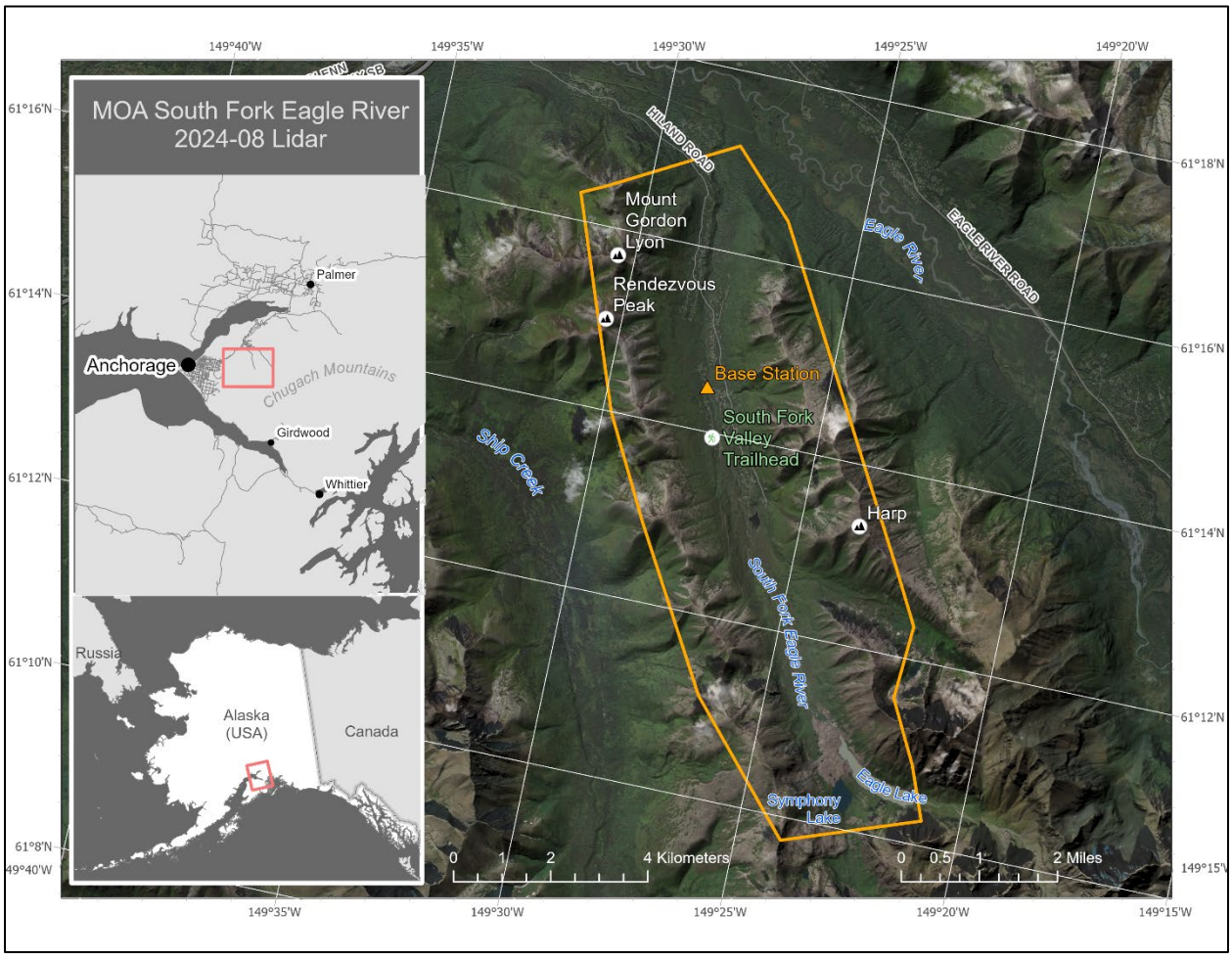
LIDAR-DERIVED ELEVATION DATA FOR SOUTH FORK EAGLE RIVER VALLEY, SOUTHCENTRAL ALASKA, COLLECTED AUGUST 17, 2024

Katreen M. Wikstrom Jones and Gabriel J. Wolken

Raw Data File 2025-20



Location map of the survey area.

This report has not been reviewed for technical content or
for conformity to the editorial standards of DGGS.

2025
STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

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LIDAR-DERIVED SURFACE ELEVATION DATA FOR SOUTH FORK EAGLE RIVER VALLEY, SOUTHCENTRAL ALASKA, COLLECTED AUGUST 17, 2024

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INTRODUCTION

The Alaska Division of Geological & Geophysical Surveys (DGGS) used aerial lidar to produce a classified point cloud, digital surface model (DSM), digital terrain model (DTM), and intensity model of South Fork Eagle River valley, Municipality of Anchorage (MOA), Southcentral Alaska, during leaf-on conditions (cover figure). The survey provides summer "snow off" surface elevations to derive snow depth information using a separately collected winter "snow-on" elevation surface. Aerial lidar data were collected on August 17, 2024, and ground control data were collected from August 21 to August 29, 2024, and subsequently merged and processed using a suite of geospatial processing software. This data collection is released as a Raw Data File with an open end-user license. All files are available to download on the DGGS website at https://doi.org/10.14509/31705.

LIST OF DELIVERABLES

Classified Points
DSM and DTM
Intensity Image
Metadata

MISSION PLAN

Aerial Lidar Survey Details

DGGS used a Riegl VUX1-LR[22] laser scanner with a global navigation satellite system (GNSS) and Northrop Grumman LN-200C inertial measurement unit (IMU) integrated by Phoenix LiDAR Systems. The sensor can collect a maximum of 1,500,000 points per second at a range of 230 m or a minimum of 50,000 points per second at 1,000 m (ranges assume ≥ 20 percent natural reflectance). The scanner operated with a pulse refresh rate of 400,000 pulses per second over heavily vegetated areas or a pulse refresh rate of 200,000 pulses per second over alpine areas. We used a Cessna 180 Skywagon fixed-wing platform to survey from an elevation of approximately 100–300 m above ground level, at a ground speed of approximately 40 m/s, and with a scan angle set from 80 to 280 degrees. A scan rate of 10 revolutions per second was unintentionally used for the entire survey, resulting in larger-than-expected gaps between scan lines. The total survey area covers approximately 59.9 km^2 (cover figure).

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Updated 12/3/2025

Weather Conditions and Flight Times

The survey area was accessed by air from Merrill Field Airport, Anchorage (fig. 1), and was part of a larger survey that covered additional areas of interest within the MOA. This part of the survey started at 11:37 a.m. AKDT and ended at 1:44 p.m. AKDT. The weather during the survey was partly cloudy, with no-to-light wind increasing throughout the day.

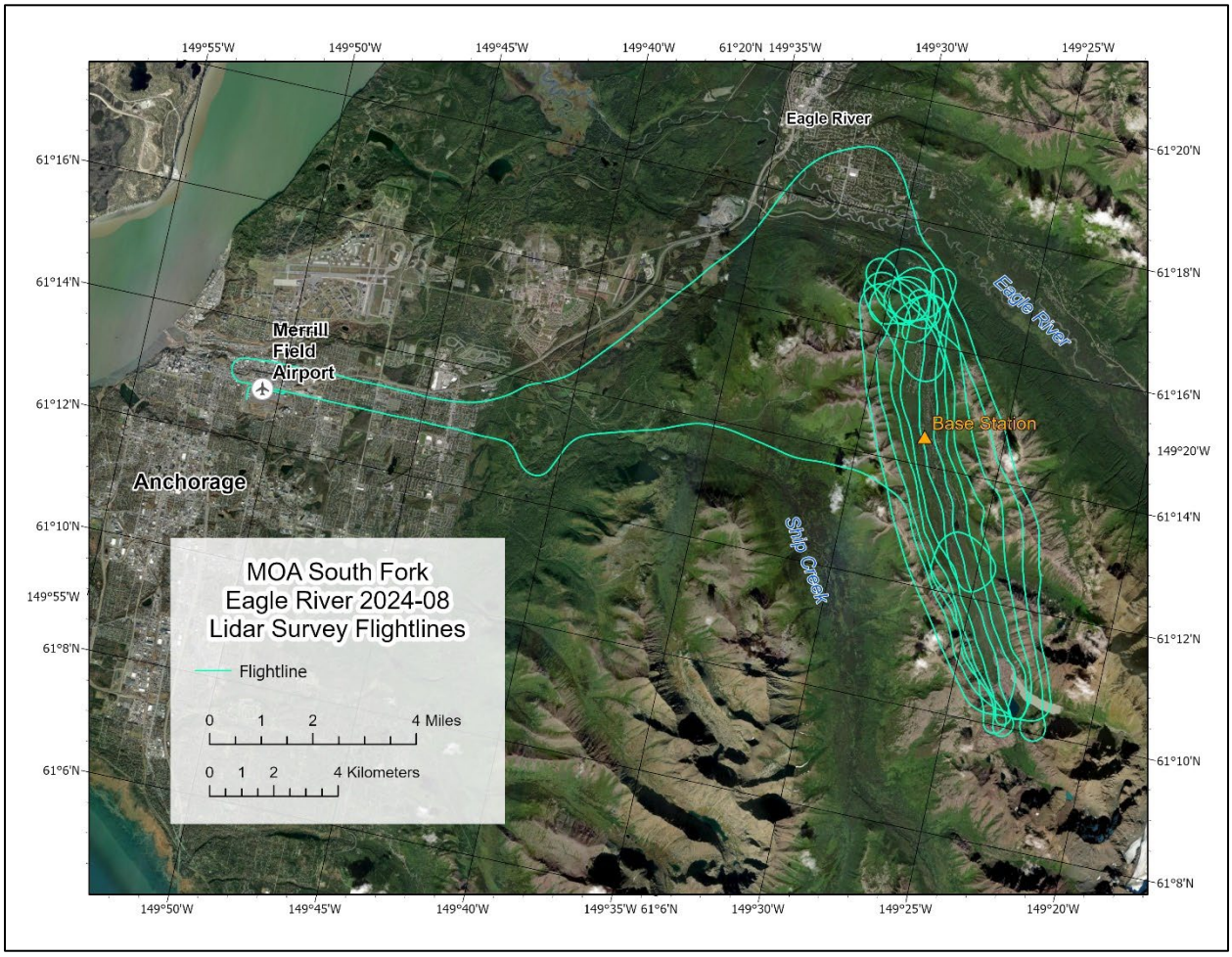

Figure 1. Lidar data collection flightlines.

PROCESSING REPORT

Lidar Dataset Processing

We processed point data in Spatial Explorer for initial filtering and multiple-time-around (MTA) disambiguation. MTA errors, corrected in this process, result from ambiguous interpretations of received pulse time intervals and occur more frequently with higher pulse refresh rates. IMU and GNSS data were processed in Inertial Explorer, and flightline information was integrated with the point cloud in Spatial Explorer. We calibrated the point data at an incrementally precise scale of sensor movement and behavior, incorporating sensor velocity, roll, pitch, and yaw fluctuations

throughout the survey. For the lidar data collection, the average pulse density is 14.9 pulses/m^2, and the average pulse spacing is 25.9 cm.

We created a macro (an ordered list of point classification commands tailored to this dataset) in Terrasolid software and classified points in accordance with the American Society for Photogrammetry & Remote Sensing (ASPRS) 2025 guidelines (ASPRS, 2025). Once classified, we applied a geometric transformation and converted the points from ellipsoidal heights to GEOID12B (Alaska) orthometric heights.

Raster products were derived from the point cloud in ArcGIS Pro. A 1-m DSM was interpolated from ground and vegetation classes using a triangulation method with a 1-m resolution and no point thinning. A 1-m DTM was interpolated from all ground-class returns with a triangulation method and no point thinning. We also produced a 1-m intensity image using average binning in ArcGIS Pro, with no normalizations or corrections.

Classified Point Cloud

Classified point cloud data are provided in LAZ format. Data are classified following ASPRS 2025 guidelines (table 1) and contain return and intensity information. For classified ground points, the average point density (fig. 2) is 9.2 pts/m^2, and the average spacing is 33.3 cm.

Table 1. Point cloud class code definitions.

Class Code	Description
1	Unclassified
2	Ground
3	Low Vegetation, ≥0.0m, <0.5m
4	Medium Vegetation, ≥0.5m, <5m
5	High Vegetation, ≥5m, ≤40m
6	Building
7	Low Noise
14	Wire - Conductor
18	High Noise

Digital Surface Model

The DSM represents surface elevations, including vegetation heights, buildings, and power lines. It is a single-band, 32-bit GeoTIFF file with a 1-m resolution and a No Data value set to -3.40282306074e+38 (32-bit, floating-point minimum).

Digital Terrain Model

The DTM represents bare earth or snow surface elevations, excluding vegetation and built structures. It is a single-band, 32-bit GeoTIFF file with a 1-m resolution and a No Data value set to -3.40282306074e+38.

Lidar Intensity Image

The lidar intensity image describes the relative amplitude of reflected signals contributing to the point cloud. Lidar intensity is (1) primarily a function of scanned object reflectance in relation to the signal frequency, (2) dependent on ambient conditions, and (3) not necessarily consistent between separate scans. The intensity image is a single-band, 32-bit GeoTIFF file of 1-m resolution, with a No Data value set to -3.40282306074e+38.

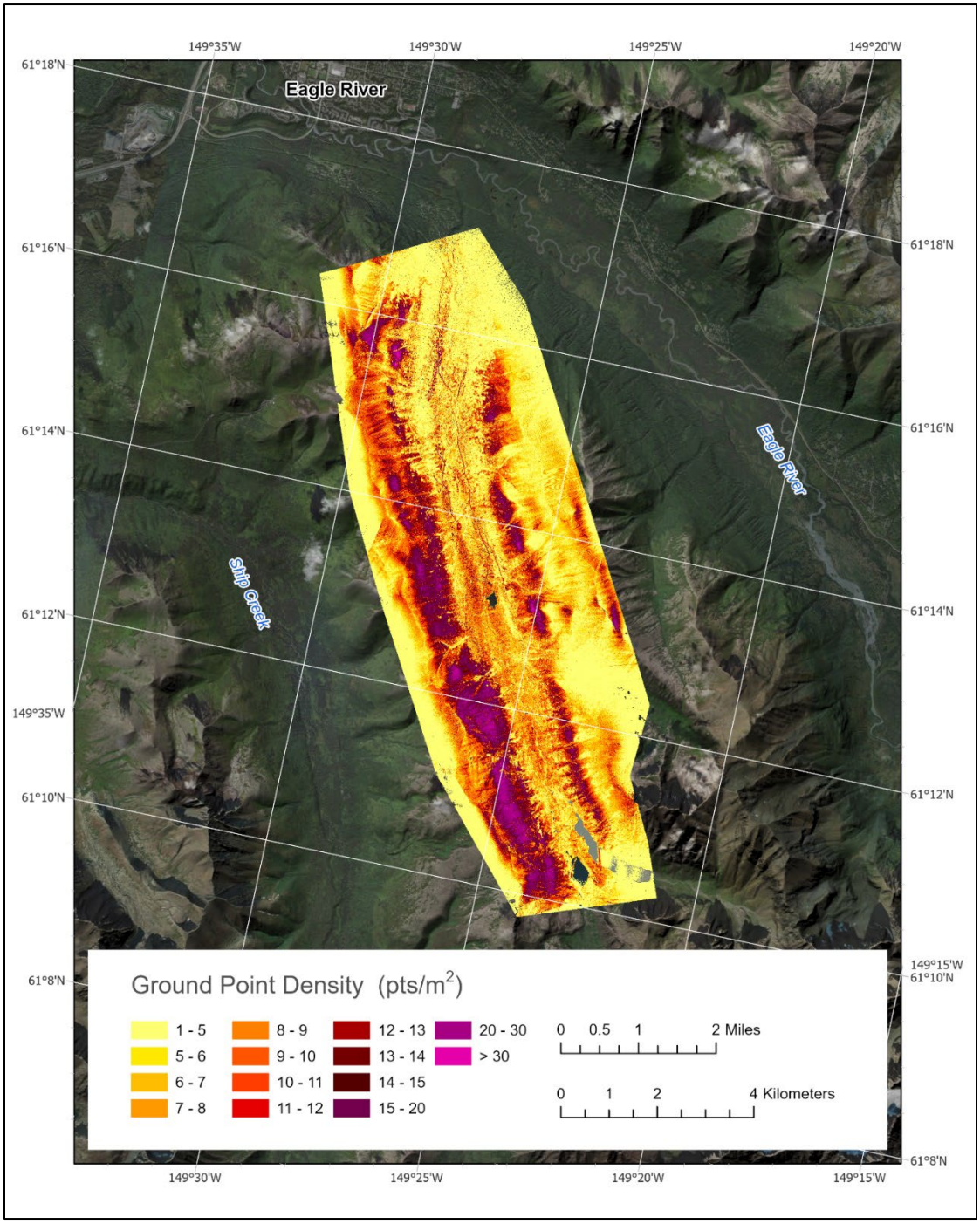

Figure 2. Ground point density for the survey displayed as a raster.

SURVEY REPORT

Ground Survey Details

Ground control points were collected by Alaska Division of Mining, Land and Water from August 21 to August 29, 2024. The data collection was performed with Trimble R12 and R12i GNSS receivers and a Trimble TSC5 controller for the static network and real-time kinematic (RTK) survey. They collected 30 Ground Control Points (GCP), and 30 Non-vegetated Vertical Accuracy (NVA) and 30 Vegetated Vertical Accuracy (VVA) check points.

Coordinate System and Datum

We processed and delivered all data in NAD83 (2011) UTM6N and vertical datum NAVD88 GEOID12B.

Horizontal Accuracy

Horizontal accuracy was not measured for this collection; it is considered inherent in the airborne GPS/IMU solution.

Vertical Accuracy

The entire MOA dataset was processed as a single unit, and relative accuracy was evaluated based on interswath overlap consistency, yielding an RMSE of 2.2 cm. We measured a mean elevation offset of +46.1 cm between 29 control points and the point cloud (app. 1). This offset was reduced by applying a constant vertical correction of -46.1 cm to the point cloud. A total of 30 independent non-vegetated checkpoints were evaluated, demonstrating an RMSE of 18.9 cm and yielding an NVA of 37.0 cm at the 95% confidence level (app. 2). A total of 29 vegetated checkpoints were evaluated. The VVA, represented as the 95th-percentile absolute vertical error, was calculated as 117 cm (app. 3). The dataset meets the USGS LiDAR Base Specification accuracy requirements for QL3 in all evaluated categories.

Data Consistency and Completeness

This is a full-release dataset. There was no over-collect. Data quality is consistent throughout the survey, save for gaps over snow areas or in very thick vegetation between flightlines.

ACKNOWLEDGMENTS

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REFERENCES

The American Society for Photogrammetry & Remote Sensing (ASPRS), 2025, LAS Specification 1.4 - R16. https://publicdocuments.asprs.org/las-v14-r16-2025

APPENDIX 1: GROUND CONTROL POINTS

NUMBER	EASTING (M)	NORTHING (M)	KNOWN Z (M)	LASER Z (M)	DZ (M)
1	368167.1	6791224	597.133	597.69	0.557
2	367643.3	6792631	546.516	547.01	0.494
3	369430.6	6790094	715.552	716.01	0.458
4	368864.2	6790835	659.388	659.92	0.532
5	368468.8	6791640	620.699	621.11	0.411
6	367066.7	6796333	369.877	370.36	0.483
7	367310	6795192	452.828	453.25	0.422
8	367102.4	6793504	597.743	598.13	0.387
9	367147.5	6794445	530.186	530.57	0.384
10	367478.8	6793965	480.03	480.48	0.45
11	367923.3	6794233	556.098	556.55	0.452
13	371456.8	6786045	782.12	782.71	0.59
14	371037.1	6786546	744.603	745.43	0.827
15	370689.3	6787109	728.086	728.41	0.324
16	370512.6	6787555	713.454	714.14	0.686
17	370105.8	6788370	716.327	717.01	0.683
18	369519.5	6788558	678.268	678.88	0.612
19	368983.5	6788852	722.146	722.53	0.384
20	368731.6	6789413	719.058	719.35	0.292
21	368147.4	6790546	675.179	675.58	0.401
22	368034.4	6790868	653.368	653.76	0.392
23	369062.5	6790277	666.359	666.94	0.581
24	368108.6	6792140	568.214	568.69	0.476
25	368021.5	6790452	730.622	730.97	0.348
26	367533.4	6791072	787.914	788.12	0.206
27	367773.9	6790334	848.267	848.7	0.433
28	367180.8	6790542	867.85	868.5	0.65
29	367380.6	6790717	936.316	936.53	0.214
30	366241.8	6792836	1029.547	1029.8	0.253

AVERAGE DZ (M)	0.687
MINIMUM DZ (M)	0.431
MAXIMUM DZ (M)	1.085
AVERAGE MAGNITUDE ERROR (M)	0.687
ROOT MEAN SQUARE ERROR (M)	0.714
STANDARD DEVIATION (M)	0.199

APPENDIX 2: NONVEGETATED CHECK POINTS

NUMBER	EASTING (M)	NORTHING (M)	KNOWN Z (M)	LASER Z (M)	DZ (M)
1	368337	6790879	599.125	599.21	0.085
2	368064.1	6791515	582.852	582.85	-0.002
3	369174	6790528	704.648	704.72	0.072
4	368922	6790456	643.508	643.57	0.062
5	369087.9	6790154	662	662.09	0.09
6	368625.6	6791227	628.838	628.81	-0.028
7	368122.5	6792492	569.948	570.03	0.082
8	367335.7	6795955	398.233	398.18	-0.053
9	367148.8	6795513	453.035	453.04	0.005
10	367252.8	6794783	494.128	494.21	0.082
11	367302.7	6793813	539.295	539.26	-0.035
12	367851.4	6793781	545.488	545.5	0.012
13	371710.8	6785418	794.464	794.08	-0.384
14	371636.9	6785699	799.627	799.63	0.003
15	371557.5	6785889	791.412	791.43	0.018
16	371188.8	6786328	756.765	756.95	0.185
17	370828.2	6786883	735.023	735.39	0.367
18	370612.6	6787316	722.931	722.87	-0.061
19	370415	6787684	715.848	715.96	0.112
20	370313	6787987	701.098	701.31	0.212
21	370170.8	6788199	708.556	708.88	0.324
22	369800.5	6788472	688.403	688.63	0.227
23	369405	6788673	679.379	679.47	0.091
24	369677.9	6789988	812.703	812.94	0.237
25	369955	6789781	920.993	921.59	0.597
26	368417.6	6791853	613.415	613.36	-0.055
27	368311.1	6791744	590.562	590.61	0.048
28	367039.6	6790901	1082.601	1082.57	-0.031
29	366739.5	6791195	1120.191	1120.13	-0.061
30	366259	6792491	1076.767	1076.51	-0.257
AVERAGE DZ (M)	0.065				
MINIMUM DZ (M)	-0.384				
MAXIMUM DZ (M)	0.597				
AVERAGE MAGNITUDE ERROR (M)	0.129				
ROOT MEAN SQUARE ERROR (M)	0.189				
STANDARD DEVIATION (M)	0.181				

APPENDIX 3: VEGETATED CHECK POINTS

NUMBER	EASTING (M)	NORTHING (M)	KNOWN Z (M)	LASER Z (M)	DZ (M)
1	368339.8	6790813	601.4	601.7	0.3
2	367818	6791906	578.366	578.33	-0.036
3	369407.9	6790154	715.087	715.71	0.623
4	369056.6	6789998	650.958	651.53	0.572
5	368005.9	6792887	574.61	575.98	1.37
6	367217.3	6796111	400.944	400.97	0.026
7	367307.5	6795620	417.676	417.76	0.084
8	367144.2	6795872	427.112	426.72	-0.392
10	367103	6793904	576.601	576.61	0.009
11	367327.7	6794202	514.306	514.52	0.214
12	368070.3	6791070	613.752	613.94	0.188
13	371689.3	6785508	804.03	804.15	0.12
14	371536.2	6785949	782.222	782.58	0.358
15	371268.8	6786257	762.907	762.97	0.063
16	370967.1	6786671	741.786	742.21	0.424
17	370639.3	6787244	723.342	723.6	0.258
18	370374	6787816	710.76	711	0.24
19	370321	6787908	705.643	705.82	0.177
20	370014.5	6788429	713.999	714.2	0.201
21	369661	6788527	681.461	681.96	0.499
22	369297.2	6788579	691.684	691.74	0.056
23	368831.8	6789007	736.866	737.09	0.224
24	368630.2	6789659	707.093	707.37	0.277
25	368355.1	6790182	678.963	678.44	-0.523
26	367969.2	6791134	629.786	629.67	-0.116
27	369543.1	6790042	756.769	757.62	0.851
28	369890.2	6789784	895.469	896.35	0.881
29	367915.1	6790831	691.768	691.64	-0.128
30	367639.7	6790605	827.874	828.2	0.326

AVERAGE DZ (M)	0.246
MINIMUM DZ (M)	-0.523
MAXIMUM DZ (M)	1.37
AVERAGE MAGNITUDE ERROR (M)	0.329
ROOT MEAN SQUARE ERROR (M)	0.445
STANDARD DEVIATION (M)	0.377