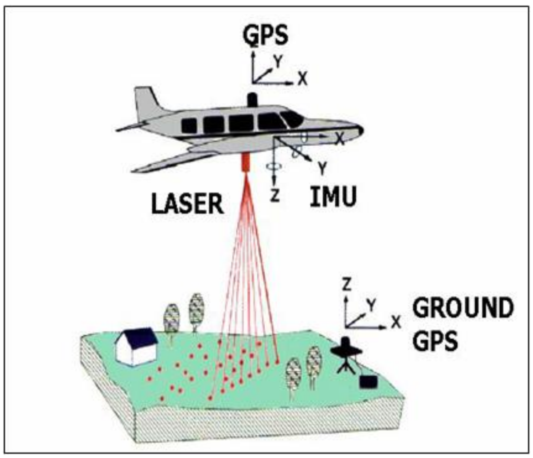
NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

LiDAR Requirements for Floodplain Mapping

Light Detection and Ranging (LiDAR) is a system for gathering digital terrain data using airborne laser systems flown aboard an aircraft equipped with GPS. The laser system is used to determine distances and angles to the ground which can determine x, y and z coordinates of both manmade and naturally occurring terrain and terrain features. Guidance for LiDAR data collection has been incorporated into Appendix A of the Guidelines and Specifications for Flood Hazard Mapping Partners.



Topographic Data Requirements

FEMA defines its topographic data accuracy requirements in map scale and contour intervals equivalent to the National Map Accuracy Standard (NMAS).

FEMA defines two general categories for vertical accuracy of LiDAR data:

- Two-Foot Equivalent – This is data that has an accuracy of ±1.2 feet (36.5cm) at the 95% confidence interval (i.e. 95% of data points have an accuracy with respect to the true ground elevation equal to 1.2 feet or smaller).
- Four-Foot Equivalent – This is data that has an accuracy of ±2.4 feet (73.2 cm) at the 95% confidence interval (i.e. 95% of data points have an accuracy with respect to the true ground elevation equal to 2.4 feet or smaller)

Two-Foot Equivalent data is generally required for modeling and mapping areas of flat terrain, particularly where closed basin modeling is required. Four-Foot Equivalent data is generally acceptable where there is moderate to steep terrain although due to improved technology, new most LiDAR datasets meet or exceed the standards for 2ft-equivalent data. In relatively flat areas like those commonly found in the Northwest Florida Water Management District (NWFWMD), one-foot equivalent data is normally achieved with modern LiDAR technology.

The required horizontal accuracy of LiDAR data is a function of the intended map panel scale. The following radial horizontal RMSE values and accuracies are required for certain map panel scales:

Map Scale	NSSDA RMSE (ft)	NSSDA Accuracy, 95% Confidence Level
1” = 500’	11	19.0
1” = 1000’	22	38.0
1” = 2000’	26.3	45.6

When only data of a lesser standard is available, the Regional Project Officer or Project Officer for FEMA may accept a lower standard if it can be demonstrated that it is the best available data and is likely to produce improved results from any effective studies.

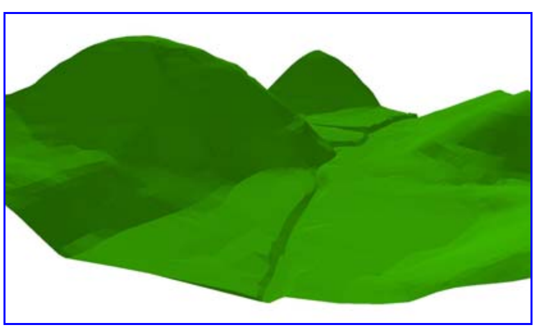
LiDAR Data Formats

LiDAR data is normally supplied as mass points and may contain breaklines if required in either a spatial file or as an ASCII text file defining x, y, z coordinates for points and breakline vertices. Breaklines can be classified into two broad types:

- Hard-Breaklines – These define sudden changes in terrain such as ridgelines
- Soft-Breaklines – These ensure that an elevation is maintained along a smooth surface without interruptions in surface smoothness such as the centerline of a road

For the purpose of hydrologic modeling, LiDAR data is normally converted into Digital Elevation Model (DEM) which is a continuous grid of regular intervals and has an elevation specified for each grid cell. Because of the gridded nature of DEMs, accuracy is somewhat diminished from the original data source and cannot be recreated exactly from the DEM. The accuracy of a DEM decreases with increased cell size and/or more rapidly varying terrain. DEMs are also commonly used in floodplain delineations although smaller cell sizes are required than would normally be used for hydrology. The cell size of the DEM must be carefully selected for its intended purpose considering the variability of the terrain.

Digital Terrain Models using a Triangulated Irregular Network (TIN) are commonly used in Geographic Information Systems (GIS) for the creation of hydraulic model geometry and provide a continuous terrain surface. Unlike a DEM they can maintain the exact features of their input data (original point and breaklines could be recreated exactly from a TIN).



Benefits of Using LiDAR for Hydrologic Studies

LiDAR data when converted to a DEM can be used to automate watershed delineations with greater accuracy that the commonly used National Elevation Dataset (NED). This is particularly beneficial in very flat areas which require closed basin hydrologic and hydraulic analysis. Care must be taken to hydro enforce any DEM used for automated watershed delineation because the occurrence of dams and roadway embankments can often be confused by applications as watershed ridgelines creating hydrologic errors in the watershed and flow line delineations.

Benefits of Using LiDAR for Hydraulic Studies

Traditionally ground surveys were used for cross sections in hydraulic models but due to limited budgets, only partial cross sections were surveyed requiring overbank areas to be determined from low accuracy USGS Quad maps. At the scoping stage of a hydraulic study, it is often impossible to determine every location where a cross section will be needed to achieve model stability. Therefore when it was determined that more data was needed after the survey is complete and the models are nearing completion, it was often not feasible to collect new survey and so copied sections or interpolates were commonly used to achieve model stability.

The arrival of high accuracy LiDAR data has enabled partial survey sections to be extended using LiDAR data with accuracy far greater than that experienced using USGS Quads and comparable to that achieved using ground survey. This has reduced the cost of ground surveys since only the channel portion of a model cross section is required by ground survey. During the modeling process when it is determined that additional sections are needed, these sections can be created from LiDAR without ground survey. Care must be taken when doing this because LiDAR datasets normally do not contain any sub water surface data and therefore field measurements or approximations are needed for the channel portions of the cross section.

At the floodplain mapping stage of a hydraulic study, the DTM can be used to accurately delineate the floodplains. The ability to automate floodplain delineations from the digital topography reduces the time and enables a more accurate delineation to be performed reducing the cost of a study. When using LiDAR data for automated hydrology and hydraulics, approximate floodplains can be redelineated for incorporation into a DFIRM at comparable expense to digital uplift giving the user a much higher quality product than the effective data that is likely to be delineated from USGS Topographic Quadrangles. The higher accuracy achieved using high accuracy LiDAR data helps meet the standards required in Procedure Memorandum 38. This process is discussed in detail in document 7-Floodplain Re-Delineation for Zone AE.