

C-4.1 Report on Nominal Pulse Spacing (NPS)

The USGS Lidar Base Specification Version 2.1 states: "The required ANPS and ANPD by QL are listed in table 1. Aggregate Nominal Pulse Density (ANPD) and Aggregate Nominal Pulse Spacing (ANPS) shall meet the requirements of the Quality Level (QL) of the project with a minimum of QL2 for 3DEP collections. Aggregate Nominal Pulse Density (ANPD) shall be no less than 2 points per square meter (QL2); assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~95%) of each swath. Aggregate Nominal Pulse Spacing (ANPS) shall be no greater than 0.70 meters (QL2); assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~95%) of each swath. Dependent on the local terrain and land cover conditions in a project, a greater pulse density may be required on specific projects."

Table 1. Aggregate nominal pulse spacing and density.

[QL, quality level; pls/m², pulses per square meter; m, meter; ≤, less than or equal to; ≥, greater than or equal to]

Quality level	Aggregate nominal pulse spacing (m)	Aggregate nominal pulse density (pls/m ²)
QL0	≤0.35	≥8.0
QL1	≤0.35	≥8.0
QL2	≤0.71	≥2.0
QL3	≤1.41	≥0.5

The purpose of this section is to report on the lidar point density and nominal point spacing by LAS file. Averages by files (not including overlap), project boundary polygons (including overlap), and aggregate project boundary polygons (including overlap) are reported.

[Data Source - D:\00_San_Miguel\Client_LAS_Swaths](#)

Quality level tested: QL2

File	Number of First Returns	Area	Point Density	NPS
CS_06001.las	25,416,861	7,121,831	3.569/0.332	0.529/1.736
CS_06002.las	117,910,139	30,793,607	3.829/0.356	0.511/1.677
CS_06003.las	159,461,329	43,925,615	3.630/0.337	0.525/1.722
CS_06004.las	193,461,425	49,082,251	3.942/0.366	0.504/1.654
CS_06005.las	81,263,095	21,818,117	3.725/0.346	0.518/1.699
CS_06038.las	3,138,481	842,884	3.724/0.346	0.518/1.699

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File	Number of First Returns	Area	Point Density	NPS
CS_06039.las	10,115,664	2,642,146	3.829/0.356	0.511/1.677
CS_06040.las	13,179,256	3,623,748	3.637/0.338	0.524/1.719
CS_06041.las	20,377,670	5,340,229	3.816/0.355	0.512/1.680
CS_06042.las	22,927,485	6,315,372	3.630/0.337	0.525/1.722
CS_06043.las	30,220,512	8,032,239	3.762/0.350	0.516/1.693
CS_06044.las	33,335,281	9,023,784	3.694/0.343	0.520/1.706
CS_06045.las	42,350,287	10,855,269	3.901/0.362	0.506/1.660
CS_06062.las	19,111,321	5,147,965	3.712/0.345	0.519/1.703
CS_06063.las	146,393,321	41,297,114	3.545/0.329	0.531/1.742
CS_06064.las	206,557,077	54,916,207	3.761/0.349	0.516/1.693
CS_06065.las	200,039,154	54,288,614	3.685/0.342	0.521/1.709
CS_06066.las	206,517,464	54,399,831	3.796/0.353	0.513/1.683
CS_06067.las	198,482,068	54,512,513	3.641/0.338	0.524/1.719
CS_06068.las	208,962,426	54,782,058	3.814/0.354	0.512/1.680
CS_06071.las	197,891,113	54,916,813	3.603/0.335	0.527/1.729
CS_06072.las	207,840,760	55,184,817	3.766/0.350	0.515/1.690
CS_06073.las	199,859,658	55,057,953	3.630/0.337	0.525/1.722
CS_06074.las	184,454,885	49,591,952	3.719/0.346	0.519/1.703
CS_06075.las	152,243,827	41,472,290	3.671/0.341	0.522/1.713
CS_06076.las	147,602,768	39,656,785	3.722/0.346	0.518/1.699
CS_06077.las	140,952,473	38,013,266	3.708/0.344	0.519/1.703
CS_06078.las	137,830,562	36,924,997	3.733/0.347	0.518/1.699
CS_06081.las	11,861,491	5,559,189	2.134/0.198	0.685/2.247
CS_06082.las	57,266,918	7,829,374	7.314/0.679	0.370/1.214
CS_06083.las	118,043,737	32,515,421	3.630/0.337	0.525/1.722
CS_06084.las	167,612,110	45,937,440	3.649/0.339	0.524/1.719
CS_06085.las	190,835,789	51,506,151	3.705/0.344	0.520/1.706
CS_06086.las	204,969,128	57,049,174	3.593/0.334	0.528/1.732
CS_06087.las	212,036,725	58,157,177	3.646/0.339	0.524/1.719
CS_06088.las	214,430,472	57,835,232	3.708/0.344	0.519/1.703
CS_06089.las	211,973,087	56,671,545	3.740/0.347	0.517/1.696
CS_06090.las	210,608,398	56,632,881	3.719/0.346	0.519/1.703
CS_06091.las	232,883,676	58,765,028	3.963/0.368	0.502/1.647

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File	Number of First Returns	Area	Point Density	NPS
CS_06092.las	219,617,248	59,862,653	3.669/0.341	0.522/1.713
CS_06093.las	235,761,989	62,233,950	3.788/0.352	0.514/1.686
CS_06094.las	233,305,320	63,424,324	3.678/0.342	0.521/1.709
CS_06096.las	238,773,305	62,959,336	3.793/0.352	0.513/1.683
CS_06097.las	233,213,687	63,678,089	3.662/0.340	0.523/1.716
CS_06098.las	248,876,926	64,622,687	3.851/0.358	0.510/1.673
CS_06099.las	240,145,828	64,619,632	3.716/0.345	0.519/1.703
CS_06100.las	250,309,076	64,430,122	3.885/0.361	0.507/1.663
CS_06101.las	238,437,391	64,135,580	3.718/0.345	0.519/1.703
CS_06102.las	252,643,541	63,640,945	3.970/0.369	0.502/1.647
CS_06103.las	228,282,375	62,292,182	3.665/0.340	0.522/1.713
CS_06104.las	247,305,084	62,445,916	3.960/0.368	0.502/1.647
CS_06105.las	229,472,728	62,562,010	3.668/0.341	0.522/1.713
CS_06106.las	233,207,552	61,283,224	3.805/0.353	0.513/1.683
CS_06107.las	219,853,819	60,856,638	3.613/0.336	0.526/1.726
CS_06108.las	236,630,698	59,481,149	3.978/0.370	0.501/1.644
CS_06109.las	214,199,570	58,136,701	3.684/0.342	0.521/1.709
CS_06117.las	206,534,316	57,122,671	3.616/0.336	0.526/1.726
CS_06118.las	219,149,625	56,896,968	3.852/0.358	0.510/1.673
CS_06119.las	201,772,937	55,959,583	3.606/0.335	0.527/1.729
CS_06120.las	212,632,152	55,413,890	3.837/0.356	0.510/1.673
CS_06121.las	201,294,486	56,181,653	3.583/0.333	0.528/1.732
CS_06122.las	214,392,164	56,592,854	3.788/0.352	0.514/1.686
CS_06123.las	202,443,481	55,802,827	3.628/0.337	0.525/1.722
CS_06125.las	44,203,869	11,877,165	3.722/0.346	0.518/1.699
CS_06126.las	55,513,120	13,414,245	4.138/0.384	0.492/1.614
CS_06127.las	53,350,370	14,681,853	3.634/0.338	0.525/1.722
CS_06128.las	66,922,820	16,121,946	4.151/0.386	0.491/1.611
CS_06129.las	64,905,194	17,365,727	3.738/0.347	0.517/1.696
CS_06130.las	76,340,086	18,883,580	4.043/0.376	0.497/1.631
CS_06131.las	74,675,689	20,159,895	3.704/0.344	0.520/1.706
CS_06132.las	86,412,831	21,730,062	3.977/0.369	0.501/1.644
CS_06133.las	83,367,096	22,868,246	3.646/0.339	0.524/1.719

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File	Number of First Returns	Area	Point Density	NPS
CS_06135.las	87,922,067	24,260,021	3.624/0.337	0.525/1.722
CS_06136.las	106,815,812	25,884,994	4.127/0.383	0.492/1.614
CS_06137.las	99,483,400	26,972,705	3.688/0.343	0.521/1.709
CS_06138.las	116,156,208	28,366,861	4.095/0.380	0.494/1.621
CS_06139.las	103,576,354	29,479,818	3.513/0.326	0.533/1.749
CS_06140.las	126,575,409	31,305,707	4.043/0.376	0.497/1.631
CS_06141.las	117,729,449	32,528,876	3.619/0.336	0.526/1.726
CS_06142.las	137,852,141	34,095,787	4.043/0.376	0.497/1.631
CS_06143.las	128,201,825	35,220,132	3.640/0.338	0.524/1.719
Average			3.748/0.348	0.517/1.696
			pp Square Meter/ pp Square US Survey Foot	Meter/ US Survey Feet
927.323	12,228,304,492	2,401,755,912	5.091/0.473	0.443/1.453
Aggregate	12,228,304,492	2,401,755,912	5.091/0.473	0.443/1.453
			pp Square Meter/ pp Square US Survey Foot	Meter/ US Survey Feet

* - indicates a swath whose NPS and Point Density were brought up to specifications due to the inclusion of one or more re-flight swaths.