



Accuracy Report – USGS LiDAR

TX_Hurricane_2018_D18_Supplemental | Texas

Block 3

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Document Control

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Client Information

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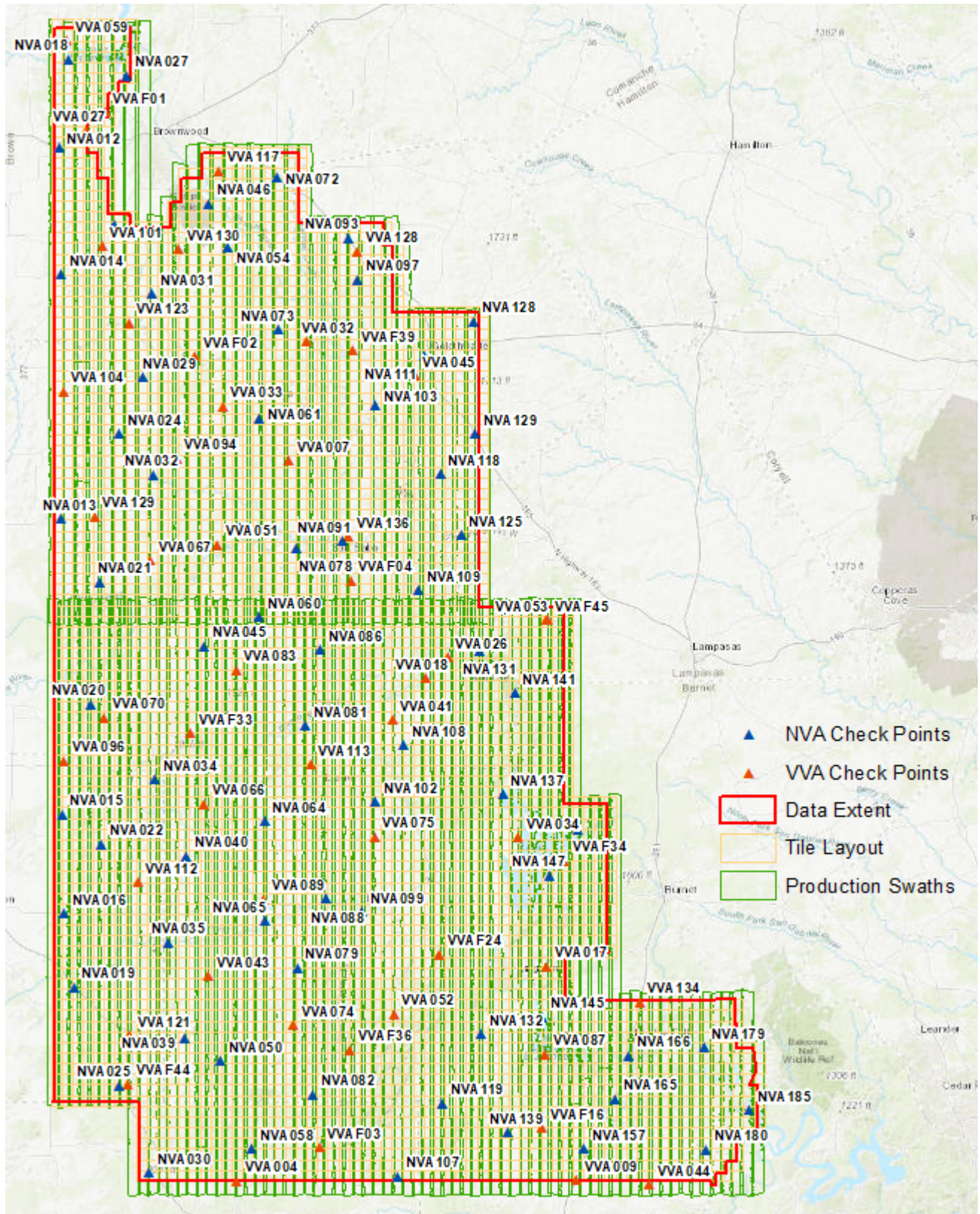
Revision History

Issue	Date	Status	Comments on Content	Prepared By	Reviewed By
01	date	For Review	Awaiting client comments	CM/CRM/JW	KS

Project Team

Initials	Name	Role
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TX Harvey Block 3 – LiDAR Check Points



1. Accuracy reporting

Data collected under this Task Order meets the National Standard for Spatial Database Accuracy (NSSDA) accuracy standards. The NSSDA standards specify that vertical accuracy be reported at the 95 percent confidence level for data tested by an independent source of higher accuracy.

1.1 Positional Accuracy

Before classification and development of derivative products from the point cloud, the absolute and relative vertical accuracies of the point cloud were verified.

1.2 Absolute Vertical Accuracy

Unclassified Lidar Point Cloud Data: The Non-Vegetated Vertical Accuracy (NVA) of the Lidar Point Cloud data was calculated against TINs derived from the final calibrated and controlled swath data. The required accuracy (ACCZ) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSEZ of 10 cm in the "open terrain" and/or "Urban" land cover categories. This is a required accuracy. Please refer to the table below for the achieved accuracies. The raw swath point cloud data met the required accuracy levels before point cloud classification and derivative product generation.

Table 1: Accuracy of the Lidar Point Cloud Data (check points against swath covering Block 3)

Raw Flight Lines	RMSEz (non-vegetated)	NVA at 95-percent confidence level
Specification (cm)	≤ 10	≤ 19.6
Calculated Values (cm)	3.8	7.5
Specification (m)	≤ 0.100	≤ 0.196
Calculated Values (m)	0.038	0.075
Number of points	73	73

Bare Earth Surface: The accuracy (ACCZ) of the derived DEM was calculated and is being reported in three (3) ways:

1. **RMSEZ (Non-Vegetated):** The required RMSEZ is ≤ 10 cm.
2. **Non-Vegetated Vertical Accuracy (NVA):** The required NVA is: ≤ 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSEZ of 10 cm in the “open terrain” and/or “Urban” land cover categories. This is a required accuracy.
3. **Vegetated Vertical Accuracy (VVA):** The required VVA is: ≤ 29.4 cm at a 95th percentile level, derived according to ASPRS Guidelines, Vertical Accuracy for Reporting LiDAR Data, i.e. based on the 95th percentile error in Vegetated land cover categories combined (Tall Grass, Brush, Forested Areas). This is a required accuracy.

Please refer to the table below for the achieved accuracies.

Table 2: Accuracy of the Derived DEM (Block 3)

DEM	RMSEz (non-vegetated)	NVA at 95-percent confidence level	VVA at 95th percentiles
Specification (cm)	≤ 10	≤ 19.6	≤ 29.4
Calculated Values (cm)	4.3	8.4	19.4
Specification (m)	≤ 0.100	≤ 0.196	≤ 0.294
Calculated Values (m)	0.043	0.084	0.194
Number of points	47	47	37

1.3 Relative Accuracy

Smooth Surface Repeatability: In ideal theoretical conditions, smooth surface repeatability is a measure of variations documented on a surface that would be expected to be flat and without variation. Users of lidar technology commonly refer to these variations as “noise.” Single-swath data was assessed using only single returns in non-vegetated areas. Repeatability was evaluated by measuring departures from planarity of single returns from hard planar surfaces, normalizing for actual variation in the surface elevation. Repeatability of only single returns was then assessed at multiple locations within hard surfaced areas (for example, parking lots or large rooftops).

Each sample area was evaluated using a signed difference raster (maximum elevation – minimum elevation) at a cell size equal to twice the ANPS, rounded up to the next integer. Sample areas were larger than 50 square meters (m²). The maximum acceptable variations within sample areas for this project is 6 cm. Isolated noise is expected within the sample areas and was disregarded.

The evaluation was done on 21 flat open sample areas over the Block 3 AOI. The results are shown in the table below, please also refer to:

Harvey_B3_Relative_Accuracy_Smooth_Surface_Repeatability.shp

Table 3: Relative Vertical Accuracy, Smooth Surface Repeatability (Block 3)

Area (square meters)	RMSDz (meters)
104.770	0.0157
206.523	0.0167
135.200	0.0228
239.656	0.0181
354.400	0.0187
180.477	0.0218
235.448	0.0212
225.511	0.0147
591.937	0.0164
373.528	0.0220
251.217	0.0208
260.553	0.0168
272.320	0.0159
224.109	0.0122
189.655	0.0175
171.515	0.0197
442.701	0.0179
305.371	0.0235
267.979	0.0187
264.876	0.0157
349.312	0.0160

Overlap Consistency: Overlap consistency is a measure of geometric alignment of two overlapping swaths; the principles used with swaths can be applied to overlapping lifts and projects as well. Overlap consistency is the fundamental measure of the quality of the calibration or boresight adjustment of the data from each lift and is of particular importance as the match between the swaths of a single lift is a strong indicator of the overall geometric quality of the data, establishing the quality and accuracy limits of all downstream data and products.

Overlap consistency was assessed at multiple locations within overlap in non-vegetated areas of only single returns.

Each overlap area was evaluated using a signed difference raster with a cell size equal to twice the ANPS, rounded up to the next integer. The difference rasters are visually examined using a bicolored ramp from the negative acceptable limit to the positive acceptable limit. Although

isolated excursions beyond the limits are expected and accepted, differences in the overlaps shall not exceed the following limits:

1. Swath overlap difference, $RMSDz \leq 8$ cm
2. Swath overlap difference, maximum ± 16 cm

The difference rasters are also statistically summarized to verify that root mean square difference in z (RMSDz) values do not exceed the project specifications. Consideration will be given for the effect of the expected isolated excursions over limits.

The result of the evaluation over 33 samples throughout the Block 3 AOI is shown in the table below, please also refer to:

Harvey_B3_Relative_Accuracy_Flightline_Overlap.shp

Table 4: Relative Vertical Accuracy, Overlap Consistency (Block 3)

Area (square meters)	RMSDz (meters)	Maximum DZ (meters)	Minimum DZ (meters)
737.11	0.0280	0.0035	-0.0603
650.56	0.0337	0.0656	-0.0032
834.07	0.0145	0.0295	-0.0453
764.20	0.0244	0.0589	-0.0189
706.09	0.0532	0.0295	-0.1101
531.54	0.0168	0.0457	-0.0307
649.80	0.0359	0.0094	-0.0754
932.33	0.0190	0.0625	-0.0375
522.30	0.0196	0.0256	-0.0696
523.76	0.0456	0.0814	0.0131
797.22	0.0185	0.0466	-0.0172
447.97	0.0445	0.0807	0.0029
558.43	0.0338	0.0835	-0.0293
618.11	0.0361	0.0027	-0.0666
402.16	0.0466	0.0933	-0.1034
436.71	0.0430	-0.0154	-0.0683
799.53	0.0358	0.0674	-0.0181
675.99	0.0139	0.0320	-0.0500
521.10	0.0206	0.0261	-0.0869
594.35	0.0246	0.0163	-0.0588
797.69	0.0156	0.0292	-0.0464
729.52	0.0164	0.0568	-0.0257
488.21	0.0287	0.0652	-0.0256
515.92	0.0494	0.1026	-0.0158
749.85	0.0226	0.0588	-0.0198
775.15	0.0198	0.0306	-0.0493
504.16	0.0343	0.0733	-0.0117

759.29	0.0171	0.0485	-0.0441
644.48	0.0392	0.0792	-0.0023
503.13	0.0510	0.0566	-0.1020
440.24	0.0310	0.0152	-0.0614
738.96	0.0306	0.0178	-0.0769
466.85	0.0528	-0.0155	-0.0930