

DPH-11 Report on Absolute Vertical Accuracy

The USGS Lidar Base Specification Version 2.1 states: "Absolute vertical accuracy of the lidar data and the derived DEM will be assessed and reported in accordance with ASPRS (2014). Vegetated and nonvegetated land cover types shall be assessed for absolute vertical accuracy.

Three absolute accuracy values shall be assessed and reported:

1. NVA for the point data
2. VVA for the point data
3. NVA for the DEM
4. VVA for the DEM

The minimum NVA and VVA requirements for all data, using the ASPRS methodology, are listed in table 4. Both the NVA and VVA required values shall be met. NVA for the point data shall be assessed by comparing check points surveyed for NVA assessment to a triangulated irregular network (TIN) constructed from ground-classified lidar points in those areas. VVA for the point data shall be assessed by comparing check points surveyed for VVA assessment to a triangulated irregular network (TIN) constructed from ground-classified lidar points in those areas. NVA and VVA for the DEM are assessed by comparing check points to the final bare-earth surface. The minimum required thresholds for absolute and relative accuracy may be increased by the USGS–NGP when any of the following conditions are met:

- A demonstrable, substantial, and prohibitive increase in cost is needed to obtain this accuracy, which is often the case in heavily vegetated project areas.
- An alternate specification is needed to conform to previously contracted phases of a single larger overall collection effort such as for multiyear statewide collections
- The USGS–NGP agrees that the use of an alternate specification is reasonable and in the best interest of all stakeholders."

Table 4. Absolute vertical accuracy for light detection and ranging data and digital elevation models.

[QL, quality level, $RMSE_z$, root mean square error in the z direction; NVA, nonvegetated vertical accuracy; VVA, vegetated vertical accuracy; m, meter; \leq , less than or equal to]

Quality level	$RMSE_z$ (nonvegetated) (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

The purpose of this section is to report on the absolute vertical accuracy of the lidar data and DEMs generated from it by testing for NVA (Nonvegetated Vertical Accuracy) and VVA (Vegetated Vertical Accuracy) against surveyed ground check points.

DPH-11 Report on Absolute Vertical Accuracy - continued

Data Source - [D:\00_Cherry\Control\NE_CBC_North_92NVA_71VVA_LidarCheckPts.shp](#)

Units: Meter (/Feet)

Vertical Accuracy Class tested: 10-cm

Check Points in defined project area (DPA):	163
Check Points with Lidar Coverage	162
Check Points with Lidar Coverage (NVA)	92
Check Points with Lidar Coverage (VVA)	70
Average Z Error (NVA)	0.002/0.007
Maximum Z Error (NVA)	0.108/0.355
Median Z Error (NVA)	0.001/0.003
Minimum Z Error (NVA)	-0.076/-0.249
Standard deviation of Vertical Error (NVA)	0.035/0.115
Skewness of Vertical Error (NVA)	0.284
Kurtosis of Vertical Error (NVA)	0.222
Non-vegetated Vertical Accuracy (NVA) RMSE(z) ¹	0.035/0.114 PASS
Non-vegetated Vertical Accuracy (NVA) at the 95% Confidence Level +/- ¹	0.068/0.224 PASS
FGDC/NSSDA Vertical Accuracy at the 95% Confidence Level +/-	0.068/0.224
Non-vegetated Vertical Accuracy (NVA) RMSE(z) (DEM) ²	0.035/0.114 PASS
Non-vegetated Vertical Accuracy (NVA) at the 95% Confidence Level (DEM) +/- ²	0.068/0.223 PASS
Vegetated Vertical Accuracy (VVA) at the 95th Percentile (TIN) +/- ¹	0.154/0.504 PASS
Vegetated Vertical Accuracy (VVA) at the 95th Percentile (DEM) +/- ²	0.144/0.472 PASS

This data set was tested to meet ASPRS Positional Accuracy Standard for Digital Geospatial Data (2014) for a 10-cm RMSEz Vertical Accuracy Class. Actual NVA accuracy was found to be RMSEz = 3.5cm, equating to +/- 6.8cm at the 95% confidence level. Actual VVA accuracy was found to be +/- 14.4cm at the 95th percentile.

¹ This value is calculated from TIN-based testing of the lidar point cloud data.

² This value is calculated from RAM-based grid testing of the lidar data. The grid cells are sized according to the Quality Level selected, and are defined in the USGS NGP Lidar Base Specification Version 2.1 (Table 6).

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to report the results of measuring the lidar point cloud data against surveyed ground NVA (nonvegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

NVA (lidar data)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
3012	277902.437	4733075.58	Yes	1039.104	1039.174	0.070	1039.168	1039.17	1039.18	4444	-1525	1,1,1		
3013	353312.558	4733752.726	Yes	871.674	871.658	-0.016	871.653	871.654	871.669	5219	-1836	1,1,1		
3014	265296.363	4708767.477	Yes	1115.704	1115.67	-0.034	1115.661	1115.669	1115.684	4798	-144	1,1,1		
3015	322324.626	4709912.486	Yes	974.734	974.766	0.032	974.738	974.76	974.777	6725	837	1,1,1		
3016	373765.923	4708916.705	Yes	885.286	885.319	0.033	885.316	885.318	885.319	6106	296	1,1,1		
3017	289853.553	4706282.302	Yes	1052.007	1051.998	-0.009	1051.989	1051.991	1052.02	7605	575	1,1,1		
3018	362506.736	4714642.934	Yes	896.948	896.964	0.016	896.943	896.977	896.998	2401	-2187	1,1,1		
3019	430060.166	4722481.115	Yes	749.075	749.105	0.030	749.101	749.102	749.118	6292	-2174	1,1,1		
3020	401285.381	4719915.024	Yes	814.056	814.028	-0.028	814.025	814.031	814.051	7281	-1499	1,1,1		
3021	310030.384	4704224.316	Yes	1014.535	1014.554	0.019	1014.55	1014.559	1014.575	7253	-325	1,1,1		
3022	374191.203	4730094.796	Yes	862.41	862.412	0.002	862.396	862.407	862.419	3076	-2968	1,1,1		
3023	364409.645	4723326.038	Yes	877.283	877.287	0.004	877.261	877.288	877.292	3728	-750	1,1,1		
3024	407932.336	4706519.567	Yes	812.368	812.372	0.004	812.341	812.376	812.4	6044	-2609	1,1,1		
3025	397185.294	4707498.177	Yes	834.274	834.275	0.001	834.271	834.271	834.294	6210	-2236	1,1,1		
3026	324099.377	4699975.405	Yes	975.86	975.871	0.011	975.857	975.873	975.889	7131	-2405	1,1,1		
3027	388466.684	4709337.033	Yes	854.11	854.039	-0.071	854.013	854.026	854.071	6914	-327	1,1,1		
3028	427797.08	4695806.842	Yes	814.175	814.137	-0.038	814.135	814.136	814.137	6655	953	1,1,1		
3028A	427890.688	4697522.933	Yes	805.349	805.329	-0.020	805.292	805.325	805.342	3707	1126	1,1,1		
3029	333731.923	4726392.127	Yes	915.79	915.813	0.023	915.803	915.807	915.827	1843	1982	1,1,1		
3030	409597.475	4713593.206	Yes	782.494	782.444	-0.050	782.441	782.442	782.485	4195	2508	1,1,1		
3031	277120.566	4715678.412	Yes	1079.069	1079.106	0.037	1079.089	1079.101	1079.144	1888	1982	1,1,1		
3032	298210.479	4734635.058	Yes	974.354	974.384	0.030	974.346	974.363	974.398	7944	554	1,1,1		
3033	428400.376	4704755.278	Yes	781.723	781.67	-0.053	781.652	781.673	781.676	5885	2730	1,1,1		
3034	415431.769	4699596.545	Yes	822.926	822.906	-0.020	822.888	822.908	822.938	6849	1640	1,1,1		
3035	344439.591	4709953.402	Yes	930.291	930.337	0.046	930.279	930.348	930.372	3097	-1202	1,1,1		
3036	314918.231	4724080.024	Yes	974.049	974.004	-0.045	973.981	974.023	974.066	2239	1545	1,1,1		
3037	277412.548	4707273.009	Yes	1085.15	1085.186	0.036	1085.161	1085.178	1085.198	4382	-1408	1,1,1		
3037A	277619.702	4708191.411	Yes	1077.495	1077.514	0.019	1077.513	1077.513	1077.529	6688	-756	1,1,1		
3038	310142.888	4715440.141	Yes	988.77	988.787	0.017	988.775	988.787	988.79	8093	-477	1,1,1		
3039	268858.526	4705737.835	Yes	1111.016	1110.963	-0.053	1110.957	1110.959	1110.974	4919	575	1,1,1		

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
3040	285742.329	4729547.213	Yes	1028.648	1028.663	0.015	1028.632	1028.647	1028.671	6223	-1815	1,1,1		
3041	358294.156	4710568.355	Yes	909.709	909.677	-0.032	909.666	909.676	909.679	3931	429	1,1,1		
3042	354208.971	4695103.234	Yes	914.645	914.689	0.044	914.685	914.686	914.701	5911	59	1,1,1		
3043	430886.272	4733386.971	Yes	670.171	670.134	-0.037	670.111	670.169	670.188	6628	-758	1,1,1		
3044	313188.017	4720751.914	Yes	954.466	954.536	0.070	954.509	954.533	954.548	4527	2403	1,1,1		
3045	344944.971	4717477.47	Yes	905.645	905.676	0.031	905.669	905.672	905.687	6822	-827	1,1,1		
3046	437980.525	4711918.669	Yes	738.913	738.862	-0.051	738.859	738.91	738.917	4159	2510	1,1,1		
3047	327691.045	4704486.483	Yes	968.724	968.726	0.002	968.714	968.731	968.751	7120	2900	1,1,1		
3048	424202.516	4716045.801	Yes	772.903	772.896	-0.007	772.874	772.902	772.907	7178	-1414	1,1,1		
3049	287053.602	4730149.518	Yes	1022.51	1022.543	0.033	1022.536	1022.542	1022.543	7827	-49	1,1,1		
3050	419784.486	4737862.583	Yes	659.051	659.052	0.001	659.038	659.053	659.057	7906	1276	1,1,1		
3051	338762.303	4702824.707	Yes	950.701	950.721	0.020	950.699	950.723	950.728	3895	1541	1,1,1		
3052	277366.769	4724664.01	Yes	1071.336	1071.336	0.000	1071.332	1071.35	1071.367	3808	1997	1,1,1		
3053	373353.455	4696342.474	Yes	889.701	889.703	0.002	889.691	889.703	889.71	3385	-98	1,1,1		
3054	336231.804	4711008.205	Yes	933.556	933.532	-0.024	933.516	933.533	933.56	6254	644	1,1,1		
3055	376720.47	4695636.171	Yes	884.84	884.831	-0.009	884.817	884.822	884.84	5965	2093	1,1,1		
3056	360866.222	4725156.572	Yes	876.683	876.684	0.001	876.675	876.691	876.693	8954	1465	1,1,1		
3056A	359768.095	4721677.042	Yes	884.339	884.365	0.026	884.352	884.358	884.379	2908	221	1,1,1		
3057	389927.47	4718822.439	Yes	840.049	840.04	-0.009	840.031	840.042	840.055	7095	2556	1,1,1		
3058	402690.108	4743905.644	Yes	678.909	678.851	-0.058	678.846	678.85	678.855	9073	-1103	1,1,1		
3059	318425.096	4727961.58	Yes	942.224	942.21	-0.014	942.173	942.213	942.223	3421	-1252	1,1,1		
3060	391101.686	4726886.678	Yes	827.774	827.742	-0.032	827.732	827.743	827.776	4249	-1417	1,1,1		
3061	412679.664	4727892.368	Yes	759.33	759.328	-0.002	759.31	759.322	759.338	7705	1583	1,1,1		
3061A	412447.52	4726282.969	Yes	776.515	776.492	-0.023	776.466	776.473	776.502	7096	882	1,1,1		
3062	433253.22	4699875.791	Yes	784.214	784.159	-0.055	784.139	784.161	784.171	7641	-3175	1,1,1		
3063	283472.262	4707126.051	Yes	1069.178	1069.174	-0.004	1069.16	1069.171	1069.202	7019	-1642	1,1,1		
3063A	281284.882	4707320.036	Yes	1071.966	1071.963	-0.003	1071.941	1071.954	1071.974	7329	-1956	1,1,1		
3064	374251.478	4733423.996	Yes	852.632	852.7	0.068	852.639	852.709	852.724	2980	-1566	1,1,1		
3065	348919.151	4726497.469	Yes	877.754	877.74	-0.014	877.734	877.736	877.742	3318	196	1,1,1		
3065A	349140.677	4728230.649	Yes	877.394	877.398	0.004	877.385	877.399	877.41	6652	271	1,1,1		
3066	369540.832	4723411.887	Yes	882.56	882.566	0.006	882.551	882.558	882.582	5098	-1414	1,1,1		
3066A	367565.1	4723461.826	Yes	875.16	875.193	0.033	875.174	875.176	875.21	4796	-1463	1,1,1		
3067	395428.903	4723130.561	Yes	821.838	821.88	0.042	821.869	821.883	821.899	5981	-1843	1,1,1		
3068	277670.944	4720644.166	Yes	1067.721	1067.697	-0.024	1067.681	1067.706	1067.71	5098	-1021	1,1,1		
3069	391709.683	4701221.379	Yes	862.614	862.576	-0.038	862.569	862.575	862.583	6494	1725	1,1,1		

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
3070	422011.671	4721918.748	Yes	773.818	773.805	-0.013	773.795	773.816	773.841	6348	1552	1,1,1		
3071	417627.403	4712465.813	Yes	787.383	787.36	-0.023	787.351	787.365	787.367	4428	-2514	1,1,1		
3071A	417224.585	4712455.898	Yes	788.177	788.165	-0.012	788.139	788.163	788.197	4458	-1750	1,1,1		
3072	308584.008	4730832.357	Yes	955.976	956.021	0.045	956.019	956.024	956.028	4720	613	1,1,1		
3073	350162.599	4699890.912	Yes	926.596	926.608	0.012	926.6	926.608	926.626	2277	6	1,1,1		
3074	402616.347	4722153.951	Yes	805.569	805.566	-0.003	805.563	805.565	805.571	7393	-309	1,1,1		
3075	288972.323	4697272.059	Yes	1070.931	1070.947	0.016	1070.93	1070.95	1070.963	7936	-621	1,1,1		
3076	274941.948	4696638.987	Yes	1113.213	1113.213	0.000	1113.209	1113.21	1113.22	4496	2803	1,1,1		
3077	400188.821	4695803.303	Yes	852.625	852.606	-0.019	852.596	852.618	852.631	6142	653	1,1,1		
3078	313524.951	4695204.286	Yes	1012.819	1012.849	0.030	1012.827	1012.849	1012.857	5210	1230	1,1,1		
3078A	316256.055	4700483.495	Yes	999.972	1000.048	0.076	999.996	1000.023	1000.065	6663	-1704	1,1,1		
3079	277434.713	4712310.979	Yes	1081.655	1081.736	0.081	1081.681	1081.736	1081.739	3750	2448	1,1,1		
3080	332873.49	4695977.756	Yes	943.996	944.005	0.009	943.998	944.014	944.03	3469	-206	1,1,1		
3080A	332900.72	4696188.787	Yes	943.432	943.466	0.034	943.462	943.465	943.47	5015	-912	1,1,1		
3081	326662.371	4734199.712	Yes	914.199	914.18	-0.019	914.169	914.186	914.203	4968	1826	1,1,1		
3082	412497.881	4732893.934	Yes	743.687	743.677	-0.010	743.665	743.676	743.686	6843	735	1,1,1		
3082A	412458.629	4732172.173	Yes	750.802	750.832	0.030	750.813	750.825	750.859	6272	607	1,1,1		
3083	372987.606	4701765.213	Yes	894.585	894.594	0.009	894.573	894.61	894.613	3744	2595	1,1,1		
3084	299924.683	4695768.543	Yes	1047.094	1047.104	0.010	1047.069	1047.133	1047.152	5565	1853	1,1,1		
3084A	304774.453	4694919.217	Yes	1035.044	1035.087	0.043	1035.079	1035.091	1035.109	6651	-476	1,1,1		
3085	265189.127	4696016.228	Yes	1166.494	1166.487	-0.007	1166.473	1166.491	1166.496	7669	-857	1,1,1		
3086	373739.235	4717063.571	Yes	881.623	881.731	0.108	881.71	881.711	881.767	5000	-1352	1,1,1		
3087	439235.269	4732650.341	Yes	633.242	633.198	-0.044	633.187	633.199	633.201	7210	-1031	1,1,1		
3088	383851.194	4734338.763	Yes	836.641	836.644	0.003	836.635	836.642	836.664	3943	-400	1,1,1		
3089	390034.728	4711516.144	Yes	845.372	845.331	-0.041	845.329	845.329	845.336	6006	-542	1,1,1		
3090	393196.759	4719653.044	Yes	831.322	831.322	0.000	831.319	831.331	831.337	8343	-608	1,1,1		
3091	430018.735	4714399.371	Yes	751.939	751.863	-0.076	751.827	751.854	751.888	6612	-2618	1,1,1		

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to report the results of measuring the lidar point cloud data against surveyed ground VVA (vegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

VVA (lidar data)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
2010	277575.781	4731878.371	Yes	1043.194	1043.259	0.065	1043.257	1043.258	1043.273	8377	69	1,1,1		
2011	353196.169	4733833.226	Yes	869.018	869.017	-0.001	868.998	869.038	869.044	4420	-1582	1,2,1		
2013	322672.579	4710274.329	Yes	970.513	970.493	-0.020	970.488	970.499	970.501	6133	-26	2,1,1		
2014	373797.238	4708929.016	Yes	885.463	885.561	0.098	885.556	885.572	885.594	8549	-272	1,1,1		
2014A	373634.504	4717134.307	Yes	877.749	877.872	0.123	877.858	877.862	877.905	8432	-1557	1,1,1		
2015	289048.854	4706290.505	Yes	1054.406	1054.443	0.037	1054.438	1054.446	1054.447	8970	646	1,1,1		
2016	361797.943	4714755.959	Yes	893.402	893.494	0.092	893.474	893.49	893.514	5424	-1885	1,1,1		
2017	430087.601	4723471.189	Yes	750.662	750.681	0.019	750.674	750.703	750.717	6618	-2231	1,2,1		
2018	402408.309	4719245.432	Yes	810.024	810.142	0.118	810.131	810.148	810.169	6377	-890	1,1,1		
2019	310217.934	4704566.239	Yes	1013.006	1013.034	0.028	1012.98	1013.041	1013.089	7303	817	1,1,1		
2020	365428.533	4723433.073	Yes	885.592	885.694	0.102	885.654	885.691	885.709	6178	-1254	1,1,1		
2021	408311.134	4706515.693	Yes	812.016	812.087	0.071	812.018	812.063	812.152	2636	-1486	2,2,2		
2022	397570.597	4706716.38	Yes	835.22	835.286	0.066	835.275	835.298	835.33	5722	-621	1,1,1		
2023	324082.27	4699994.92	Yes	976.249	976.324	0.075	976.315	976.32	976.334	7650	-2326	1,1,1		
2024	388388.396	4708838.712	Yes	853.178	853.228	0.050	853.208	853.242	853.249	6253	-878	1,1,1		
2025	427829.544	4696041.444	Yes	811.631	811.724	0.093	811.696	811.721	811.771	6373	1019	1,1,1		
2026	332402.993	4727407.666	Yes	914.487	914.539	0.052	914.515	914.523	914.56	7933	-611	1,1,1		
2027	409520.881	4713630.195	Yes	777.285	777.332	0.047	777.309	777.313	777.348	3024	3050	2,2,1		
2028	277099.523	4715705.894	Yes	1077.788	1077.871	0.083	1077.862	1077.868	1077.893	6708	1903	1,1,1		
2029	298224.943	4734609.933	Yes	974.026	974.089	0.063	974.06	974.078	974.116	7503	483	1,1,1		
2029A	304022.08	4731385.927	Yes	963.544	963.586	0.042	963.582	963.594	963.612	7781	-982	1,1,1		
2030	428944.925	4704735.147	Yes	780.507	780.717	0.210	780.691	780.716	780.735	7071	956	1,2,1		
2031	415375.766	4699490.874	Yes	822.553	822.613	0.060	822.606	822.64	822.653	6761	1440	1,1,1		
2032	344667.465	4709948.922	Yes	929.187	929.349	0.162	929.335	929.355	929.386	7156	714	1,1,1		
2033	277256.136	4706292.704	Yes	1086.375	1086.539	0.164	1086.472	1086.538	1086.549	6455	1891	1,1,1		
2033A	277425.741	4712288.026	Yes	1080.683	1080.773	0.090	1080.722	1080.788	1080.801	6533	2774	1,1,1		
2034	309707.451	4715305.219	Yes	991.377	991.393	0.016	991.382	991.385	991.4	8252	14	1,1,1		
2035	268592.796	4705937.19	Yes	1111.098	1111.22	0.122	1111.22	1111.224	1111.254	7165	1223	1,1,1		
2036	358295.532	4710542.349	Yes	910.728	910.73	0.002	910.714	910.748	910.76	6857	519	1,1,1		
2037	353993.582	4695132.249	Yes	914.037	914.057	0.020	914.033	914.054	914.066	7435	128	1,1,1		

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
2038	430741.31	4733542.987	Yes	649.109	649.17	0.061	649.158	649.163	649.24	5663	-1203	2,1,2		
2038A	430399.428	4733689.09	Yes	619.283	619.183	-0.100	619.156	619.157	619.215	2395	-2725	2,2,2		
2039	344900.171	4717643.718	Yes	906.496	906.488	-0.008	906.481	906.485	906.503	8483	-1366	1,1,1		
2040	437978.954	4710063.008	Yes	738.393	738.396	0.003	738.39	738.439	738.471	3789	2746	1,1,3		
2041	327412.906	4703572.584	Yes	969.035	969.052	0.017	969.034	969.049	969.079	7357	-907	1,1,1		
2042	425230.649	4715852.234	Yes	772.734	772.668	-0.066	772.63	772.666	772.682	6591	2086	1,1,1		
2043	285207.445	4729472.456	Yes	1031.252	1031.287	0.035	1031.282	1031.285	1031.314	7556	-2911	1,1,1		
2044	419806.983	4737514.089	Yes	652.905	652.982	0.077	652.866	652.947	653.019	6522	1202	1,1,1		
2045	337523.711	4700567.298	Yes	947.879	948.012	0.133	947.993	948.001	948.017	5487	21	1,1,1		
2045A	334399.238	4699596.917	Yes	955.199	955.256	0.057	955.23	955.303	955.324	3322	1983	2,3,1		
2046	277415.931	4723697.085	Yes	1084.751	1084.838	0.087	1084.835	1084.841	1084.858	7190	-1291	1,1,1		
2047	338755.043	4709944.914	Yes	934.661	934.732	0.071	934.714	934.727	934.739	4789	85	1,1,1		
2048	375211.534	4695574.79	Yes	886.802	886.826	0.024	886.769	886.827	886.838	7367	2543	1,1,1		
2049	360892.604	4725131.644	Yes	876.685	876.763	0.078	876.755	876.76	876.77	7496	1377	1,1,1		
2049A	359912.085	4722138.301	Yes	882.874	882.897	0.023	882.884	882.908	882.932	6324	1748	1,1,1		
2050	389847.917	4718769.258	Yes	840.224	840.356	0.132	840.349	840.352	840.362	7029	2540	1,1,1		
2051	402680.687	4743886.734	Yes	678.508	678.521	0.013	678.503	678.522	678.525	8725	-1149	1,1,1		
2052	317326.65	4728158.627	Yes	943.043	943.066	0.023	943.056	943.071	943.09	7591	-1757	1,1,1		
2053	391221.228	4726652.201	Yes	826.602	826.702	0.100	826.689	826.725	826.728	7561	-1146	1,1,1		
2054	412635.74	4727256.564	Yes	757.308	757.391	0.083	757.278	757.429	757.447	5543	1394	1,1,1		
2054A	412425.095	4726446.367	Yes	772.312	772.293	-0.019	772.285	772.298	772.329	5792	779	2,2,2		
2055	433151.891	4699895.959	Yes	783.918	784.002	0.084	783.957	783.997	784.022	6794	-2710	1,1,1		
2056	374240.827	4733466.767	Yes	852.903	852.9	-0.003	852.701	852.894	852.925	5171	-1452	1,1,1		
2057	348687.926	4725752.469	Yes	877.987	878.108	0.121	878.087	878.108	878.21	5600	2659	1,1,1		
2057A	348916.715	4726518.846	Yes	876.174	876.262	0.088	876.208	876.268	876.268	5544	145	1,2,1		
2058	370239.199	4723457.265	Yes	874.265	874.342	0.077	874.324	874.343	874.361	8285	-1580	1,1,1		
2059	396024.165	4722851.445	Yes	819.845	820.208	0.363	820.142	820.23	820.269	3298	-984	1,1,1		
2060	277694.015	4720212.689	Yes	1066.862	1066.849	-0.013	1066.818	1066.847	1066.886	6016	-2647	1,1,1		
2061	391646.593	4701295	Yes	861.65	861.707	0.057	861.7	861.707	861.712	6966	2977	1,1,1		
2062	308408.198	4730923.275	Yes	954.54	954.65	0.110	954.646	954.648	954.655	8473	348	1,1,1		
2063	289857.124	4695196.208	Yes	1077.306	1077.395	0.089	1077.385	1077.397	1077.406	6910	-1001	1,1,1		
2063A	304766.451	4694933.042	Yes	1033.695	1033.799	0.104	1033.755	1033.813	1033.83	8201	-421	1,1,1		
2064	400251.791	4696154.958	Yes	848.653	848.719	0.066	848.716	848.726	848.758	7060	1458	1,1,1		
2065	312785.382	4695240.833	Yes	1013.667	1013.783	0.116	1013.774	1013.791	1013.8	9593	1292	1,1,1		
2065A	316252.631	4700476.335	Yes	1000.984	1001.127	0.143	1001.123	1001.137	1001.163	7940	-1704	1,1,1		

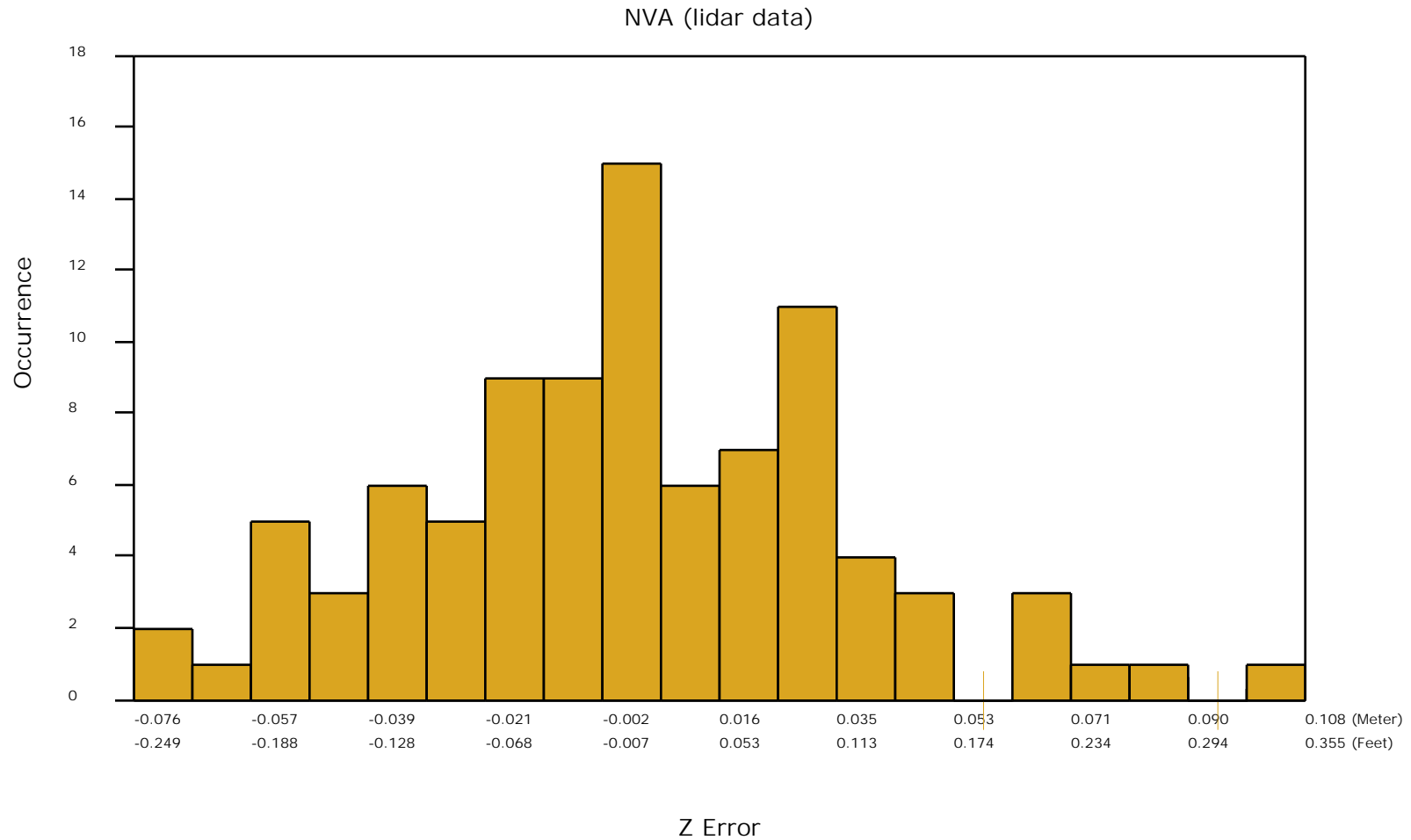
Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Minimum Z	Median Z	Maximum Z	Intensity	Scan Angle Rank	Returns	Description	Comments
2066	326666.618	4733408.621	Yes	908.541	908.541	0.000	908.5	908.526	908.552	7356	-721	1,1,1		
2067	265204.171	4696028.817	Yes	1166.704	1166.826	0.122	1166.765	1166.795	1166.94	6770	-820	1,1,1		
2067A	265230.576	4696791.756	Yes	1136.058	1136.041	-0.017	1136.026	1136.031	1136.106	5685	1781	1,1,1		
2068	438995.546	4733831.692	Yes	667.443	667.539	0.096	667.527	667.543	667.549	4390	-191	2,1,1		
2069	384211.86	4734194.314	Yes	836.633	836.693	0.060	836.671	836.692	836.697	5396	1581	1,1,1		

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a frequency distribution chart of the non-vegetated vertical accuracy (NVA) of the lidar point cloud data measured against surveyed ground check points.

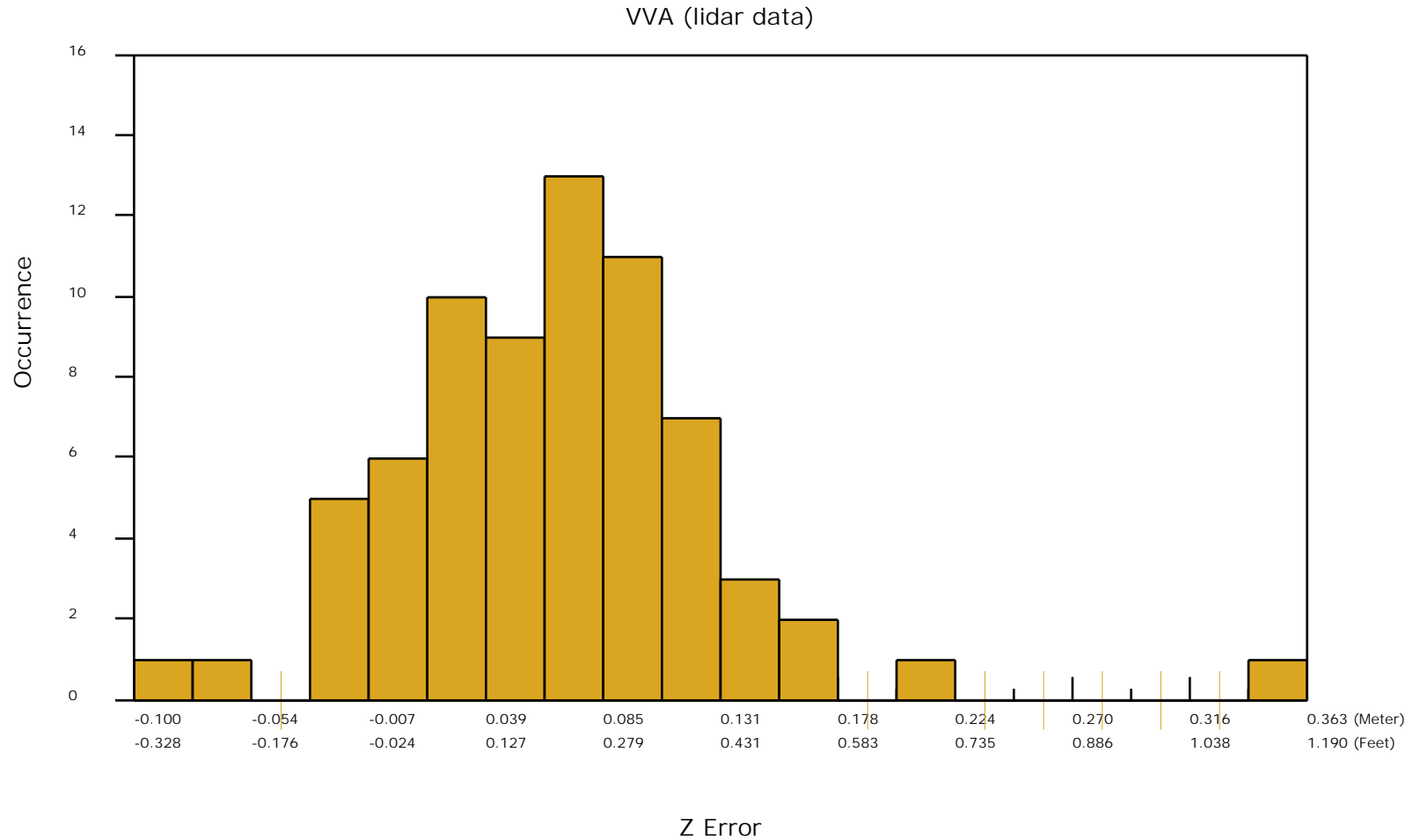
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DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a frequency distribution chart of the vegetated vertical accuracy (VVA) of the lidar point cloud data measured against surveyed ground check points.

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DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to report the results of measuring the DEM data against surveyed ground NVA (nonvegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

NVA (DEM)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
3012	277902.437	4733075.58	Yes	1039.104	1039.172	0.068		
3013	353312.558	4733752.726	Yes	871.674	871.664	-0.010		
3014	265296.363	4708767.477	Yes	1115.704	1115.665	-0.039		
3015	322324.626	4709912.486	Yes	974.734	974.771	0.037		
3016	373765.923	4708916.705	Yes	885.286	885.319	0.033		
3017	289853.553	4706282.302	Yes	1052.007	1052.008	0.001		
3018	362506.736	4714642.934	Yes	896.948	896.961	0.013		
3019	430060.166	4722481.115	Yes	749.075	749.090	0.015		
3020	401285.381	4719915.024	Yes	814.056	814.020	-0.036		
3021	310030.384	4704224.316	Yes	1014.535	1014.551	0.016		
3022	374191.203	4730094.796	Yes	862.41	862.425	0.015		
3023	364409.645	4723326.038	Yes	877.283	877.257	-0.026		
3024	407932.336	4706519.567	Yes	812.368	812.357	-0.011		
3025	397185.294	4707498.177	Yes	834.274	834.274	0.000		
3026	324099.377	4699975.405	Yes	975.86	975.874	0.014		
3027	388466.684	4709337.033	Yes	854.11	854.044	-0.066		
3028	427797.08	4695806.842	Yes	814.175	814.136	-0.039		
3028A	427890.688	4697522.933	Yes	805.349	805.348	-0.001		
3029	333731.923	4726392.127	Yes	915.79	915.806	0.016		
3030	409597.475	4713593.206	Yes	782.494	782.430	-0.064		
3031	277120.566	4715678.412	Yes	1079.069	1079.104	0.035		
3032	298210.479	4734635.058	Yes	974.354	974.426	0.072		
3033	428400.376	4704755.278	Yes	781.723	781.665	-0.058		
3034	415431.769	4699596.545	Yes	822.926	822.918	-0.008		
3035	344439.591	4709953.402	Yes	930.291	930.320	0.029		
3036	314918.231	4724080.024	Yes	974.049	974.059	0.010		
3037	277412.548	4707273.009	Yes	1085.15	1085.157	0.007		
3037A	277619.702	4708191.411	Yes	1077.495	1077.519	0.024		
3038	310142.888	4715440.141	Yes	988.77	988.780	0.010		
3039	268858.526	4705737.835	Yes	1111.016	1110.971	-0.045		

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
3040	285742.329	4729547.213	Yes	1028.648	1028.655	0.007		
3041	358294.156	4710568.355	Yes	909.709	909.669	-0.040		
3042	354208.971	4695103.234	Yes	914.645	914.692	0.047		
3043	430886.272	4733386.971	Yes	670.171	670.171	0.000		
3044	313188.017	4720751.914	Yes	954.466	954.487	0.021		
3045	344944.971	4717477.47	Yes	905.645	905.666	0.021		
3046	437980.525	4711918.669	Yes	738.913	738.874	-0.039		
3047	327691.045	4704486.483	Yes	968.724	968.712	-0.012		
3048	424202.516	4716045.801	Yes	772.903	772.886	-0.017		
3049	287053.602	4730149.518	Yes	1022.51	1022.542	0.032		
3050	419784.486	4737862.583	Yes	659.051	659.051	0.000		
3051	338762.303	4702824.707	Yes	950.701	950.724	0.023		
3052	277366.769	4724664.01	Yes	1071.336	1071.364	0.028		
3053	373353.455	4696342.474	Yes	889.701	889.702	0.001		
3054	336231.804	4711008.205	Yes	933.556	933.547	-0.009		
3055	376720.47	4695636.171	Yes	884.84	884.834	-0.006		
3056	360866.222	4725156.572	Yes	876.683	876.686	0.003		
3056A	359768.095	4721677.042	Yes	884.339	884.349	0.010		
3057	389927.47	4718822.439	Yes	840.049	840.043	-0.006		
3058	402690.108	4743905.644	Yes	678.909	678.851	-0.058		
3059	318425.096	4727961.58	Yes	942.224	942.204	-0.020		
3060	391101.686	4726886.678	Yes	827.774	827.753	-0.021		
3061	412679.664	4727892.368	Yes	759.33	759.325	-0.005		
3061A	412447.52	4726282.969	Yes	776.515	776.490	-0.025		
3062	433253.22	4699875.791	Yes	784.214	784.136	-0.078		
3063	283472.262	4707126.051	Yes	1069.178	1069.158	-0.020		
3063A	281284.882	4707320.036	Yes	1071.966	1071.963	-0.003		
3064	374251.478	4733423.996	Yes	852.632	852.712	0.080		
3065	348919.151	4726497.469	Yes	877.754	877.751	-0.003		
3065A	349140.677	4728230.649	Yes	877.394	877.391	-0.003		
3066	369540.832	4723411.887	Yes	882.56	882.551	-0.009		
3066A	367565.1	4723461.826	Yes	875.16	875.193	0.033		
3067	395428.903	4723130.561	Yes	821.838	821.893	0.055		
3068	277670.944	4720644.166	Yes	1067.721	1067.680	-0.041		
3069	391709.683	4701221.379	Yes	862.614	862.578	-0.036		

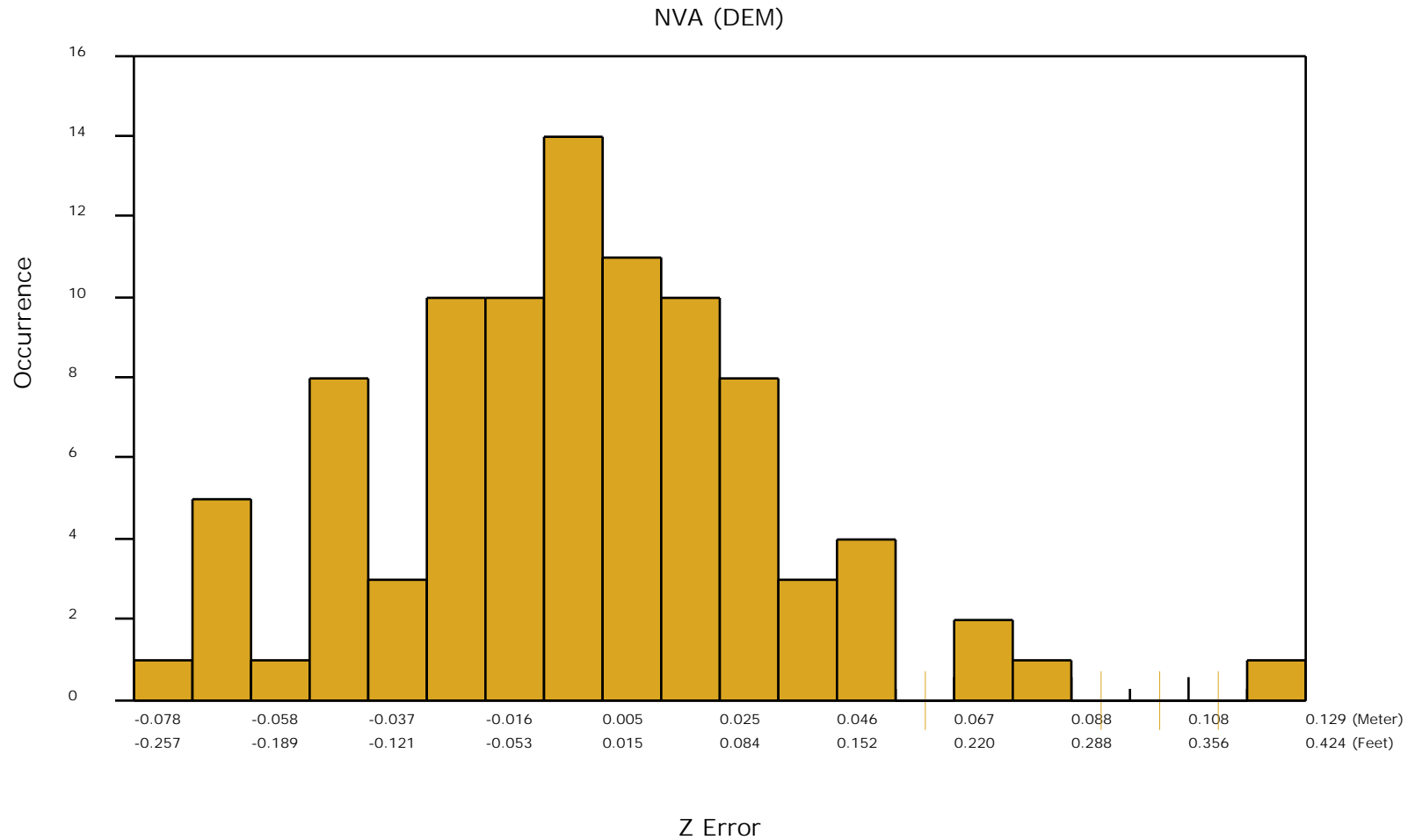
Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
3070	422011.671	4721918.748	Yes	773.818	773.800	-0.018		
3071	417627.403	4712465.813	Yes	787.383	787.363	-0.020		
3071A	417224.585	4712455.898	Yes	788.177	788.150	-0.027		
3072	308584.008	4730832.357	Yes	955.976	956.021	0.045		
3073	350162.599	4699890.912	Yes	926.596	926.590	-0.006		
3074	402616.347	4722153.951	Yes	805.569	805.555	-0.014		
3075	288972.323	4697272.059	Yes	1070.931	1070.949	0.018		
3076	274941.948	4696638.987	Yes	1113.213	1113.216	0.003		
3077	400188.821	4695803.303	Yes	852.625	852.576	-0.049		
3078	313524.951	4695204.286	Yes	1012.819	1012.857	0.038		
3078A	316256.055	4700483.495	Yes	999.972	1000.020	0.048		
3079	277434.713	4712310.979	Yes	1081.655	1081.709	0.054		
3080	332873.49	4695977.756	Yes	943.996	944.012	0.016		
3080A	332900.72	4696188.787	Yes	943.432	943.462	0.030		
3081	326662.371	4734199.712	Yes	914.199	914.182	-0.017		
3082	412497.881	4732893.934	Yes	743.687	743.686	-0.001		
3082A	412458.629	4732172.173	Yes	750.802	750.811	0.009		
3083	372987.606	4701765.213	Yes	894.585	894.565	-0.020		
3084	299924.683	4695768.543	Yes	1047.094	1047.107	0.013		
3084A	304774.453	4694919.217	Yes	1035.044	1035.077	0.033		
3085	265189.127	4696016.228	Yes	1166.494	1166.505	0.011		
3086	373739.235	4717063.571	Yes	881.623	881.752	0.129		
3087	439235.269	4732650.341	Yes	633.242	633.200	-0.042		
3088	383851.194	4734338.763	Yes	836.641	836.655	0.014		
3089	390034.728	4711516.144	Yes	845.372	845.327	-0.045		
3090	393196.759	4719653.044	Yes	831.322	831.309	-0.013		
3091	430018.735	4714399.371	Yes	751.939	751.878	-0.061		

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a frequency distribution chart of the non-vegetated vertical accuracy (NVA) of the DEM data measured against surveyed ground check points.

[Data Source - D:\00_Cherry\Client_LAS](#)



DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to report the results of measuring the DEM data against surveyed ground VVA (vegetated vertical accuracy) check points. All XY coordinates and Z values reported are in the selected data units.

VVA (DEM)

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
2010	277575.781	4731878.371	Yes	1043.194	1043.260	0.066		
2011	353196.169	4733833.226	Yes	869.018	868.995	-0.023		
2013	322672.579	4710274.329	Yes	970.513	970.499	-0.014		
2014	373797.238	4708929.016	Yes	885.463	885.600	0.137		
2014A	373634.504	4717134.307	Yes	877.749	877.871	0.122		
2015	289048.854	4706290.505	Yes	1054.406	1054.442	0.036		
2016	361797.943	4714755.959	Yes	893.402	893.477	0.075		
2017	430087.601	4723471.189	Yes	750.662	750.680	0.018		
2018	402408.309	4719245.432	Yes	810.024	810.135	0.111		
2019	310217.934	4704566.239	Yes	1013.006	1012.945	-0.061		
2020	365428.533	4723433.073	Yes	885.592	885.653	0.061		
2021	408311.134	4706515.693	Yes	812.016	812.125	0.109		
2022	397570.597	4706716.38	Yes	835.22	835.305	0.085		
2023	324082.27	4699994.92	Yes	976.249	976.325	0.076		
2024	388388.396	4708838.712	Yes	853.178	853.254	0.076		
2025	427829.544	4696041.444	Yes	811.631	811.725	0.094		
2026	332402.993	4727407.666	Yes	914.487	914.518	0.031		
2027	409520.881	4713630.195	Yes	777.285	777.271	-0.014		
2028	277099.523	4715705.894	Yes	1077.788	1077.883	0.095		
2029	298224.943	4734609.933	Yes	974.026	974.047	0.021		
2029A	304022.08	4731385.927	Yes	963.544	963.578	0.034		
2030	428944.925	4704735.147	Yes	780.507	780.720	0.213		
2031	415375.766	4699490.874	Yes	822.553	822.644	0.091		
2032	344667.465	4709948.922	Yes	929.187	929.380	0.193		
2033	277256.136	4706292.704	Yes	1086.375	1086.499	0.124		
2033A	277425.741	4712288.026	Yes	1080.683	1080.785	0.102		
2034	309707.451	4715305.219	Yes	991.377	991.391	0.014		
2035	268592.796	4705937.19	Yes	1111.098	1111.221	0.123		
2036	358295.532	4710542.349	Yes	910.728	910.726	-0.002		
2037	353993.582	4695132.249	Yes	914.037	914.061	0.024		

Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
2038	430741.31	4733542.987	Yes	649.109	649.144	0.035		
2038A	430399.428	4733689.09	Yes	619.283	619.174	-0.109		
2039	344900.171	4717643.718	Yes	906.496	906.497	0.001		
2040	437978.954	4710063.008	Yes	738.393	738.306	-0.087		
2041	327412.906	4703572.584	Yes	969.035	969.067	0.032		
2042	425230.649	4715852.234	Yes	772.734	772.672	-0.062		
2043	285207.445	4729472.456	Yes	1031.252	1031.293	0.041		
2044	419806.983	4737514.089	Yes	652.905	652.943	0.038		
2045	337523.711	4700567.298	Yes	947.879	948.006	0.127		
2045A	334399.238	4699596.917	Yes	955.199	955.240	0.041		
2046	277415.931	4723697.085	Yes	1084.751	1084.830	0.079		
2047	338755.043	4709944.914	Yes	934.661	934.721	0.060		
2048	375211.534	4695574.79	Yes	886.802	886.813	0.011		
2049	360892.604	4725131.644	Yes	876.685	876.762	0.077		
2049A	359912.085	4722138.301	Yes	882.874	882.942	0.068		
2050	389847.917	4718769.258	Yes	840.224	840.362	0.138		
2051	402680.687	4743886.734	Yes	678.508	678.524	0.016		
2052	317326.65	4728158.627	Yes	943.043	943.071	0.028		
2053	391221.228	4726652.201	Yes	826.602	826.679	0.077		
2054	412635.74	4727256.564	Yes	757.308	757.423	0.115		
2054A	412425.095	4726446.367	Yes	772.312	772.280	-0.032		
2055	433151.891	4699895.959	Yes	783.918	784.018	0.100		
2056	374240.827	4733466.767	Yes	852.903	853.042	0.139		
2057	348687.926	4725752.469	Yes	877.987	878.079	0.092		
2057A	348916.715	4726518.846	Yes	876.174	876.245	0.071		
2058	370239.199	4723457.265	Yes	874.265	874.338	0.073		
2059	396024.165	4722851.445	Yes	819.845	820.228	0.383		
2060	277694.015	4720212.689	Yes	1066.862	1066.892	0.030		
2061	391646.593	4701295	Yes	861.65	861.700	0.050		
2062	308408.198	4730923.275	Yes	954.54	954.637	0.097		
2063	289857.124	4695196.208	Yes	1077.306	1077.392	0.086		
2063A	304766.451	4694933.042	Yes	1033.695	1033.748	0.053		
2064	400251.791	4696154.958	Yes	848.653	848.726	0.073		
2065	312785.382	4695240.833	Yes	1013.667	1013.801	0.134		
2065A	316252.631	4700476.335	Yes	1000.984	1001.132	0.148		

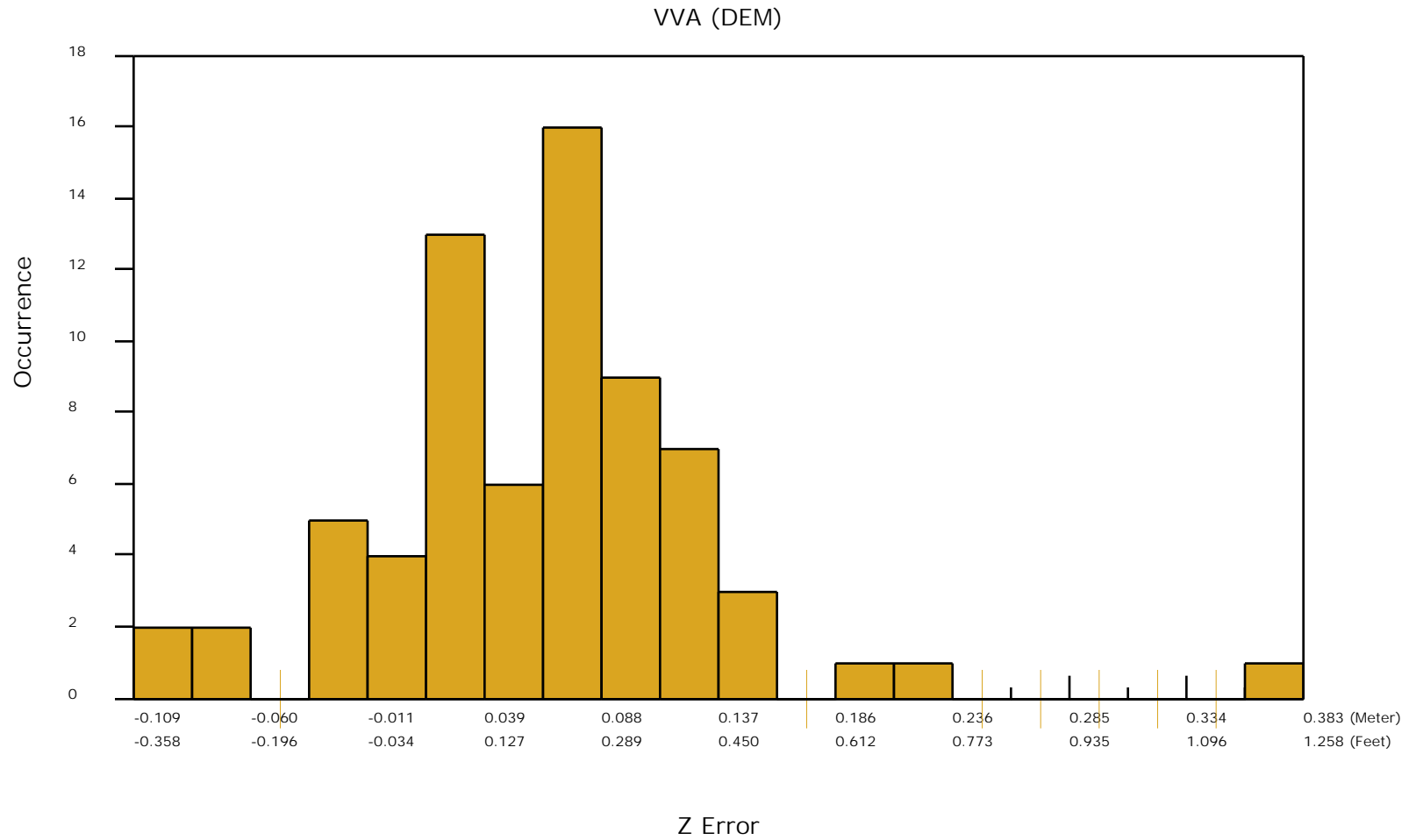
Check Points Vertical Accuracy - continued

ID	X	Y	Coverage	Z	Z From Lidar	Z Error	Description	Comments
2066	326666.618	4733408.621	Yes	908.541	908.529	-0.012		
2067	265204.171	4696028.817	Yes	1166.704	1166.787	0.083		
2067A	265230.576	4696791.756	Yes	1136.058	1136.082	0.024		
2068	438995.546	4733831.692	Yes	667.443	667.525	0.082		
2069	384211.86	4734194.314	Yes	836.633	836.708	0.075		

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a frequency distribution chart of the vegetated vertical accuracy (VVA) of the DEM data measured against surveyed ground check points.

[Data Source - D:\00_Cherry\Client_LAS](#)

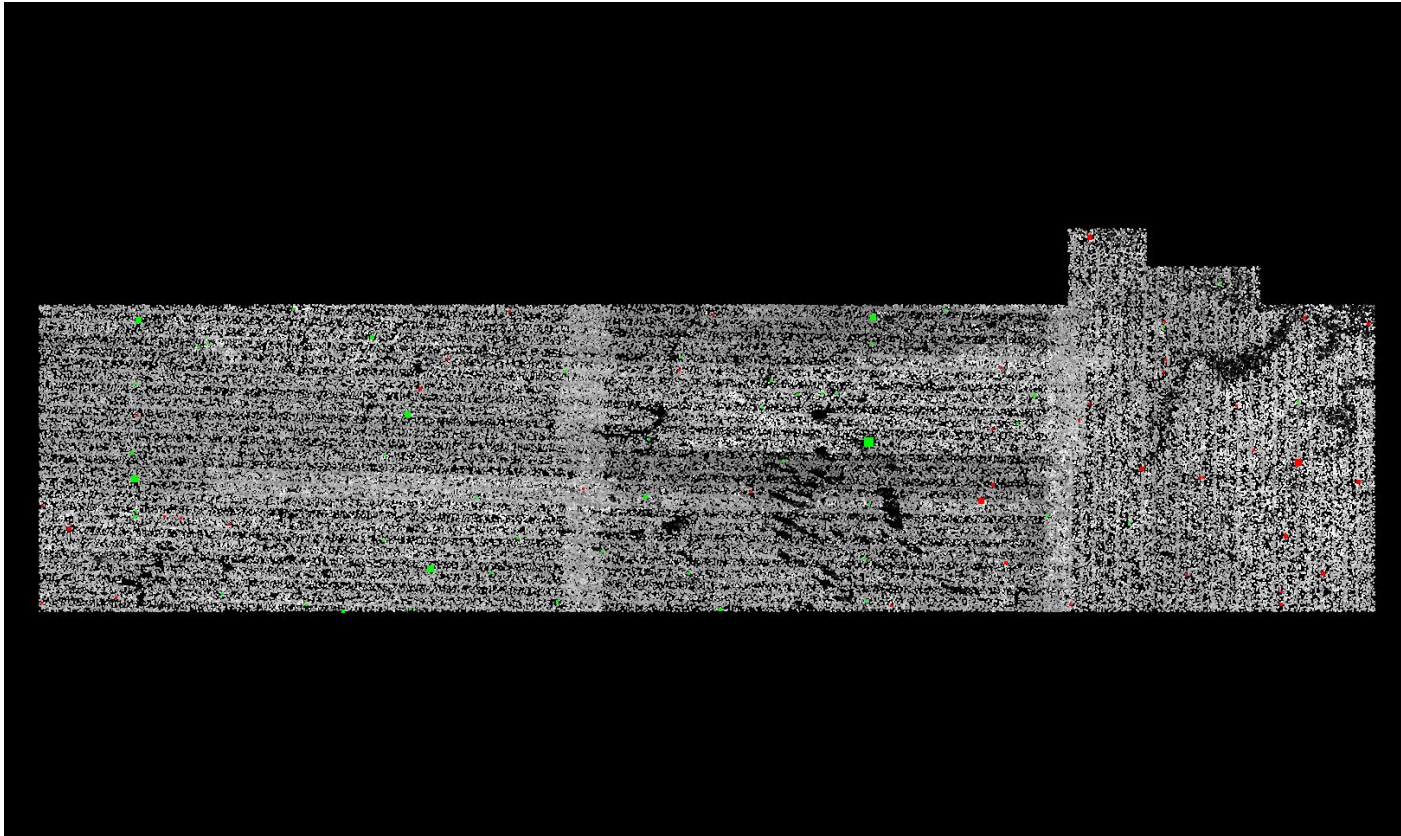


DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a graphic of lidar data points colored by intensity with NVA check points rendered "thematically" showing the green and red squares sized by Z error.

[Data Source - D:\00_Cherry\Client_LAS](#)

[Result Path - D:\00_Cherry\NE_CherryBrownCuster_North_Block_QC\DPH_11\ColorByIntensity_CheckPoints_NVA.jpg](#)



■ Green represents where the lidar surface is above the check point (positive elevation error).

■ Red represents where the lidar surface is below the check point (negative elevation error).

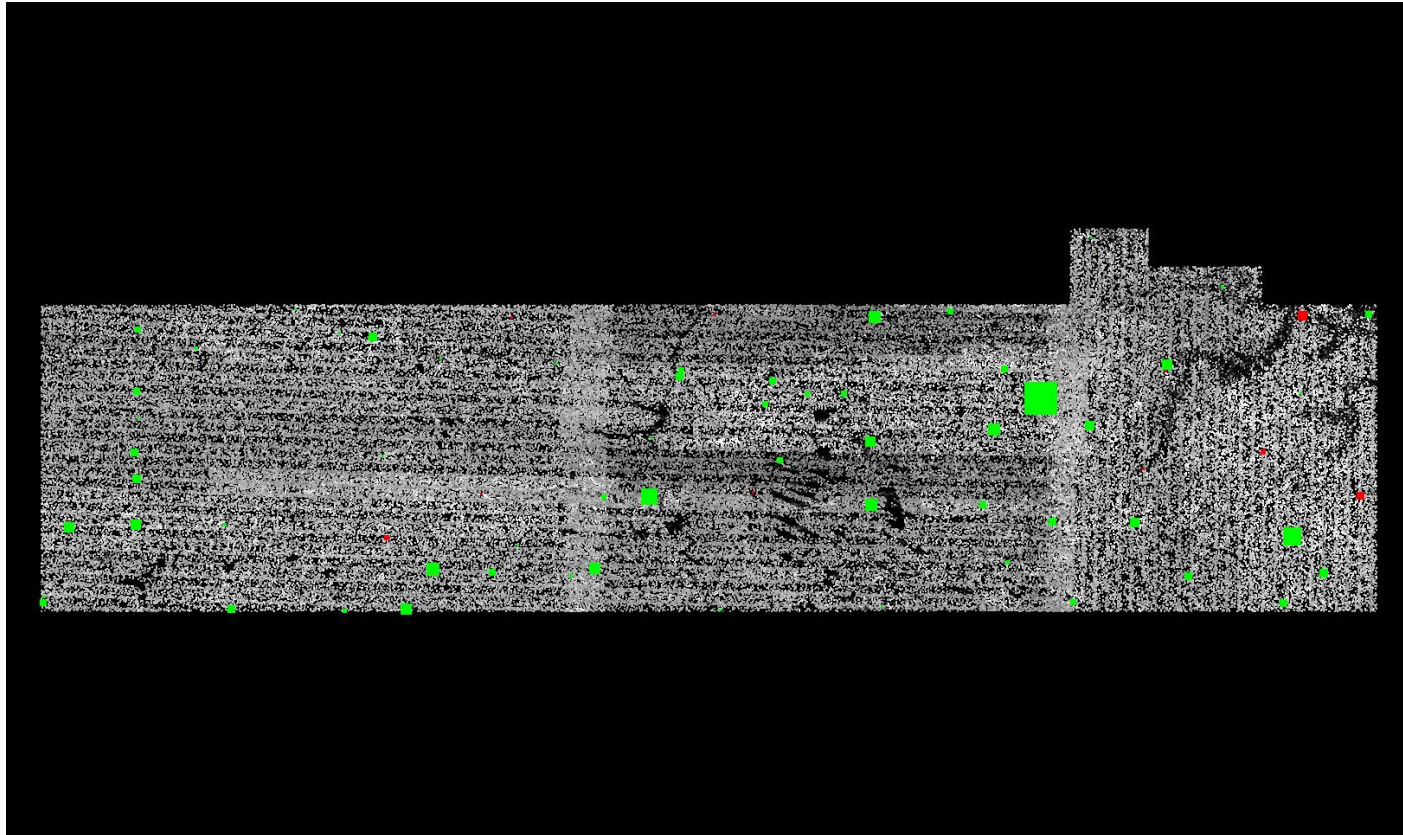
The size of the square symbol represents the absolute value magnitude of error.

DPH-11 Report on Absolute Vertical Accuracy - continued

The purpose of this section is to show a graphic of lidar data points colored by intensity with VVA check points rendered "thematically" showing the green and red squares sized by Z error.

[Data Source - D:\00_Cherry\Client_LAS](#)

[Result Path - D:\00_Cherry\NE_CherryBrownCuster_North_Block_QC\DPH_11\ColorByIntensity_CheckPoints_VVA.jpg](#)



■ Green represents where a DEM of the lidar surface is above the check point (positive elevation error).

■ Red represents where a DEM of the lidar surface is below the check point (negative elevation error).

The size of the square symbol represents the absolute value magnitude of error.