

Specification for Building Outlines

Version 2.0

Topographic Data, Location Information

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Terms and Definitions

Terms	Definitions
Building footprint	The perimeter of a building's structure at ground level.
Building outline	A polygon geometry representing a building shown on imagery.
Building roofline	The perimeter of a building at its outer roof extents.
Hut	A simple roofed shelter in remote areas, including the backcountry, usually for recreational use such as tramping.
Silo	A tall structure used for the storage of grains, usually on farms.
Tank	A structure used for the storage of liquid, such as water, milk, wine, oil, or petroleum.

1 Foreword

1.1 Purpose of Specification

This specification was developed by Toitū Te Whenua, Land Information New Zealand (LINZ) for use by contracting organisations when providing building outlines from aerial imagery.

1.2 Related Documents

The following documents are related to this specification:

- NZ Building Outlines: <https://data.linz.govt.nz/layer/101290>

1.3 Contact Information

Manager Topography
Location Information
Land Information New Zealand
Radio New Zealand House
155 The Terrace
PO Box 5501
Wellington 6145

Email: info@linz.govt.nz

1.4 Version Control

Version 1.0	Released 30 July 2021
Version 2.0	Released 28 March 2023

2 Introduction

2.1 Scope of this Specification

This specification defines the requirements for the capture and provision of building outlines to Toitū Te Whenua, Land Information New Zealand (LINZ) by contracting organisations (suppliers).

2.2 Variations from this Specification

- a) Compliance with all aspects of this specification is expected.
- b) It is recognised that on occasions, a better outcome may be obtained through an alternative approach. If a supplier believes this to be the case, a variation to these specifications must be sought.
- c) Any application for a variation must be in writing and agreed to by the LINZ contract manager, prior to any work being carried out.

2.3 Precedence of Contract Documents

In all situations, any contract document (including notes on map images) and/or agreed written instruction from LINZ, takes precedence over this specification. LINZ recommends that this specification be read together with any contract (or Works Order) and/or supplementary agreements, as these may specify items in addition to, or in direct conflict with, this specification.

If there is any conflict among any of the documents, the hierarchy is:

1. Variations or supplementary agreements
2. Contract and/or Works Order
3. Bid/ Proposal (Request for Proposal)
4. This Specification
5. Other referenced documents

3 Source Imagery

Building outlines shall be captured and delivered for each area of capture as specified by LINZ. Each area of capture will correspond to a source imagery dataset supplied by LINZ on a regional basis.

This imagery shall be used as the primary source for the capture of building outlines. Even if additional source data is used by the supplier to support this capture, LINZ will assess the data deliverables only against the imagery supplied by LINZ.

All buildings shown on this imagery shall be captured where they meet this specification, independent of whether they have been captured previously from older imagery and are already represented in LINZ's NZ Building Outlines dataset. LINZ will manage the conflation of newly captured buildings to those captured previously.

Source imagery will be supplied as one of the following data types:

3.1 Aerial Imagery

Aerial imagery will have:

- a) Area of between 10 km² and 50,000 km².
- b) Tiled tiff format.
- c) Spatial resolution between 0.05m and 0.3m.
- d) 3 bands (RGB), or 4 bands (including infrared).
- e) Coordinate reference system: EPSG 2193 (NZGD2000 / New Zealand Transverse Mercator 2000).
- f) Coverage of rural or urban landscape, or a mixture of both.

3.2 Other Imagery

Other imagery will be supplied to minimum requirements, as agreed to by the supplier.

4 Area of Capture Extents

For each area of capture, LINZ will provide a capture extent geometry to define which buildings shall be captured. In some cases, the capture extent will match the imagery extents, but in other cases, there may be some differences to help manage overlapping regions.

5 Building Identification

Building outlines shall be captured as discrete polygon geometries, for each real world building as seen on the imagery supplied by LINZ.

Note: If additional source data is used to support this capture, building outlines shall always match the imagery supplied by LINZ.

5.1 Buildings to be Included

The following buildings shall be captured from imagery where they meet **minimum size** criteria (Section 7), and are completely within the area of capture extents provided by LINZ:

- a) Permanent buildings with a solid structure, enclosed by walls and a roof, including commercial glasshouses and greenhouses, and enclosed walkways.
- b) Circular buildings, including tanks and silos.
- c) Buildings in remote areas, including huts and open-sided shelters.

Note: Buildings in remote areas, including huts and shelters, can be important locations in emergency situations, and could be used as shelter by recreational trampers, etc.

The following dataset can be used to assist in the capture of huts and shelters where they meet **minimum size** criteria:

- NZ Building Points (Topo, 1:50k), <https://data.linz.govt.nz/layer/50245> (where "bldg_use" = 'hut' or 'shelter')

Additional care shall be taken in remote areas to avoid capturing rocks, trees, or other natural features as building outlines.

See [Appendix Section A](#) for examples.

5.2 Buildings to be Excluded

The following buildings shall be excluded from capture:

- a) Buildings that do not meet minimum size criteria (Section 7).

- b) Buildings straddling the edge of the imagery or "area of capture extent". Partial buildings shall not be captured.
- c) Non-building features. There are many features that can be incorrectly interpreted as buildings, which shall be excluded from capture. Here are some examples:
- Temporary structures
 - Buildings under construction
 - Residential glasshouses and greenhouses
 - Shade houses, shade cloth, frost cloth
 - Open-sided shelters (such as awnings, pergolas, carports, and shelters and walkways not enclosed by walls), except for huts and shelters in remote areas
 - Shade sails, large umbrellas
 - Trampolines, playgrounds
 - Swimming pools
 - Balconies, decks, patios, paved areas
 - Driveways
 - Vehicles (such as trucks, tractors, buses, caravans, cars)
 - Shipping containers
 - Dams, bridges, culverts, fords
 - Hay bales, fertiliser piles
 - Industrial/farm materials (such as machinery or farm supplies)
 - Electricity pylons, radio transmission masts
 - Natural features (such as rocks, bare ground, clearings, trees, shelter belts, gardens)

See [Appendix Section B](#) for examples.

5.3 Open Areas Enclosed by a Building

- a) Open areas (such as courtyards or grass) enclosed by a building, shall be captured as a hole (inner ring) within the enclosing building, where the open area is at ground-level and meets the minimum size criteria.
- b) Open areas (such as courtyards or grass) enclosed by a building, that are either not at ground-level or are smaller than the minimum size criteria, shall be excluded from capture and the enclosing building shall cover the open area.

See [Appendix Section C](#) for examples.

6 Building Delineation

Building outlines shall be captured at the outside extents of the building's roof line, as seen on the imagery supplied by LINZ.

6.1 Standalone Buildings

- a) Standalone buildings with cohesive roof structures shall be captured as a **single polygon**.
- b) Residential standalone buildings with adjoining and enclosed garages, extensions, sunrooms, or annexes shall be captured together as a **single polygon**.

See [Appendix Section D](#) for examples.

6.2 Adjoining Buildings and Awnings

- a) Commercial buildings that are joined shall be captured as adjoining **separate polygons**. The line where two roof structures join shall be used as the line separating two buildings. Additional care shall be taken to separate adjoining buildings in retail areas, such as a row of shops. High-rise buildings in city CBD areas shall be separated from adjoining buildings, but different sections of the same building (such as tower blocks and lower level sections) shall be captured together as one single polygon.
- b) Where adjoining commercial buildings have been captured as separate polygons, common edges between buildings shall be coincident with each other, with no gaps or overlaps.
- c) Where adjoining commercial buildings have been captured as separate polygons, each polygon shall have at least one edge on the outside perimeter of the group of buildings (i.e., land-locked polygons shall not be added).
- d) Awnings and overhangs over the footpath shall be excluded from commercial building outlines.

Note: The following dataset can be used to assist in the capture of high-rise buildings in city CBD areas:

- NZ Property Titles Including Owners, <https://data.linz.govt.nz/layer/50805>

See [Appendix Section E](#) for examples.

6.3 Spatial Accuracy

- a) Building outlines shall be spatially accurate to within 1.0 metres (i.e., all vertices and all parts of all line segments shall be less than 1.0 metres away from the corresponding building object seen on imagery.)

Note: To achieve the required spatial accuracy, geometries shall:

- include sufficient vertices to represent the building object seen on imagery (i.e., not over generalised).
 - be positioned with the same angle (not rotated) as the building object seen on imagery.
 - be captured to where the edge of the building's roof line is likely to be, even when partially obscured by other features (such as overhanging vegetation or shadows)
 - exclude adjoining non-building features
-
- b) Building outline geometries shall have the minimum number of vertices required to meet the specified spatial accuracy. Additional vertices shall be removed.
 - c) Building outline corners shall be squared off to 90 degrees where the object corner angles are between 80 and 100 degrees.
 - d) Building outlines shall not be exaggerated in size compared to the building objects seen on imagery, especially those that are slightly smaller than the minimum size criteria.
 - e) Circular buildings, especially tanks and silos, shall be captured individually (not grouped together with adjacent buildings, tanks or silos).
 - f) Circular buildings shall be captured as polygons that look like circles (i.e., not squares, octagons or other shapes).

See [Appendix Section F](#) for examples.

7 Minimum Size

Building outlines shall meet the following minimum size criteria:

- a) Building outlines (excluding circular buildings) shall have an area greater than 10m².
- b) Circular buildings, including tanks and silos, shall have an area greater than 20m² (approximately 5m diameter).
- c) Open areas (such as courtyards or grass) enclosed by a building, shall have an area greater than 30m².

8 Topology

All building outlines shall have the following valid topology:

- a) One geometry: No empty or NULL geometries.
- b) A single-part polygon: No multi-part polygons.
- c) No overlap errors: Does not overlap with other building outlines. Overlaps caused by the rounding of vertex coordinates (such as due to a coordinate resolution) of up to 0.0001 metres are acceptable.
- d) No self-intersections: Does not contain lines that intersect with itself.
- e) No duplicate vertices: Does not contain doubled up vertices.
- f) No spikes: No sharp angles that are not representative of the building shape.

9 Data Deliverables

9.1 Data Format

Each building outlines area of capture shall be supplied to LINZ in the following format:

- a) A single geopackage or shapefile with a polygon geometry type, containing captured building outlines
- b) Coordinate reference system: EPSG 2193 (NZGD2000 / New Zealand Transverse Mercator 2000)

9.2 Acceptance Criteria

Each building outlines area of capture shall be assessed by LINZ to determine whether the data deliverables meet the specifications, within the tolerances specified in the following table.

Criteria	Error Tolerance ¹	Comments
Building Identification – False Negatives	< = 5%	Buildings missed from being captured, as specified in Section 5.
Building Identification – False Positives	< = 5%	Buildings captured from features that should not be captured, as specified in Section 5.
Building Delineation	< = 5%	As specified in Sections 6.
Minimum Size and Topology	= 0%	As specified in Sections 7 and 8.

¹ Tolerance is a measure of the percentage of captured building outline geometries within the data deliverable that meet the corresponding criteria. This will be tested using one or more of the following methods:

- Assess all features
- Assess all features within a sample area, or multiple sample areas.
- Assess several randomly selected features within the deliverable.

9.3 Data Licensing

LINZ shall take full ownership of the data deliverables and hold the copyright.

LINZ shall publish the data deliverables, or a derived version of them, as CC BY 4.0 or equivalent:

- a) All data sources shall permit this licensing.
- b) All software and applications used for data capture shall permit this licensing.

Appendix – Building Outlines Guidance

A) Buildings to be Included

See [Specification Section 5.1](#)

Permanent buildings, solid, enclosed, meeting minimum size (Section 5.1a)



Correct capture of permanent buildings with a solid structure, enclosed by walls and a roof. Other structures have been correctly excluded.

Circular buildings including tanks and silos, meeting minimum size (Section 5.1b)



Correct capture of two circular tanks with each diameter greater than 5m, or each area greater than 20m².

Buildings in remote areas, meeting minimum size (Section 5.1c)



Incorrect non-capture of hut building in remote area (left). Correct capture of hut building (right).

B) Buildings to be Excluded

See [Specification Section 5.2](#)

Buildings under minimum size (Section 5.2a)



Correct non-capture of buildings under minimum size, such as sheds and small tanks.

Buildings straddling the edge of "area of capture extent" (Section 5.2b)



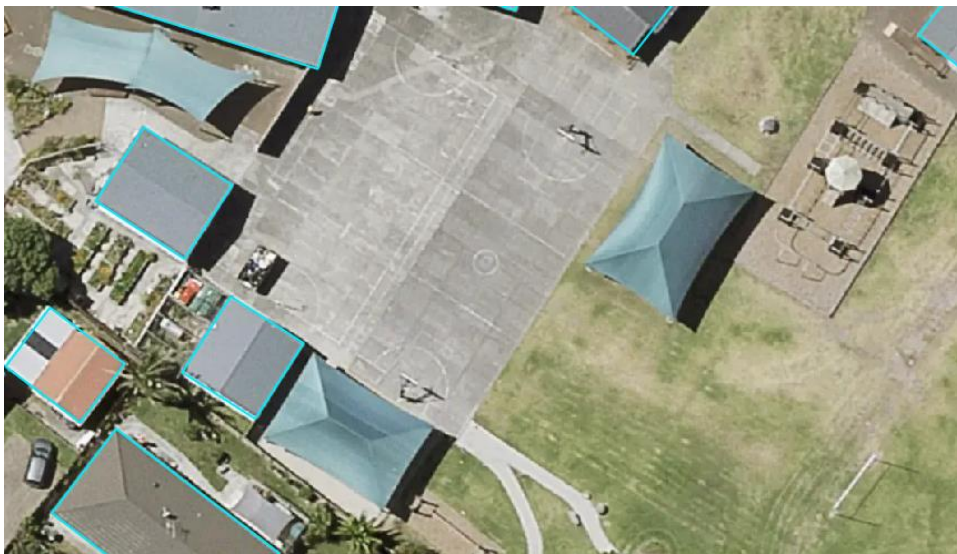
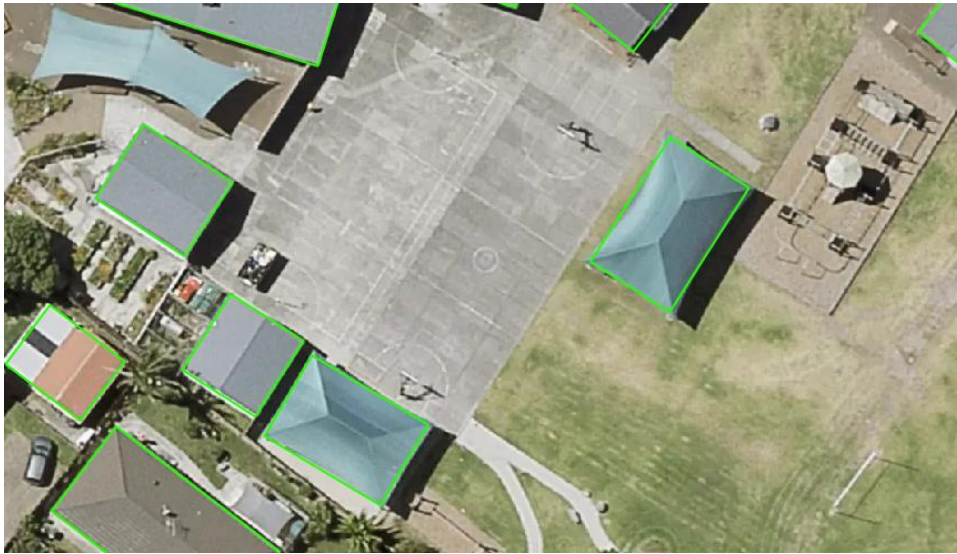
Correct non-capture of building straddling the edge of the "area of capture extent" boundary (red line, with the area of capture on the right side).

Non-building features – under construction (Section 5.2c)



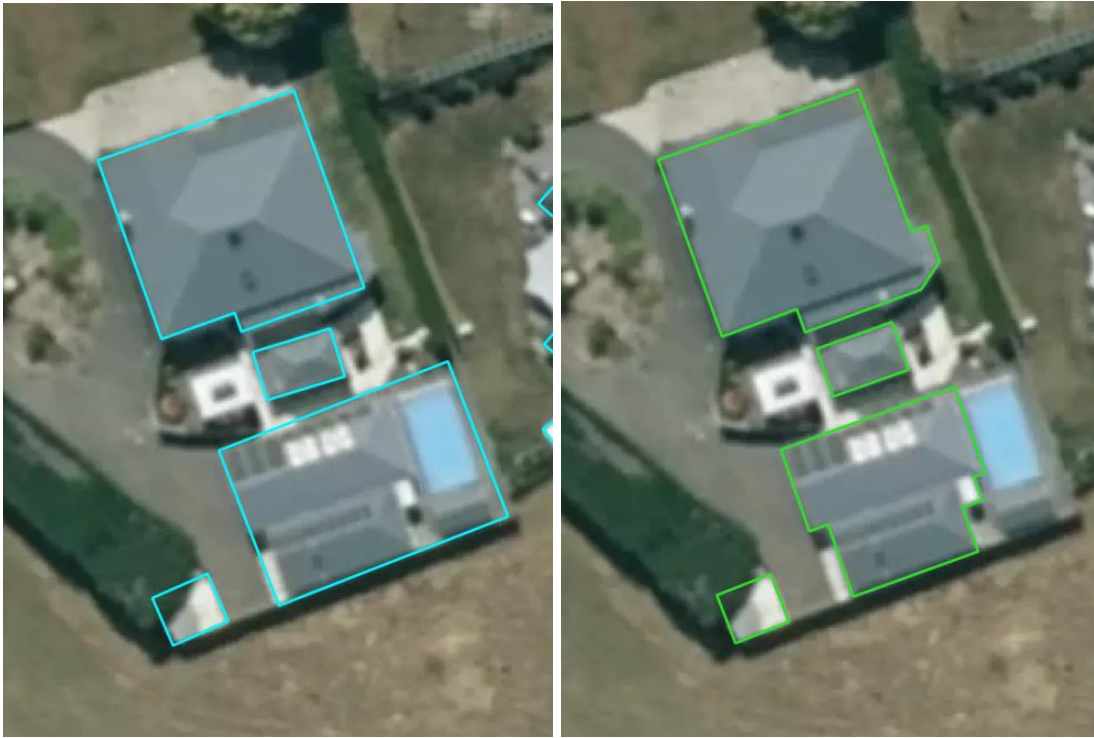
Incorrect capture of buildings under construction (left). Correct non-capture of buildings under construction (right).

Non-building features – shade sails (Section 5.2c)



Incorrect capture of shade sails (top). Correct non-capture of shade sails (bottom).

Non-building features – swimming pools (Section 5.2c)



Incorrect capture of swimming pool attached to building (left). Correct non-capture of swimming pool (right).

Non-building features – decks (Section 5.2c)



Incorrect capture of deck attached to building (left). Correct non-capture of deck (right).

Non-building features – caravans (Section 5.2c)



Incorrect capture of caravans in campground/holiday park (top left). Correct non-capture of caravans in campground/holiday park (top right). View of caravan examples from street view (bottom).

Non-building features – manure piles (Section 5.2c)



Incorrect capture of farm manure piles (left). Correct non-capture of farm manure piles (right).

Non-building features – hay bales (Section 5.2c)



Incorrect capture of hay bales (left). Correct non-capture of hay bales (right).

C) Open Areas Enclosed by a Building

See [Specification Section 5.3](#)

Open area at ground level, meeting minimum size – capture as a hole (Section 5.3a)



Correct capture of open area enclosed by a building as a hole (inner ring) within the enclosing building.

Open area not at ground level – exclude from capture (Section 5.3b)



Correct non-capture of open area enclosed by a building, as it is not at ground-level.

D) Standalone Buildings

See [Specification Section 6.1](#)

Cohesive roof structure (Section 6.1a)



Correct capture of three standalone buildings with cohesive roof structures as single polygons.

Adjoining extensions (Section 6.1b)



Correct capture of residential standalone building with adjoining enclosed garage and extension.

E) Adjoining Buildings and Awnings

See [Specification Section 6.2](#)

Adjoining commercial buildings and awnings (Section 6.2)



Correct capture of commercial buildings that are joined:

- Captured as adjoining separate polygons. The line where two roof structures join are used as the line separating two buildings.
- Common edges between buildings are coincident with each other, with no gaps or overlaps.
- Each polygon has at least one edge on the outside perimeter of the group of buildings.
- Awnings and overhangs over the footpath are excluded.

Adjoining commercial buildings and awnings - high-rise buildings (Section 6.2)



Correct capture of high-rise buildings in city CBD areas. Different sections of the same building (such as tower blocks and lower level sections) are captured together as one single polygon. Awnings and overhangs over the footpath are excluded.

F) Spatial Accuracy

See [Specification Section 6.3](#)

Sufficient vertices (Section 6.3a)



Incorrect capture of two buildings with insufficient vertices (left). Correct capture of two buildings with sufficient vertices (right).

Match buildings on imagery and not rotated (Section 6.3a)



Incorrect capture of three buildings not meeting spatial accuracy requirements (left).

- Capture is not within the specified spatial accuracy distance to the building's roof line.
- Capture is incorrectly rotated from the building's roof line.

Correct capture meeting spatial accuracy requirements (right).

Capture obscured in full (Section 6.3a)



Correct capture of buildings obscured by vegetation or shadows.

Minimum number of vertices (Section 6.3b)



Incorrect capture using extraneous vertices that should be removed (top left and bottom left). Correct capture using the minimum number of vertices to meet the specified spatial accuracy (top right and bottom right).

Corners squared off to 90 degrees (Section 6.3c)



Correct capture using 90 degrees angles, even when the imagery shows close to, but not exactly 90 degrees.

Size not exaggerated (Section 6.3d)



Incorrect capture and exaggeration of two circular tanks compared to the objects shown on imagery (left). Correct non-capture of under sized circular tanks (right).

Circular buildings not grouped together (Section 6.3e)



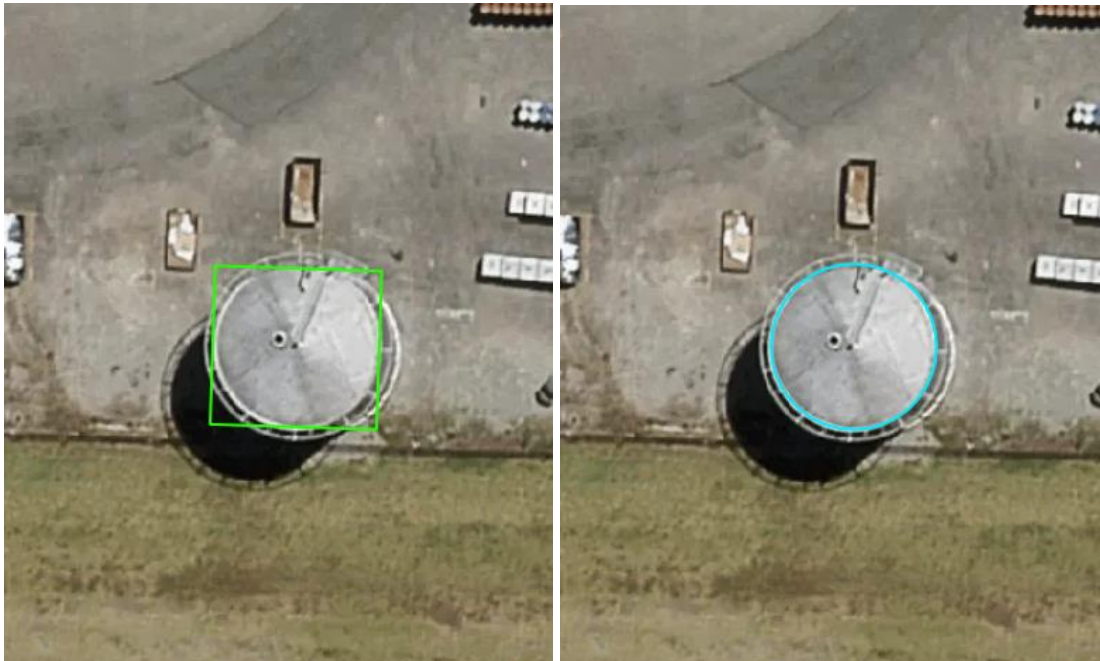
Incorrect capture and grouping of multiple undersized tanks (left). Correct non-capture of undersized tanks (right).

Circular buildings not grouped with adjacent buildings (Section 6.3e)



Incorrect capture of undersized tanks and grouping them with nearby building (left). Correct non-capture of undersized tanks (right).

Circular buildings captured as circles (Section 6.3f)



Incorrect capture of circular tank as a square (left). Correct capture of circular tank as a circle (right).