



**2024 Light Detection and Ranging (LiDAR) Project
MEMORANDUM OF AGREEMENT
between**

North Carolina Emergency Management

Chatham County

I. General information

1. This Agreement is between North Carolina Emergency Management (hereinafter referred as NCEM) and Chatham County.
2. This Memorandum of Agreement (MOA) is in accordance with the responsibility of NCEM for coordination of installation and operation of water level gauges and meteorological sensors across North Carolina.

II. Authority

1. This agreement is authorized between NCEM and the Chatham County pursuant to N.C. Gen. Stat. § 166A-19.12(14).

III. Purpose

The purpose of this MOA is to develop a partnership between NCEM and Chatham County.

1. Collect Quality Level 1 Light Detection and Ranging (LiDAR) data in Chatham County.
2. Perform quality control of the collected Lidar data in the Phase III.
3. Provide the Chatham County the collected and quality control LiDAR data and data products listed in the attached project summary (pages 3-4)



The project deliverables would conform to the USGS product specification for LiDAR and derived products in effect at the time of project data acquisition. As of this writing, the current version of the USGS Lidar Base Specification as posted on the USGS “[Lidar Base Specification Online](https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-online)” website (<https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-online>) is **2022**

rev. A.

In brief, the collection would entail the following:

- Aggregate nominal pulse density ≥ 8 pls/m²
- Aggregate nominal post spacing of ≤ 0.35 m
- Vertical accuracy of 10 cm (3.36 inch) RMSEz
- 5-foot DEMs and 10-foot DEMs in Esri grid format
- Metadata
- Intensity images
- A 500-meter buffer zone that would extend into the bordering North Carolina counties as well as the bordering South Carolina and Virginia counties.
- LAS files would be delivered in the ASPRS version in effect at the time of the GPSC task order. The current version is 1.4-R15 format (<https://www.asprs.org/divisions-committees/lidar-division/laser-las-file-format-exchange-activities>). The LAS files would have 13 levels of Classification and an optional 2 levels of additional Classification (Table 3).

Table 3. The North Carolina LiDAR classification scheme of 15 categories, 2 of which are

Code	Description
1	Default
2	Ground
3	Low veg/strata
4	Medium veg/strata
5	High veg/strata
6	Buildings (automated)
7	Low points/noise
9	Water
10	Breakline proximity
11	Withheld (high points)
13	Roads (optional)
14	Bridges (optional)
17	Overlap default
18	Overlap ground
25	Overlap water

For more information about our proposed project, please read the details below:

- **Raw point cloud data**
 - Compliant LAS v1.4-R15
 - Delivered in statewide 2,500 ft x 2,500 ft tiling scheme (approximately 14,400 tiles)
 - Metadata to FGDC standards
 - Georeferenced information included in all LAS file headers
 - GPS times would be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each return
 - Intensity values
 - Full swaths, all collected points to be delivered
 - 1 file per swath, 1 swath per file, file size not to exceed 2GB

- **Classified point cloud data**
 - Compliant LAS v1.4-R15
 - Georeferenced information would be included in the LAS header
 - GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each return
 - Intensity values
 - Tiled delivery, without overlap

- **Bare earth surface (raster DEM) -**
 - DEMs at five cell sizes: 3.125-ft, 5-ft, 10-ft, 20-ft, and 50-ft.
 - Delivery in Esri grid format
 - Georeferenced information would be included in raster file
 - Tiled delivery, without overlap
 - DEM tiles would show no edge artifacts or mismatch
 - Void areas (i.e., areas outside the project boundary, but within the tiling scheme) would be coded using a unique “NODATA” value. This value would be identified in the appropriate location within the file header.
 - Depressions (natural or man-made sinks) would not be filled (as in hydro-enforcement)
 - Water bodies (ponds and lakes), wide streams and rivers (“double-line”), and other non-tidal water bodies would be hydro-flattened (hydro-corrected) in GeoTIFF format in 3.125-ft, 5-ft, 10-ft, 20-ft, and 50-ft raster sizes
 - Tree/Veg Canopy (optional item)
 - Impervious surfaces (optional item)

- **Intensity images**
 - Gray scale, 8-bit, GeoTIFF format, 10 ft raster cell size (Figure 8)

- **Breaklines**
 - Hydro breaklines files to USGS specs (2 acres or 100 ft across), Esri shapefile format
 - Hydro-Flattening (Optional)
 - Waterbodies with a surface area greater than 0.25 acres
 - Riverways wider than 40'

- **Tiling scheme**
 - Data tiled to the North Carolina statewide seamless tiling scheme created from the 10,000 ft x 10,000 ft grid specified in the [“https://it.nc.gov/documents/files/north-carolina-”](https://it.nc.gov/documents/files/north-carolina-)



Figure 8. An example of an intensity

[technical-specification-lidar-base-mapping](https://it.nc.gov/documents/files/north-carolina-technical-specification-lidar-base-mapping)” (<https://it.nc.gov/documents/files/north-carolina-technical-specification-lidar-base-mapping>). The new tiling scheme is 2,500 ft x 2,500 ft, which would allow for easier use based on the size of the data.

- **Terrain datasets by county**
- **Independent QA/QC report**
 - Validation of the data includes vertical quality control with independent surveyed control points collected within each county; automated checks of density; road comparisons against existing road lines; point density comparisons within class, such as noise points misclassified; and road classification validation. Quality control would be completed referencing the USGS product specification for LiDAR and derived products in effect at the time of the GPSC task order. As of this writing, the current version of the USGS Lidar Base Specification as posted on the USGS “[Lidar Base Specification Online](https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-online)” website (<https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-online>) is **2022 rev. A** and the current vertical accuracy table is posted on “[Lidar Base Specification: Tables](https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-tables)” webpage (<https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-tables>) (Table 4).

Table 4. Absolute vertical accuracy in meters (m) for LiDAR data and digital elevation models for the following:

- RMSE_z: Root mean square error in z
- NVA: Nonvegetated vertical accuracy
- VVA: Vegetated vertical accuracy

Quality Level	RMSE _z (nonvegetated area) (m)	NVA at the 95-percent confidence level (m)	VVA at the 95th percentile (m)
QL0	≤ 0.050	≤ 0.098	≤ 0.15
QL1	≤ 0.100	≤ 0.196	≤ 0.30
QL2	≤ 0.100	≤ 0.196	≤ 0.30
QL3	≤ 0.200	≤ 0.392	≤ 0.60

- **Project Timeline:**

LiDAR data collection will be performed during leaf-off conditions (January – March). The estimated delivery dates for the processing and classification and all products would proceed as follows (Table 5):

Table 5. The estimated delivery dates for the processing and classification and all products and

	Delivery dates	
When the Acquisition phase is actually conducted	Processing calibration and classification would be delivered on an incremental schedule until the beginning of:	All products and deliverables should be available by beginning of:
January-March	November -December of the same year as data acquisition	February (of the following year of acquisition)

Note: Quality control would be performed with all deliverables.