

## C-4.1 Report on Nominal Pulse Spacing (NPS)

The USGS Lidar Base Specification Version 1.3 states: "Assessment and reporting of the NPS are made against single swath, single instrument, first-return-only data, including only the geometrically usable part of the swath and excluding acceptable data voids. Higher net densities of lidar point measurements are being achieved more often by flying multiple passes of the lidar instrument over the project area or flying with large amounts (greater than [ $>$ ] 50 percent) of overlap between swaths, creating a need for a new term to describe total pulse density without being confused with NPS and NPD. This specification will use the terms aggregate nominal pulse spacing (ANPS) and aggregate nominal pulse density (ANPD) to describe the net overall pulse spacing and density, respectively. The required ANPS and ANPD by QL are listed in Table 1. 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/m<sup>2</sup>, pulses per square meter; m, meter;  $\leq$ , less than or equal to;  $\geq$ , greater than or equal to]

Quality level	Aggregate nominal pulse spacing (m)	Aggregate nominal pulse density (pls/m <sup>2</sup> )
QL0	$\leq 0.35$	$\geq 8.0$
QL1	$\leq 0.35$	$\geq 8.0$
QL2	$\leq 0.71$	$\geq 2.0$
QL3	$\leq 1.41$	$\geq 0.5$

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 - Y:\Mapping\Projects\65220171\\_USGS-TX\\_West\\_Texas\Production\Final\\_Client\\_Deliverables\Lot6\\_utm13\point\\_cloud\Swaths](Y:\Mapping\Projects\65220171_USGS-TX_West_Texas\Production\Final_Client_Deliverables\Lot6_utm13\point_cloud\Swaths)

Quality level tested: QL2

File	Number of First Returns	Area	Point Density	NPS
01002.las	323,586,914	100,597,424	3.217/0.299	0.558/1.831
01003.las	295,061,654	98,077,776	3.008/0.279	0.577/1.893
01004.las	323,591,570	99,133,440	3.264/0.303	0.553/1.814
02053.las	144,118,547	42,513,904	3.390/0.315	0.543/1.781

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File	Number of First Returns	Area	Point Density	NPS
02061.las	311,890,726	96,013,136	3.248/0.302	0.555/1.821
02076.las	458,695,871	137,524,960	3.335/0.310	0.548/1.798
02085.las	307,271,899	99,054,080	3.102/0.288	0.568/1.864
02091.las	293,650,251	97,775,248	3.003/0.279	0.577/1.893
02094.las	69,280,420	23,048,704	3.006/0.279	0.577/1.893
02100.las	308,947,410	100,415,840	3.077/0.286	0.570/1.870
02109.las	317,050,399	97,264,608	3.260/0.303	0.554/1.818
02127.las	85,199,541	25,823,520	3.299/0.306	0.551/1.808
02131.las	622,682,413	199,450,096	3.122/0.290	0.566/1.857
02135.las	443,834,711	140,302,864	3.163/0.294	0.562/1.844
02144.las	289,919,850	96,614,992	3.001/0.279	0.577/1.893
02148.las	290,573,306	96,851,968	3.000/0.279	0.577/1.893
02150.las	288,842,169	96,535,664	2.992/0.278	0.578/1.896
02153.las	60,776,331	21,040,128	2.889/0.268	0.588/1.929
02161.las	340,442,982	102,903,264	3.308/0.307	0.550/1.804
02165.las	330,254,824	99,322,608	3.325/0.309	0.548/1.798
02192.las	530,283,054	160,043,648	3.313/0.308	0.549/1.801
02195.las	91,098,537	26,599,536	3.425/0.318	0.540/1.772
02199.las	672,655,273	200,417,344	3.356/0.312	0.546/1.791
02201.las	611,065,969	201,987,680	3.025/0.281	0.575/1.886
02204.las	472,546,020	141,358,016	3.343/0.311	0.547/1.795
02212.las	310,022,819	98,974,288	3.132/0.291	0.565/1.854
02213.las	300,252,220	98,536,848	3.047/0.283	0.573/1.880
02222.las	60,338,443	20,723,152	2.912/0.271	0.586/1.923
02231.las	309,283,253	101,070,832	3.060/0.284	0.572/1.877
02237.las	305,094,237	99,216,400	3.075/0.286	0.570/1.870
02263.las	594,551,039	198,750,080	2.991/0.278	0.578/1.896
02270.las	616,155,395	199,946,656	3.082/0.286	0.570/1.870
02275.las	315,625,262	106,627,424	2.960/0.275	0.581/1.906
02294.las	9,184,003	2,079,360	4.417/0.410	0.476/1.562
02303.las	328,954,532	100,823,952	3.263/0.303	0.554/1.818
02330.las	720,597,563	199,199,952	3.617/0.336	0.526/1.726
02337.las	665,799,099	200,070,832	3.328/0.309	0.548/1.798

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File	Number of First Returns	Area	Point Density	NPS
02339.las	674,902,391	202,072,688	3.340/0.310	0.547/1.795
02352.las	298,746,777	97,939,104	3.050/0.283	0.573/1.880
02367.las	296,487,052	98,167,888	3.020/0.281	0.575/1.886
02393.las	603,626,476	197,331,440	3.059/0.284	0.572/1.877
02399.las	617,671,506	198,384,608	3.114/0.289	0.567/1.860
02401.las	608,518,237	202,387,264	3.007/0.279	0.577/1.893
02411.las	294,723,322	97,776,448	3.014/0.280	0.576/1.890
02427.las	324,590,609	99,502,592	3.262/0.303	0.554/1.818
02440.las	324,011,936	98,278,672	3.297/0.306	0.551/1.808
02451.las	737,019,626	198,573,104	3.712/0.345	0.519/1.703
02457.las	656,898,941	200,181,680	3.282/0.305	0.552/1.811
02459.las	658,325,488	201,853,904	3.261/0.303	0.554/1.818
02469.las	295,164,395	97,925,504	3.014/0.280	0.576/1.890
02485.las	300,652,522	98,032,048	3.067/0.285	0.571/1.873
02509.las	600,742,939	198,000,672	3.034/0.282	0.574/1.883
02514.las	616,524,325	199,256,144	3.094/0.287	0.569/1.867
02516.las	611,875,316	201,991,136	3.029/0.281	0.575/1.886
02525.las	286,474,464	96,330,992	2.974/0.276	0.580/1.903
02565.las	737,211,486	198,365,840	3.716/0.345	0.519/1.703
02570.las	661,571,526	200,139,952	3.306/0.307	0.550/1.804
02572.las	652,845,617	201,870,208	3.234/0.300	0.556/1.824
02616.las	606,673,965	196,703,280	3.084/0.287	0.569/1.867
02621.las	637,191,347	198,111,104	3.216/0.299	0.558/1.831
02623.las	610,756,435	201,471,856	3.031/0.282	0.574/1.883
02664.las	717,609,421	198,802,368	3.610/0.335	0.526/1.726
02669.las	670,106,845	199,112,304	3.365/0.313	0.545/1.788
02671.las	644,495,602	201,930,176	3.192/0.297	0.560/1.837
02690.las	296,305,467	98,267,872	3.015/0.280	0.576/1.890
02711.las	605,586,977	197,298,640	3.069/0.285	0.571/1.873
02716.las	623,374,020	198,717,472	3.137/0.291	0.565/1.854
02717.las	617,665,261	202,086,496	3.056/0.284	0.572/1.877
02725.las	296,010,354	96,920,320	3.054/0.284	0.572/1.877
02756.las	716,765,922	198,706,560	3.607/0.335	0.527/1.729

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File	Number of First Returns	Area	Point Density	NPS
02762.las	635,309,455	201,834,464	3.148/0.292	0.564/1.850
02770.las	294,251,825	97,669,536	3.013/0.280	0.576/1.890
02804.las	541,737,365	185,158,560	2.926/0.272	0.585/1.919
02812.las	296,318,649	97,556,256	3.037/0.282	0.574/1.883
02851.las	301,932,238	99,056,992	3.048/0.283	0.573/1.880
02886.las	285,473,848	97,756,672	2.920/0.271	0.585/1.919
03031.las	7,677,469	965,840	7.949/0.738	0.355/1.165
Average			3.200/0.297	0.559/1.834
			pp Square Meter/ pp Square US Survey Foot	Meter/ US Survey Feet
Lot_6	30,971,660,624	7,633,528,856	4.057/0.377	0.496/1.627
Aggregate	30,971,660,624	7,633,528,856	4.057/0.377	0.496/1.627
			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.