Manual for QGIS plugin

BoundaryDelineation

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Summary

This manual explains the use of the QGIS plugin BoundaryDelineation. Most of the steps are explained in the graphical user interface of the plugin. This manual serves as an extended explanation of the installation and use of the plugin. The plugin was designed to support the semi-automatic delineation of visible cadastral boundaries from UAV data. The plugin is experimental. The plugin is part of a delineation tool, in which the output from gPb contour detection and SLIC superpixels are combined based on random forest classification. The subsequent interactive delineation is managed with the BoundaryDelineation plugin. Scripts and info on the other workflow parts can be found here. The plugin's code is available here. A video demonstration its use can be found here.

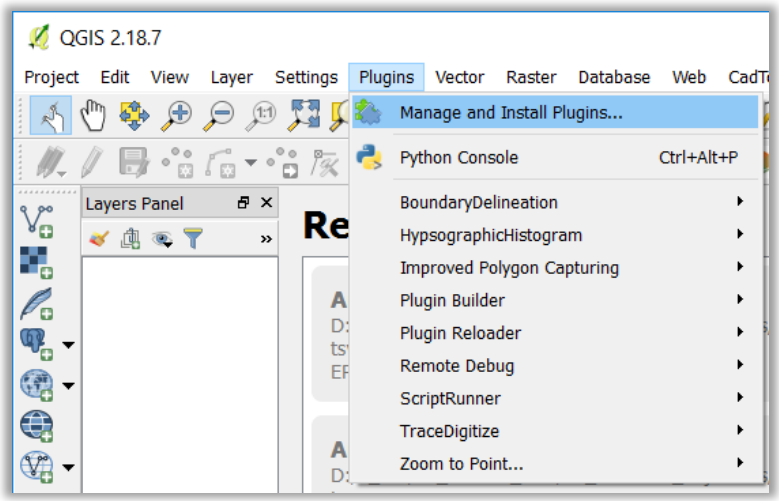
This research is part of its4land, a European Commission Horizon 2020 project that aims to deliver an innovative suite of land tenure recording tools. These tools are intended to respond to sub Saharan Africa's immense challenge to rapidly and cost-effectively map millions of unrecognized or unrecorded land rights, in order to register them in formal land administration systems. A recent overview of the project can be found here.

The work package (WP 5 – Automate It) that this plugin is developed, for is part of its4land. It aims to exploit the use of high-resolution UAV imagery combined with an image interpretation workflow that automatically extracts relevant land tenure features from UAV data. These can be physical objects such as hedges, fences, stone walls, tree lines, roads, walkways or waterways that often demarcate cadastral boundaries. Such an approach cannot deliver complete matching – as some tenure boundaries are only social and not visible to sensors – however, even 50% matching would radically alter tenure mapping workflow costs and times. The scientific progress of finding optimal methods and combining them in a workflow is ongoing. A review on related issues and case studies, such as the combination of cadastral mapping and remote sensing as well as image-based feature extraction methods can be found here. The initial workflow step – gPb contour detection – is explained and evaluated here. The second workflow step – SLIC superpixels – is evaluated here. The final workflow step – the combination of automatically extracted features through random forest – will soon be submitted. Info and scripts can be found here.

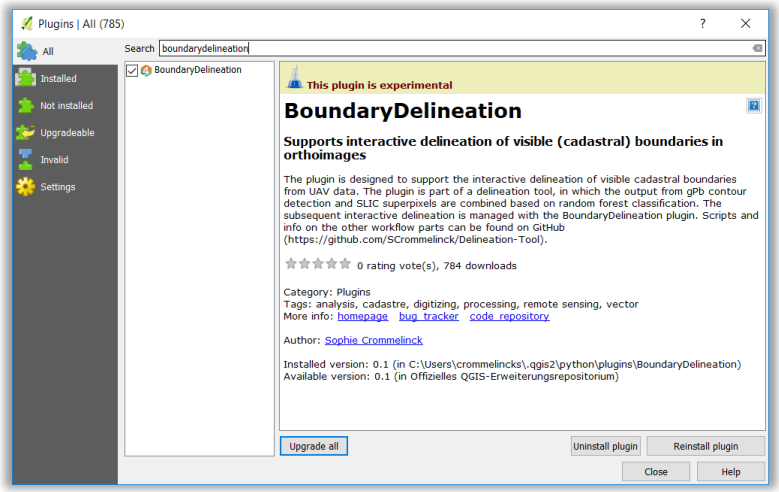
BoundaryDelineation Manual

1. Install the plugin

- Open QGIS
- Click **Plugins > Manage and Install Plugins…**



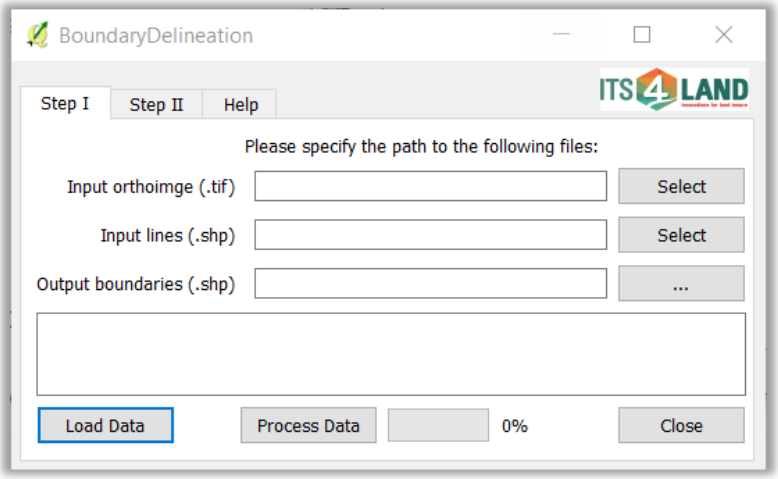
- Search for BoundaryDelineation plugin
- Click **Install plugin**



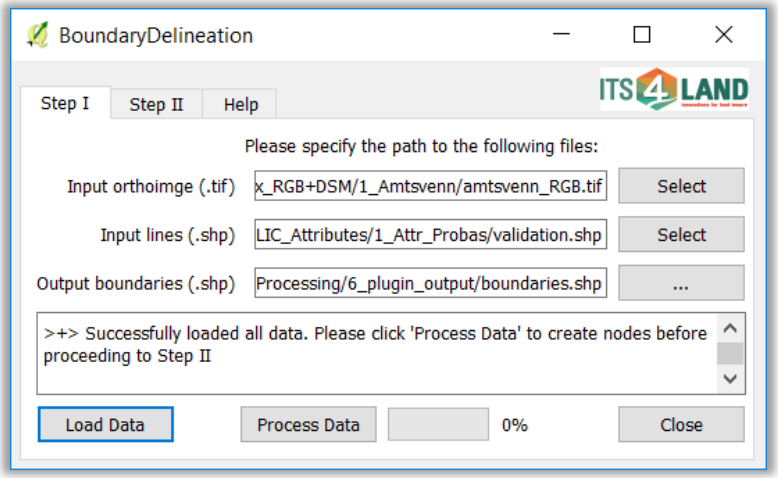
2. Run the Plugin

2.1. Step I

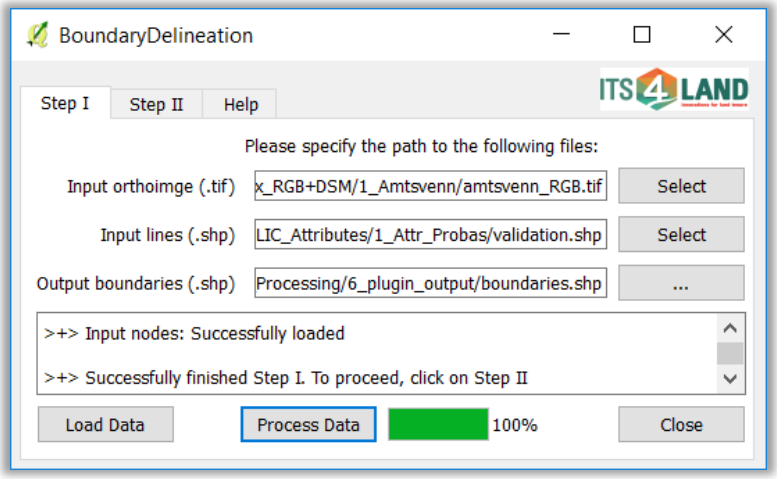
- Open the plugin
    - Click on the BoundaryDelineation plugin icon in the QGIS toolbar



- Specify the path to the files
- Click **Load Data**
    - Do not rename loaded layers in QGIS while using the plugin

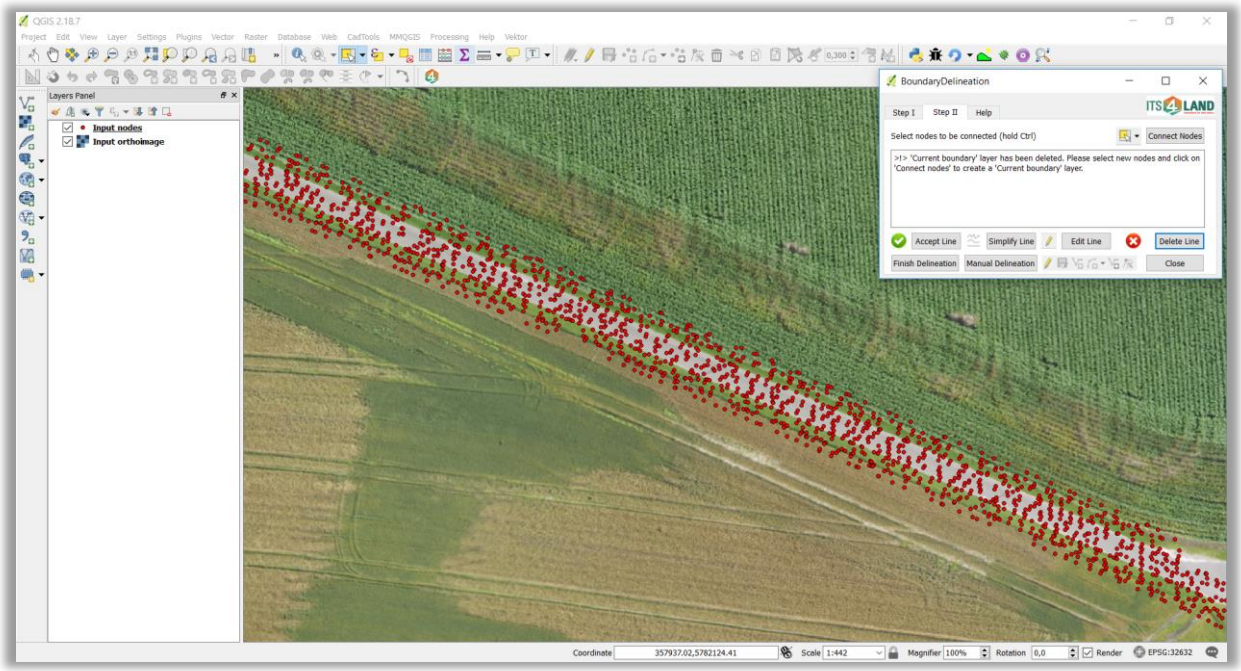


- Click **Process Data**
    - This step can take several minutes depending on the size of the input files

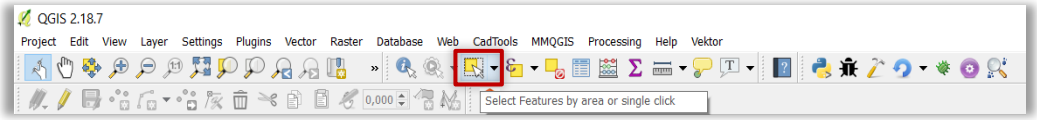


2.2. Step II

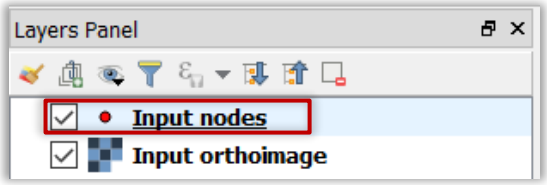
- Click on **Step II**
- Zoom to an area, where a land parcel boundary is visible and overlaid by *input nodes* layer



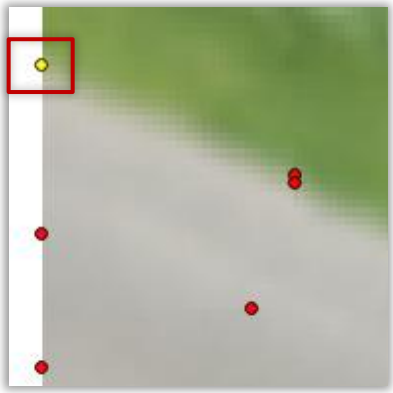
- Select two or more nodes along the land parcel boundary
  - Hold *Ctrl* and click on the nodes to be connected

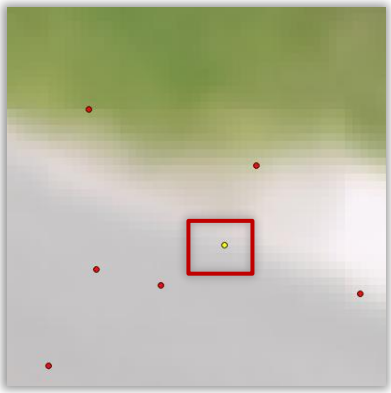


  - *Input nodes* should be selected as active layer in the *Layer Panel*

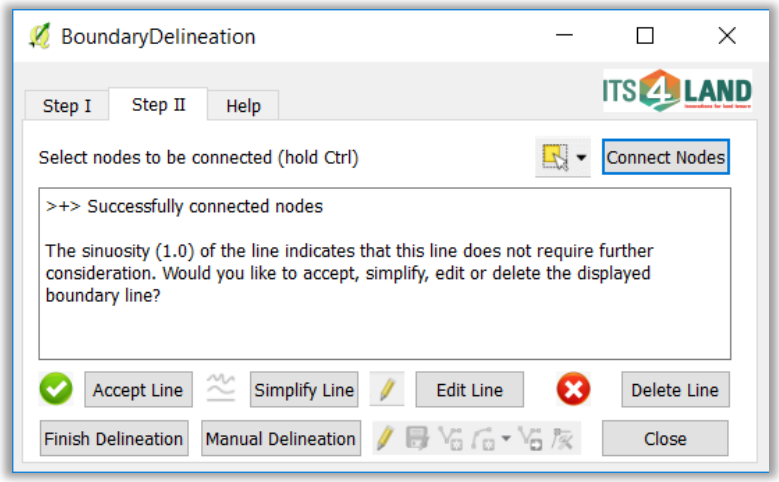


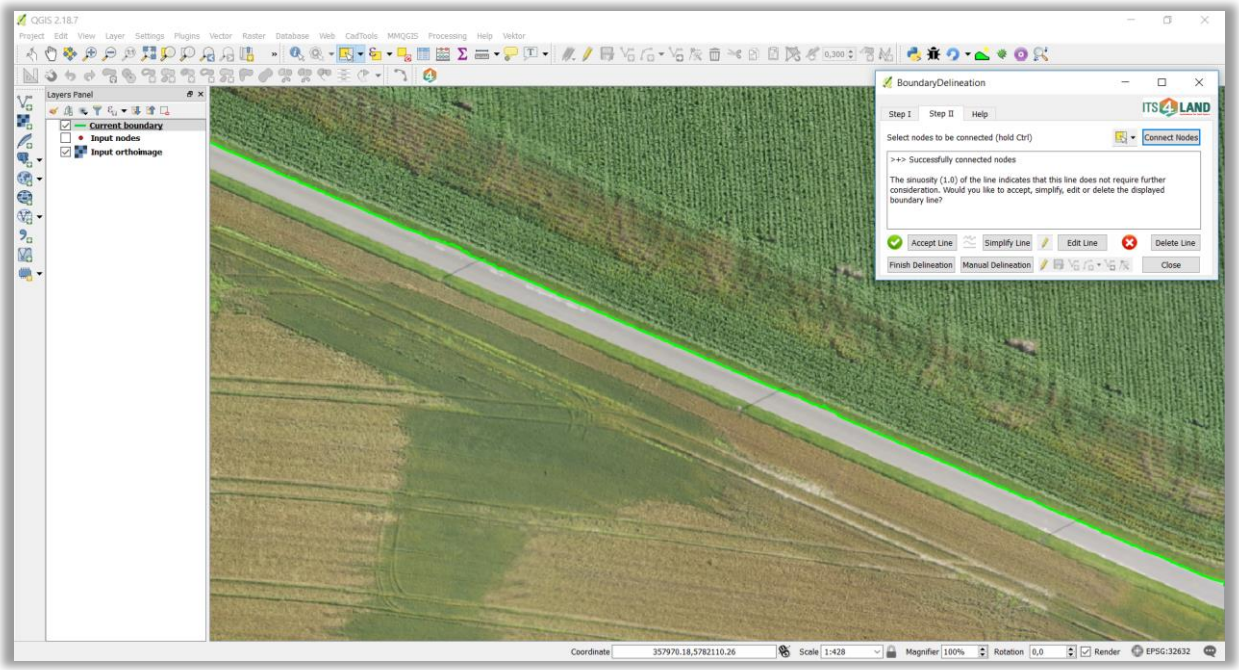
  - Select nodes at start-, end- and optionally middle points of line to be connected





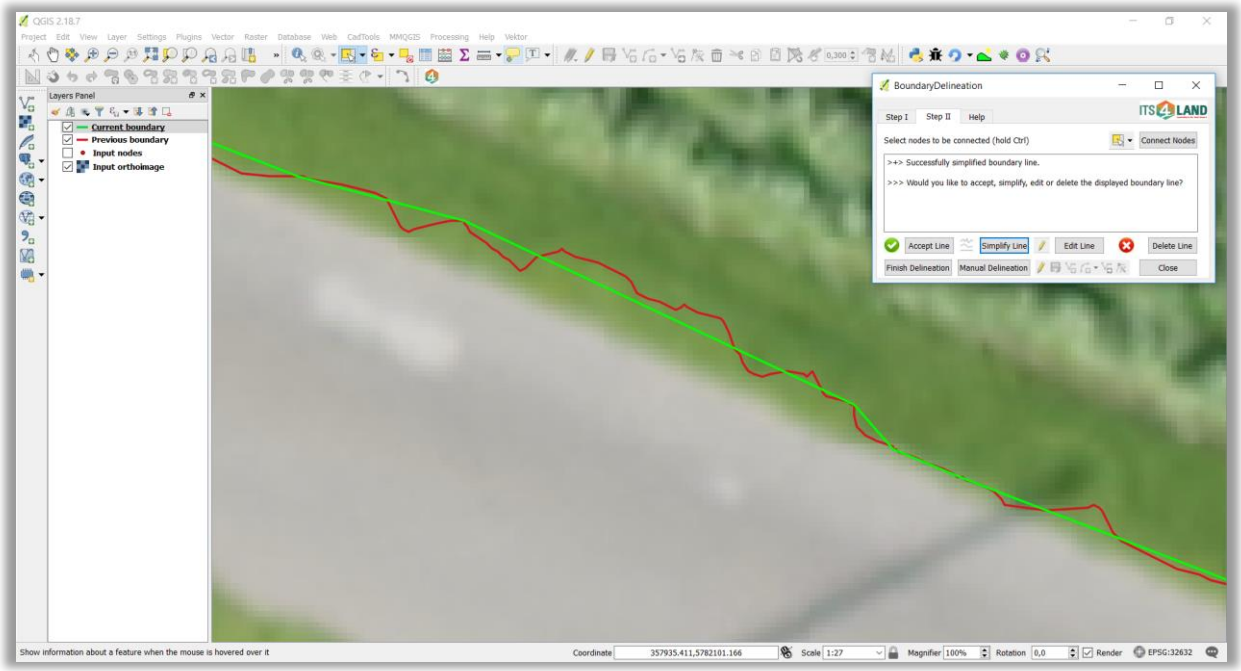
- Click on **Connect Nodes**



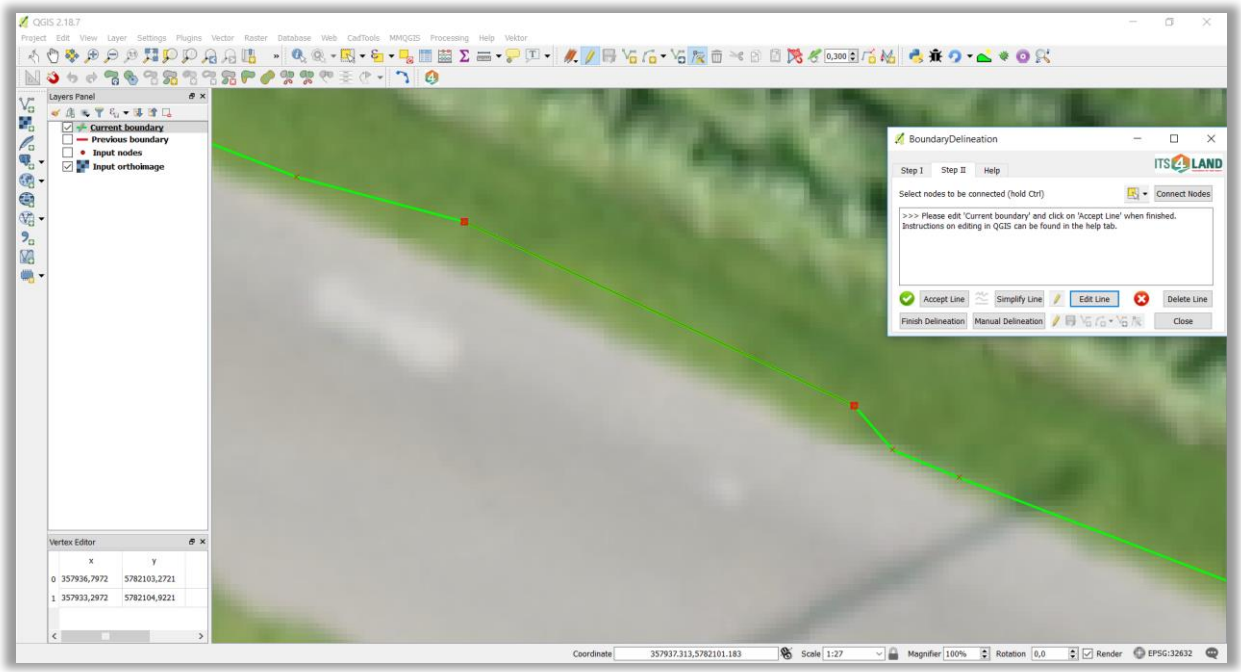


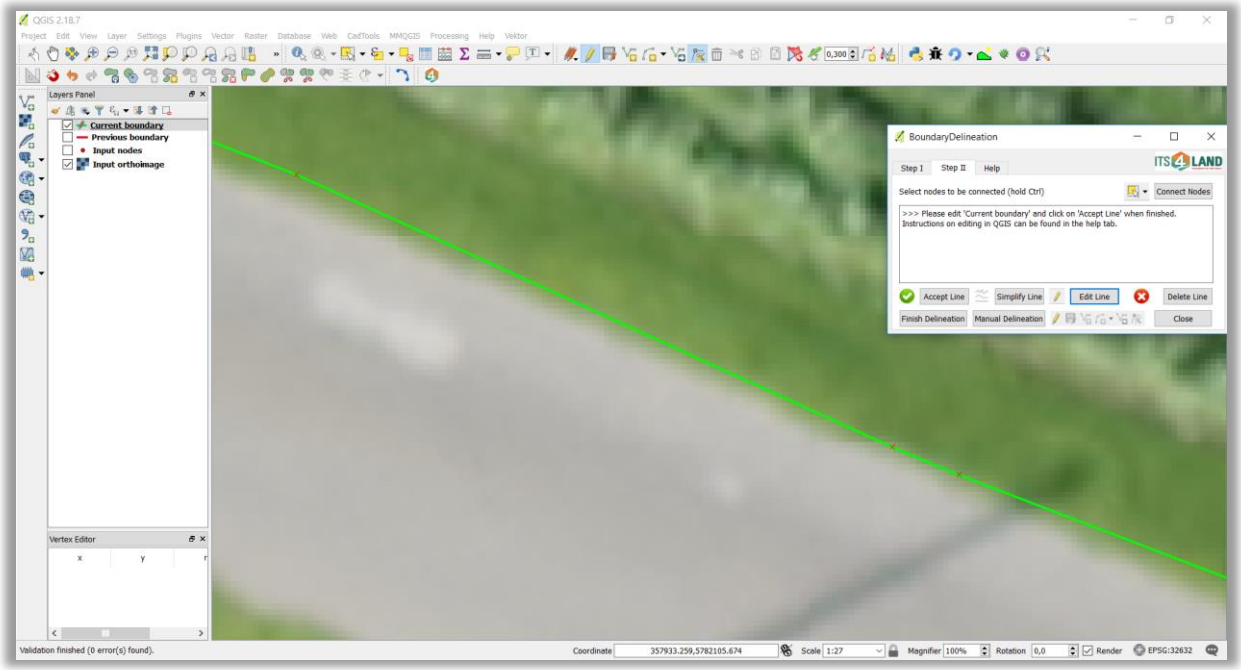
- Decide to accept, simplify, edit or delete the displayed boundary line
    - Although the displayed line is already smoothed, it is mostly advisable to simplify the line again

- Click on **Simplify Line**
    - This step can be repeated multiple times until the line cannot be further simplified



- Zoom to incorrectly delineated parts
- Click on **Edit Line**
- Use the QGIS Digitizing Toolbar to manually add/move/delete segments or nodes of the line
    - In this example, it would be advisable to click on the Node Tool, delete all wrong nodes by pressing Delete and snapping the ends of the remaining correct nodes to each other





- Click on **Accept Line**
- Restart Step II

- Click on **Finish Delineation**, once no more boundaries can be digitized with the help of the *input nodes* layer
- Click on **Manal Delineation** to add further boundaries in areas, where the *input nodes* layer is not available (e.g., socially perceived boundaries)

2.3. Acknowledgements

This work is supported by its4land, which is part of the Horizon 2020 program of the European Union [project number 687828]. The screenshots used for this manual are based on UAV data captured and processed within the project.

2.4. Online References

its4land website (WP5)

YouTube video on plugin's use

GitHub repository for QGIS plugin

GitHub repository for entire delineation tool

2.5. Literature References

Crommelinck, S., Bennett, R., Gerke, M., Nex, F., Yang, M.Y., Vosselman, G., 2016. Review of automatic feature extraction from high-resolution optical sensor data for UAV-based cadastral mapping. *Remote Sensing*, 8(8), pp. 1-28. (link)

Crommelinck, S., Bennett, R., Gerke, M., Yang, M.Y., Vosselman, G., 2017. Contour detection for UAV-based cadastral mapping. *Remote Sensing*, 9(2), pp. 1-13. (link)

Crommelinck, S., Bennett, R., Gerke, M., Koeva, M., Yang, M.Y., Vosselman, G., 2017. SLIC superpixels for object delineation from UAV data. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, IV-2/W3, pp. 9-16. (link)

Koeva, M., Bennett, R., Gerke, M., Crommelinck, S., Stöcker, C., Crompvoets, J., S.Ho, Schwering, A., Chipofya, M., Schultz, C., Zein, T., Biraro, M., Alemie, B., Wayumba, R., Kundert, K., 2017. Towards Innovative Geospatial Tools for Fit-For-Purpose Land Rights Mapping. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-2/W, pp. 37-43. (link)

Bennett, R., Gerke, M., Crompvoets, J., Ho, S., Schwering, A., Chipofya, M., Schultz, C., Zein, T., Biraro, M., Alemie, B., Wayumba, R., Kundert, K., Crommelinck, S., Stöcker, C. Building Third Generation Land Tools: Its4land, Smart Sketchmaps, UAVs, Automatic Feature Extraction, and the GeoCloud. In: *Annual World Bank Conference on Land and Poverty (Responsible Land Governance: Towards and Evidence Based Approach)*, Washington D.C. (US), 20-24 March 2017, pp. 1-23. (link)