LANDPRO

Make the most of your land

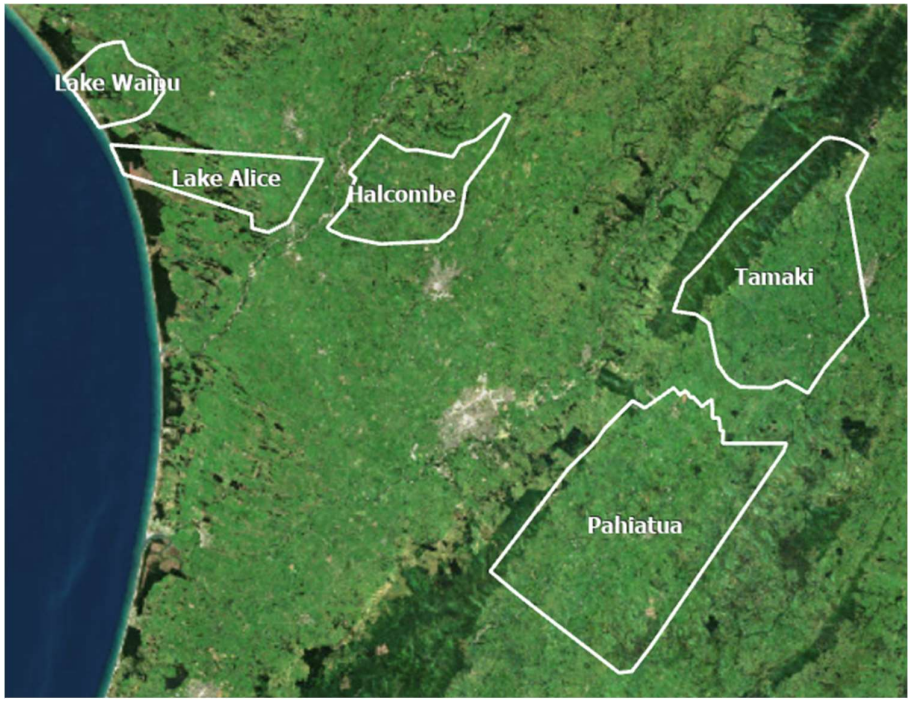
METADATA REPORT

Prepared for Horizons Regional Council

Airborne Laser Scanning (LiDAR)

Project	Airborne Laser Scanning (LiDAR)
Client	Horizons Regional Council
Contact	Jeff Watson

Summary of data	Landpro began data capture including LiDAR and imagery of the requested area on **2/07/2022** and completed capture on the **16/01/2023**. The data has been processed into a variety of digital map and data products. The supplied dataset includes the following items: Acquisition of topographic and bathymetric LiDAR data for multiple AOIs within the Horizon Region for the purposes of mapping and modelling hydrological events and flood inundation, for gravel and river management and for the management of coastal lakes. • Point cloud classified to ground, above ground, vegetation, water, and building classes in LAS and LAZ formats • Hydrobreaklines in SHP format • Crown of roads and railways in SHP format for the rural areas only • Flight lines with capture date and time (UTC and NZDT) in SHP format • Detailed metadata report

Data acquisition	The image below outlines the area surveyed.  Data was captured using the following systems: Topographic and bathymetric LiDAR: • Nadir Phase One 100MP RGB • Riegl VQ880 GII LiDAR Scanner Topographic LiDAR: • Leica RCD30 • Leica ALS60

Reference systems	**Projection:** NZTM NZGD2000 **Vertical Datum:** NZVD16 **Reference Station:** DNVK, GNBK, NRRD, NRSW, TAKP, GSPN, MANG, and PTOI

DNVK: Mark details

MARK IDENTIFICATION

Code:	**DNVK**	Country:	**New Zealand**
Name:	**Dannevirke**	Land District:	**Hawkes Bay**
Alternatives:	**50224M001**	Topo50 sheet:	**BM36**
		NZTM:	**5534258.492 1869145.546**

NZGD 2000 COORDINATES

Latitude:	**40° 17' 55.88757" S**	Order:	**0**	Previous coordinates
Longitude:	**176° 09' 59.96980" E**	Authorised:	**25-Oct-2018**	
Ellipsoidal height (m):	**457.618**	Reference:	**PositioNZ Update (DefMod v20171201 ITRF2008@2018-01-01)**	

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Hawkes Bay Circuit 2000	**727923.840**	**356898.567**	**1.0000229**	**-0° 19' 40"**	Previous coordinates
Wairarapa Circuit 2000	**869432.233**	**444162.769**	**1.0000240**	**+0° 20' 09"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**440.5850**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained:	**15-May-2018**
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:	**Other**
Beacon type:	**Pillar**
Protection type:	**Post & rail enclosure**

GNBK: Mark details

MARK IDENTIFICATION

Code: **GNBK**
Name: **Greenbank**
Alternatives:

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BL33**
NZTM: **5560924.982 1790830.592**

NZGD 2000 COORDINATES

Latitude: **40° 04' 49.23455" S**
Longitude: **175° 14' 17.27581" E**
Ellipsoidal height (m): **90.277**
Order: **2**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Wanganui Circuit 2000	**817913.931**	**378683.100**	**1.0000056**	**-0° 09' 39"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**78.3240**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained: **10-Jun-2021**
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**

NRRD: Mark details

MARK IDENTIFICATION

Code: **NRRD**
Name: **North Range Road**
Alternatives:

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BM35**
NZTM: **5525800.033 1834391.235**

NZGD 2000 COORDINATES

Latitude: **40° 23' 07.58732" S**
Longitude: **175° 45' 40.82304" E**
Ellipsoidal height (m): **500.680**
Order: **2**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Hawkes Bay Circuit 2000	**718033.271**	**322536.875**	**1.0000738**	**-0° 35' 28"**	Previous coordinates
Wairarapa Circuit 2000	**859941.148**	**409689.923**	**1.0000012**	**+0° 04' 26"**	Previous coordinates
Wanganui Circuit 2000	**784030.199**	**423205.062**	**1.0000066**	**+0° 10' 37"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**485.9740**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained: **10-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: **Other**
Beacon type: **Deep Drilled Braced Monument**
Protection type: **Post & rail enclosure**

NRSW: Mark details

MARK IDENTIFICATION

Code: **NRSW**
Name: **Norsewood**
Alternatives:

Country: **New Zealand**
Land District: **Hawkes Bay**
Topo50 sheet: **BL36**
NZTM: **5554754.719 1872726.624**

NZGD 2000 COORDINATES

Latitude: **40° 06' 47.97472" S**
Longitude: **176° 12' 00.14105" E**
Ellipsoidal height (m): **364.077**
Order: **2**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Hawkes Bay Circuit 2000	**748540.806**	**359626.720**	**1.0000201**	**-0° 18' 18"**	Previous coordinates
Wanganui Circuit 2000	**814038.511**	**460698.668**	**1.0000453**	**+0° 27' 31"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference	Previous heights
New Zealand Vertical Datum 2016	**346.8540**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**	

MARK DETAILS

Last maintained: **21-Feb-2017**
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: **Other**
Beacon type: **Deep Drilled Braced Monument**
Protection type: **Post & rail enclosure**

TAKP: Mark details

MARK IDENTIFICATION

Code: **TAKP**
Name: **Takapari Road**
Alternatives:

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BL36**
NZTM: **5561202.274 1852706.260**

NZGD 2000 COORDINATES

Latitude: **40° 03' 41.63126" S**
Longitude: **175° 57' 46.51357" E**
Ellipsoidal height (m): **698.824**
Order: **2**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Hawkes Bay Circuit 2000	**754153.742**	**339365.649**	**1.0000452**	**-0° 27' 26"**	Previous coordinates
Wanganui Circuit 2000	**819920.919**	**440514.184**	**1.0000202**	**+0° 18' 20"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference	Previous heights
New Zealand Vertical Datum 2016	**682.3040**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**	

MARK DETAILS

Last maintained: **03-Apr-2016**
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: **Other**
Beacon type: **Pillar**
Protection type: **Post & rail enclosure**

GSPN: Mark details

MARK IDENTIFICATION

Code: **GSPN**
Name: **Palmerston North Riddet**
Alternatives:

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BM34**
NZTM: **5525882.704 1822272.150**

NZGD 2000 COORDINATES

Latitude: **40° 23' 16.86178" S**
Longitude: **175° 37' 07.25662" E**
Ellipsoidal height (m): **73.538**
Order: **3**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Hawkes Bay Circuit 2000	**717612.439**	**310426.708**	**1.0000987**	**-0° 41' 00"**	Previous coordinates
Wairarapa Circuit 2000	**859660.938**	**397576.725**	**1.0000001**	**-0° 01' 06"**	Previous coordinates
Wanganui Circuit 2000	**783771.792**	**411091.337**	**1.0000015**	**+0° 05' 04"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**59.879**	**2V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained: **16-Feb-2021**
Maintenance level:
Mark condition: **Reliably Placed**
Description: **N/A**
Mark type: **Forced Centering**
Beacon type: **Unknown**
Protection type: **Not specified**

MANG: Mark details

MARK IDENTIFICATION

Code: **MANG**
Name: **Mangatainoka River**
Alternatives:

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BN34**
NZTM: **5494831.454 1817642.319**

NZGD 2000 COORDINATES

Latitude: **40° 40' 07.31021" S**
Longitude: **175° 34' 29.52978" E**
Ellipsoidal height (m): **417.946**
Order: **2**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Wairarapa Circuit 2000	**828490.744**	**393882.201**	**1.0000005**	**-0° 02' 49"**	Previous coordinates
Wanganui Circuit 2000	**752608.292**	**407340.549**	**1.0000007**	**+0° 03' 23"**	Previous coordinates

ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference	Previous heights
New Zealand Vertical Datum 2016	**402.5500**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**	

MARK DETAILS

Last maintained: **13-Dec-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**

PTOI: Mark details

MARK IDENTIFICATION

Code: **PTOI**
Name: **Puketoi**
Alternatives:

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BN36**
NZTM: **5501202.554 1853775.793**

NZGD 2000 COORDINATES

Latitude: **40° 36' 03.82101" S**
Longitude: **175° 59' 57.36778" E**
Ellipsoidal height (m): **511.551**
Order: **2**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Wairarapa Circuit 2000	**835944.438**	**429797.404**	**1.0000109**	**+0° 13' 44"**	Previous coordinates

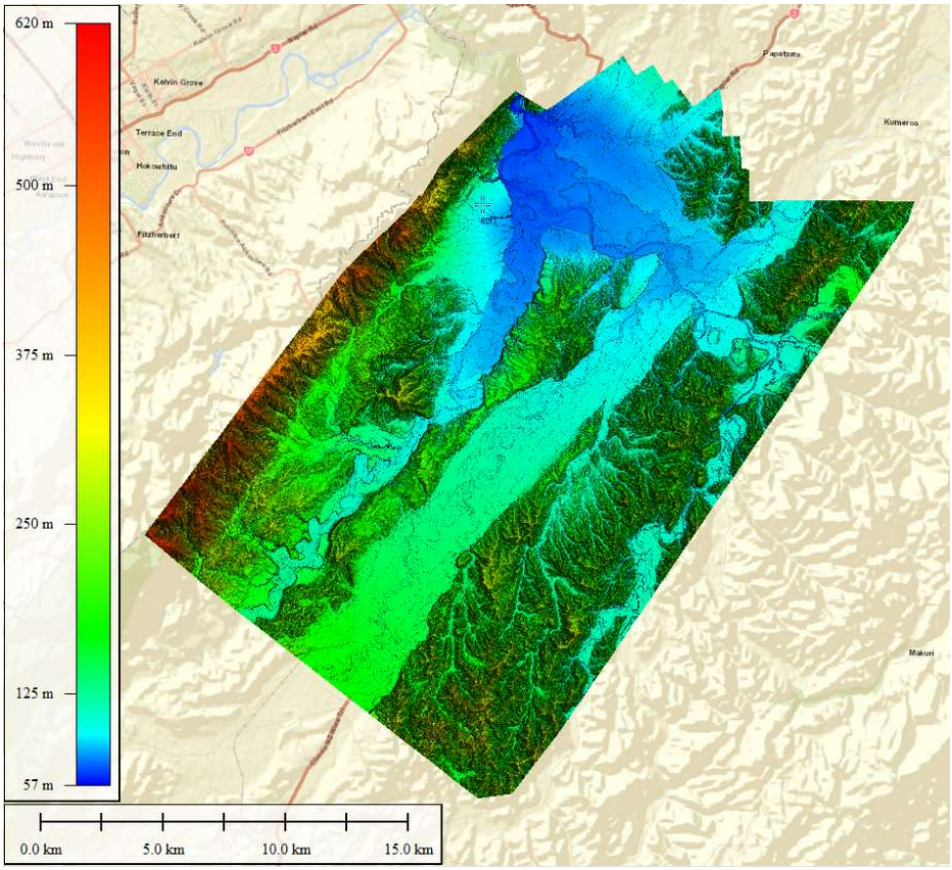
ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference	Previous heights
New Zealand Vertical Datum 2016	**494.6710**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**	

MARK DETAILS

Last maintained: **10-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**

Data processing	<u>LiDAR point processing</u> 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 DNVK, GNBK, NRRD, NRSW, TAKP, GSPN, MANG, and PTOI 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. Topographic data captured using the Leica RCD30 and ALS60 system was processed using Leica Frame Pro and any radiometric adjustment applied as required. LiDAR data was generated via Leica Cloud Pro. Topographic and bathymetric data captured using the Riegl system (Nadir Phase One 100 MP RGB camera and Riegl VQ880 GII LiDAR Scanner) was processed using Capture One Processing Engine and any radiometric adjustment applied as required. LiDAR data was generated via Riegl Riprocess. <u>LiDAR calibration</u> 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. <u>LiDAR point editing</u> 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. Overage is defined as 1 degree scan angle on each edge of each strip, to be excluded from use. Bathymetric Refraction Correction has been applied to ground points under water.



Vertical accuracy

	Lake Waipu, Lake Alice + Halcombe Blocks	Tamaki Block	Pahiatua Block
Average dz	+0.010	-0.010	-0.000
Minimum dz	-0.094	-0.118	-0.092
Maximum dz	+0.109	+0.097	+0.130
Average magnitude	0.030	0.037	0.035
Root mean square	0.037	0.046	0.044
Std. deviation	0.036	0.045	0.044

Horizontal accuracy

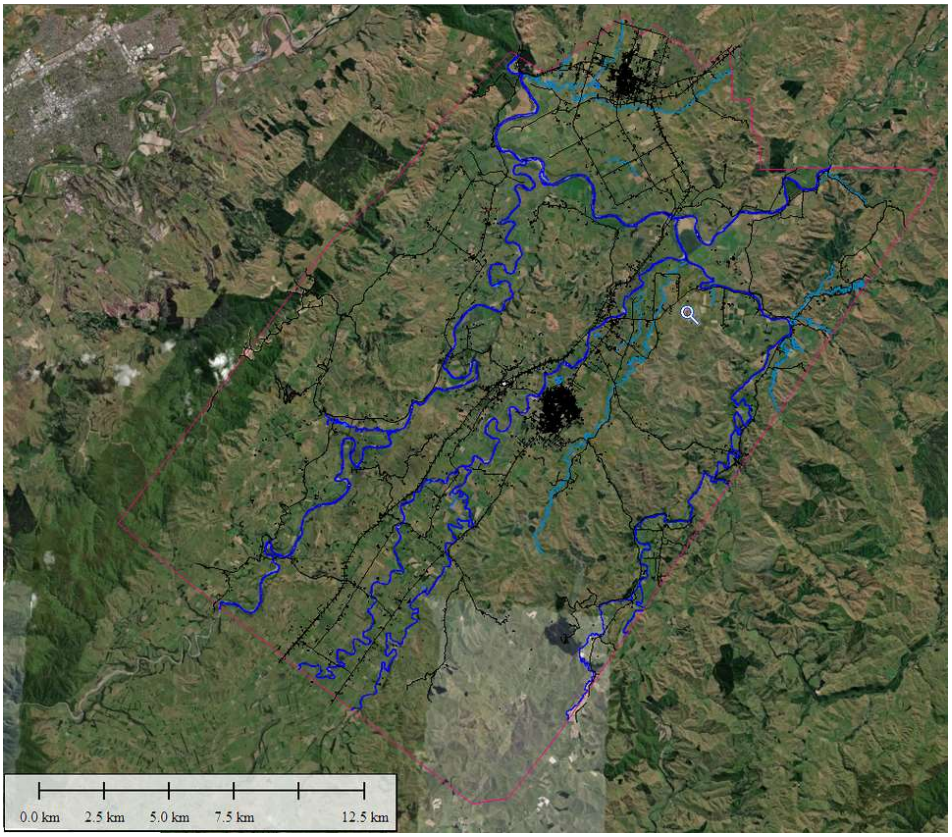
The positional accuracy of the LiDAR data was checked by plotting Landpro Ltd. check points and displaying the LiDAR by intensity. The LiDAR was in position.

Vector data

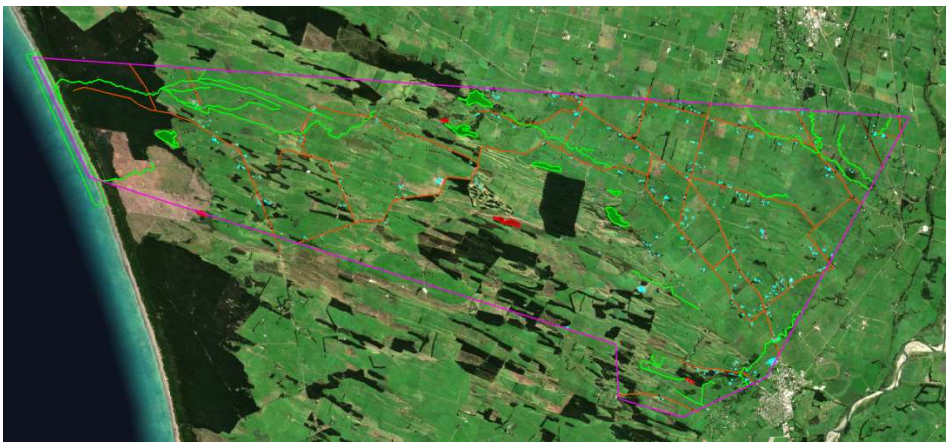
A variety of vector data has been provided, including:

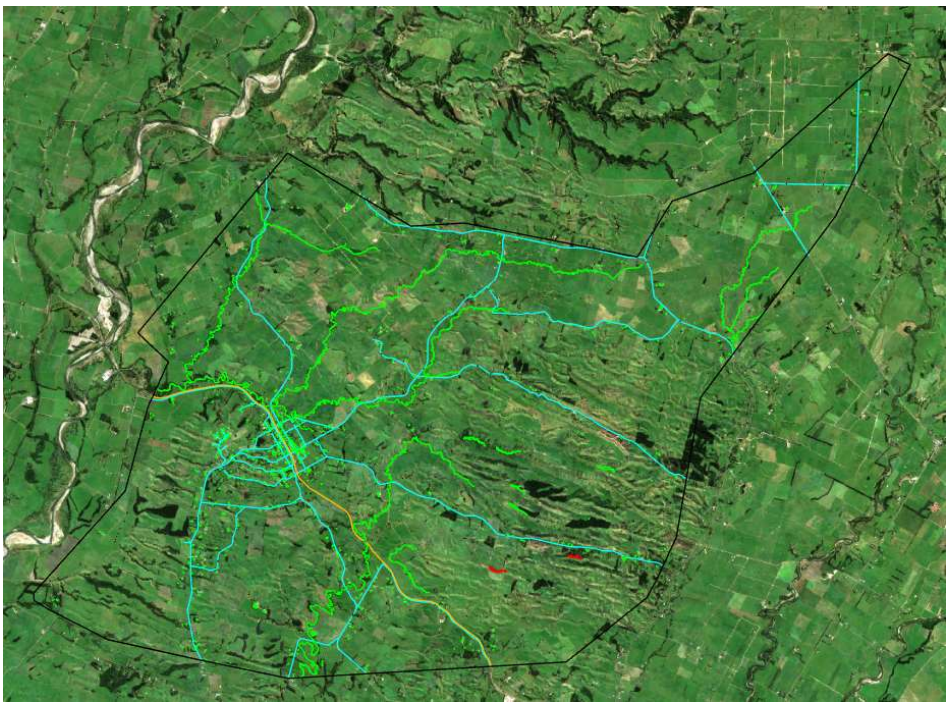
- Hydro breaklines
- Culverts and other water crossings
- The tops and bottoms of drainage channels
- Crowns of roads and railway
- Buildings layer (buildings greater than 10 m^2)

All vector data has been provided in .shp format and is compatible with ESRI software.




0 m
250 m
500 m
750 m





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
Date of metadata creation	30 March 2023

LANDPRO

Make the most of your land

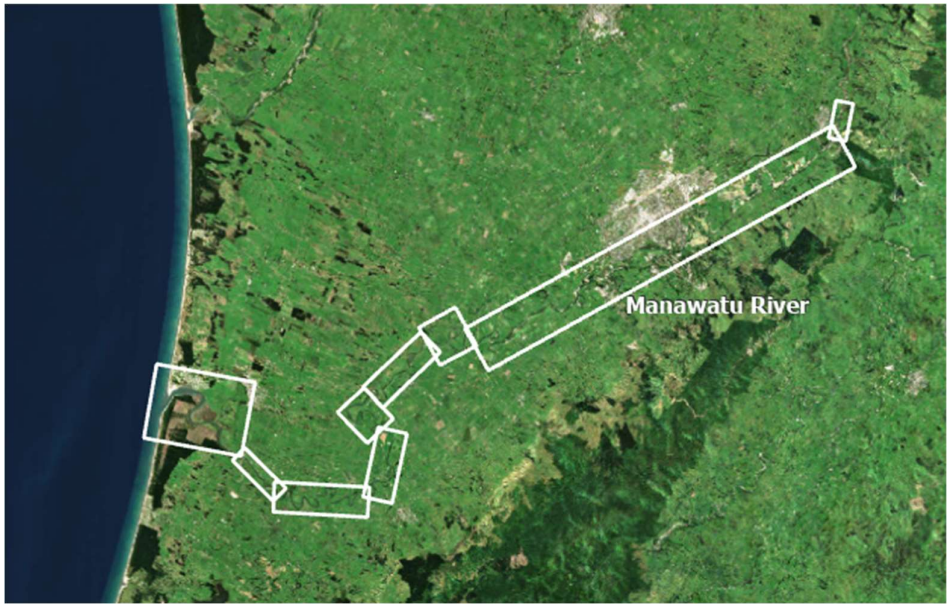
METADATA REPORT

Prepared for Horizons Regional Council

Manawatu River - LiDAR and Imagery

Project	Manawatu River - LiDAR and Imagery
Client	Horizons Regional Council
Contact	Andrew Steffert

Summary of data	Landpro completed data capture including LiDAR and imagery of the requested area on **29/12/2022.** The data has been processed into a variety of digital map and data products. The supplied dataset includes the following items: Acquisition of LiDAR and imagery over the Manawatu River for flood analysis purposes. • RGB ortho rectified image in Tiff format, tiled* and at 10 cm GSD • RGB encoded point cloud classified to ground, above ground, vegetation, water, and building classes, tiled* and in LAS 1.4 format • 1 m grid bare earth DEM, tiled* and in ASCII and RASTER formats • 1 m grid DSM, tiled* and in ASCII and RASTER formats • Hydro flattened and hydro breaklines in DWG and SHP formats • Contours at 1 m major and 0.25 m minor intervals in DWG and SHP formats • Detailed metadata report **All tiling was completed using the LINZ 1:1000 tile grid.*

Data acquisition	The image below outlines the area surveyed.  Data was captured using the following systems: • Leica RCD30 • Leica ALS60

Reference systems	**Projection:** NZTM NZGD2000 **Vertical Datum:** NZVD16 **Reference Station:** LEVN

LEVN: Mark details

MARK IDENTIFICATION

Code: **LEVN**
Name: **Moutere No 3**
Alternatives:

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BN33**
NZTM: **5504477.520 1789614.915**

NZGD 2000 COORDINATES

Latitude: **40° 35' 19.61409" S**
Longitude: **175° 14' 26.29772" E**
Ellipsoidal height (m): **96.131**
Order: **2**
Authorised: **21-Dec-2018**
Reference: **CORS Update (Constrained to PositioNZ stations DefMod v20180701 ITRF2008@2018-01-01)**

Previous coordinates

Circuit	Northing (m)	Easting (m)	Scale Factor	Convergence	
Wanganui Circuit 2000	**761456.858**	**379054.653**	**1.0000054**	**-0° 09' 39"**	Previous coordinates

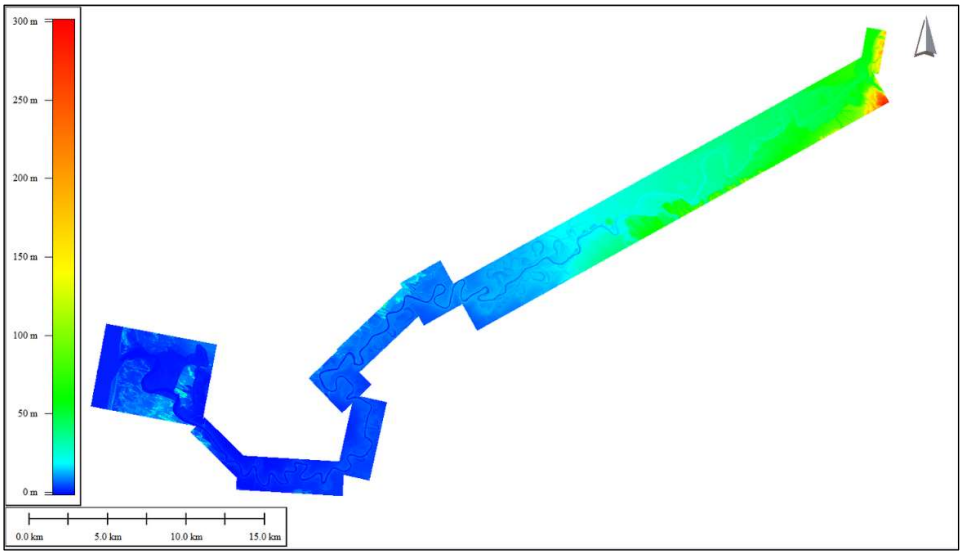
ORTHOMETRIC HEIGHTS

Height datum	Height (m)	Order	Calculation Date	Reference
New Zealand Vertical Datum 2016	**83.6800**	**1V**	**25-Feb-2020**	**2020CORS NZVD2016 Point Load**

MARK DETAILS

Last maintained: **27-Apr-2021**
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**

Data processing	<u>LiDAR point processing</u> 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 LEVN 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 Frame Pro and any radiometric adjustment applied as required. LiDAR data was generated via Leica Cloud Pro. <u>LiDAR calibration</u> 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. <u>LiDAR point editing</u> 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. Overage is defined as 1 degree scan angle on each edge of each strip, to be excluded from use.



Vertical accuracy

Average dz	-0.013
Minimum dz	-0.078
Maximum dz	+0.148
Average magnitude	0.026
Root mean square	0.039
Std deviation	0.037

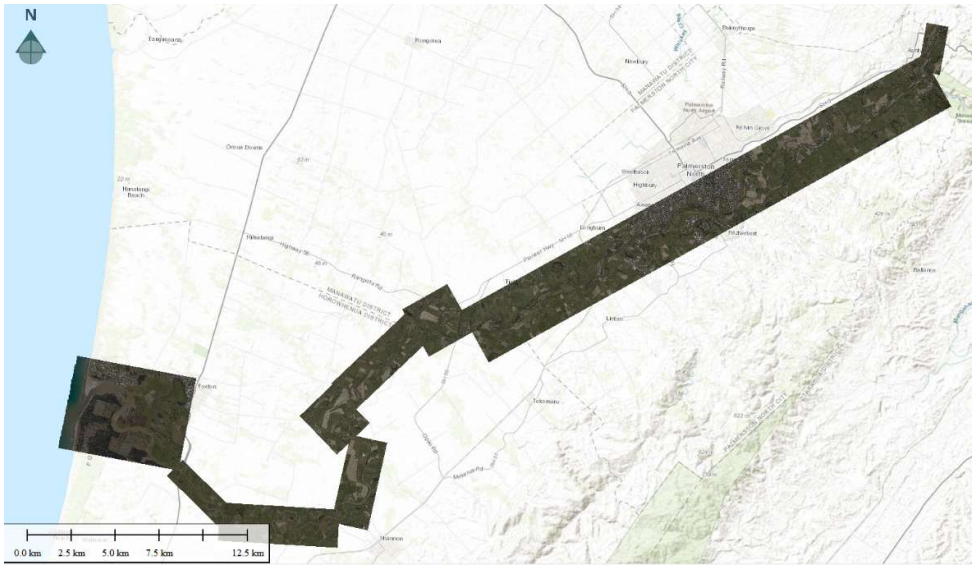
Horizontal accuracy

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

Orthophoto rectification procedure

The imagery was developed into tiffs using Leica Frame Pro. The exterior orientation was obtained by using IPAS CO+, which uses the trajectory and event file to determine an accurate orientation of every image.

The imagery was then run using Pix4D. Keypoints were computed on the images and matches were then determined. From these matches, Automatic Aerial Triangulation (AAT) was run. This results in the creation of an Orthomosaic based on orthorectification.

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
Date of metadata creation	30 March 2023