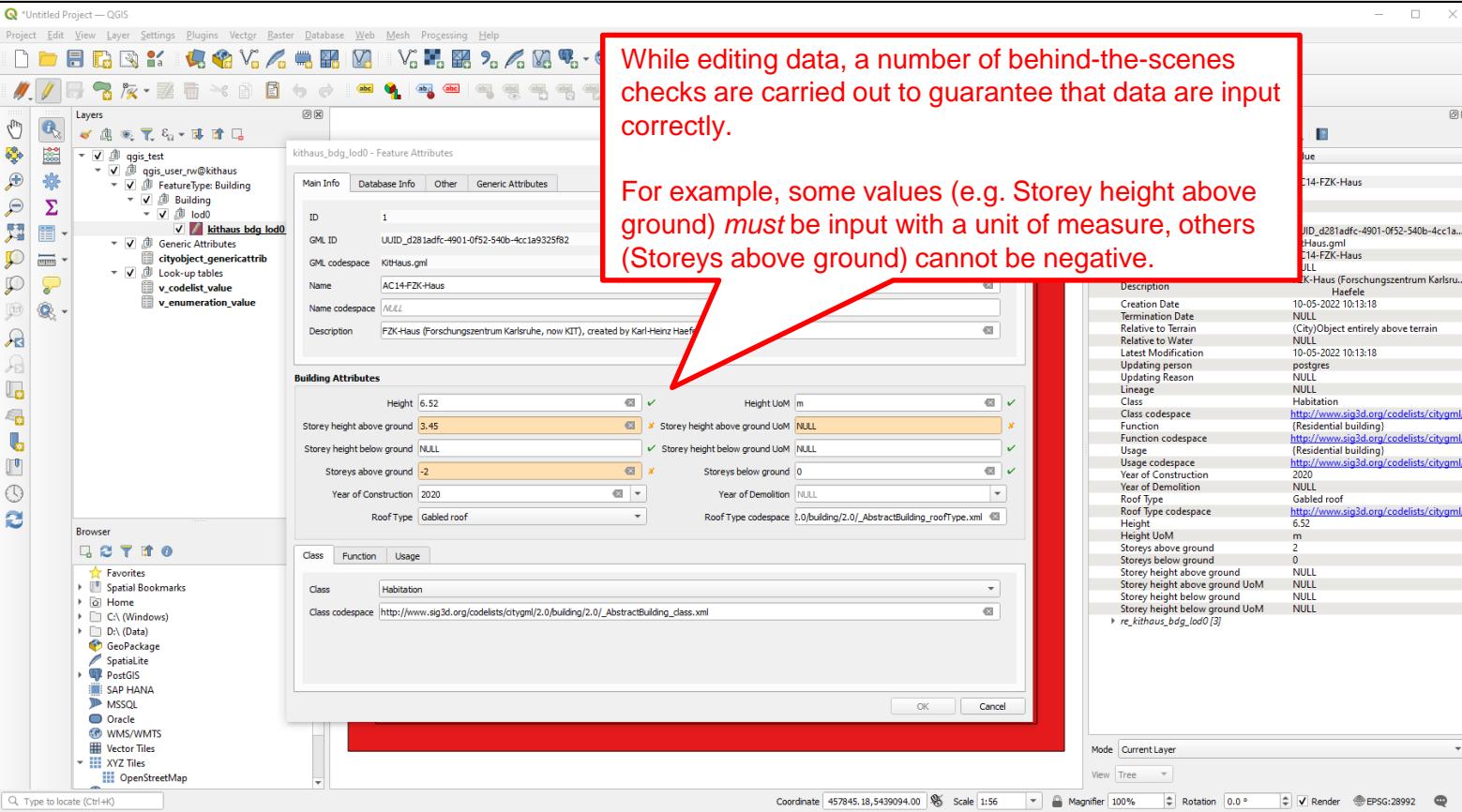


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While editing data, a number of behind-the-scenes checks are carried out to guarantee that data are input correctly.

For example, some values (e.g. Storey height above ground) *must* be input with a unit of measure, others (Storeys above ground) cannot be negative.



The screenshot shows the QGIS attribute editor for a building feature. The 'Building Attributes' group contains several fields:

- Height: 6.52 (green checkmark)
- Storey height above ground: 3.45 (orange error icon)
- Storey height below ground: NULL (green checkmark)
- Storeys above ground: -2 (orange error icon)
- Year of Construction: 2020 (green checkmark)
- Roof Type: Gabled roof (green checkmark)
- Height UoM: m (green checkmark)
- Storey height above ground UoM: NULL (orange error icon)
- Storey height below ground UoM: NULL (green checkmark)
- Storeys below ground: 0 (green checkmark)
- Year of Demolition: NULL (green checkmark)
- Roof Type codespace: 2.0/building/2.0/\_AbstractBuilding\_roofType.xml (green checkmark)

A red arrow points from the text "For example, some values (e.g. Storey height above ground) *must* be input with a unit of measure, others (Storeys above ground) cannot be negative." to the 'Storey height above ground' field, which has an orange error icon.

On the right side of the interface, there is a detailed log of validation results for the feature:

```

Description
Creation Date
Termination Date
Relative to Terrain
Relative to Water
Latest Modification
Updating person
Updating reason
Lineage
Class
Class codespace
Function
Function codespace
Usage
Usage codespace
Year of Construction
Year of Demolition
Roof Type
Roof Type codespace
Height
Height UoM
Storeys above ground
Storeys below ground
Storey height above ground
Storey height above ground UoM
Storey height below ground
Storey height below ground UoM
> re_kithaus_bdg_id0[3]

```

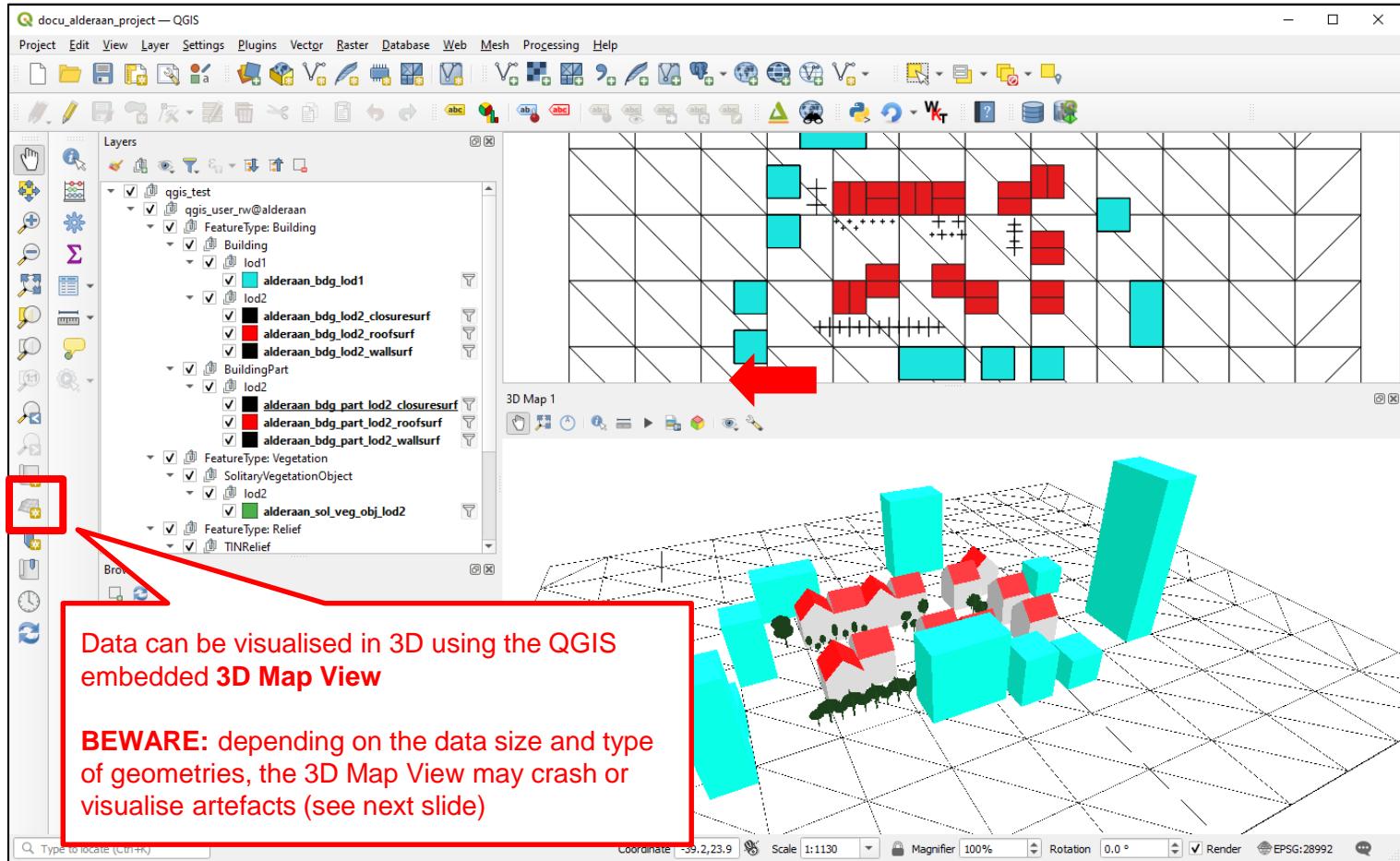
The log shows various attributes and their validation status, such as 'Creation Date' being 'NULL' and 'Relative to Terrain' being '(City)Object entirely above terrain'.

# Use in QGIS: 3D visualisation

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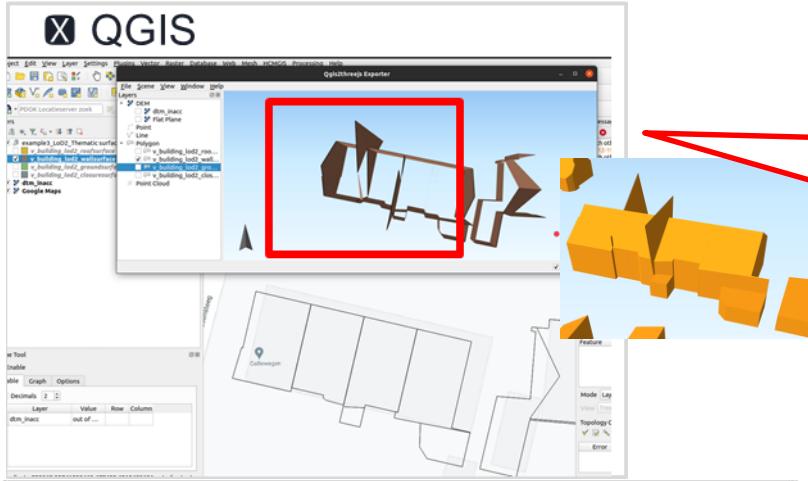
- Layer Loader
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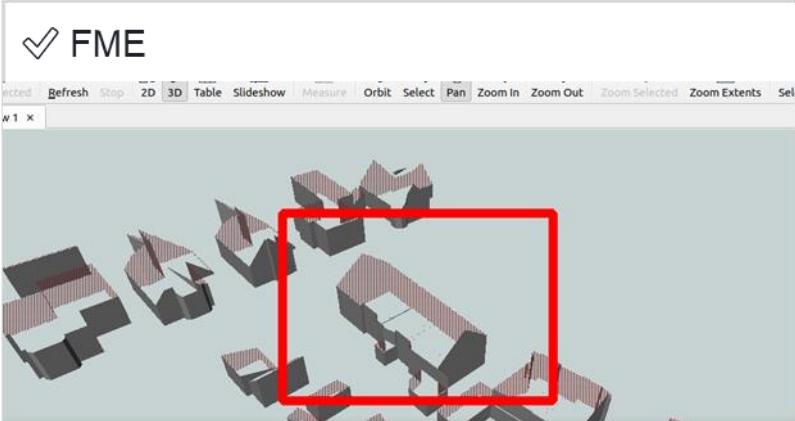


# Use in QGIS: 3D visualisation

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In our tests, such artefacts are however a 3D visualisation issue (QGIS 3D renderer?) and *not* related to the actual data. 3D visualisation in FME and in Google Earth show indeed correct results.

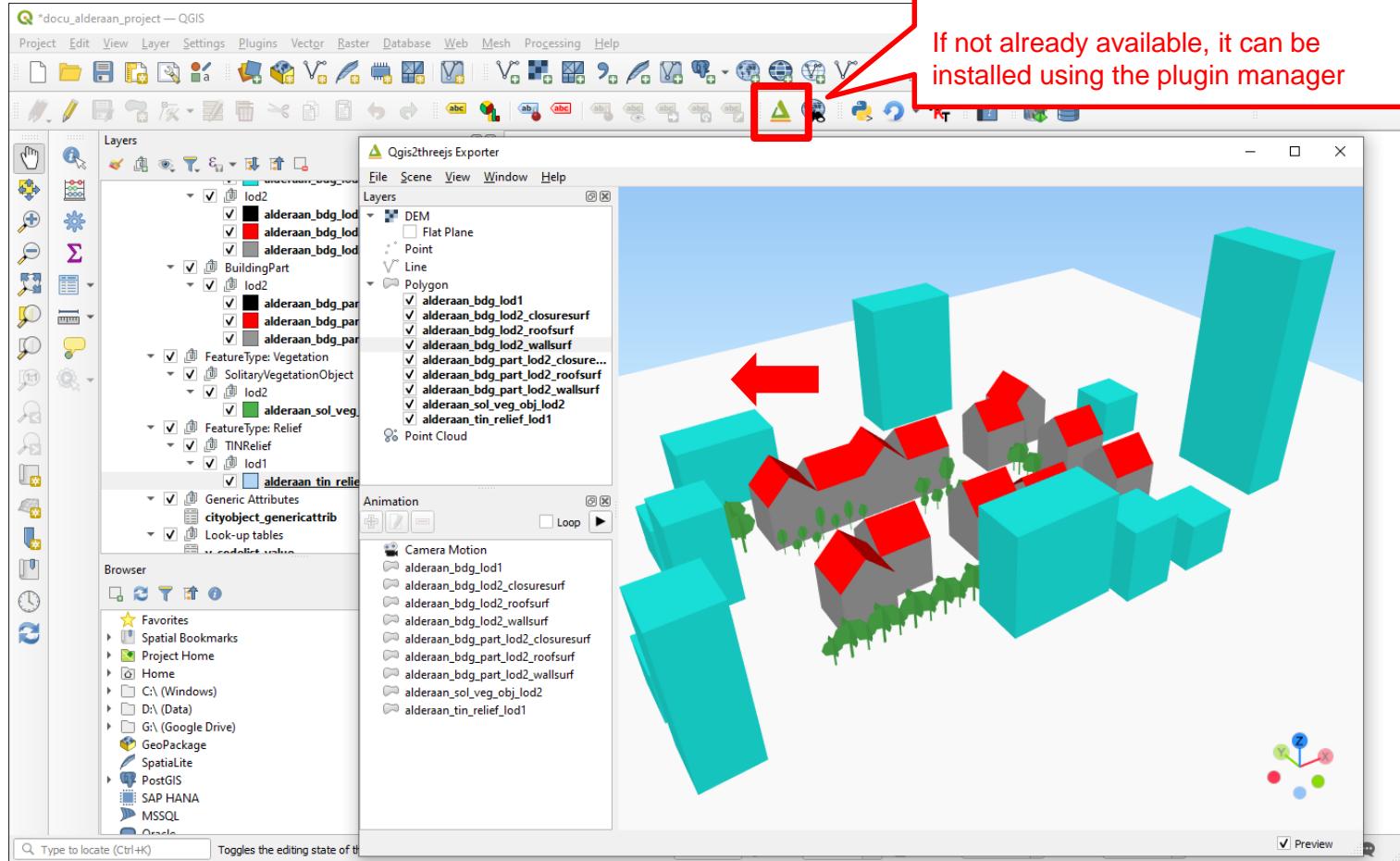


✓  
 Google  
 earth  
 (as KML)

# Use in QGIS: 3D visualisation

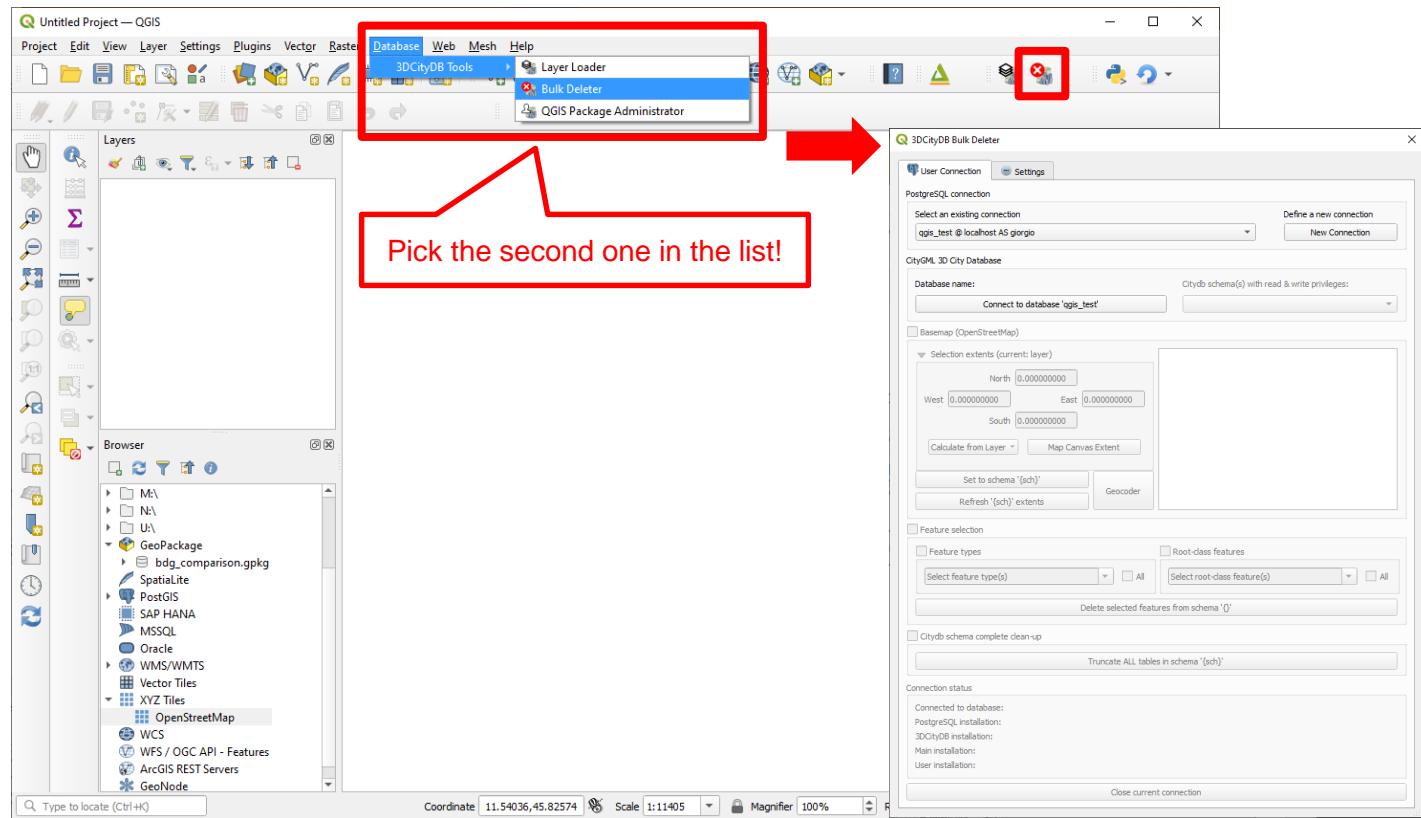
Alternatively, the **Qgis2threejs** plugin can be used for 3D visualisation.

If not already available, it can be installed using the plugin manager



# Bulk Deleter

Open the **Bulk Deleter** from the menu or by clicking on the icon

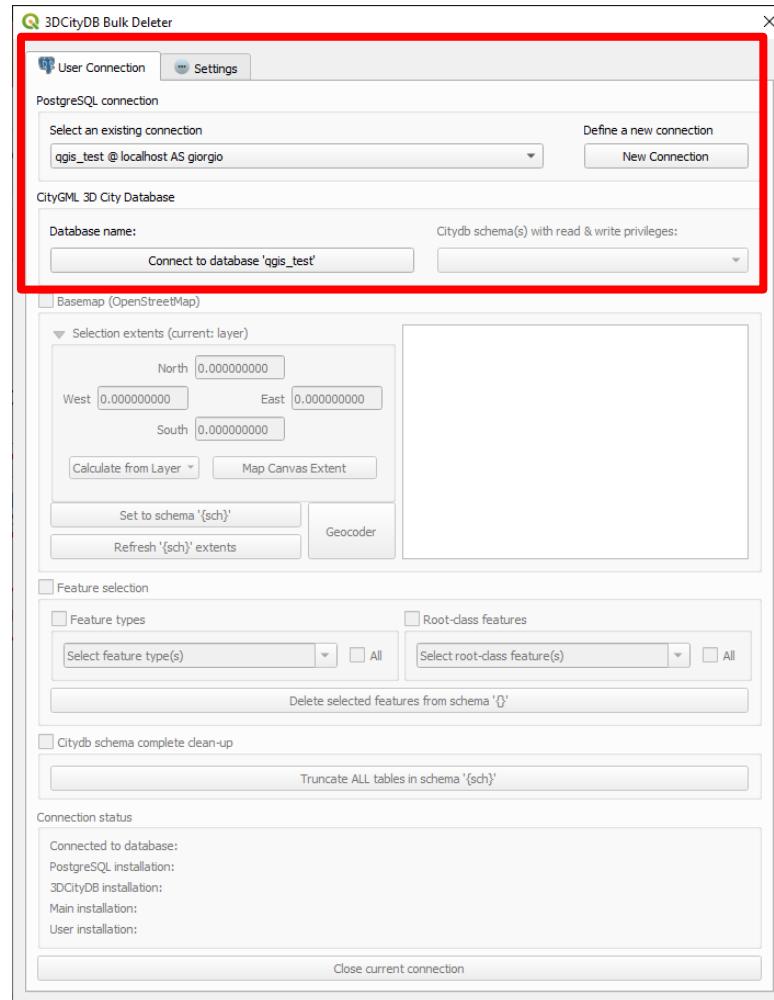


# Bulk Deleter

In the "User Connection" tab

1) Create a new connection or use an existing one to the desired 3DCityDB instance (here: "qgis\_test")

2) Connect to the chosen database

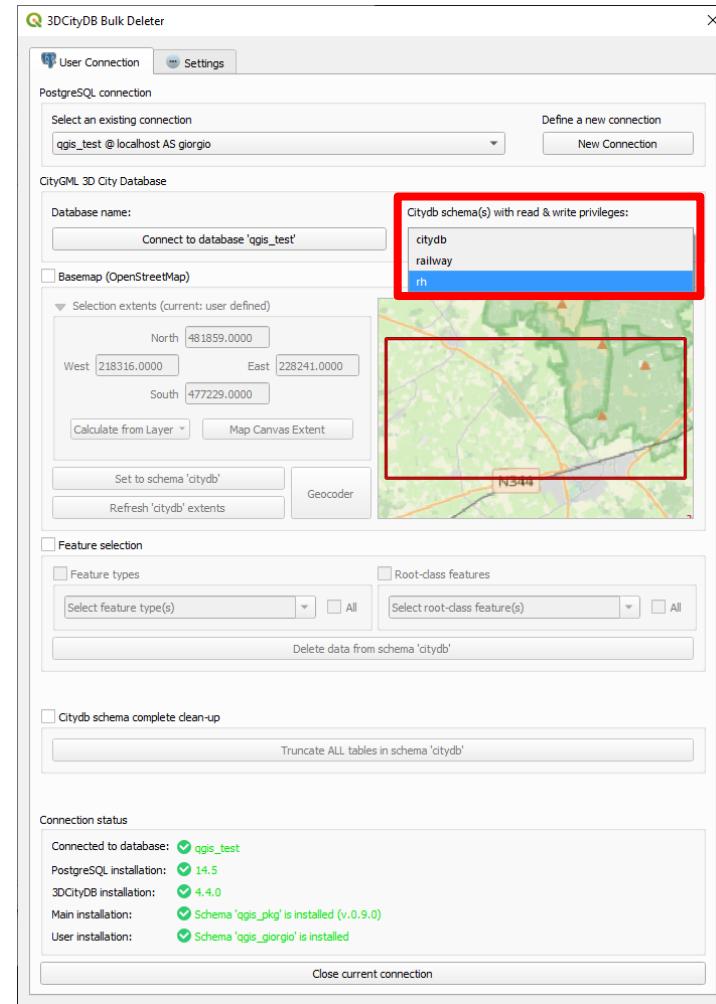


# Bulk Deleter

3) Once connected, choose one of the available citydb schemas

**Nota bene:** Only those for **which you have read & write ("rw") privileges** are listed

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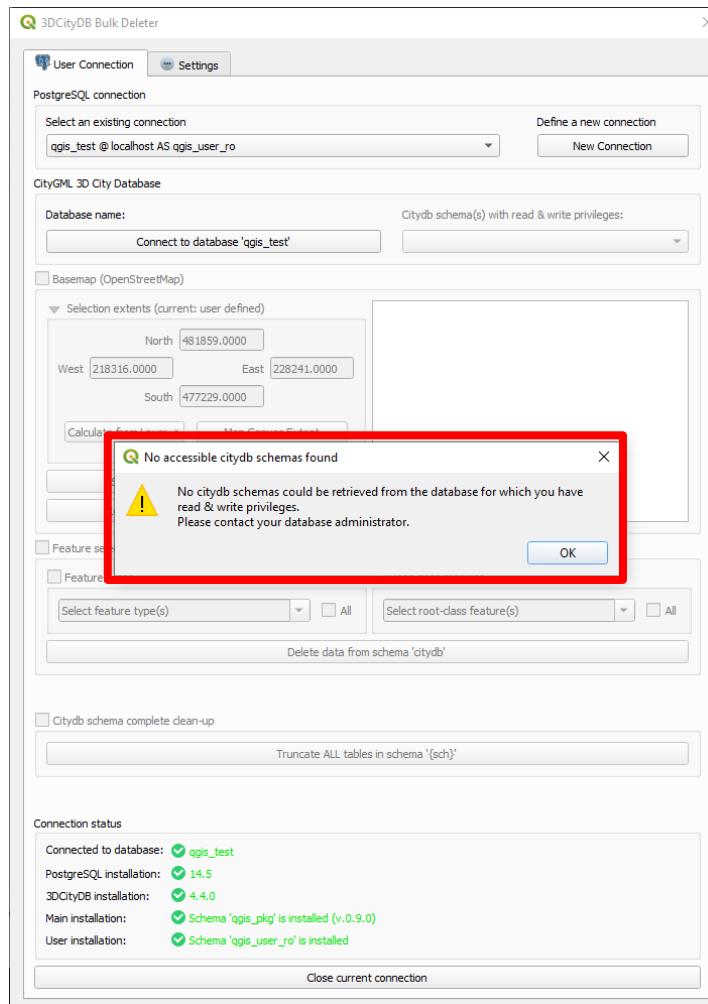


# Bulk Deleter

3) Once connected, choose one of the available citydb schemas

**Nota bene:** Only those for which you have read & write ("rw") privileges are listed

If there are no citydb schemas for which you have "rw" privileges, you will be notified before the connection is closed and the GUI completely disabled.

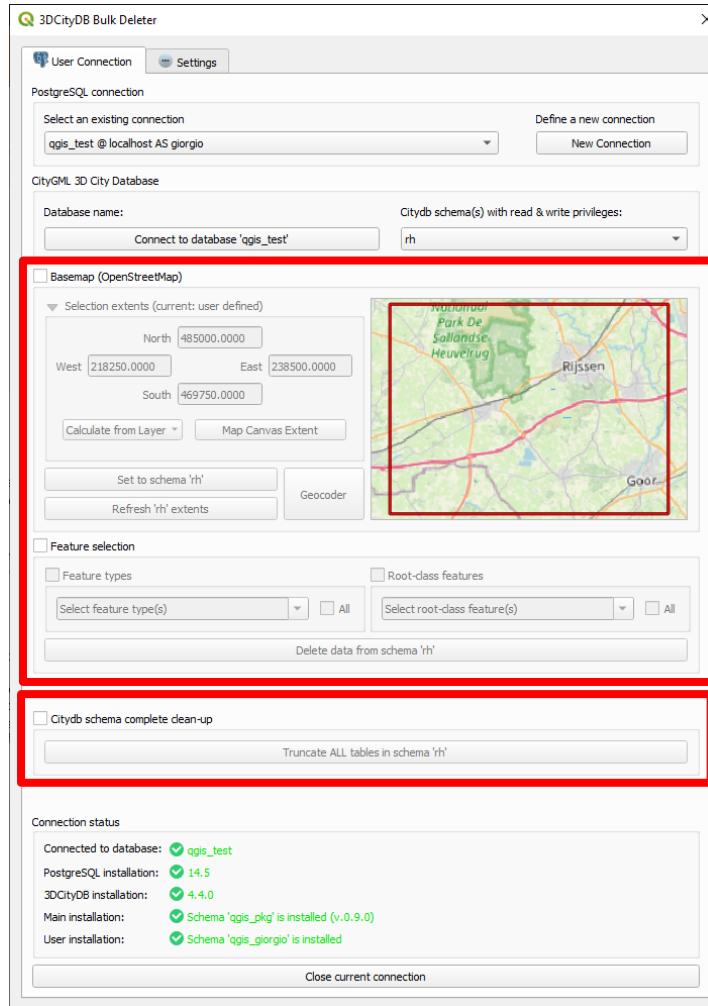


# Bulk Deleter

4) Once you have selected the citydb schema, you can perform 2 types of actions:

- Select specific features to delete (and optionally define a spatial filter, too)
- Clean up the whole schema, i.e. truncate all tables of the selected citydb schema

The GUI will prevent you from choosing both at the same time.



# Bulk Deleter

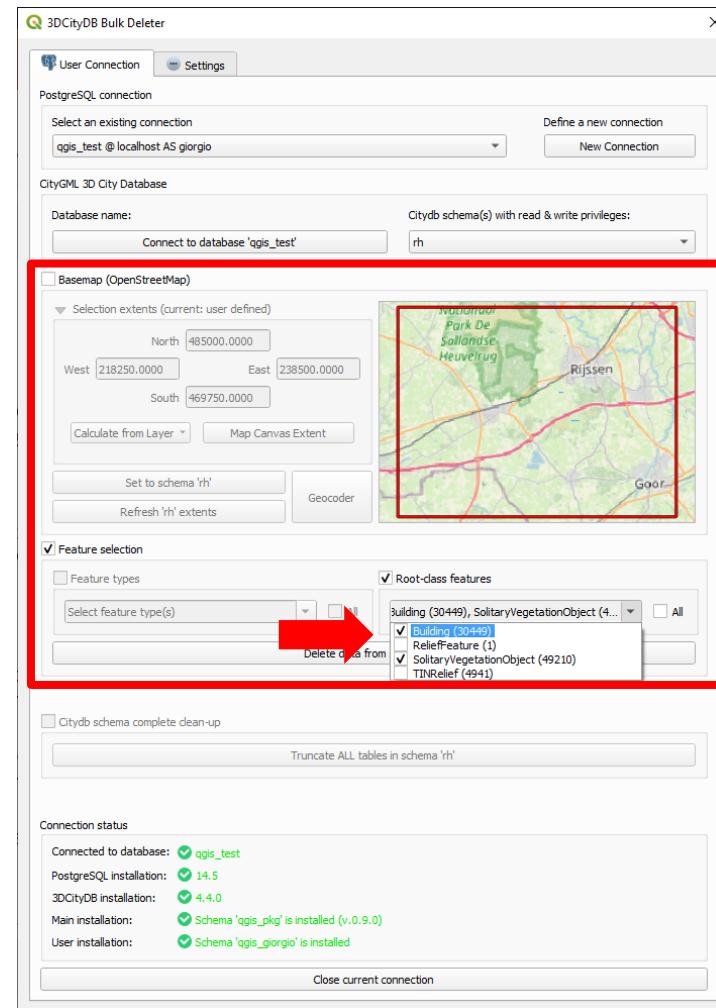
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5a) Select the features to delete. Activate the **Feature selection box**. You can now select:

- either CityGML Features types
- or root-class features

**Remember:** Feature Types correspond to CityGML modules, i.e. they may contain multiple root-class features. For example:

- Feature Type "Vegetation" includes "Solitary Vegetation Object" and "PlantCover" root classes
- Feature Type "Relief" includes "TINRelief", "BreakLineRelief" and "MassPointRelief" root classes



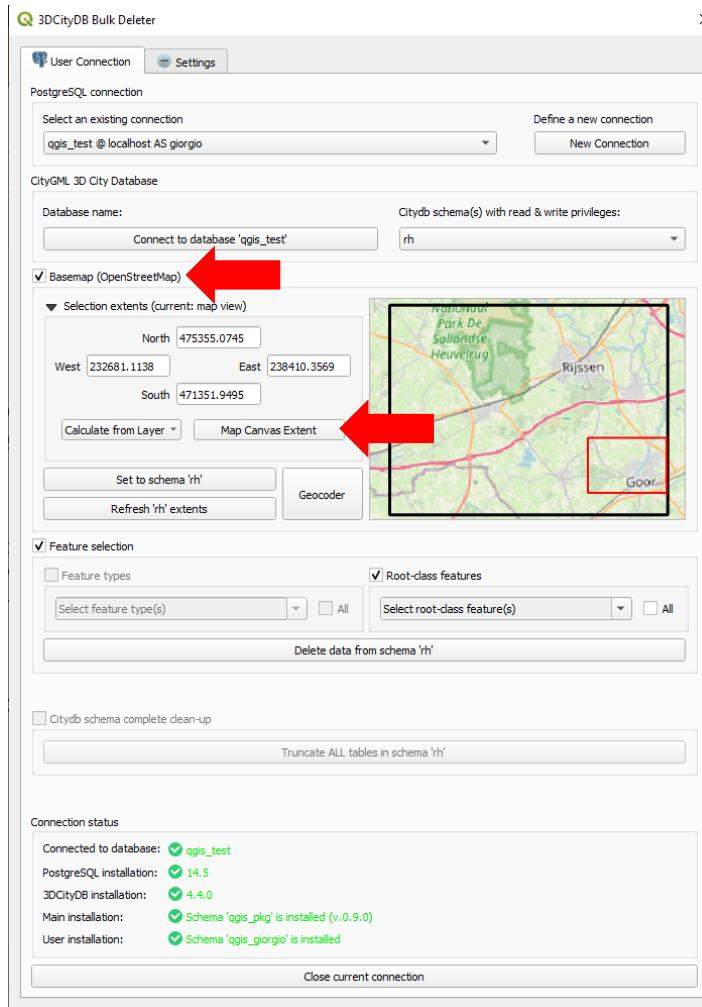
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- 5a) Select the features to delete. Activate the **Feature selection box**. You can now select:
- either CityGML Features types
  - or root-class features
  - and, optionally, define the extents of the area where to delete the selected feature. You must then also activate the **Basemap box** and press the **Map Canvas Extent button**

The delete extents are represented by the **red bounding box**.

**Please note:** The Set to schema {cdb\_schema}, Refresh {cdb\_schema} and GeoCoder buttons follow the same logic as in the Layer Loader



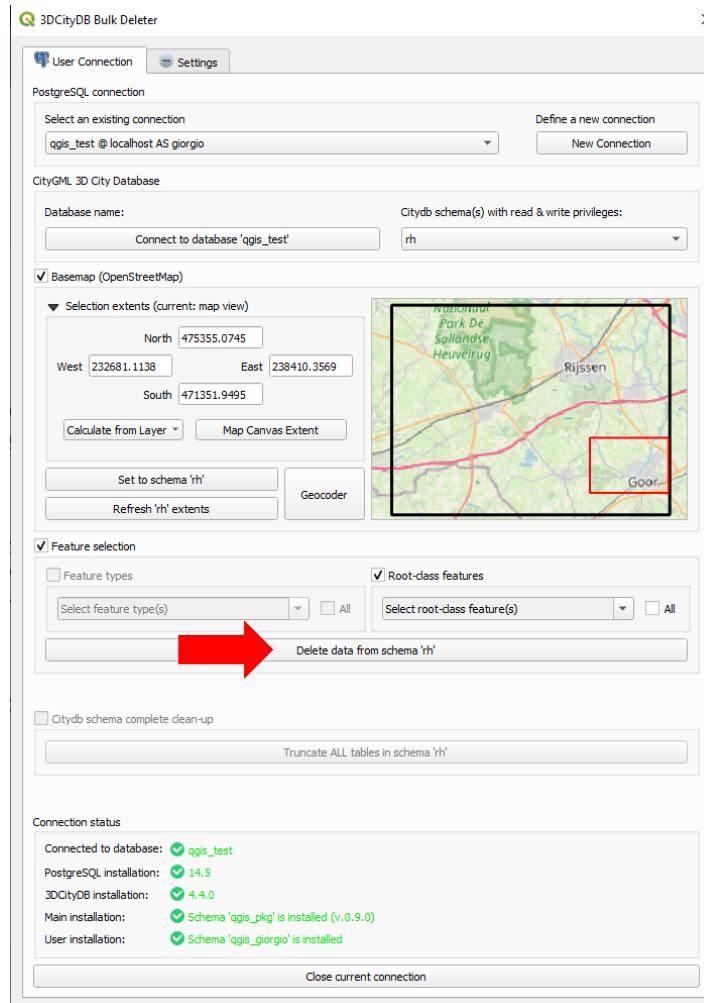
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6a) Press the **Delete data from schema {cdb\_schema}** button

**BEWARE:** Depending on the quantity of selected features, the operation might take some time.

If you want to completely delete the database, you are recommended to use the other option (see next slides) which is much faster!

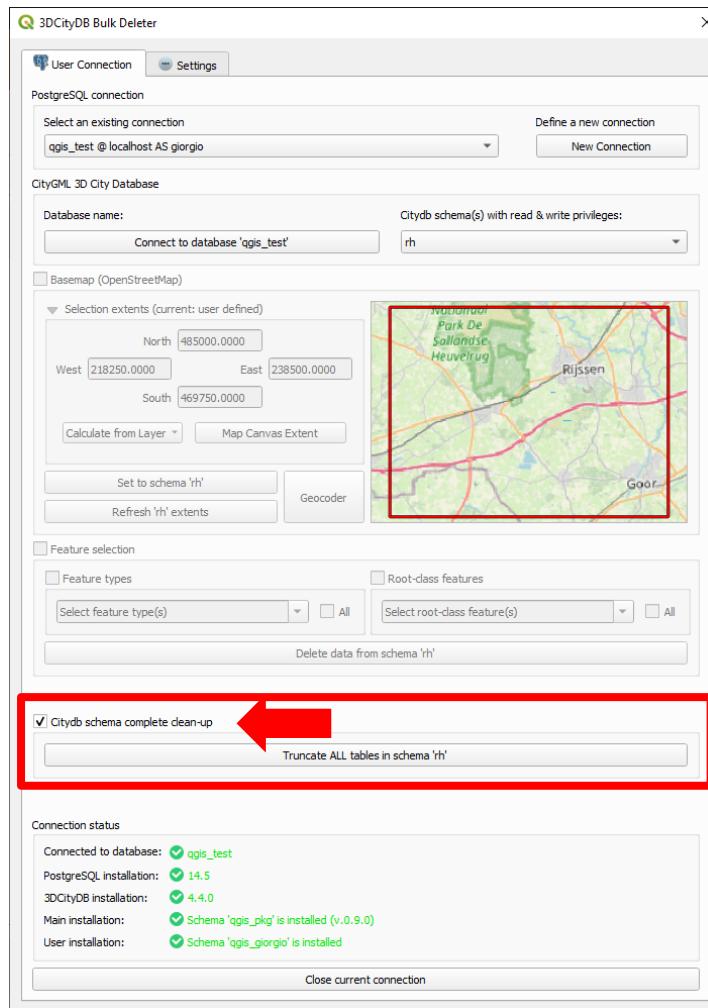


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5b) Enable the **Citydb schema complete clean-up box** and press the **Truncate ALL tables in schema {cdb\_schema}** button.

**BEWARE:** The selected citydb schema will be completely emptied and reset to its initial state. In addition, all preexisting privileges (also of other users) will be reset to "None".



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# Codelists and look-up tables

For certain CityGML properties (e.g. class, function, usage, roof type, etc.) the QGIS attribute forms in the Layer Loader can be linked to look-up tables containing

- values from the non-normative CityGML specifications
- values optionally defined by the user.

This applies to properties containing single (e.g. class, roof type) or, possibly, multiple values (e.g. function, usage).

If required, in this way the user does not have to "remember" specific codes, thus reducing the chances of wrong data input.

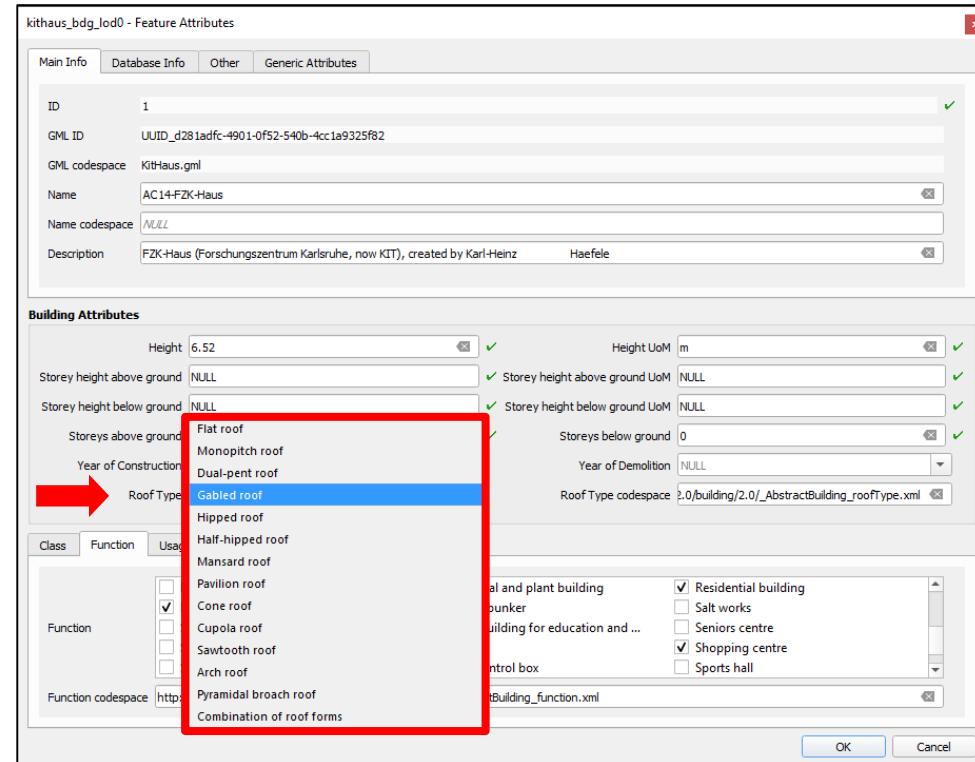
See next slides for examples.

# Codelists and look-up tables

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In the case of a CityGML property with cardinality **[0..1]**, the associated codelist values are presented as a drop-down list.

Example: property **Roof type**



# Codelists and look-up tables

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In the case of a CityGML property with cardinality [0..\*], the associated codelist values are presented as a multiple-selection list.

Example: property (Building) function

kithaus\_bdg\_Iod0 - Feature Attributes

Main Info Database Info Other Generic Attributes

ID	1
GML ID	UUID_d281adfc-4901-0f52-540b-4cc1a9325f82
GML codespace	KitHaus.gml
Name	AC14-FZK-Haus
Name codespace	NULL
Description	FZK-Haus (Forschungszentrum Karlsruhe, now KIT), created by Karl-Heinz Haefele

**Building Attributes**

Height	6.52	Height UoM	m
Storey height above ground	NULL	Storey height above ground UoM	NULL
Storey height below ground	NULL	Storey height below ground UoM	NULL
Storeys above ground	2	Storeys below ground	0
Year of Construction	2020	Year of Demolition	NULL
Roof Type	Gabled roof	Roof Type codespace	2.0/building/2.0/_AbstractBuilding_roofType.xml

Class Function Usage

Function	Residential and office building	Residential and plant building	Residential building
<input checked="" type="checkbox"/> Restaurant	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/> Sanatorium	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Shipping terminal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Signal box or stop signal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Function codespace	http://www.sig3d.org/codelists/citygml/2.0/building/2.0/_AbstractBuilding_function.xml		

OK Cancel



# Codelists and look-up tables

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## Behind the scenes:

In the 3DCityDB, string-based columns of attributes containing multiple values (separated by the --\-- field separator) are transformed into arrays in the QGIS Package layers.

Trigger functions take care of data conversion from/to arrays when needed.

## 3DCityDB table BUILDING (excerpt)

<b>id</b> <b>[PK]</b>	<b>class</b>	<b>function</b>
1531	Mixed-use	overige gebruiksfunctie--/\-woonfunctie
4431	Mixed-use	winkelfunctie--/\-woonfunctie
7839	Non-residential (multi function)	gezondheidszorgfunctie--/\-kantoorfunctie--/\-winkel functie
15423	Non-residential (multi function)	gezondheidszorgfunctie--/\-kantoorfunctie
15499	Mixed-use	gezondheidszorgfunctie--/\-kantoorfunctie--/\-winkelfunctie--/\-woonf.
16545	Mixed-use	overige gebruiksfunctie--/\-woonfunctie
14490	Mixed-use	bijeenkomstfunctie--/\-gezondheidszorgfunctie--/\-kantoorfunctie--/\-...
15956	Mixed-use	overige gebruiksfunctie--/\-woonfunctie

## QGIS Package layer BUILDING (excerpt)

```
function
character varying[])
("overige gebruiksfunctie",woonfunctie)
{winkelfunctie,woonfunctie}
{gezondheidszorgfunctie,kantoorfunctie,winkelfunctie}
{gezondheidszorgfunctie,kantoorfunctie}
{gezondheidszorgfunctie,kantoorfunctie,winkelfunctie,woonfunctie}
("overige gebruiksfunctie",woonfunctie)
{bijeenkomstfunctie,gezondheidszorgfunctie,kantoorfunctie,"overige gebruiksfunctie",woonfunctie}
```



# Codelists and look-up tables



- All codelists values are retrieved from the view **v\_codelist\_value** in the user schema of every user (e.g. "qgis\_user\_rw")
- By default, all CityGML codelists are already available
- To set up the QGIS attributes form, please refer to the next slides

**View V\_CODELISTS\_VALUE (excerpt)**

<b>id</b> bigint	<b>data_model</b> character varying	<b>name</b> character varying	<b>value</b> character varying	<b>description</b> text	<b>name_space</b> character varying
1	CityGML 2.0	MimeType	model/vrml	VRML97	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
2	CityGML 2.0	MimeType	application/x-3ds	3ds max	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
3	CityGML 2.0	MimeType	application/dxf	AutoCad DXF	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
4	CityGML 2.0	MimeType	application/x-autocad	AutoCad DXF	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
39	CityGML 2.0	_AbstractBuildingClass	1110	Maintainence and waste mana...	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
40	CityGML 2.0	_AbstractBuildingClass	1120	Healthcare	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
41	CityGML 2.0	_AbstractBuildingClass	1130	Communicating	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
42	CityGML 2.0	_AbstractBuildingClass	1140	Security	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
43	CityGML 2.0	_AbstractBuildingClass	1150	Storage	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
44	CityGML 2.0	_AbstractBuildingClass	1160	Industry	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
45	CityGML 2.0	_AbstractBuildingClass	1170	Traffic	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
46	CityGML 2.0	_AbstractBuildingClass	1180	Other function	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
47	CityGML 2.0	_AbstractBuildingClass	9999	Unknown	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
48	CityGML 2.0	_AbstractBuildingFunct...	1000	Residential building	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>
49	CityGML 2.0	_AbstractBuildingFunct...	1010	Tenement	<a href="https://www.sig3d.org/codelists/stan...">https://www.sig3d.org/codelists/stan...</a>

# Codelists and look-up tables

Example: property **Roof type**  
(cardinality [0..1])

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### Advanced options

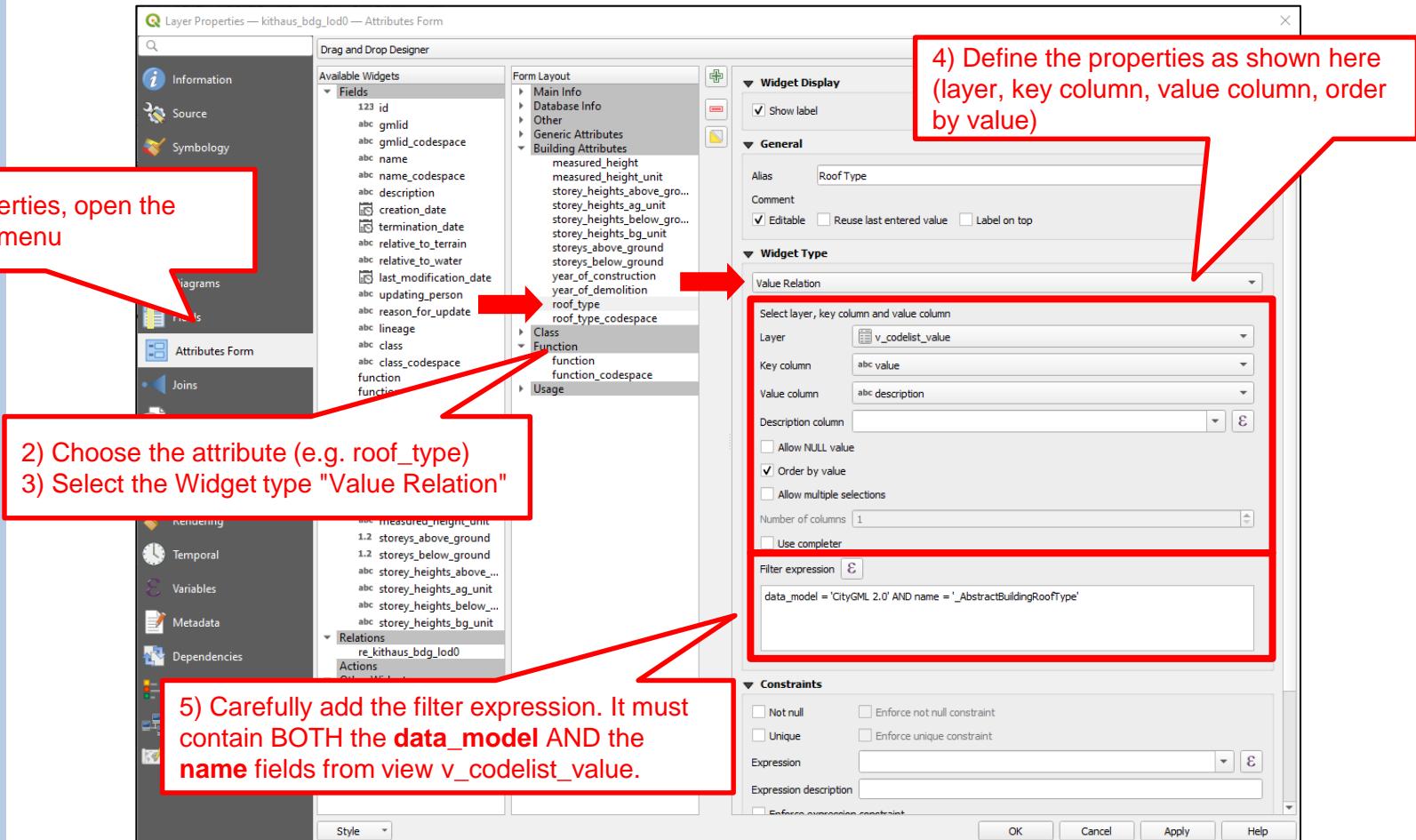
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- 1) In the Layer properties, open the Attributes Form submenu



The screenshot shows the 'Attributes Form' tab selected in the 'Layer Properties' dialog for the layer 'kithaus\_bgd\_lod0'. The 'Widget Type' section is set to 'Value Relation'. The 'Select layer, key column and value column' panel is expanded, showing:

- Layer: v\_codelist\_value
- Key column: abc.value
- Value column: abc.description
- Description column: (empty)
- Allow NULL value:
- Order by value:
- Allow multiple selections:
- Number of columns: 1
- Use completer:
- Filter expression: `data_model = 'CityGML 2.0' AND name = '_AbstractBuildingRoofType'`

Red boxes and arrows highlight specific steps:

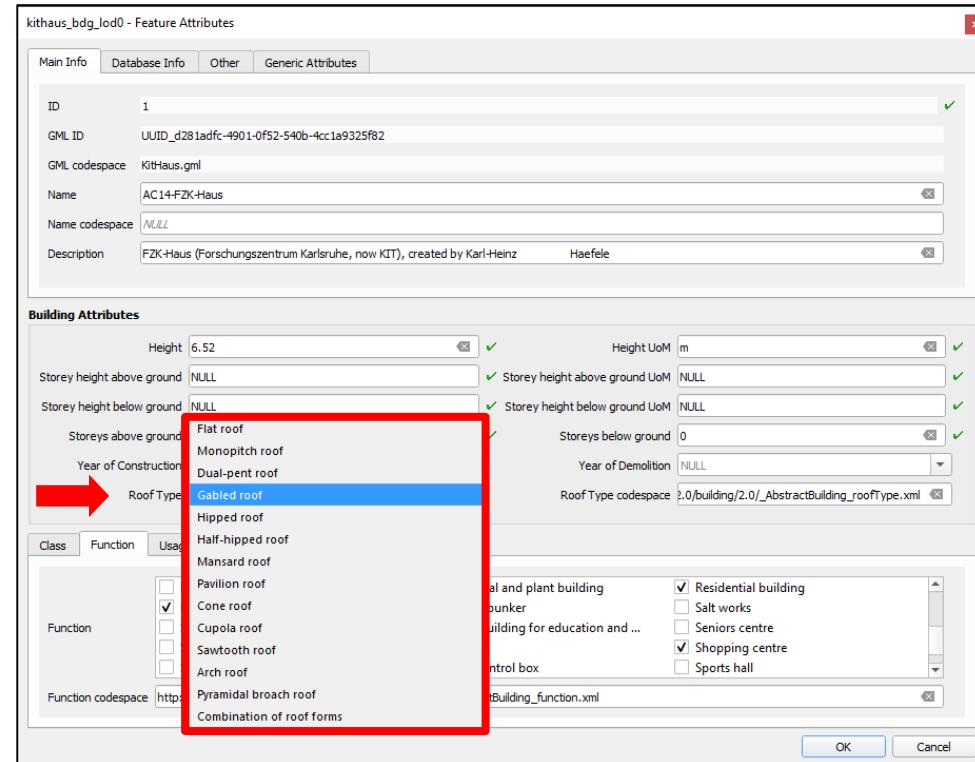
- Step 1: A red box surrounds the 'Attributes Form' submenu in the left sidebar.
- Step 2: A red box surrounds the 'roof\_type' attribute in the 'Available Widgets' list.
- Step 3: A red box surrounds the 'Value Relation' option in the 'Widget Type' dropdown.
- Step 4: A red box surrounds the 'Widget Display' and 'General' sections on the right, with a red arrow pointing from the 'Value Relation' configuration back to this area.
- Step 5: A red box surrounds the 'Filter expression' field, with a red arrow pointing from the 'Relations' section in the left sidebar to this field.

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Apply the Layer Properties,  
 reload the attributes form from  
 QGIS as usual.

Et voilà! 😊



# Codelists and look-up tables

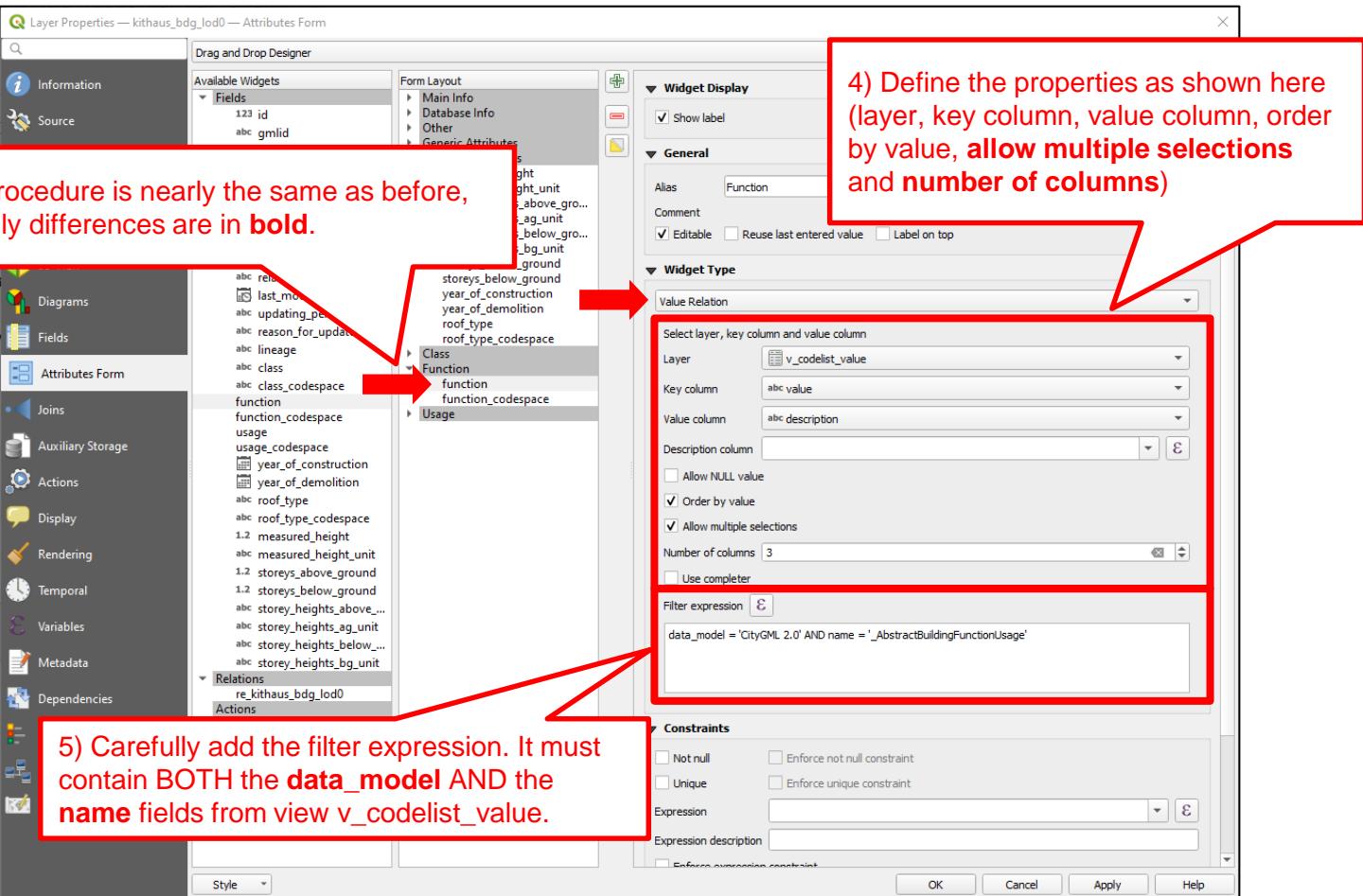
Example: property **(Building)**  
function (cardinality [0..\*])

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The procedure is nearly the same as before,  
 the only differences are in **bold**.

4) Define the properties as shown here  
 (layer, key column, value column, order by value, **allow multiple selections** and **number of columns**)

5) Carefully add the filter expression. It must contain **BOTH** the **data\_model** AND the **name** fields from view **v\_codelist\_value**.

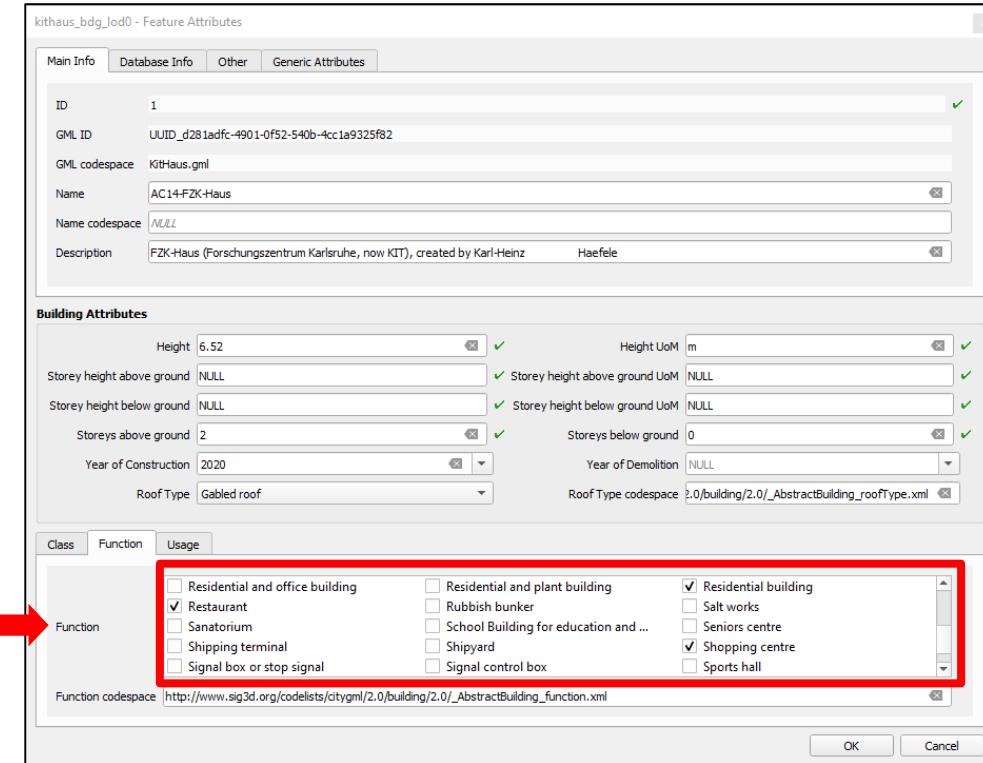


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Apply the Layer Properties,  
 reload the attributes form from  
 QGIS as usual.

Et voilà! 😊



# Codelists and look-up tables

To add or customise codelist values, **two tables** in the qgis user schema must be edited: **codelist** and **codelist\_value**

Table **codelist** contains some metadata values such as the codelist name, its name\_space and data\_model.

It is referenced by table **codelist\_value** which contains the actual values.

Tables (6)
> <b>codelist</b>
> <b>codelist_value</b>
> <b>enumeration</b>
> <b>enumeration_value</b>
> <b>extents</b>
> <b>layer_metadata</b>

**Table CODELIST (excerpt)**

<b>id</b> [PK] bigint	<b>data_model</b> character varying	<b>name</b> character varying	<b>name_space</b> character varying	<b>description</b> text
1	CityGML 2.0	MimeType	https://www.sig3d.org/codelists/standard/core/2.0/ImplicitGeometry_mimeType.xml	[null]
2	CityGML 2.0	_AbstractBridgeClass	https://www.sig3d.org/codelists/standard/bridge/2.0/_AbstractBridge_class.xml	
3	CityGML 2.0	_AbstractBridgeFunctionUsage	https://www.sig3d.org/codelists/standard/bridge/2.0/_AbstractBridge_function.xml	
4	CityGML 2.0	_AbstractBuildingClass	https://www.sig3d.org/codelists/standard/building/2.0/_AbstractBuilding_class.xml	
5	CityGML 2.0	_AbstractBuildingFunctionUsage	https://www.sig3d.org/codelists/standard/building/2.0/_AbstractBuilding_function.xml	
6	CityGML 2.0	_AbstractBuildingRoofType	https://www.sig3d.org/codelists/standard/building/2.0/_AbstractBuildingRoof_type.xml	
7	CityGML 2.0	RoomClass	https://www.sig3d.org/codelists/standard/building/2.0/Room_class.xml	
8	CityGML 2.0	RoomFunctionUsage	https://www.sig3d.org/codelists/standard/building/2.0/RoomFunction_usage.xml	
9	CityGML 2.0	BuildingFurnitureClass	https://www.sig3d.org/codelists/standard/building/2.0/BuildingFurniture_class.xml	
10	CityGML 2.0	BuildingFurnitureFunctionUsage	https://www.sig3d.org/codelists/standard/building/2.0/BuildingFurnitureFunction_usage.xml	

**Table CODELIST\_VALUE (excerpt)**

<b>id</b> [PK] bigint	<b>code_id</b> integer	<b>value</b> character varying	<b>description</b> text
1	1	model/vrml	VRML97
2	1	application/x-3ds	3ds max
3	1	application/dxf	AutoCad DXF
4	1	application/x-autocad	AutoCad DXF
5	1	application/x-dxf	AutoCad DXF
6	1	application/acad	AutoCad DWG
13	1	image/tiff	*.tiff, *.tif images
14	1	image/bmp	*.bmp images
15	2	1000	Arced bridge
16	2	1010	Cable-stayed bridge
17	2	1020	Deck bridge
18	2	1030	Cable-stayed overpass

# Codelists and look-up tables

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To add (or remove) values from the **codelist** and **codelist\_value** tables, the user can for example issue a SQL statement such as:

```
-- Optionally, delete previously loaded values belonging to the same codelist in user schema "qgis_giorgio"  
DELETE FROM qgis_giorgio.codelist WHERE data_model = 'NL-BAG';  
-- Insert first the codelist metadata and then the values in one single SQL statement  
WITH cl AS (  
    INSERT INTO qgis_giorgio.codelist (data_model, name, name_space, description)  
    VALUES  
        ('NL-BAG', 'BAG', 'https://..some_url_here.....', 'Codelist containing the values of the Dutch Basisregistratie  
        Adressen en Gebouwen')  
    RETURNING id)  
INSERT INTO qgis_giorgio.codelist_value (code_id, value, description)  
SELECT cl.id, v.value, v.description FROM cl, (VALUES  
    ('apple' , 'Codelist value for "apple"' ),  
    ('orange' , 'Codelist value for "orange"' ),  
    ('pear' , 'Codelist value for "pear"' ),  
    ('banana' , 'Codelist value for "banana"' )  
) AS v(value, description);
```

This SQL statement can be adapted by changing only the parts in red

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# Software uninstall

Uninstallation consists of two parts:

## 1) Partial/complete removal of the QGIS Package from PostgreSQL

- This operation can be carried out only by the database administrator
- The administrator can choose to drop only the schema of a selected user (e.g. "qgis\_giorgio")
- The administrator can remove all user schemas AND the qgis\_pkg schema

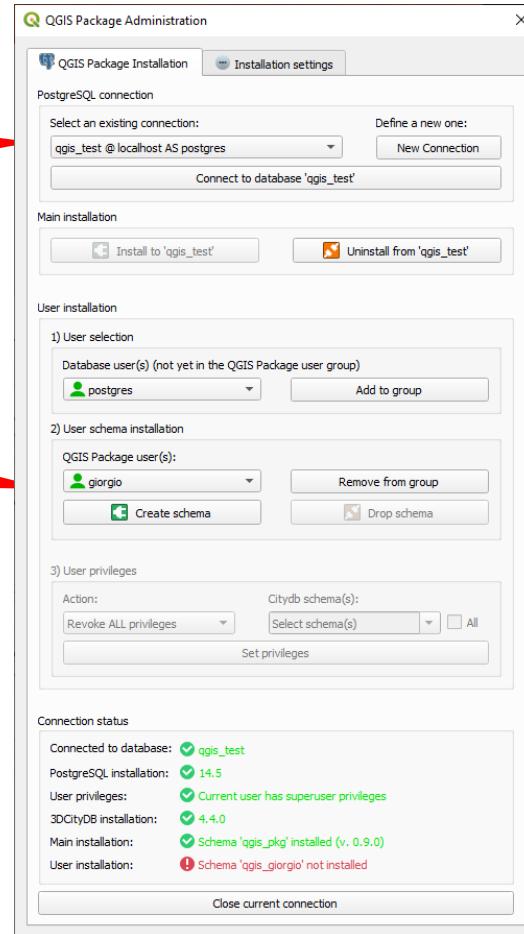
## 2) Removal of the 3DCityDB-Loader plugin from QGIS

- This operation can be carried out by any user
- The plugin can be uninstalled from the \Plugins\Manage and Install Plugins... Menu in QGIS
- Alternatively, it can be uninstalled manually by simply removing the plugin folder

# Drop user schema

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2) Connect as administrator

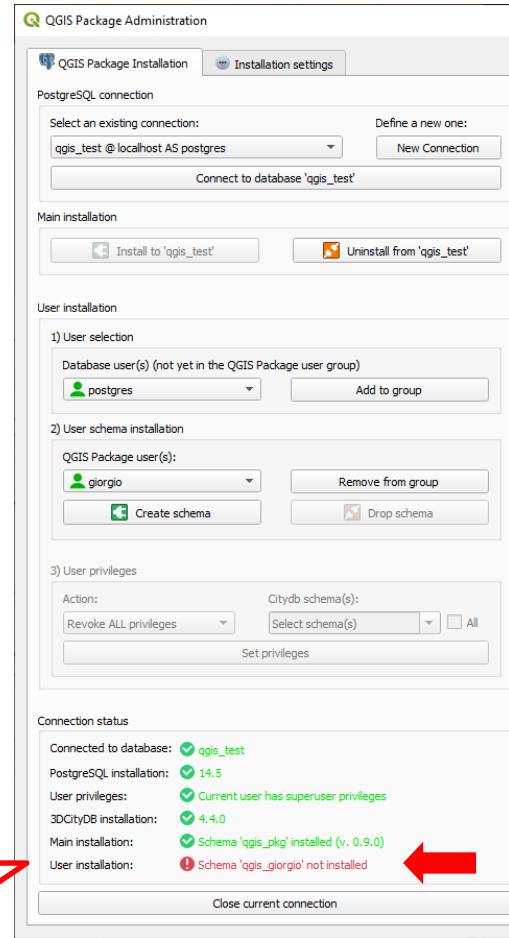


3) Select the user

4) Drop the schema of the selected user.  
All privileges will be automatically reset to "None"

# Drop user schema

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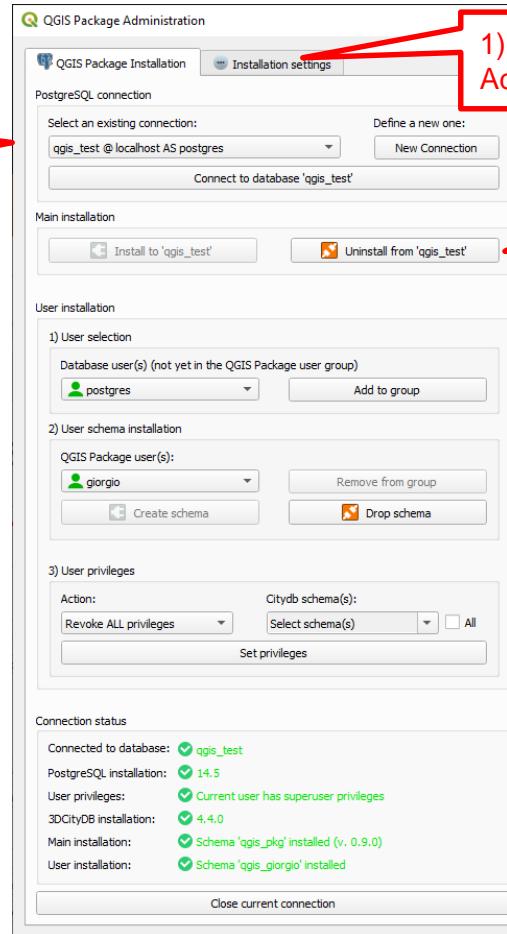


5) The user installation field  
is now red again

# Software uninstall: Uninstall QGIS Package

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2) Connect as administrator

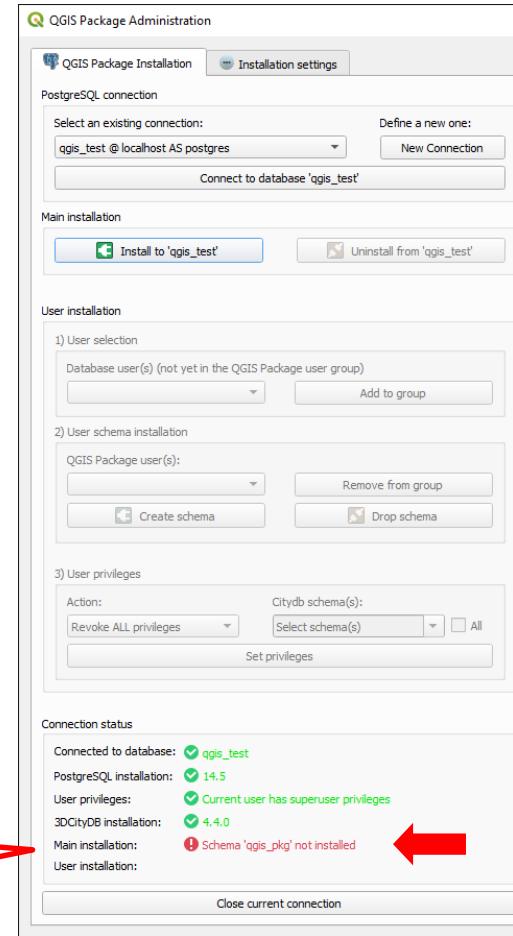


1) Load the "QGIS Package Administration" GUI

3) Uninstall the QGIS Package from the current database

# Uninstall QGIS Package

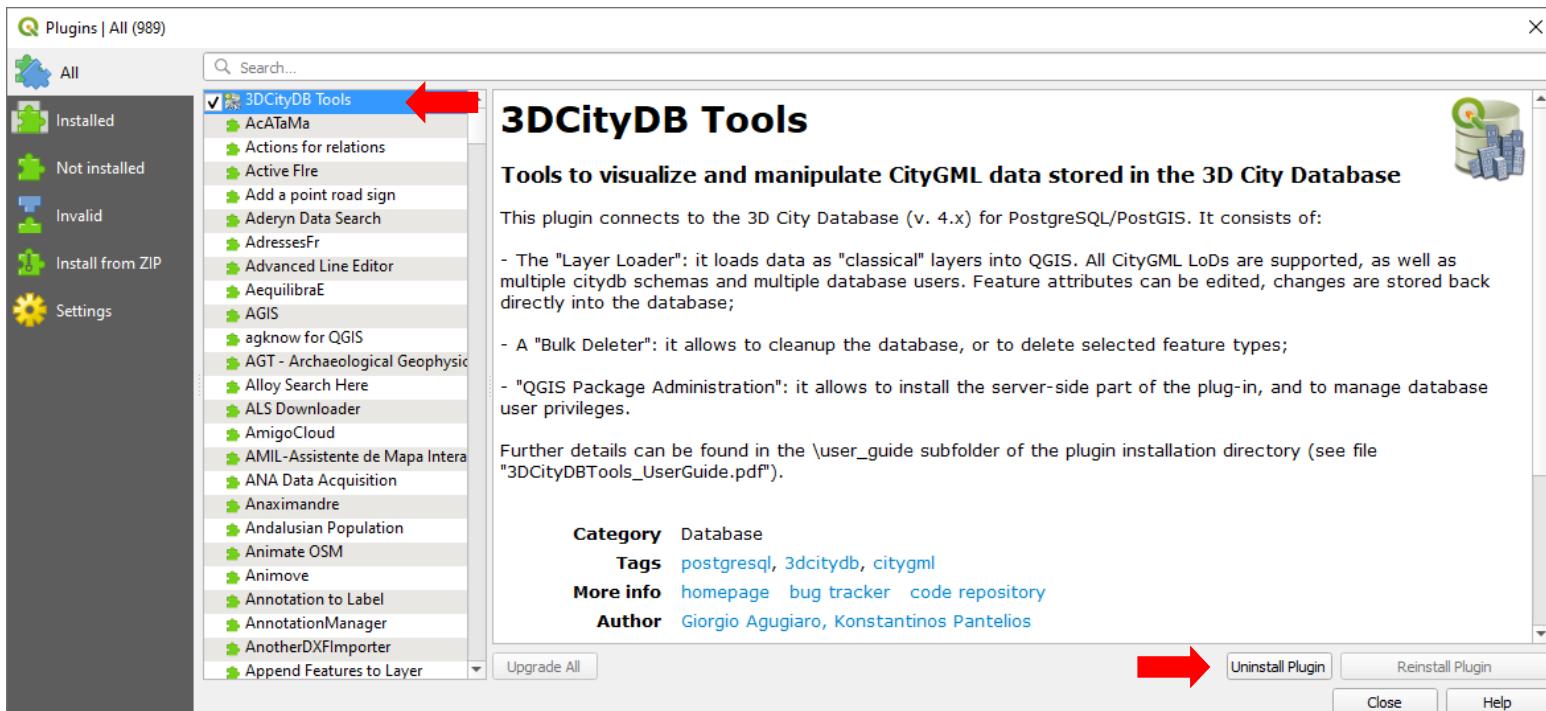
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# Uninstall 3DCityDB-Tools

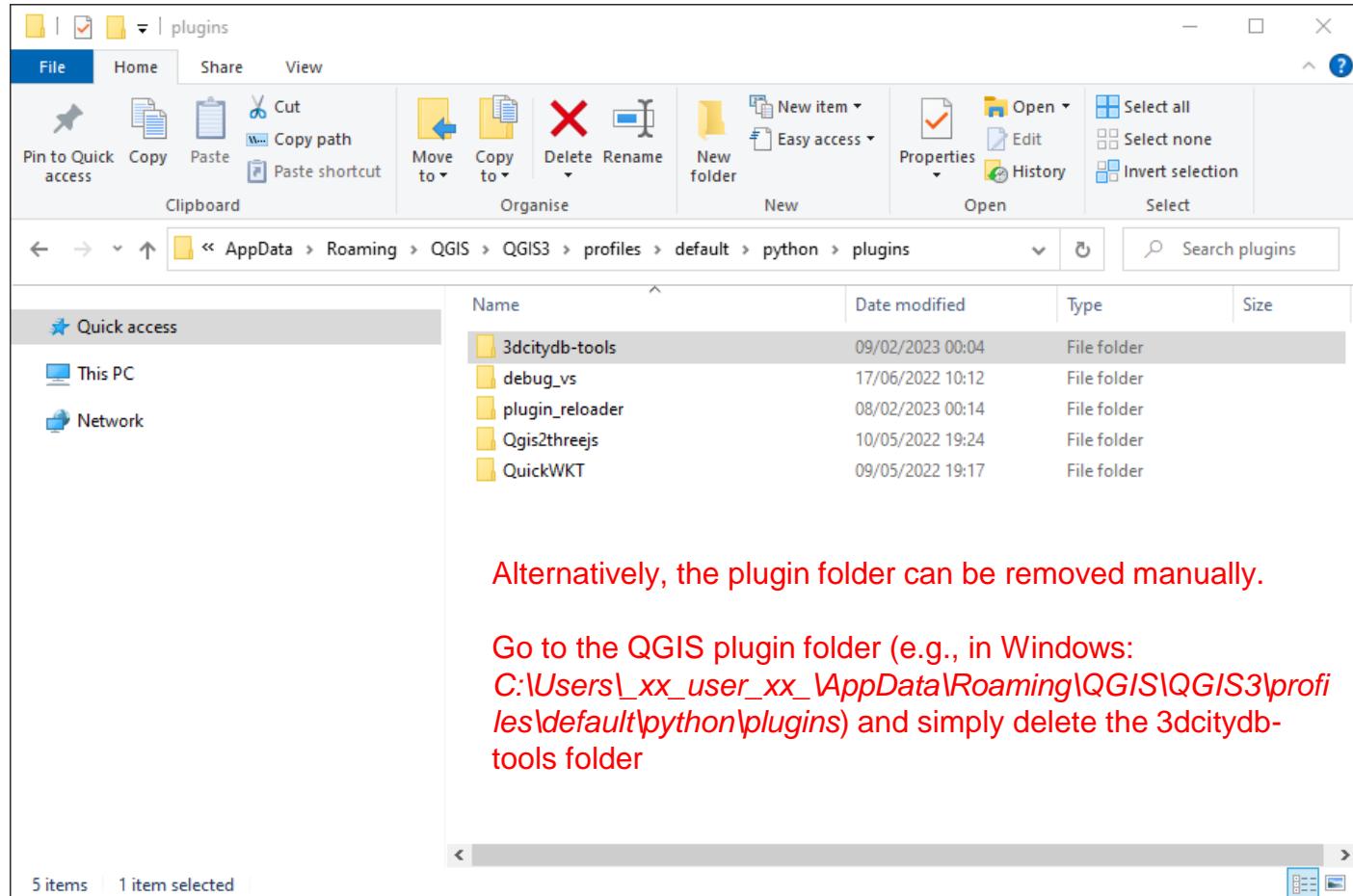
The plugin can be uninstalled from the \Plugins\Manage and Install Plugins... Menu in QGIS

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# Uninstall 3DCityDB-Tools

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Alternatively, the plugin folder can be removed manually.

Go to the QGIS plugin folder (e.g., in Windows:

C:\Users\xx\_user\_xx\AppData\Roaming\QGIS\QGIS3\profiles\default\python\plugins) and simply delete the 3dcitydb-tools folder

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# Current limitations

## As of plugin version 0.7

In general:

- CityGML appearances are not supported
- The Layer Loader does not support CityObjectGroups
- CityGML ADEs (Application Domain Extensions) are not supported

The QGIS Package does not support:

- Raster-based Relief features
- Generation of layers for CityObjectGroups

In the 3DCityDB-Tools (at least) following functionalities are still missing:

- GUI for codelist/look-up table management

In particular, when it comes to attributes editing:

- The design of the attribute forms is still being improved
- Children tables like Address or ExternalReferences are missing
- Forms of children tables will undergo some redesign in future released

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# QGIS Package in a nutshell

- It represents the **server-side part** of the QGIS plugin
  - Most of the actions carried out from the QGIS GUI can be actually performed also by interacting directly with the database (e.g. using **PgAdmin**)
- It can be installed and used independently from the QGIS client-side part
  - E.g. with FME, or programmatically via Python, SQLAlchemy, etc.
- It requires
  - PostgreSQL **v. 10 or higher**
  - An existing installation of the 3DCityDB **v. 4.x**
- All relevant entities are installed in the "**qgis\_pkg**" database schema
  - Database types
  - Triggers and trigger functions
  - Functions
  - Tables, mostly used as templates for the user schemas

# QGIS Package in a nutshell

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The database administrator can:

- Create user schemas
- Grant/revoke privileges per user and per citydb schema
- Create, refresh, drop layers
- Drop user schemas

The required SQL functions are all available in schema **qgis\_pkg**.

# QGIS Package: Create user schemas

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The database administrator can create user schemas for specific database users.  
For example:

- User "giorgio" -> schema "qgis\_giorgio"
- User "konstantinos" -> schema "qgis\_konstantinos"
- User "postgres" -> schema "qgis\_postgres"

Each user schema will be used only by the corresponding user

Each user schema is accessible only by the corresponding user (and the database superusers)

In a user schema all necessary tables, updatable views, materialized views etc. will be created

## SQL example

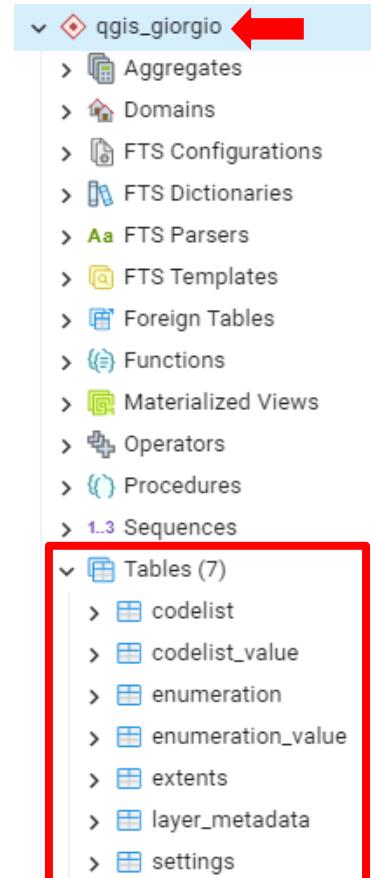
```
-- Create the schema for user "giorgio". It will create schema "qgis_giorgio" in the current database
SELECT qgis_pkg.create_qgis_usr_schema('giorgio');
```

# QGIS Package: Create user schemas

## User schema overview

In each user schema (e.g. "qgis\_giorgio") some tables are generated upon schema creation:

- Table **LAYER\_METADATA** contains information about all generated and refreshed layers
- Table **EXTENTS** contains the bounding boxes of the citydb schemas and those of the materialized views
- Tables **ENUMERATION** and **ENUMERATION\_VALUE** are used to store enumeration values
- Tables **CODELIST** and **CODELIST\_VALUE** are used to store codelist values. To add customized codelists, please refer to the slides on **advanced options** for more details
- Table **SETTINGS** is used to store the user's settings (from the QGIS GUI)



# QGIS Package: User management

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The database administrator can grant user privileges

## SQL examples

-- Database user "giorgio" is added to group "qgis\_pkg\_usrgroup\_qgis\_test", can access data in citydb schema "citydb" of database "qgis\_test" with read-only privileges

```
SELECT qgis_pkg.grant_qgis_usr_privileges('giorgio', 'ro','citydb');
```

-- Database user "konstantinos" is added to group "qgis\_pkg\_usrgroup\_qgis\_db", can access data in citydb schema "citydb\_2" of database "qgis\_db" with read-write privileges

```
SELECT qgis_pkg.grant_qgis_usr_privileges('konstantinos', 'rw','citydb_2');
```

-- Database user "camilo" is added to group "qgis\_pkg\_usrgroup\_starwars", can access data in ALL citydb schemas of the current database "starwars" with read-write privileges

```
SELECT qgis_pkg.grant_qgis_usr_privileges('camilo ', 'rw');
```

# QGIS Package: User management

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The database administrator can revoke user privileges

## SQL examples

```
-- Database user "giorgio" cannot access anymore data in citydb schema "citydb" of the current database
SELECT qgis_pkg.revoke_qgis_usr_privileges('giorgio', 'citydb');
```

```
-- Database user "camilo" cannot access anymore ANY citydb schemas of the current database
SELECT qgis_pkg.revoke_qgis_usr_privileges('camilo');
```

**IMPORTANT:** The database users are NOT automatically removed from the group "qgis\_pkg\_usrgroup\_{cdb\_schema}". If required, the administrator has to remove them manually (or use the QGIS plugin GUI).

```
-- Database user "giorgio" is removed from group "qgis_pkg_usrgroup_starwars" and won't be able to use the QGIS plugin anymore for the database "starwars"
```

```
REVOKE qgis_pkg_usrgroup_starwars FROM giorgio;
```

# QGIS Package: Layer management

The database administrator can create layers with function **qgis\_pkg.create\_layers(...)**.

- All materialized views and updatable views are created, but only if corresponding data exist in the database
- The user can create layers only for selected CityGML modules using the similar functions:
  - **qgis\_pkg.create\_layers\_bridge(...)**
  - **qgis\_pkg.create\_layers\_building(...)**
  - ...
  - **qgis\_pkg.create\_layers\_waterbody(...)**
- All functions are in schema **qgis\_pkg** and have the same signature (see next slide)

# QGIS Package: Layer management

## Function

```
qgis_pkg.create_layers(usr_schema, cdb_schema [, perform_snapping] [, digits]  
[, area_poly_min] [, bbox_corners_array] [, force_layer_creation])
```

Parameter	Type	Description
<b>usr_schema</b>	varchar	The database user schema, e.g. "qgis_giorgio".
<b>cdb_schema</b>	varchar	the citydb schema where data are stored, e.g. "citycb", or "citydb2".
<b>perform_snapping</b>	integer	DEFAULT 0 (i.e. disabled). If 1, geometry simplification is performed. Unused if perform_snapping is set to 0.
<b>digits</b>	integer	DEFAULT 3. Number of decimal positions to keep during geometry simplification. Unused if perform_snapping is set to 0.
<b>area_poly_min</b>	numeric	DEFAULT 0.001 [m <sup>2</sup> ]. Minimum polygon area during geometry simplification. Unused if perform_snapping is set to 0.
<b>bbox_corners_array</b>	numeric[]	DEFAULT Null, i.e. the extents of the whole <i>cdb_schema</i> . Otherwise, extents of the materialized views to be created, e.g. {x_min, y_min, x_max, y_max}. Coordinates must be in the same SRS as the <i>cdb_schema</i> !
<b>force_layer_creation</b>	boolean	DEFAULT False. Otherwise: force creation of all layers, also the empty ones.

# QGIS Package: Layer management

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## SQL examples

-- For user "giorgio", create all layers for existing data in citydb schema "citydb"

**SELECT** qgis\_pkg.create\_layers('giorgio', 'citydb');

-- For user "giorgio", create all layers for existing data in citydb schema "citydb2" and perform geometry simplification with 2 decimal places and 0.01 m<sup>2</sup> minimum area for polygons

**SELECT** qgis\_pkg.create\_layers('giorgio', 'citydb', 1, 2, 0.01);

-- For user "camilo", create all building module layers for existing data in citydb schema "vienna"

**SELECT** qgis\_pkg.create\_layers\_building('camilo', 'vienna');

-- For user "konstantinos", create all waterbody module layers for existing data in citydb schema "alderaan" within a certain bounding box

**SELECT** qgis\_pkg.create\_layers\_waterbody('konstantinos', 'alderaan', bbox\_corners\_array := '{10, 20, 110, 220}');

# QGIS Package: Layer management

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## SQL examples

-- The following query works, but actually it is not written in a user-friendly way.

```
SELECT qgis_pkg.create_layers('giorgio', 'citydb', 1, 2, 0.01);
```

-- In general, therefore, it is always a good habit to use **named parameters** when calling functions!

```
SELECT qgis_pkg.create_layers(  
    usr_name := 'giorgio',  
    cdb_schema := 'citydb',  
    perform_snapping := 1,  
    digits := 2,  
    area_poly_min := 0.01)
```

# QGIS Package: Layer management

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The database administrator can refresh the materialized views with function **qgis\_pkg.refresh\_mvviews(...)**.

- All materialized views created before will be refreshed. This is necessary every time the layers are generated (or re-generated using a different bounding box).
- The user can refresh the materialized views only for selected CityGML modules using the similar functions:
  - **qgis\_pkg.refresh\_mvviews\_bridge(...)**
  - **qgis\_pkg.refresh\_mvviews\_building(...)**
  - ...
  - **qgis\_pkg.refresh\_mvviews\_waterbody(...)**
- All functions are in schema qgis\_pkg and have the same signature (see next slide)

# QGIS Package: Layer management

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## Function

**qgis\_pkg.refresh\_mviews(usr\_schema, cdb\_schema)**

Parameter	Type	Description
<b>usr_schema</b>	varchar	The database user schema, e.g. "qgis_giorgio".
<b>cdb_schema</b>	varchar	the citydb schema where data are stored, e.g. "citycb", or "citydb2".

## SQL examples

-- In user schema "qgis\_giorgio", refresh all materialized views in citydb schema "citydb"

**SELECT** qgis\_pkg.refresh\_mviews('qgis\_giorgio', 'citydb');

-- In user schema "qgis\_konstantinos", refresh all waterbody module materialized views in citydb schema "alderaan"

**SELECT** qgis\_pkg.refresh\_mviews\_waterbody('qgis\_konstantinos', 'alderaan');

# QGIS Package: Layer management

The database administrator can drop layers with function **qgis\_pkg.drop\_layers(...)**.

- All existing layers in the selected user schema and related to the selected citydb schema will be dropped
- The user can drop layers only for selected CityGML modules using the similar functions:
  - **qgis\_pkg.drop\_layers\_bridge(...)**
  - **qgis\_pkg.drop\_layers\_building(...)**
  - ...
  - **qgis\_pkg.drop\_layers\_waterbody(...)**
- All functions are in schema **qgis\_pkg** and have the same signature (see next slide)

# QGIS Package: Layer management

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## Function

**qgis\_pkg.drop\_layers(usr\_schema, cdb\_schema)**

Parameter	Type	Description
<b>usr_schema</b>	varchar	The database user schema, e.g. "qgis_giorgio".
<b>cdb_schema</b>	varchar	the citydb schema where data are stored, e.g. "citycb", or "citydb2".

## SQL examples

-- In user schema "qgis\_giorgio", drop all layers related to citydb schema "citydb"

**SELECT** qgis\_pkg.drop\_layers('qgis\_giorgio', 'citydb');

-- In user schema "qgis\_konstantinos", drop all waterbody module layers related to citydb schema "alderaan"

**SELECT** qgis\_pkg.drop\_layers\_waterbody('qgis\_konstantinos', 'alderaan');

# QGIS Package: Drop user schema

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The database administrator can drop a user schema

FIRST, revoke privileges of the user for all citydb schemas, THEN drop the user schema.  
Please refer to the previous slides for more details about user privileges.

SQL example

```
-- First revoke all ro/rw privileges of user "giorgio" for all citydb schemas
SELECT qgis_pkg.revoke_qgis_usr_privileges('giorgio');

-- Then drop the layers using the drop_layer_x functions
SELECT qgis_pkg.drop_layers_building('qgis_giorgio');
SELECT qgis_pkg.drop_layers_bridge('qgis_giorgio');

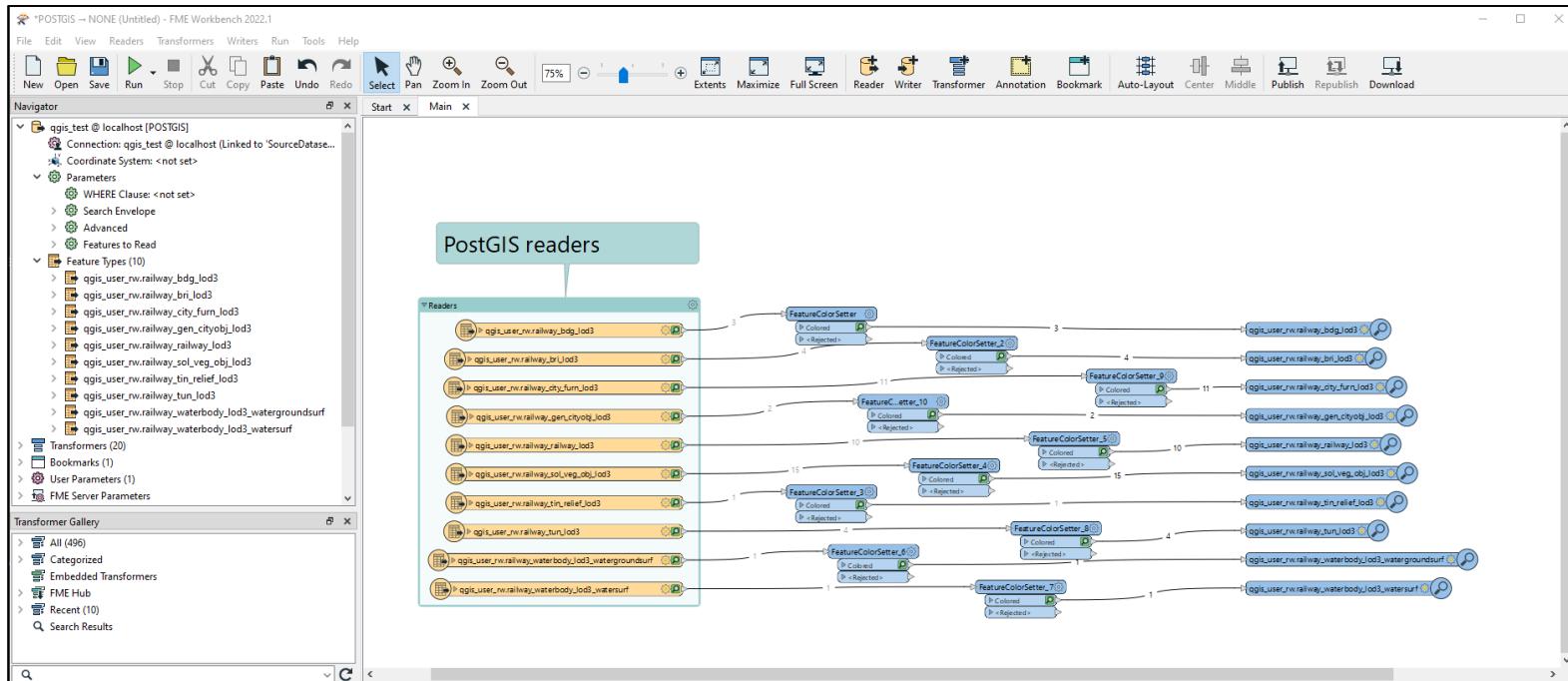
...
-- Then drop the user schema
DROP SCHEMA qgis_giorgio CASCADE;
-- Optionally (if necessary) remove user "giorgio" from the "qgis_pkg_usrgroup_qgis_test" associated to database
-- "qgis_test"
REVOKE qgis_pkg_usrgroup_qgis_test FROM giorgio;
```

# QGIS Package via FME

This is a simple example of how the QGIS package can be used via FME

- Simply connect to the 3D City Database and import the views with **PostGIS readers**

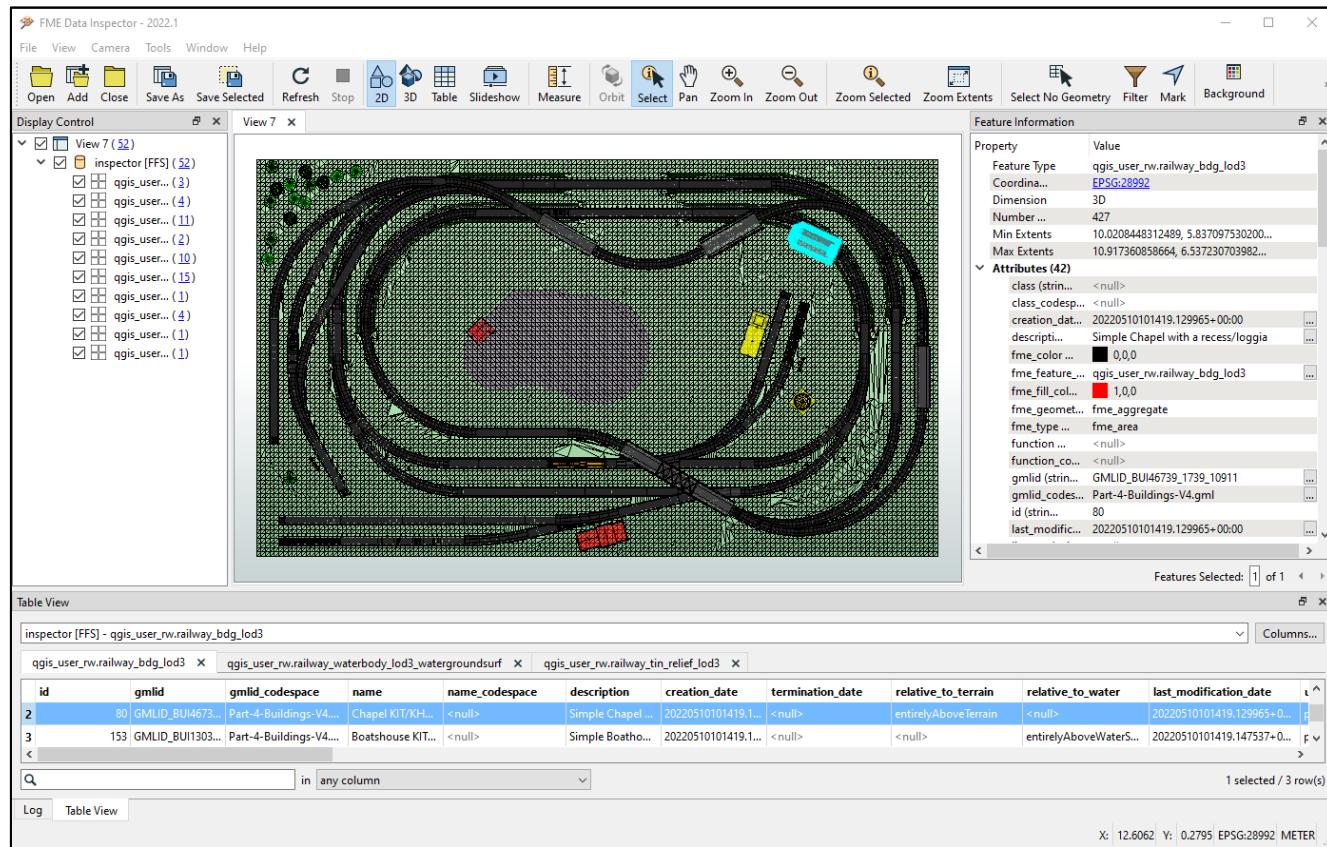
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# QGIS Package via FME

- 2D visualisation via FME Data Inspector

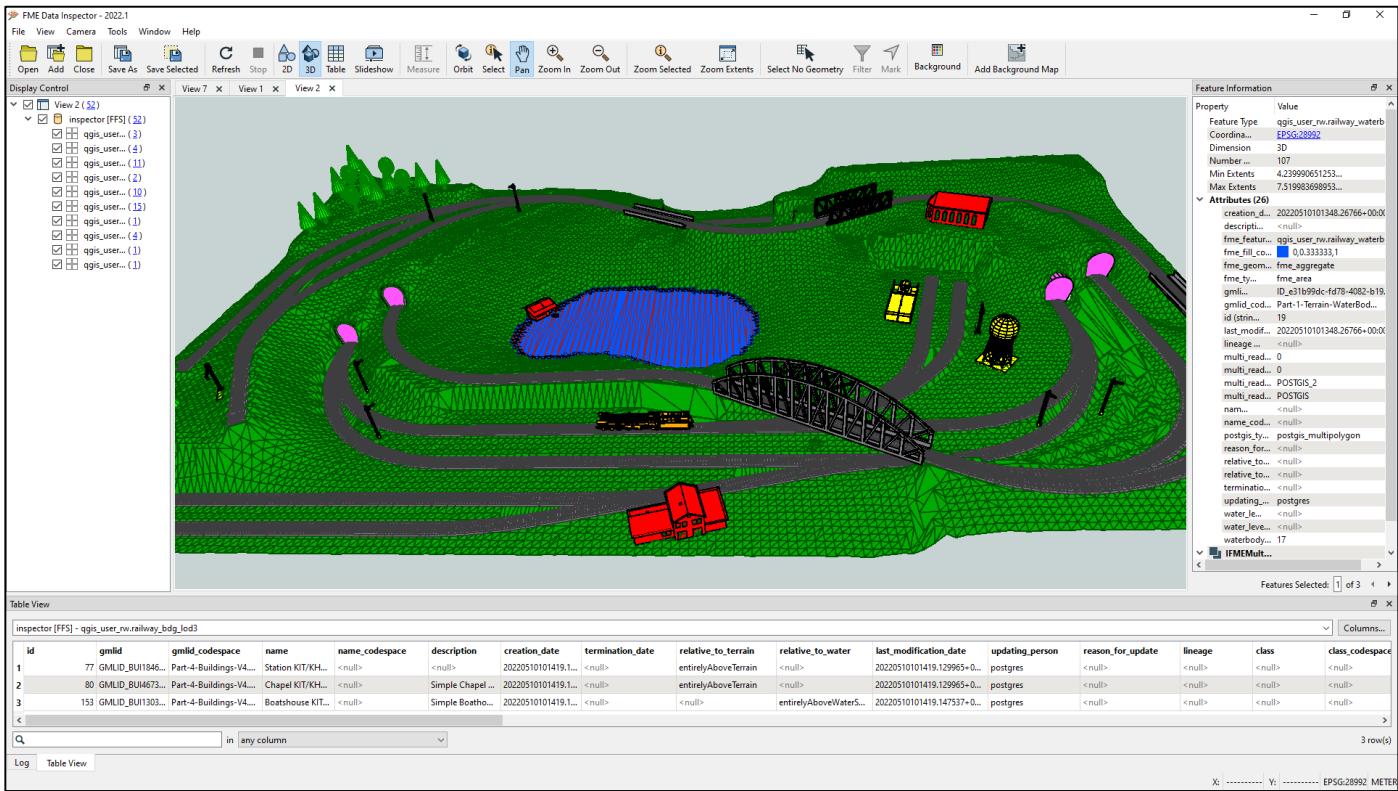
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# QGIS Package via FME

- 3D visualisation via FME Data Inspector

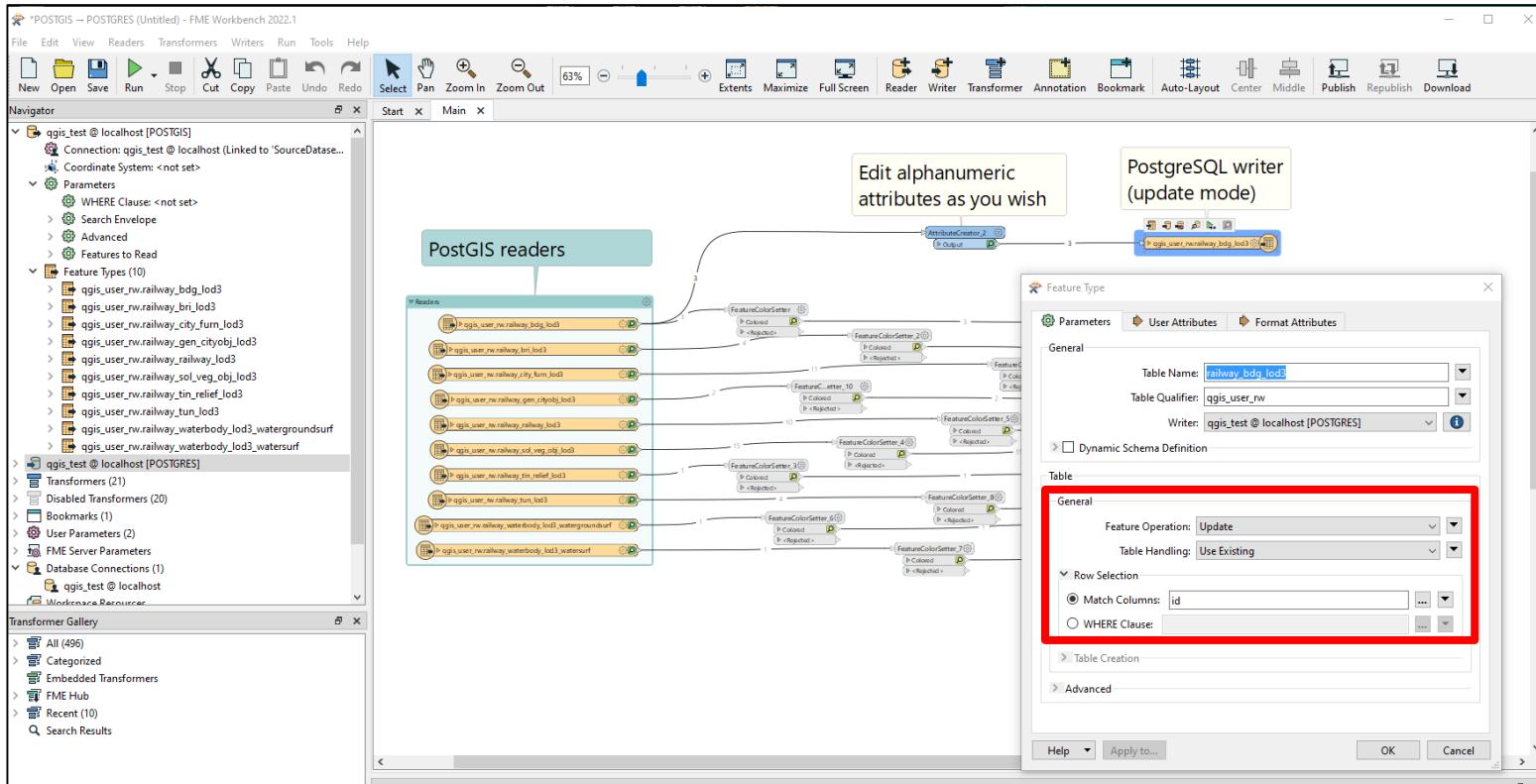
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# QGIS Package via FME

- Remember: alphanumeric attributes in the views are updatable! 😊
- You will need a PostgreSQL writer in update mode

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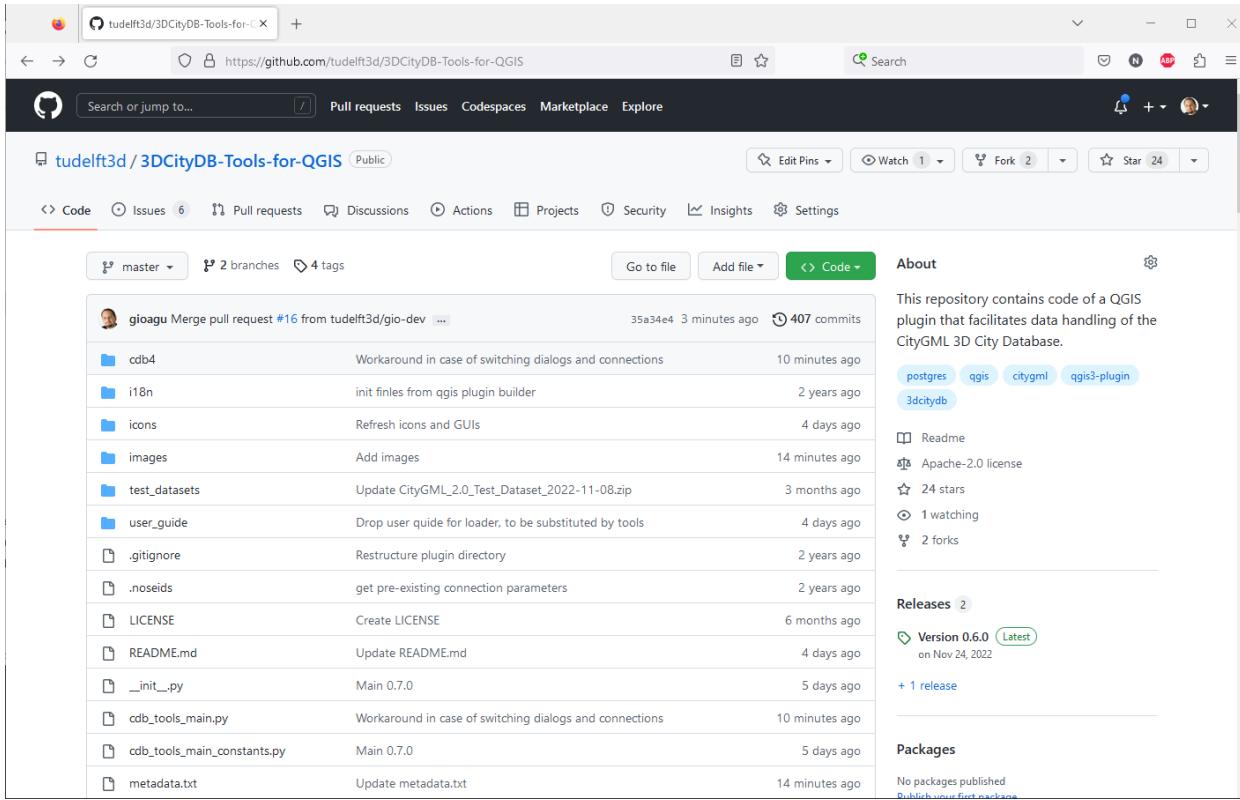
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# Resources

## Source code and GitHub repository

- GitHub: <https://github.com/tudelft3d/3DCityDB-Tools-for-QGIS>



The screenshot shows the GitHub repository page for 'tudelft3d / 3DCityDB-Tools-for-QGIS'. The repository is public and contains 407 commits. The main page displays a list of files and their commit history, including '.gitignore', 'LICENSE', 'README.md', 'cdb4', 'i18n', 'icons', 'images', 'test\_datasets', 'user\_guide', and 'metadata.txt'. The 'About' section provides a brief description of the plugin's purpose: 'This repository contains code of a QGIS plugin that facilitates data handling of the CityGML 3D City Database.' It also lists tags like 'postgres', 'qgis', 'citygml', 'qgis3-plugin', and '3dcitydb'. The 'Releases' section shows a single release, 'Version 0.6.0 (Latest)', dated Nov 24, 2022. The 'Packages' section indicates that no packages have been published.

This repository contains code of a QGIS plugin that facilitates data handling of the CityGML 3D City Database.

Tags: postgres, qgis, citygml, qgis3-plugin, 3dcitydb

Releases: 2

Version 0.6.0 (Latest) on Nov 24, 2022

+ 1 release

Packages: No packages published

Published your first package

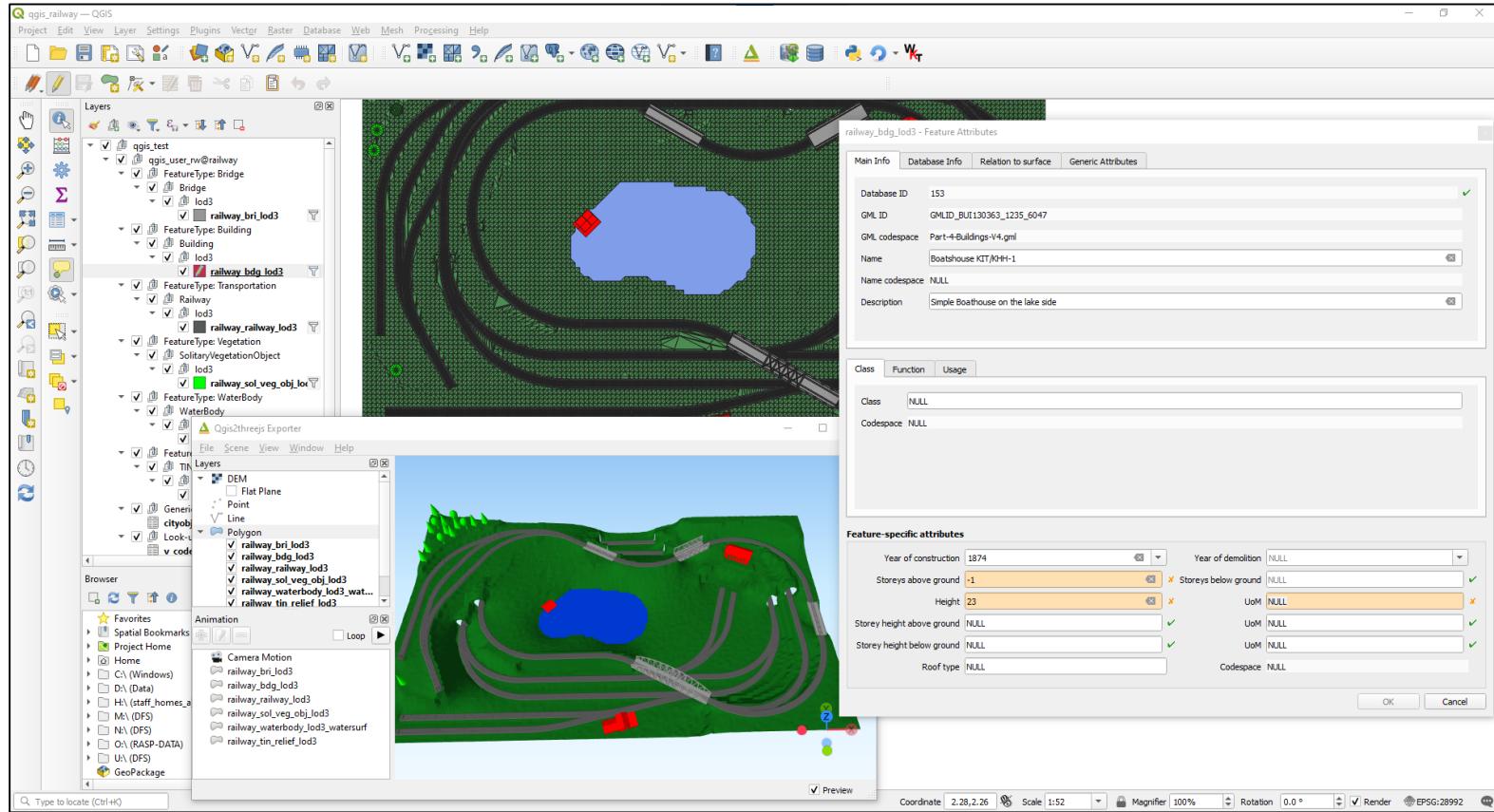
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## Test datasets

- In the GitHub repository, you will find test datasets that you can import into the 3DCityDB (using the Importer/Exporter) to test the 3DCityDB-Tools plugin. They are located in subfolder \test\_datasets
  - The test datasets are:
    - CityGML\_2.0\_Test\_Dataset\_2022-03-11.zip (aka "Railway")
    - FZK-Haus-LoD-all-KIT-IAI-KHH-B36-V1.zip (aka "Kit House")
    - DenHaag\_bdg\_lod2.zip
  - You can find links to many additional free and open CityGML/CityJSON datasets at:
    - Awesome CityGML: <https://github.com/OloOcki/awesome-citygml>
    - 3D Geoinformation group @ TU Delft: <https://3d.bk.tudelft.nl/opendata/opencities/>

# Enjoy! ☺



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# 3DCityDB Tools

for



QGIS