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# Accuracy Report – LiDAR

CPRA LADOTD Lidar 2019 | Louisiana

## **Block 4**

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Version 01

**Prepared for: CPRA/LADOTD**



# Document Control

## Document Information

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## Client Information

Client	Prepared for: CPRA/LADOTD
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Client Contact	Stephen Melton

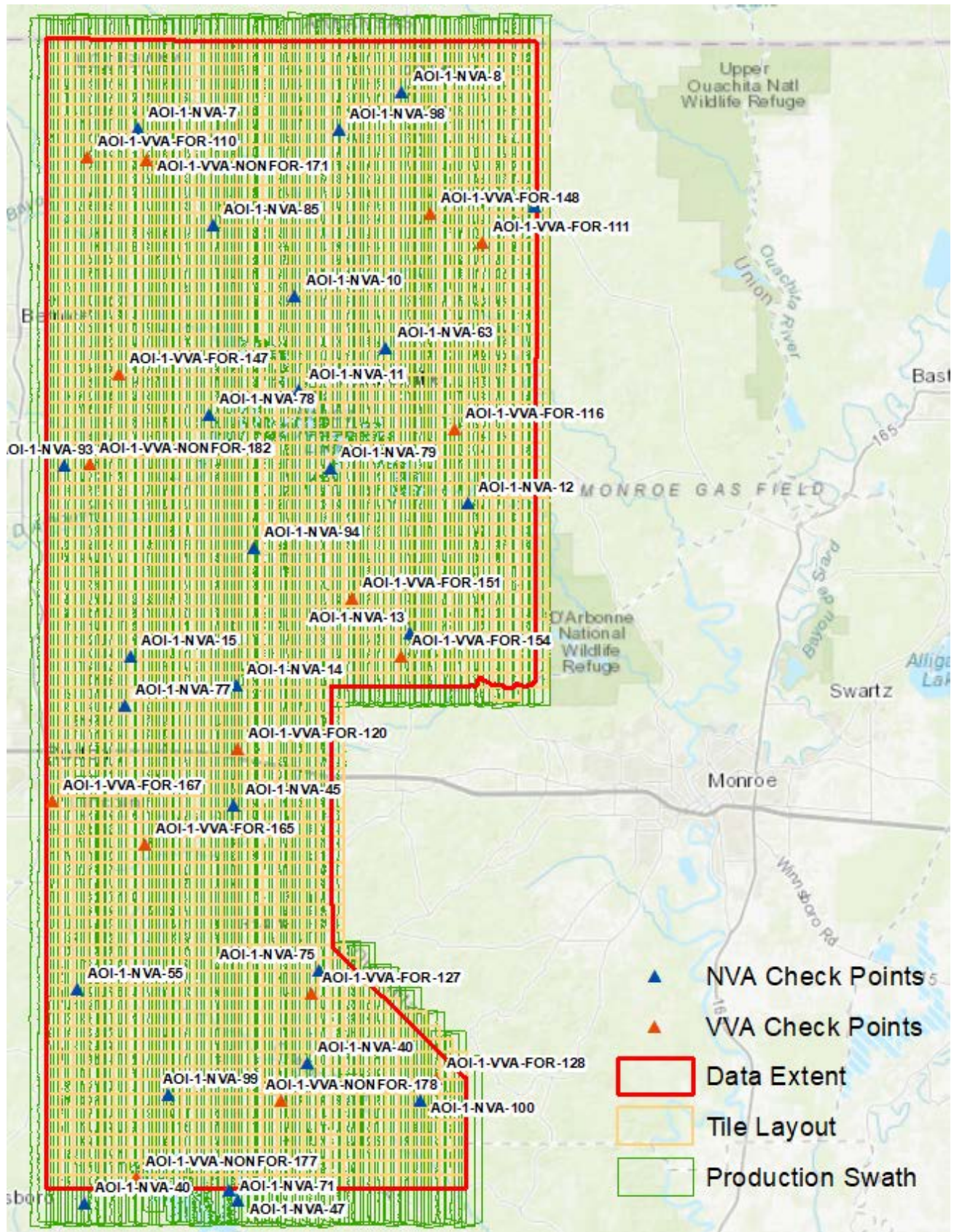
## Revision History

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

## Project Team

Initials	Name	Role
KS	Katie Springman	Project Manager
JW	Jaroslava Waters	Terrain Department Supervisor

# CPRA Block 4 – LiDAR Check Points



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# 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 4)

Raw Flight Lines	RMSEz (non-vegetated)	NVA at 95-percent confidence level
Specification (cm)	≤ 10	≤ 19.6
Calculated Values (cm)	4.4	8.6
Specification (m)	≤ 0.100	≤ 0.196
Calculated Values (m)	0.044	0.086
Number of points	26	26

**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  $\leq 10$  cm.
2. **Non-Vegetated Vertical Accuracy (NVA):** The required NVA is:  $\leq 19.6$  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:  $\leq 29.4$  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 4)

DEM	RMSEz (non-vegetated)	NVA at 95-percent confidence level	VVA at 95th percentiles
Specification (cm)	$\leq 10$	$\leq 19.6$	$\leq 29.4$
Calculated Values (cm)	3.9	7.6	13.8
Specification (m)	$\leq 0.100$	$\leq 0.196$	$\leq 0.294$
Calculated Values (m)	0.039	0.076	0.138
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 (m<sup>2</sup>). 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 18 flat open sample areas over Block 4 AOI. The results are shown in the table below, please also refer to:

*CPRA\_Block4\_Lidar\_Relative\_Accuracy\_Smooth\_Surface\_Repeatability\_UTM15.shp*

Table 3: Relative Vertical Accuracy, Smooth Surface Repeatability (Block 4)

Area (square meters)	RMSDz (meters)
50.01	0.0248
50.01	0.0463
50.01	0.0529
50.01	0.0527
50.01	0.0240
50.01	0.0186
50.01	0.0252
50.01	0.0288
50.01	0.0470
50.01	0.0249
50.01	0.0211
50.01	0.0331
50.01	0.0506
50.01	0.0311
50.01	0.0230
50.01	0.0513
50.01	0.0357
50.01	0.0476

**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  $\pm 16$  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 23 samples throughout Block 4 AOI is shown in the table below, please also refer to:

*CPRA\_Block4\_Lidar\_Relative\_Accuracy\_Swath\_Overlap\_UTM15.shp*

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

Area (square meters)	RMSDz (meters)	Maximum DZ (meters)	Minimum DZ (meters)
450.10	0.0334	0.1047	-0.0453
450.10	0.0293	0.0625	-0.0055
450.10	0.0139	0.0482	-0.0152
450.10	0.0178	0.0680	-0.0397
450.10	0.0166	0.0277	-0.0459
450.10	0.0301	0.0664	-0.0340
450.10	0.0263	0.0715	-0.0455
450.10	0.0407	0.0776	-0.1451
450.10	0.0116	0.0366	-0.0168
450.10	0.0111	0.0300	-0.0294
450.10	0.0138	0.0306	-0.0349
450.10	0.0476	0.1230	-0.0500
450.10	0.0381	0.0814	-0.0287
450.10	0.0583	-0.0179	-0.1179
450.10	0.0142	0.0497	-0.0270
450.10	0.0240	0.0204	-0.0859
450.10	0.0157	0.0249	-0.0445
450.10	0.0494	0.0979	0.0062
450.10	0.0243	0.0584	-0.0452
450.10	0.0384	0.0226	-0.0894
450.10	0.0243	0.0861	-0.0543
450.10	0.0331	0.0324	-0.0765
450.10	0.0192	0.0260	-0.0586