Accuracy Report – LiDAR

CPRA LADOTD Lidar 2019 | Louisiana

Block 3

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01	date	For Review	Awaiting client comments	JW	KS

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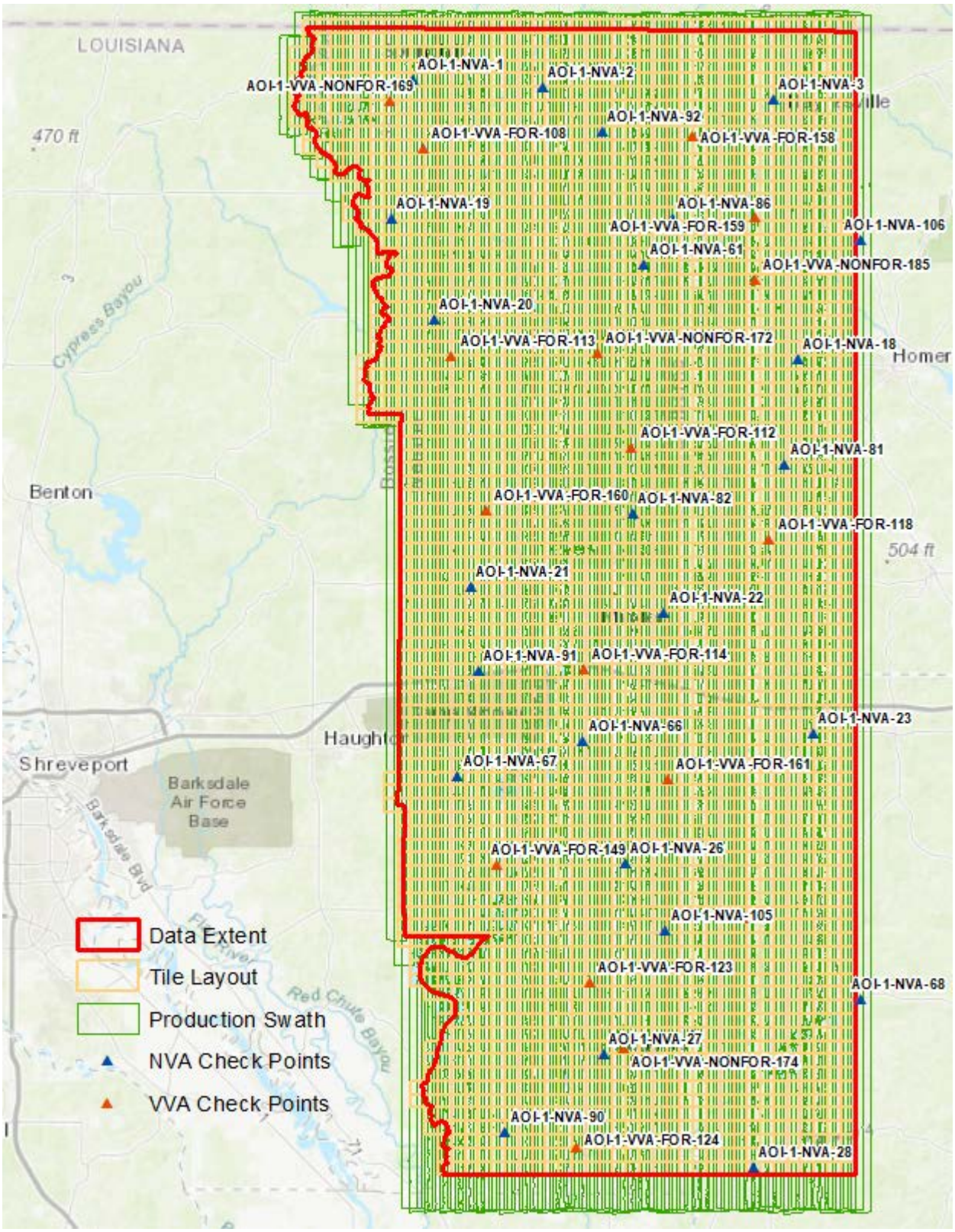
CPRA Block 3 – LiDAR Check Points



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 (Block 3)

Raw Flight Lines	RMSEz (non-vegetated)	NVA at 95-percent confidence level
Specification (cm)	≤ 10	≤ 19.6
Calculated Values (cm)	5.6	10.9
Specification (m)	≤ 0.100	≤ 0.196
Calculated Values (m)	0.056	0.109
Number of points	25	25

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)	5.2	10.2	20.5
Specification (m)	≤ 0.100	≤ 0.196	≤ 0.294
Calculated Values (m)	0.052	0.102	0.205
Number of points	23	23	17

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 38 flat open sample areas over Block 3 AOI. The results are shown in the table below, please also refer to:

CPRA_Block3_Lidar_Relative_Accuracy_Smooth_Surface_Repeatability_UTM15.shp

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

Area (square meters)	RMSDz (meters)
50.265	0.0579
50.265	0.0196
50.265	0.0188
50.265	0.0319
50.265	0.0340
50.265	0.0454
50.265	0.0170
50.265	0.0402
50.265	0.0348
50.265	0.0213
50.265	0.0281
50.265	0.0182
50.265	0.0590
50.265	0.0120
50.265	0.0224
50.265	0.0364
50.265	0.0275
50.265	0.0429
50.265	0.0197
50.265	0.0277
50.265	0.0362
50.265	0.0535
50.265	0.0433
50.265	0.0303
50.265	0.0268
50.265	0.0413
50.265	0.0265
50.265	0.0240
50.265	0.0279
50.265	0.0544
50.265	0.0196
50.265	0.0327
50.265	0.0488
50.265	0.0203
50.265	0.0195
50.265	0.0571
50.265	0.0366
50.265	0.0261

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 ≤ 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 Block 3 AOI is shown in the table below, please also refer to:

CPRA_Block3_Lidar_Relative_Accuracy_Swath_Overlap_UTM15.shp

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

Area (square meters)	RMSDz (meters)	Maximum DZ (meters)	Minimum DZ (meters)
450	0.0138	0.0372	-0.0210
450	0.0210	0.0153	-0.0462
450	0.0227	0.0464	-0.0049
450	0.0318	0.0673	-0.0021
450	0.0148	0.0381	-0.0359
450	0.0468	-0.0126	-0.0760
450	0.0193	0.0452	-0.0437
450	0.0278	0.0534	-0.0143
450	0.0256	0.0858	-0.0113
450	0.0242	0.1258	-0.1251

450	0.0219	0.0552	-0.0366
450	0.0535	-0.0079	-0.1034
450	0.0163	0.0235	-0.0397
450	0.0161	0.0448	-0.0288
450	0.0140	0.0352	-0.0442
703	0.0185	0.0158	-0.0441
703	0.0284	0.0080	-0.0700
703	0.0377	0.0613	0.0084
703	0.0178	0.0411	-0.0134
703	0.0585	0.0993	0.0126
703	0.0340	0.0096	-0.0565
703	0.0363	0.0001	-0.0733
703	0.0371	0.0797	-0.0197
703	0.0274	0.0081	-0.1396
703	0.0135	0.0357	-0.0274
703	0.0196	0.0504	-0.0327
703	0.0122	0.0387	-0.0430
703	0.0332	0.0023	-0.0647
703	0.0298	0.0116	-0.0539
703	0.0136	0.0369	-0.0282
703	0.0191	0.0445	-0.0142
703	0.0578	-0.0206	-0.0884
703	0.0423	-0.0075	-0.0768