LANDPRO

Make the most of your land

METADATA REPORT

Prepared for NIWA

Tairawhiti - Priority Area

Project	Tairawhiti - Priority Area
Client	NIWA
Contact	Neville Ching

Supplier	Landpro Ltd.
Address	13 Pinot Noir Drive Cromwell 9310 New Zealand
Phone	+64 3 445 9905
Supplier contact	Andy Burrell andy@landpro.co.nz
Landpro Reference	23370
Date of metadata creation	21 December 2023

Contents

1. Introduction

1.1 Background

Landpro Ltd was contracted by NIWA to capture and supply LiDAR topographic data and co-captured, orthorectified imagery for the area of interest presented in Figure 1. The primary purpose for the contract was as a means to support the region, through updated geospatial data following Cyclone Gabriel.

The purpose of this report is to provide detailed information regarding the acquisition, processing, and delivery of the requested orthorectified imagery, LiDAR topographic survey and their associated deliverables as provided to NIWA.

1.2 Survey Coverage

The Tairawhiti - Priority Area project for NIWA comprised of one area of interest, as shown in Figure 1 and covered a total area of 2259.2 km^2.

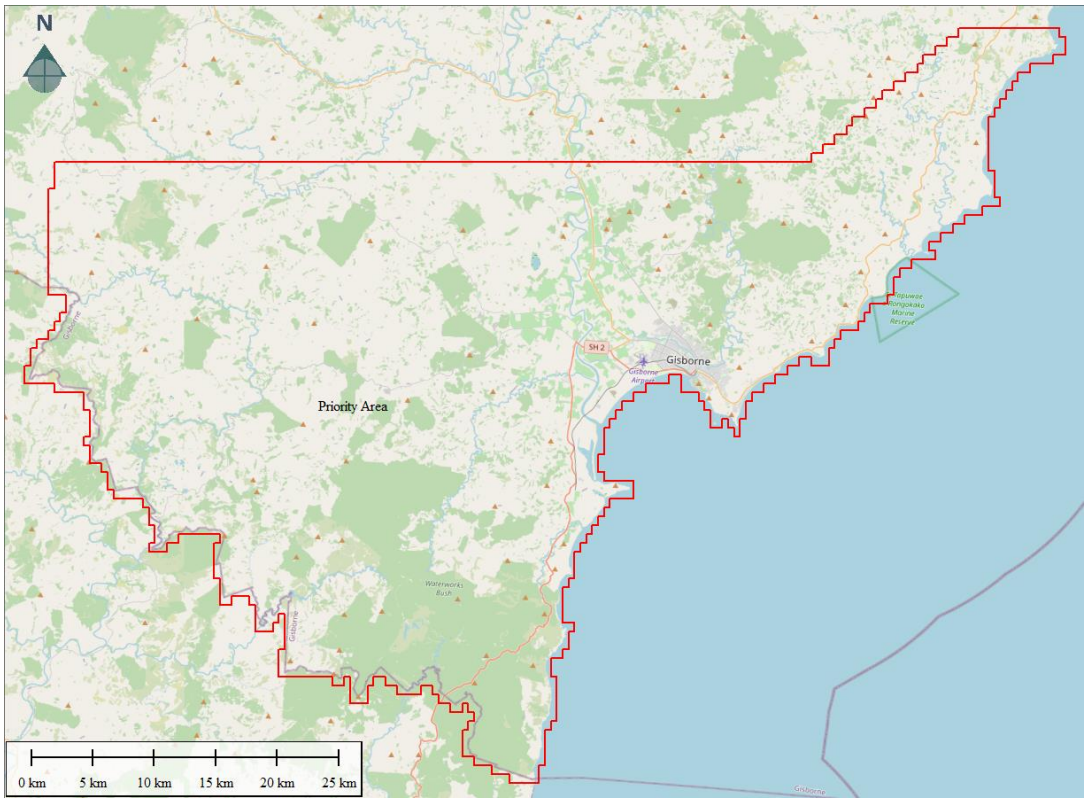

Figure 1. Area of interest surveyed as part of the Tairawhiti - Priority Area project captured for NIWA.

2. Data Acquisition

2.1 Data Capture

Imagery & LiDAR for this project was acquired on the following dates: 11/09/2023 to 20/09/2023 using the Leica Terrain Mapper system. The Leica Terrain Mapper includes the use of a 150 Hz LiDAR sensor, combined with a Leica RCD30 80MP (RGBN) camera. The integrated system is fitted to a Leica PAV100 high performance, gyro-stabilised mount, for optimal capture.

A copy of the Leica Terrain Mapper calibration certificate can be made available upon request.

Figure 2: Leica Terrain Mapper showing the RCD30 camera head, and Terrain Mapper system respectively.

Sensor	Serial Number
Leica Terrain Mapper	6626
Leica PAV100 HP Mount	91014
Leica RCD30 80MP	82594

The supplied dataset includes the following items:

- 8 bit RGBN ortho mosiac in RASTER (GeoTiff & ECW) format at 10 cm GSD
- LiDAR point cloud classified to ground, above ground, water vegetation, and building classes in LAS 1.4 format
- 1 m DEM in RASTER (GeoTiff) and ASCII formats
- 1 m DSM in RASTER (GeoTiff) and ASCII formats
- Canopy Height Model in RASTER (GeoTiff) format
-
-
- All data has been supplied in NZTM NZGD2000 and NZVD16

2.2 Flight Planning

Careful consideration was given during flight planning to geographic location, terrain, topographical characteristics of the area, acquisition efficiency, final output resolution and meeting the requested orthophoto quality specifications. Table 1 provides a summary of the flight parameters during the capture of the Tairawhiti - Priority Area project.

Table 1: Summary of the flight planning parameters for the Tairawhiti - Priority Area project.

	Summary
No. of flight lines	117
Total length of flight lines (km)	3947.3
Planned GSD (cm)	10
Sidelap (%)	20 (minimum)

2.3 Environmental capture requirements

All imagery was captured without the presence of cloud or cloud shadow within the specified areas of interest. All capture flights occurred during times when the sun angle was 25 degrees or higher.

2.4 Ground Control

Ground control was carried out by Landpro within a week of the final capture date.

2.5 Safety

No safety incidents were reported during the completion of this project.

3. Data Processing

3.1 GNSS Processing

Projection: NZTM NZGD2000
Vertical Datum: NZVD16
Reference Station: GISB

GISB: Mark details

MARK IDENTIFICATION

Code:	**GISB**	Country:	**New Zealand**
Name:	**Gisborne**	Land District:	**Gisborne**
Alternatives:	**50223M001**	Topo50 sheet:	**BG43**
		NZTM:	**5712349.695 2025367.883**
		Scale factor	**1.0018289**
		Convergence	**+3° 03' 19"**

NZGD 2000 COORDINATES

Latitude:	**38° 38' 07.21293" S**	Order:	**0**	Previous coordinates
Longitude:	**177° 53' 09.72572" E**	Authorised:	**25-Oct-2018**	
Ellipsoidal height (m):	**87.177**	Reference:	**PositioNZ Update (DefMod v20171201 ITRF2008@2018-01-01)**	

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Poverty Bay Circuit 2000	**798790.843**	**400041.738**	**1.0000000**	**+0° 00' 01"**	Previous coordinate

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**65.1300**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained:	**06-May-2022**
Maintenance level:	
Mark condition:	**Reliably Placed**
Description:	**Continuously operating GNSS station or CORS site. Mark is unable to be physically occupied. Horizontal reference point is the centre of 5/8ö thread. The vertical reference is the plate at top of pillar. 0.055m spacer is between GNSS antenna reference point (ARP) and vertical reference plate (antenna height). For more information see http://www.linz.govt.nz/positionz**
Mark type:	**Forced Centering**
Beacon type:	**Pillar**
Protection type:	**Post & rail enclosure**

3.2 LiDAR Point Processing

Data processing has been in accordance with our standard policies and procedures surrounding acceptable tolerances, therefore ensuring optimal accuracy of deliverables.

GNSS/IMU data was processed using the GISB Base Station and precise ephemeris data.

The GNSS and IMU were processed in a tightly coupled loop to give an optimum trajectory. This data was then applied to the LiDAR and image exterior orientations prior to LAS and ortho creation.

Image data was processed using Leica HxMap and any radiometric adjustment applied as required. LiDAR data was generated via Leica HxMap.

3.3 LiDAR Calibration

Overlapping LiDAR points from adjacent aircraft trajectories were used to check the LiDAR calibration for heading, roll, pitch and scale.

These values were then used to make small flight-specific adjustments to the LiDAR data.

3.4 LiDAR Point Editing

A "1st run" automatic classification was carried out on the raw LiDAR points using *TerraSolid's TerraScan* software to separate the LiDAR points into ground hits and non-ground hits. This results in a greater than 90 % correct classification. A manual classification was then used to edit points where gross classification errors occurred in the automatic classification process.

The DEM for the area of interest is presented in Figure 3.

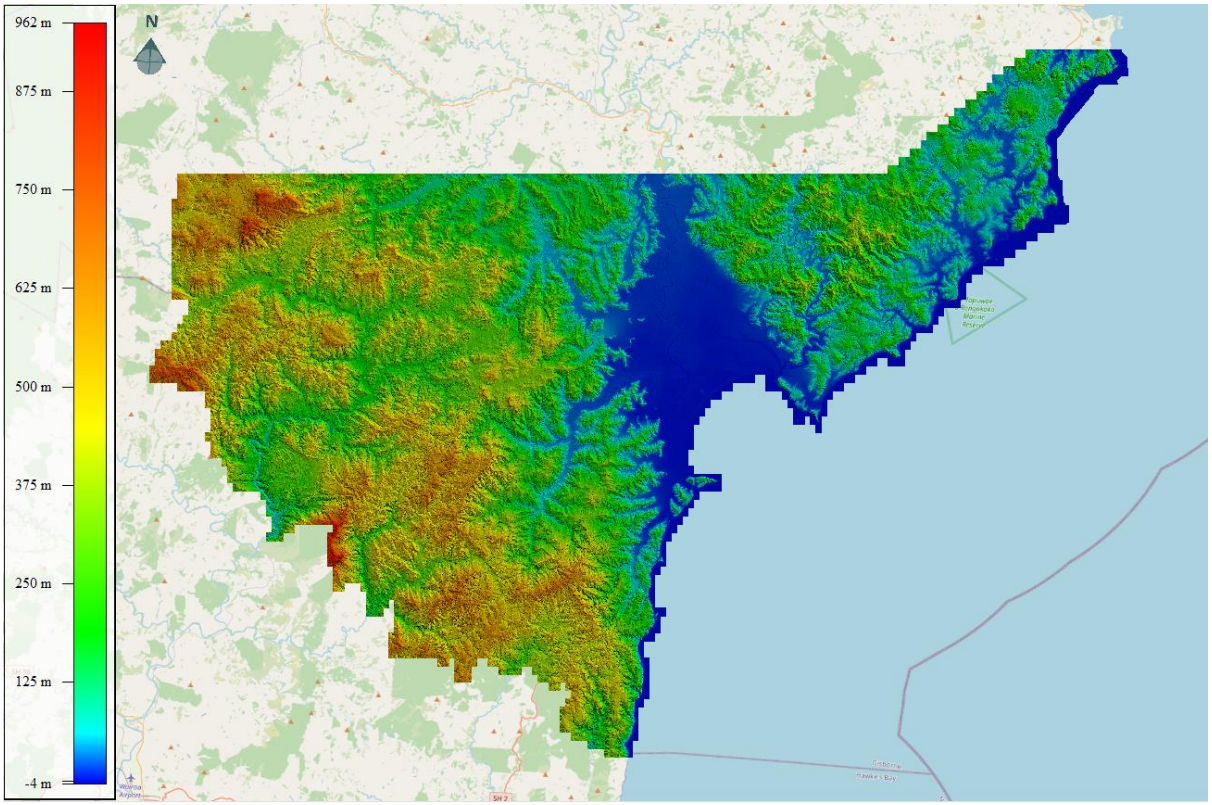

Figure 3: DEM for the Priority Area's area of interest.

3.5 Vertical LiDAR Accuracy

Average dz	-0.000
Minimum dz	-0.143
Maximum dz	+0.142
Average magnitude	0.047
Root mean square	0.061
Std deviation	0.061

3.6 Horizontal Accuracy

The positional accuracy of the LiDAR data was checked by plotting Landpro Ltd. check points and displaying the LiDAR by intensity. The LiDAR was found to be in position.

3.7 Orthophoto Rectification

The imagery was developed into Tiff format using Leica HxMap. The exterior orientation was obtained by using the GNSS processed trajectory and internal camera event file to determine an accurate orientation of every image.

The imagery was then run in Leica HxMap using the Triangulation perspective tab, through the creation of a Triangulation Project. Keypoints were computed on the images and matches were then determined by using the APM (Automatic Point Matching) process. Ground control points supplied by Landpro were used to georeferenced the imagery. No abnormalities or complications were encountered during this phase.

Blockwide radiometric profiles were used for the project, with each strip being radiometrically balanced as a whole. ensuring optimal results across the final ortho-mosaic. Various quality checks including accuracy, colour, contrast, sharpness, seamline positioning, refraction and generation artifacts were performed and found satisfactory on the final orthophoto tiles.

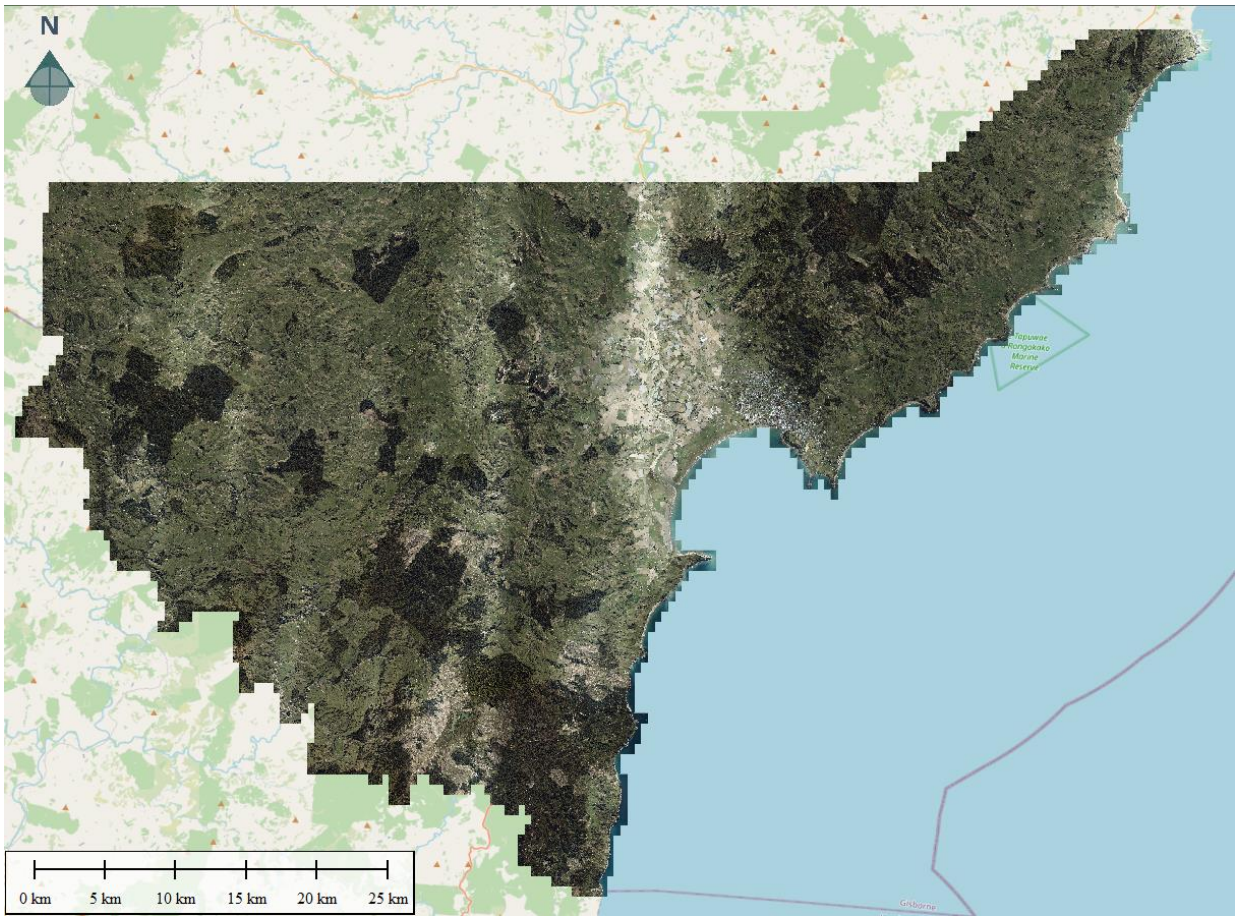

Figure 4: Ortho image for the Priority Area's area of interest.

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METADATA REPORT

Prepared for NIWA

Tairawhiti - Remainder

Project	Tairawhiti - Remainder
Client	NIWA
Contact	Neville Ching

Supplier	Landpro Ltd.
Address	13 Pinot Noir Drive Cromwell 9310 New Zealand
Phone	+64 3 445 9905
Supplier contact	Andy Burrell andy@landpro.co.nz
Landpro Reference	23370
Date of metadata creation	6 March 2024

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1.1 Background

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The purpose of this report is to provide detailed information regarding the acquisition, processing, and delivery of the requested orthorectified imagery, LiDAR topographic survey and their associated deliverables as provided to NIWA.

1.2 Survey Coverage

The Tairawhiti - Remainder project for NIWA comprised of one area of interest, as shown in Figure 1 and covered a total area of 6446.52 km^2.

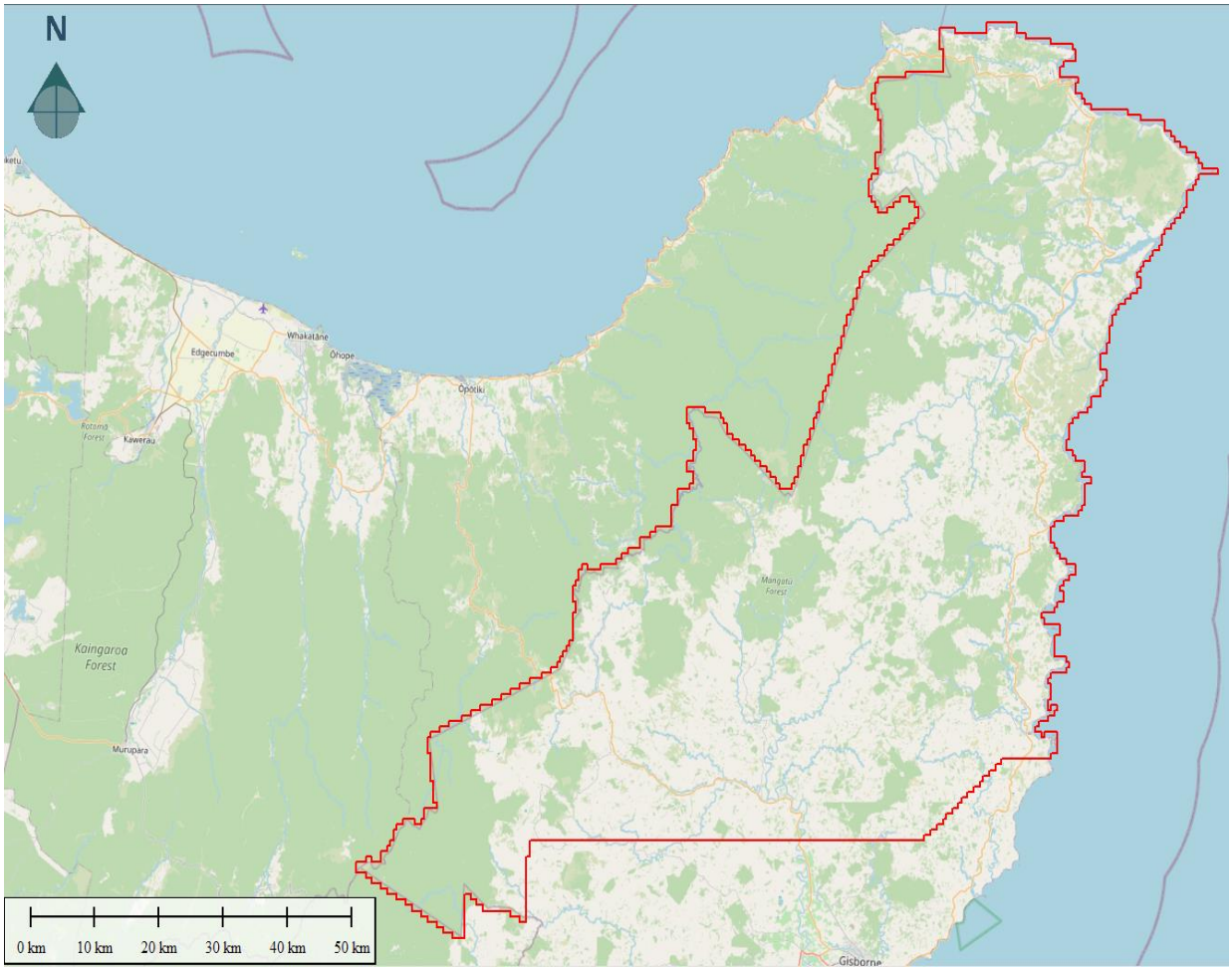

Figure 1. Area of interest surveyed as part of the Tairawhiti - Remainder project captured for NIWA.

2. Data Acquisition

2.1 Data Capture

Imagery & LiDAR for this project was acquired between 11th of September 2023 and 16th December 2023 using the Leica Terrain Mapper system. The Leica Terrain Mapper includes the use of a 150 Hz LiDAR sensor, combined with a Leica RCD30 80MP (RGBN) camera. The integrated system is fitted to a Leica PAV100 high performance, gyro-stabilised mount, for optimal capture.

A copy of the Leica Terrain Mapper calibration certificate can be made available upon request.

Figure 2: Leica Terrain Mapper showing the RCD30 camera head, and Terrain Mapper system respectively.

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- 1 m DEM in RASTER (GeoTiff) and ASCII formats
- 1 m DSM in RASTER (GeoTiff) and ASCII formats
- Canopy Height Model in RASTER (GeoTiff) format
- All data has been supplied in NZTM NZGD2000 and NZVD16

2.2 Flight Planning

Careful consideration was given during flight planning to geographic location, terrain, topographical characteristics of the area, acquisition efficiency, final output resolution and meeting the requested orthophoto quality specifications. Table 1 provides a summary of the flight parameters during the capture of the Tairawhiti - Remainder project.

Table 1: Summary of the flight planning parameters for the Tairawhiti - Remainder project.

	Summary
No. of flight lines	258
Total length of flight lines (km)	14092
Planned GSD (cm)	10
Sidelap (%)	20 (minimum)

2.3 Environmental capture requirements

All imagery was captured without the presence of cloud or cloud shadow within the specified areas of interest. All capture flights occurred during times when the sun angle was 25 degrees or higher.

2.4 Ground Control

Ground control was carried out by Landpro a month before the final capture date.

2.5 Safety

No safety incidents were reported during the completion of this project.

3. Data Processing

3.1 GNSS Processing

Projection: NZTM NZGD2000
Vertical Datum: NZVD16
Reference Station: ANAU, GISB, HIKB, MATW & PAKI

ANAU: Mark details

MARK IDENTIFICATION

Code:	**ANAU**	Country:	**New Zealand**
Name:	**Anaura Bay**	Land District:	**Gisborne**
Alternatives:		Topo50 sheet:	**BF44**
		NZTM:	**5751162.877 2063012.391**
		Scale factor	**1.0022412**
		Convergence	**+3° 16' 58"**

NZGD 2000 COORDINATES

Latitude:	**38° 16' 05.57340" S**	Order:	2	Previous coordinates
Longitude:	**178° 17' 28.40256" E**	Authorised:	**21-Dec-2018**	
Ellipsoidal height (m):	**229.308**	Reference:	**CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**	

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Poverty Bay Circuit 2000	**839465.409**	**435500.671**	**1.0000155**	**+0° 15' 05"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**206.8263**	1V	**30-Nov-2018**	**Height updated in National Geodetic Adjustment. Last used observation 2012**

MARK DETAILS

Last maintained:	**01-Apr-2022**
Maintenance level:	
Mark condition:	**Reliably Placed**
Description:	**Continuously operating GNSS station or CORS site. Mark is unable to be physically occupied. Horizontal reference point is the centre of 5/8ö thread. The vertical reference is the flat surface at top of monument. There is a 0.002m difference between the GNSS antenna reference point (ARP) and the vertical reference point (antenna height). For more information see https://www.geonet.org.nz/data/network/sensor/search**
Mark type:	**Forced Centering**
Beacon type:	**Deep Drilled Braced Monument**
Protection type:	**Post & rail enclosure**

HIKB: Mark details

MARK IDENTIFICATION

Code:	**HIKB**	Country:	**New Zealand**
Name:	**Hicks Bay**	Land District:	**Gisborne**
Alternatives:	**50225M001**	Topo50 sheet:	**BD45**
		NZTM:	**5829645.743 2068554.756**
		Scale factor	**1.0023053**
		Convergence	**+3° 14' 20"**

NZGD 2000 COORDINATES

Latitude:	**37° 33' 39.74892" S**	Order:	**0**	Previous coordinates
Longitude:	**178° 18' 12.06902" E**	Authorised:	**25-Oct-2018**	
Ellipsoidal height (m):	**107.289**	Reference:	**PositioNZ Update (DefMod v20171201 ITRF2008@2018-01-01)**	

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Poverty Bay Circuit 2000	**917953.825**	**436913.871**	**1.0000168**	**+0° 15' 17"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**85.8590**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained:	**06-May-2022**
Maintenance level:	
Mark condition:	**Reliably Placed**
Description:	**Continuously operating GNSS station or CORS site. Mark is unable to be physically occupied. Horizontal reference point is the centre of 5/8ö thread. The vertical reference is the plate at top of pillar. 0.055m spacer is between GNSS antenna reference point (ARP) and vertical reference plate (antenna height). For more information see http://www.linz.govt.nz/positionz**
Mark type:	**Forced Centering**
Beacon type:	**Pillar**
Protection type:	**Post & rail enclosure**

GISB: Mark details

MARK IDENTIFICATION

Code:	**GISB**	Country:	**New Zealand**
Name:	**Gisborne**	Land District:	**Gisborne**
Alternatives:	**50223M001**	Topo50 sheet:	**BG43**
		NZTM:	**5712349.695 2025367.883**
		Scale factor	**1.0018289**
		Convergence	**+3° 03' 19"**

NZGD 2000 COORDINATES

Latitude:	**38° 38' 07.21293" S**	Order:	**0**	Previous coordinates
Longitude:	**177° 53' 09.72572" E**	Authorised:	**25-Oct-2018**	
Ellipsoidal height (m):	**87.177**	Reference:	**PositioNZ Update (DefMod v20171201 ITRF2008@2018-01-01)**	

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Poverty Bay Circuit 2000	**798790.843**	**400041.738**	**1.0000000**	**+0° 00' 01"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**65.1300**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained:	**06-May-2022**
Maintenance level:	
Mark condition:	**Reliably Placed**
Description:	**Continuously operating GNSS station or CORS site. Mark is unable to be physically occupied. Horizontal reference point is the centre of 5/8ö thread. The vertical reference is the plate at top of pillar. 0.055m spacer is between GNSS antenna reference point (ARP) and vertical reference plate (antenna height). For more information see http://www.linz.govt.nz/positionz**
Mark type:	**Forced Centering**
Beacon type:	**Pillar**
Protection type:	**Post & rail enclosure**

MATW: Mark details

MARK IDENTIFICATION

Code:	**MATW**	Country:	**New Zealand**
Name:	**Matawai**	Land District:	**Gisborne**
Alternatives:		Topo50 sheet:	**BF41**
		NZTM:	**5747438.006 1995675.919**
		Scale factor	**1.0015286**
		Convergence	**+2° 48' 40"**

NZGD 2000 COORDINATES

Latitude:	**38° 20' 01.84945" S**	Order:	2	Previous coordinates
Longitude:	**177° 31' 34.33164" E**	Authorised:	**21-Dec-2018**	
Ellipsoidal height (m):	**646.230**	Reference:	**CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**	

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Poverty Bay Circuit 2000	**832196.813**	**368580.776**	**1.0000122**	**-0° 13' 22"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference	Previous heights
New Zealand Vertical Datum 2016	**622.0360**	1V	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**	

MARK DETAILS

Last maintained:	**16-Feb-2012**
Maintenance level:	
Mark condition:	**Reliably Placed**
Description:	**Continuously operating GNSS station or CORS site. Mark is unable to be physically occupied. Horizontal reference point is the centre of 5/8ö thread. The vertical reference is the plate at top of pillar. 0.055m spacer is between GNSS antenna reference point (ARP) and vertical reference plate (antenna height). For more information see https://www.geonet.org.nz/data/network/sensor/search**
Mark type:	**Forced Centering**
Beacon type:	**Pillar**
Protection type:	**Post & rail enclosure**

PAKI: Mark details

MARK IDENTIFICATION

Code:	**PAKI**	Country:	**New Zealand**
Name:	**Pakihiroa**	Land District:	**Gisborne**
Alternatives:		Topo50 sheet:	**BE44**
		NZTM:	**5793751.691 2047025.586**
		Scale factor	**1.0020621**
		Convergence	**+3° 07' 37"**

NZGD 2000 COORDINATES

Latitude:	**37° 53' 38.33360" S**	Order:	2	Previous coordinates
Longitude:	**178° 04' 57.37266" E**	Authorised:	**21-Dec-2018**	
Ellipsoidal height (m):	**828.422**	Reference:	**CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**	

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Poverty Bay Circuit 2000	**881064.091**	**417332.102**	**1.0000037**	**+0° 07' 16"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference	Previous heights
New Zealand Vertical Datum 2016	**804.7290**	1V	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**	

MARK DETAILS

Last maintained:	**20-Mar-2022**
Maintenance level:	
Mark condition:	**Reliably Placed**
Description:	**Continuously operating GNSS station or CORS site. Mark is unable to be physically occupied. Horizontal reference point is the centre of 5/8ö thread. The vertical reference is the flat surface at top of monument. There is a 0.002m difference between the GNSS antenna reference point (ARP) and the vertical reference point (antenna height). For more information see https://www.geonet.org.nz/data/network/sensor/search**
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3.2 LiDAR Point Processing

Data processing has been in accordance with our standard policies and procedures surrounding acceptable tolerances, therefore ensuring optimal accuracy of deliverables.

GNSS/IMU data was processed using the ANAU, GISB, HIKB, MATW & PAKI Base Stations and precise ephemeris data.

The GNSS and IMU were processed in a tightly coupled loop to give an optimum trajectory. This data was then applied to the LiDAR and image exterior orientations prior to LAS and ortho creation.

Image data was processed using Leica HxMap and any radiometric adjustment applied as required. LiDAR data was generated via Leica HxMap.

3.3 LiDAR Calibration

Overlapping LiDAR points from adjacent aircraft trajectories were used to check the LiDAR calibration for heading, roll, pitch and scale.

These values were then used to make small flight-specific adjustments to the LiDAR data.

3.4 LiDAR Point Editing

A "1st run" automatic classification was carried out on the raw LiDAR points using *TerraSolid's TerraScan* software to separate the LiDAR points into ground hits and non-ground hits. This results in a greater than 90 % correct classification. A manual classification was then used to edit points where gross classification errors occurred in the automatic classification process.

3.5 Vertical LiDAR Accuracy

Average dz	-0.000
Minimum dz	-0.143
Maximum dz	+0.142
Average magnitude	0.047
Root mean square	0.061
Std deviation	0.061

3.6 Horizontal Accuracy

The positional accuracy of the LiDAR data was checked by plotting Landpro Ltd. check points and displaying the LiDAR by intensity. The LiDAR was found to be in position.

3.7 Orthophoto Rectification

The imagery was developed into Tiff format using Leica HxMap. The exterior orientation was obtained by using the GNSS processed trajectory and internal camera event file to determine an accurate orientation of every image.

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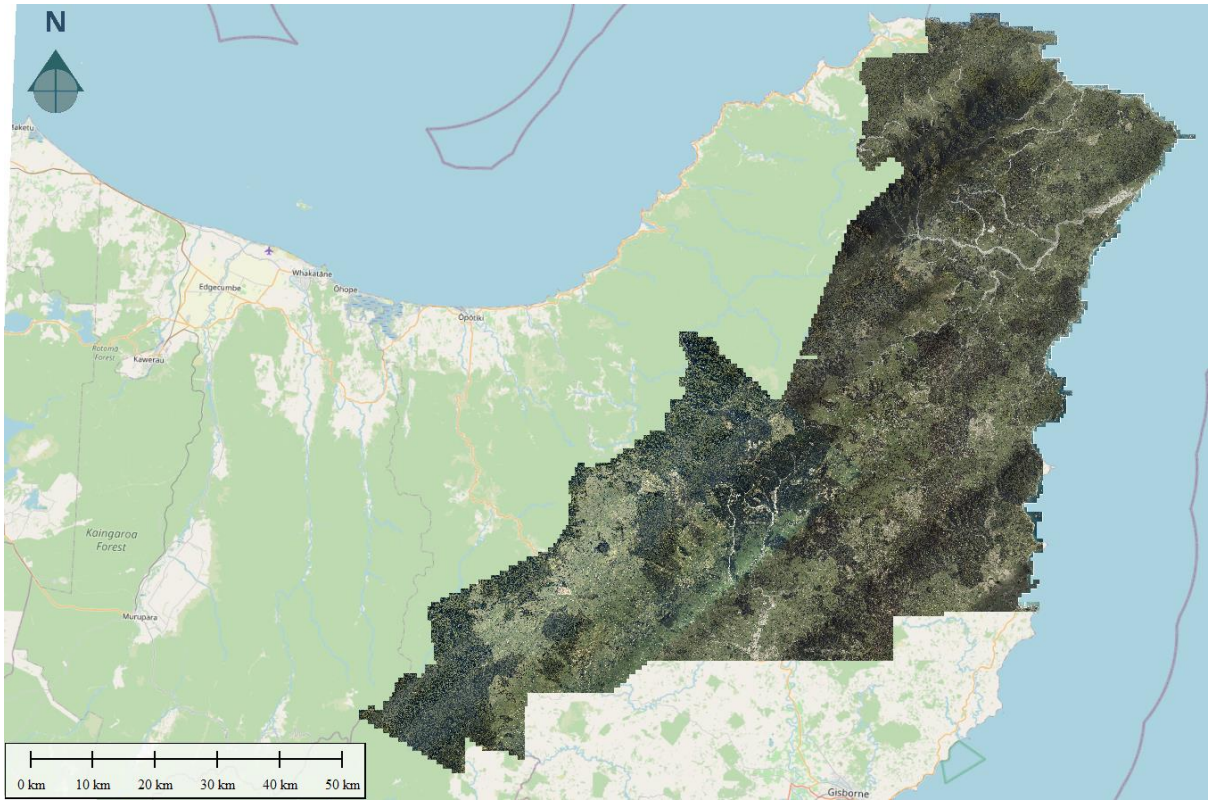

Figure 3: Ortho image for the Remaining Area area of interest.