TECHNICAL NOTE

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Guidelines for Light Detection and Ranging (LiDAR) – Contour Intervals

The creation and use of LiDAR Digital Elevation Model (DEM) derived contour data by the South Dakota (SD) Natural Resources Conservation Service (NRCS) Geographic Information System (GIS) users should not exceed (be smaller than) a 2 feet contour interval, unless the contours are for internal (NRCS) use only.

The use of LiDAR derived contours with a **contour interval less than 2 feet will be allowed <u>with the following qualifications</u>**:

- The derived contours are for **NRCS internal** use only. In the SD NRCS, we do not want to distribute information that does not meet our own levels of accuracy. If we do, it might be misconstrued as being official.
- **Maps** generated for use or **viewing outside of the NRCS will not include these contours** for the same reason as above.
- The **contours** will **not** be used as a **sole source** for **boundary** digitization.

The ongoing acquisition and distribution of LiDAR digital elevation datasets in SD, including DEMs, allows GIS users to generate a variety of derivative products, including; slope, aspect, hill shades, and contours. There is apt to be some confusion as to how tight of a contour interval is feasible when deriving contours from LiDAR DEMs.

LiDAR is available in many areas and in various degrees of quality. Table 1 provides specifications for 5 quality levels. Much of the NRCS collected airborne LiDAR currently available in SD is Quality Level (QL) 3.

Table 1 Quality level (QL) specifications

Elevation [1/] quality level (QL)	Horizontal resolution terms		Vertical accuracy terms	
	Point density, points/m²	Nominal pulse spacing, m	RMSEz [2/] in open terrain, cm	Equivalent contour accuracy, ft
QL 1	8	0.35	9.25	1 [3/]
QL 2	2	0.7	9.25	1
QL 3	1–0.25	1–2	≤18.5	2
QL 4	0.04	5	46.3–139	5–15
QL 5	0.04	5	92.7–185	10–20

[1/]Quality levels are based on National Enhancement Elevation Assessment (NEEA) quality levels

[2/]RMSEz = Root mean square error in the vertical direction.

Table 1 shows that LiDAR Quality Level 3 translates to ≤ 18.5 cm. (≈ 7.28 in.) vertical accuracy (RMSE[1]) on bare earth[2]. This figure is increased to 37 cm. (≈ 14.5 in.) vertical accuracy (RMSE) in obscured vegetative areas.

Table 2 Comparison of vertical accuracies

Equivalent contour interval National Map Accuracy Standard (NMAS) (ft)	RMSEz NSSDA (ft)	Accuracy$_{(z)}$ NSSDA (ft)
0.5	0.15 (4.60 cm)	0.30 (9.10 cm)
1	0.30 (9.25 cm)	0.60 (18.2 cm)
2	0.61 (18.5 cm)	1.19 (36.3 cm)
4	1.22 (37.0 cm)	2.38 (72.6 cm)
5	1.52 (46.3 cm)	2.98 (90.8 cm)
10	3.04 (92.7 cm)	5.96 (181.6 cm)

Table 2 shows that accurate contours down to 2 feet can be produced on a dataset with an 18.5 cm. RMSE and down to 4 feet on a dataset with a 37cm. RMSE. This can be done with a 95 percent confidence level[2].

LiDAR derived contours with a contour interval tighter than these specifications is a generalization and interpretation of the data made by the computer. Therefore, they are not necessarily accurate. The contour values may not coincide with measurements made with more accurate data or instruments.

An example of an allowed use of LiDAR QL 3 derived contours with an interval of less than 2 feet would be to determine the landform of an area, e.g., the overall shape of a wetland. Using a contour interval less than 2 feet to delineate a boundary would be misuse of the LiDAR data.

[1] RMSE: the root mean square error is derived from a statistical formula for measuring the accuracy of our data against independently obtained "truth" data. The resulting RMSE value is a measure of the difference between these two sets of data.

[2] Specifications provided by the United States Geological Survey (USGS) EROS Data Center and National Map Accuracy Standards (NMAS).