

REGIONAL SOFTWARE HOLDINGS LIMITED (RSHL) NORTH ISLAND WEATHER EVENTS LIDAR 2023-2024 VOLUME: PRJ45792_01_Horizons

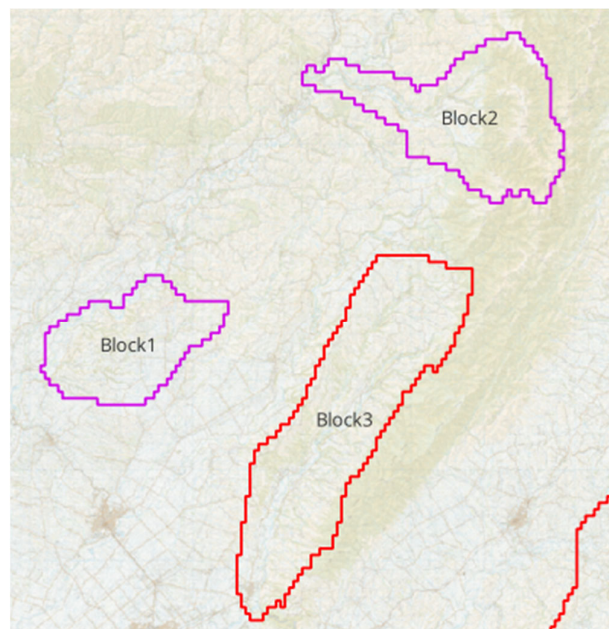
PROJECT SUMMARY

Regional Software Holdings Limited (RSHL), on behalf of the New Zealand Government, were tasked and funded to obtain aerial LIDAR data over selected storm damaged areas over the North Island of New Zealand. Woolpert has been contracted to provide data and related services for sites in Bay of Plenty, Horizons and Auckland Regions.

This report describes the products supplied for Horizons Block's 1-3.

Horizons Block 1 was captured on 15th February 2024, Horizons Block 2 was captured on 17th February and 10th of March 2024, and Horizons Block 3 was captured on 28th April 2024.

The survey was planned to achieve $\leq 20\text{cm}$ vertical accuracy (95% CI), $\leq 100\text{cm}$ horizontal accuracy (95% CI) with an emitted pulse density of 8ppsm, and ground classification to ICSM level 2. Imagery was also required over Horizons Blocks 1-2, not required for Block 3.



DATA SUMMARY

This volume includes the following data in NZTM2000 projection, NZVD2016 vertical datum:

- Horizons Block 1 - comprised of 524 x NZTopo50 1:1000 tiles.
- Horizons Block 2 - comprised of 781 x NZTopo50 1:1000 tiles.
 - ICSM L2 Colourised Classified Point Cloud data in LAZ v1.4 format
 - 1m cell DEM in GeoTIFF format
 - 1m cell DSM in GeoTIFF format
 - 1m cell CHM in GeoTIFF format
 - 12.5cm gsd RGBI Imagery in GeoTIFF format
 - Ancillary files in ESRI Shapefile format – Tile Index, Block Extent, Flightlines, Hydro Breaklines & Bridge breaklines.
- Horizons Block 3 – comprised of 1228 x NZTopo50 1:1000 tiles.
 - ICSM L2 Classified Point Cloud data in LAZ v1.4 format
 - 1m cell DEM in GeoTIFF format
 - 1m cell DSM in GeoTIFF format
 - 1m cell CHM in GeoTIFF format
 - Ancillary files in ESRI Shapefile format – Tile Index, Block Extent, Flightlines, Hydro Breaklines & Bridge breaklines.
- File listing in text file format
- Survey report in PDF format
- Metadata file: This document in PDF format

CONTENTS

- 1. Data Information..... 4
- 2. Metadata 6
- 3. Conditions Of Supply..... 10
- 4. Validation 11

1. DATA INFORMATION

Data supply: LINZ AWS
 Number of files: 17,791 data files, 1 file list, 1 survey report, 1 metadata file
 Data formatted on: Blocks 1-2: 30/04/2024 - 20/05/2024, Block 3: 27/06/2024
 Metadata Document: This file

Previous Deliveries	Date	Title	Contents

File Naming in this Delivery	Contents
CL2_BL34_2024_1000_2140.LAZ	Classified point cloud in LAZ v1.4 format (Horizons Block 1&2 LAZ are colourised)
DEM_BL34_2024_1000_2140.tif/tfw	1m grid DEM
DSM_BL34_2024_1000_2140.tif/tfw	1m grid DSM
CHM_BL34_2024_1000_2140.tif/tfw	1m grid CHM (canopy height above ground)
RGBI_BL34_2024_1000_2140.tif/tfw	12.5cm gsd RGBI imagery (Horizons block 1&2 only)
Ancillary files Horizons Block 1: PRJ45792_01_Horizons_Block1_Hydro_NZTM PRJ45792_01_Horizons_Block1_Extent_NZTM PRJ45792_01_Horizons_Block1_Bridges_NZTM PRJ45792_01_Horizons_Block1_TileIndex_NZTM PRJ45792_01_Horizons_Block1_Flightlines_NZTM	ESRI Shapefile format: Hydro breaklines Extent Bridge breaklines Tile Index Flight lines
Ancillary files Horizons Block 2: PRJ45792_01_Horizons_Block2_Hydro_NZTM PRJ45792_01_Horizons_Block2_Extent_NZTM PRJ45792_01_Horizons_Block2_Bridges_NZTM PRJ45792_01_Horizons_Block2_TileIndex_NZTM PRJ45792_01_Horizons_Block2_Flightlines_NZTM	Hydro breaklines Extent Bridge breaklines Tile Index Flight lines

<p>Ancillary files Horizons Block 3:</p> <p>PRJ45792_01_Horizons_Block3_Hydro_NZTM</p> <p>PRJ45792_01_Horizons_Block3_Extent_NZTM</p> <p>PRJ45792_01_Horizons_Block3_Bridges_NZTM</p> <p>PRJ45792_01_Horizons_Block3_TileIndex_NZTM</p> <p>PRJ45792_01_Horizons_Block3_Flightlines_NZTM</p>	<p>Hydro breaklines</p> <p>Extent</p> <p>Bridge breaklines</p> <p>Tile Index</p> <p>Flight lines</p>
<p>Readme_PRJ45792_01_Horizons.pdf</p>	<p>Metadata Report</p>
<p>PRJ45792_NIWE_Horizons1-3_LiDAR_Report.pdf</p>	<p>Survey Report</p>
<p>PRJ45792_01_Horizons1-3_FileListing.txt</p>	<p>List of product files delivered in this volume</p>

2. METADATA

Source Data	Source	Description	Ref No	Date
LiDAR & Imagery	Woolpert	TerrainMapper2 – 527	FL021660	15.02.2024
		TerrainMapper2 – 527	FL021684	17.02.2024
		TerrainMapper2 – 527	FL021878	10.03.2024
		TerrainMapper2 – 527	FL021884	10.03.2024
		TerrainMapper2 – 527	FL022332	28.04.2024
GPS Base Data	GeoNET /LINZ	GeoNET CORS, LINZ GDB co-ordinates	PRJ45792	As above
Control	Sounds Surveying	RTK GNSS	PRJ45792	19-23 Feb 2024
				18 Feb - 11 Mar 2024

LiDAR Characteristics	Description
Format	LAZ 1.4
Emitted Density	8 ppm2
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
ICSM Classification	Level 2. Ground surface improvement
Capture Constraints	Coastline captured within 3 hours of low tide. (not applicable in these areas)

Number	Point Class	Description	ICSM	CI %
1	Default	Unclassified	1	95
2	Ground	Ground	2	98
3	Low vegetation	< 2.0 m	2	95
4	Medium vegetation	2.0 – 8.0 m	2	95
5	High vegetation	> 8.0 m	2	95
6	Buildings, structures	Buildings, houses, sheds, silos etc.	2	95
7	Low / high points	Spurious low point returns (unusable)	2	98
9	Water	Any point in water	2	98
17	Bridge	Any bridge or overpass	2	98
18	High Noise	Spurious high point returns (unusable)	2	98

Ortho Characteristics	Description
Format	GeoTIFF & ECW
Ground Sample Distance	12.5cm
Terrain Model	Concurrent LiDAR
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
Sample Type	8-bit Integer
Image Bands	RGBI
Orientation/AT	Aero Triangulation/GPS-IMU
Capture Constraints	Nil specific to imagery – captured under LiDAR capture conditions above, in daylight hours

Reference Systems	Horizontal	Vertical
Datum	NZGD2000	NZVD2016
Projection	NZTM2000	N/A
Geoid Model	N/A	NZGeoid2016

Accuracy Specification	Measured Point	Derived Point	Basis of Estimation
Control Points	0.05m		Survey Methodology
LiDAR (Horizontal)	0.40m		Project design
LiDAR (Vertical)	0.10m		Project design
Orthophoto	0.30m		Project design

Notes On Expected Accuracy

- Values shown represent standard error (68% confidence level or 1 sigma), in metres
- “Derived points” are those interpolated from a terrain model.
- “Measured points” are those observed directly.
- Accuracy estimates for terrain modeling by LiDAR refer to the terrain definition on clear ground.

- LASER strikes have been classified into “ground” and “non-ground”, based upon algorithms tailored for major terrain/vegetation combinations existing in the project area. The definition of the ground may be less accurate in isolated pockets of dissimilar terrain/vegetation combinations.

Limitations of Data

- The definition of the ground under trees may be less accurate.
- Users should be aware that as the vegetation classification is automated, the Canopy Height Model may contain features that are not vegetation such as poles, wires, cars etc.

Data Validation – LiDAR Data

- **Horizons – Block 1.** Vertical Accuracy Validation - Ground data has been compared to ~260 test points obtained by field survey and assumed to be error-free. The test points were distributed in 6 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:

Mean difference: 0.002 m
Std Deviation: 0.030 m
Standard Error (RMS): 0.030 m or 0.058 m @ 95% CI

A shift of -0.170 was applied to the data before testing against the check points to produce the results shown above.

- **Horizons – Block 2.** Vertical Accuracy Validation - Ground data has been compared to ~415 test points obtained by field survey and assumed to be error-free. The test points were distributed in 8 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:

Mean difference: -0.003 m
Std Deviation: 0.043 m
Standard Error (RMS): 0.043 m or 0.083 m @ 95% CI

A shift of -0.078 was applied to the data before testing against the check points to produce the results shown above.

- **Horizons – Block 3.** Vertical Accuracy Validation - Ground data has been compared to ~605 test points obtained by field survey and assumed to be error-free. The test points were distributed in 5 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:

Mean difference: 0.005 m
Std Deviation: 0.029 m
Standard Error (RMS): 0.029 m or 0.057 m @ 95% CI

A shift of -0.170 was applied to the data before testing against the check points to produce the results shown above.

- Horizontal Accuracy – the LiDAR data was compared to visible horizontal control using the intensity imagery. The data was found to fit well. The expected horizontal accuracy at 95% CI is 50cm, within the specification of 100cm.
- Data classification has been manually checked and edited against available imagery.
- More information is available in the Survey Report: PRJ45792_NIWE_Horizons_LiDAR_Report.pdf

Data Validation – Orthophoto Image

- This data has not been field tested for accuracy. Spot checks comparing the orthophoto with horizontal check points supported the estimated horizontal accuracy of < 50cm. Full proof of accuracy achieved requires comparison to independent test points.

3. CONDITIONS OF SUPPLY

The data in this volume was commissioned by Regional Software Holdings Limited (**RSHL**). The data is provided by Woolpert to **RSHL** under the Terms of Engagement described in **RSHL-Woolpert Contract LIDAR Data Collection Ref 2023-21** date 15th December 2023.

This provides the client, **RSHL** with ownership of the deliverables, allowing release of data for re-use with a Creative Commons license (CC BY) with attribution to the buyer in line with the New Zealand Government Open Access Licensing framework (NZGOAL). This specification places no restrictions on the rights of Woolpert to resell data or derivative products.

1. This file (Readme_PRJ45792_01_Horizons.pdf) will always be stored with the unaltered data contained in this volume.

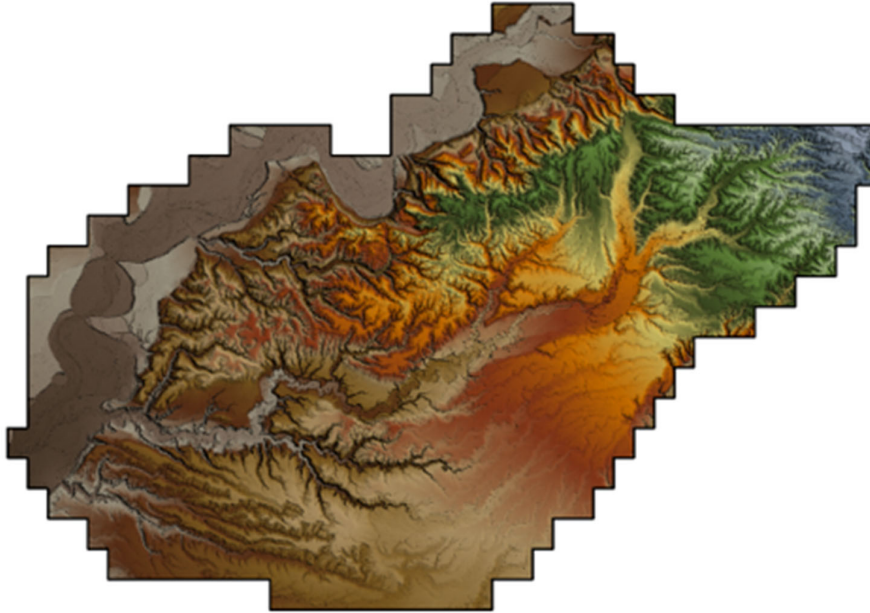
This data is provided in accordance with the specifications agreed with RSHL and Land Information NZ. Any problems associated with the information in the data files contained in this volume should be reported to Woolpert, Asia-Pacific.

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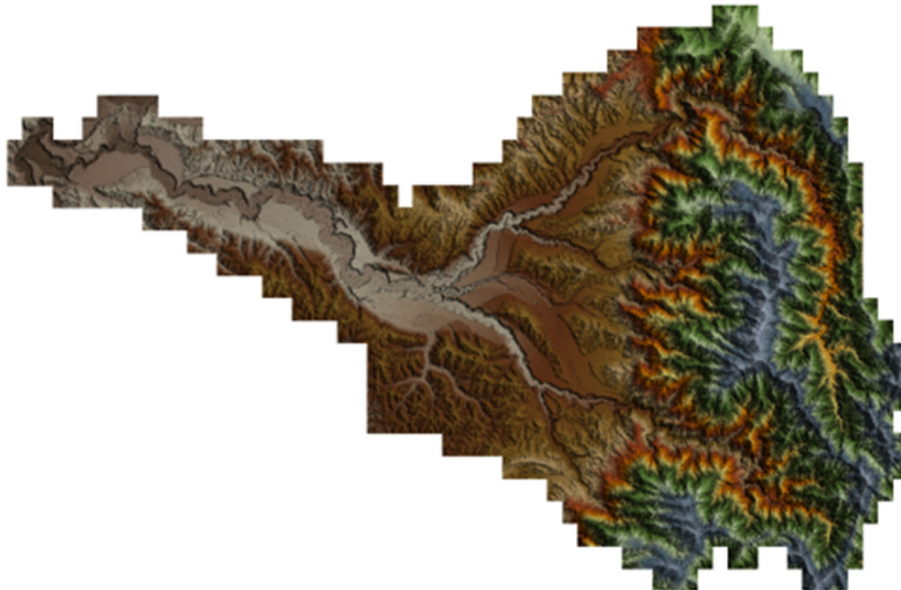
woolpert.com
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4. VALIDATION

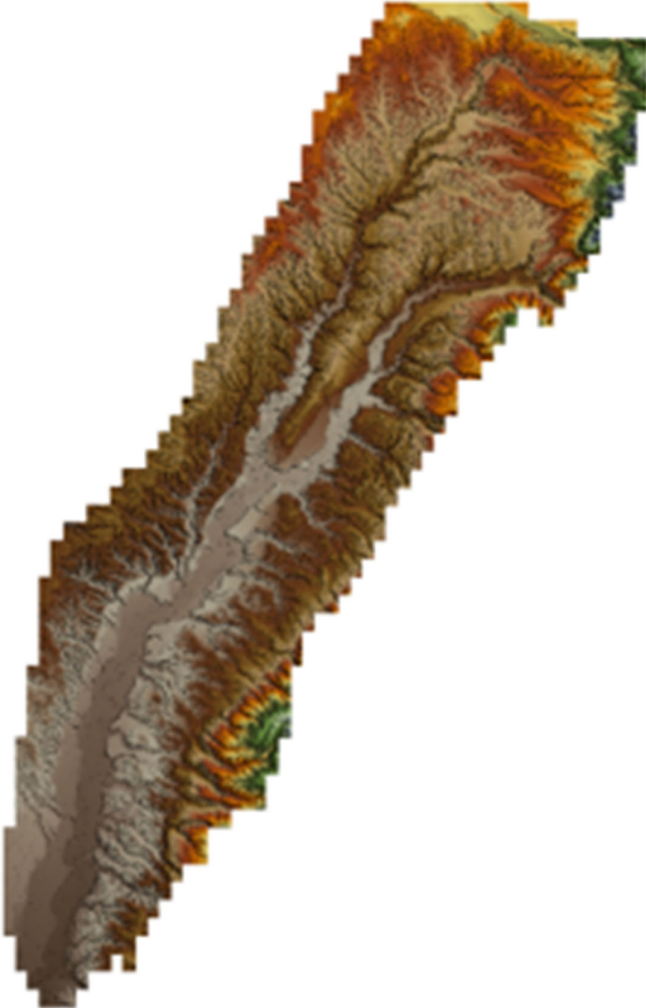
Horizons Block 1 – colour by elevation



Horizons Block 2 – colour by elevation



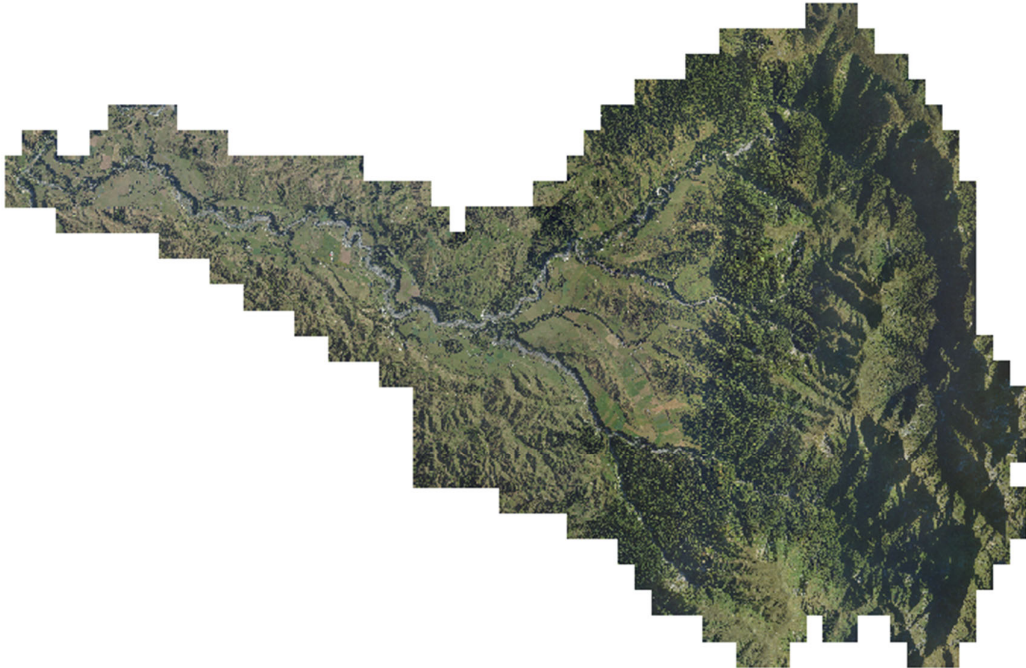
Horizons Block 3 – colour by elevation



Horizons Block 1 - imagery



Horizons Block 2 - imagery



REGIONAL SOFTWARE HOLDINGS LIMITED (RSHL) NORTH ISLAND WEATHER EVENTS LIDAR 2023-2024 VOLUME: PRJ45792_02_Horizons

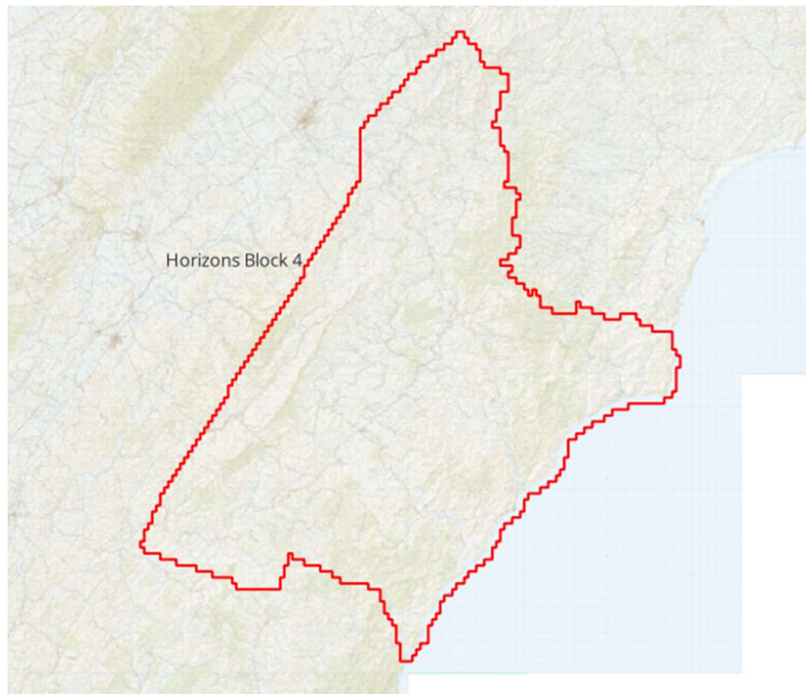
PROJECT SUMMARY

Regional Software Holdings Limited (RSHL), on behalf of the New Zealand Government, were tasked and funded to obtain aerial LIDAR data over selected storm damaged areas over the North Island of New Zealand. Woolpert has been contracted to provide data and related services for sites in Bay of Plenty, Horizons and Auckland Regions.

This report describes the products supplied for Horizons Block's 4.

Horizons Block 4 was captured between 26th January and 4th May 2024.

The survey was planned to achieve $\leq 20\text{cm}$ vertical accuracy (95% CI), $\leq 100\text{cm}$ horizontal accuracy (95% CI) with an emitted pulse density of 8ppsm, and ground classification to ICSM level 2.



DATA SUMMARY

This volume includes the following data in NZTM2000 projection, NZVD2016 vertical datum:

- Horizons Block 4 – comprised of 6134 x NZTopo50 1:1000 tiles.
 - ICSM L2 Classified Point Cloud data in LAZ v1.4 format
 - 1m cell DEM in GeoTIFF format
 - 1m cell DSM in GeoTIFF format
 - 1m cell CHM in GeoTIFF format
 - Ancillary files in ESRI Shapefile format – Tile Index, Block Extent, Flightlines, Hydro Breaklines & Bridge breaklines.
- File listing in text file format
- Survey report in PDF format
- Metadata file: This document in PDF format

CONTENTS

- 1. Data Information 4
- 2. Metadata 5
- 3. Conditions Of Supply 9
- 4. Validation 10

1. DATA INFORMATION

Data supply: LINZ AWS
 Number of files: 42,532 data files, 1 file list, 1 survey report, 1 metadata file
 Data formatted on: Block 4: 26-30/08/2024
 Metadata Document: This file

Previous Deliveries	Date	Title	Contents
PRJ45792_01_Horizons	30/04/2024 – 27/06/2024	North Island Weather Events LiDAR	Horizons Blocks 1-3
PRJ45792_01-03_BOP	23/04/2024 – 29/07/2024	North Island Weather Events LiDAR	Bay of Plenty

File Naming in this Delivery	Contents
CL2_BL34_2024_1000_2140.LAZ	Classified point cloud in LAZ v1.4 format
DEM_BL34_2024_1000_2140.tif/tfw	1m grid DEM
DSM_BL34_2024_1000_2140.tif/tfw	1m grid DSM
CHM_BL34_2024_1000_2140.tif/tfw	1m grid CHM (canopy height above ground)
Ancillary files Horizons Block 3: PRJ45792_01_Horizons_Block4_Hydro_NZTM PRJ45792_01_Horizons_Block4_Extent_NZTM PRJ45792_01_Horizons_Block4_Bridge_NZTM PRJ45792_01_Horizons_Block4_TileIndex_NZTM PRJ45792_01_Horizons_Block4_Flightlines_NZTM	Hydro breaklines Extent Bridge breaklines Tile Index Flight lines
Readme_PRJ45792_02_Horizons.pdf	Metadata Report
PRJ45792_01_Horizons4_FileListing.txt	List of product files delivered in this volume

2. METADATA

Source Data	Source	Description	Ref No	Date
LiDAR & Imagery	Woolpert	TerrainMapper2 – 527	FL021477	26.01.2024
		TerrainMapper2 – 527	FL021660	15.02.2024
		TerrainMapper2 – 527	FL021749	24.02.2024
		TerrainMapper2 – 527	FL021852	07.03.2024
		TerrainMapper2 – 527	FL021869	09.03.2024
		TerrainMapper2 – 527	FL021884	10.03.2024
		TerrainMapper2 – 527	FL022283	23.04.2024
		TerrainMapper2 – 527	FL022338	28.04.2024
		TerrainMapper2 – 527	FL022340	29.04.2024
		TerrainMapper2 – 527	FL022353	30.04.2024
		TerrainMapper2 – 527	FL022410	04.05.2024
GPS Base Data	GeoNET /LINZ	GeoNET CORS, LINZ GDB co-ordinates	PRJ45792	As above
Control	Sounds Surveying	RTK GNSS	PRJ45792	19-23 Feb 2024
				18 Feb - 11 Mar 2024

LiDAR Characteristics	Description
Format	LAZ 1.4
Emitted Density	8 ppm2
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
ICSM Classification	Level 2. Ground surface improvement
Capture Constraints	Coastline captured within 3 hours of low tide. (not applicable in these areas)

Number	Point Class	Description	ICSM	CI %
1	Default	Unclassified	1	95
2	Ground	Ground	2	98
3	Low vegetation	< 2.0 m	1	95
4	Medium vegetation	2.0 – 8.0 m	1	95
5	High vegetation	> 8.0 m	1	95
6	Buildings, structures	Buildings, houses, sheds, silos etc.	1	95
7	Low / high points	Spurious low point returns (unusable)	2	98
9	Water	Any point in water	2	98
17	Bridge	Any bridge or overpass	2	98
18	High Noise	Spurious high point returns (unusable)	2	98

Reference Systems	Horizontal	Vertical
Datum	NZGD2000	NZVD2016
Projection	NZTM2000	N/A
Geoid Model	N/A	NZGeoid2016

Accuracy Specification	Measured Point	Derived Point	Basis of Estimation
Control Points	0.05m		Survey Methodology
LiDAR (Horizontal)	0.40m		Project design
LiDAR (Vertical)	0.10m		Project design
Orthophoto	0.30m		Project design

Notes On Expected Accuracy

- Values shown represent standard error (68% confidence level or 1 sigma), in metres
- “Derived points” are those interpolated from a terrain model.
- “Measured points” are those observed directly.
- Accuracy estimates for terrain modelling by LiDAR refer to the terrain definition on clear ground.

- LASER strikes have been classified into “ground” and “non-ground”, based upon algorithms tailored for major terrain/vegetation combinations existing in the project area. The definition of the ground may be less accurate in isolated pockets of dissimilar terrain/vegetation combinations.

Limitations of Data

- The definition of the ground under trees may be less accurate.
- Users should be aware that as the vegetation classification is automated, the Canopy Height Model may contain features that are not vegetation such as poles, wires, cars etc.

Data Validation – LiDAR Data

- **Horizons – Block 4.** Vertical Accuracy Validation - Ground data has been compared to ~2374 test points obtained by field survey and assumed to be error-free. The test points were distributed in 47 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:

Mean difference: 0.004 m

Std Deviation: 0.035 m

Standard Error (RMS): 0.035 m or 0.069 m @ 95% CI

A shift of -0.056 was applied to the data before testing against the check points to produce the results shown above.

Comparison by site:

Site	Post dZ	Post RMS	Post SD
Horizons_Site_01_NZTM_NZVD2016	-0.032	0.038	0.020
Horizons_Site_04_NZTM_NZVD2016	0.006	0.014	0.013
Horizons_Site_05_NZTM_NZVD2016	-0.006	0.021	0.021
Horizons_Site_08_NZTM_NZVD2016	-0.036	0.042	0.022
Horizons_Site_09_NZTM_NZVD2016	0.036	0.041	0.020
Horizons_Site_12_NZTM_NZVD2016	-0.012	0.029	0.026
Horizons_Site_13_NZTM_NZVD2016	-0.021	0.034	0.027
Horizons_Site_15_NZTM_NZVD2016	0.028	0.035	0.022
Horizons_Site_19_NZTM_NZVD2016	0.039	0.044	0.020
Horizons_Site_21_NZTM_NZVD2016	0.008	0.020	0.018
Horizons_Site_22_NZTM_NZVD2016	-0.040	0.046	0.023
Horizons_Site_26_NZTM_NZVD2016	-0.063	0.066	0.019
Horizons_Site_27_NZTM_NZVD2016	-0.024	0.030	0.019
Horizons_Site_34_NZTM_NZVD2016	0.050	0.055	0.023
Horizons_Site_36_NZTM_NZVD2016	0.035	0.042	0.024
Horizons_Site_41_NZTM_NZVD2016	0.054	0.055	0.012
Horizons_Site_46_NZTM_NZVD2016	-0.027	0.034	0.020
Horizons_Site_51_NZTM_NZVD2016	0.026	0.034	0.022
Horizons_Site_53_NZTM_NZVD2016	0.000	0.022	0.023
Horizons_Site_54_NZTM_NZVD2016	-0.027	0.033	0.019
Horizons_Site_02_NZTM_NZVD2016	0.024	0.029	0.016
Horizons_Site_03_NZTM_NZVD2016	0.003	0.020	0.020
Horizons_Site_06_NZTM_NZVD2016	-0.007	0.020	0.018
Horizons_Site_07_NZTM_NZVD2016	0.016	0.025	0.018
Horizons_Site_10_NZTM_NZVD2016	0.003	0.032	0.032
Horizons_Site_11_NZTM_NZVD2016	0.003	0.021	0.021
Horizons_Site_14_NZTM_NZVD2016_r1	0.029	0.034	0.016
Horizons_Site_16_NZTM_NZVD2016	-0.002	0.021	0.021
Horizons_Site_18_NZTM_NZVD2016	0.023	0.028	0.016
Horizons_Site_20_NZTM_NZVD2016	-0.045	0.049	0.019
Horizons_Site_23_NZTM_NZVD2016	-0.002	0.022	0.023
Horizons_Site_24_NZTM_NZVD2016	0.068	0.073	0.026
Horizons_Site_25_NZTM_NZVD2016	-0.003	0.017	0.017
Horizons_Site_28_NZTM_NZVD2016_r1	0.006	0.020	0.019
Horizons_Site_30_NZTM_NZVD2016	-0.014	0.021	0.016
Horizons_Site_32_NZTM_NZVD2016	0.014	0.026	0.022
Horizons_Site_35_NZTM_NZVD2016	0.023	0.030	0.021
Horizons_Site_37_NZTM_NZVD2016	-0.023	0.030	0.020
Horizons_Site_39_NZTM_NZVD2016	0.005	0.017	0.017
Horizons_Site_40_NZTM_NZVD2016	-0.028	0.033	0.016
Horizons_Site_42_NZTM_NZVD2016	0.000	0.020	0.020
Horizons_Site_43_NZTM_NZVD2016_r1	0.033	0.038	0.019
Horizons_Site_44_NZTM_NZVD2016	0.012	0.022	0.018
Horizons_Site_47_NZTM_NZVD2016	0.037	0.042	0.020
Horizons_Site_48_NZTM_NZVD2016	0.057	0.060	0.019
Horizons_Site_52_NZTM_NZVD2016	0.000	0.018	0.019
Horizons_Site_73_NZTM_NZVD2016	0.021	0.026	0.016

- Horizontal Accuracy – the LiDAR data was compared to visible horizontal control using the intensity imagery. The data was found to fit well. The expected horizontal accuracy at 95% CI is 38cm, within the specification of 100cm.
- Data classification has been manually checked and edited against available imagery.
- More information is available in the Survey Report: PRJ45792_NIWE_Horizons_LiDAR_Report.pdf

3. CONDITIONS OF SUPPLY

The data in this volume was commissioned by Regional Software Holdings Limited (**RSHL**). The data is provided by Woolpert to **RSHL** under the Terms of Engagement described in **RSHL-Woolpert Contract LIDAR Data Collection Ref 2023-21** date 15th December 2023.

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4. VALIDATION

Horizons Block 4 – colour by elevation

