FL2101 Tampa Bay TopoBathymetric Lidar, Imagery, and Shoreline Mapping

GROUND SURVEY REPORT FOR LIDAR

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Prepared For:

National Oceanic and Atmospheric Administration

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1. INTRODUCTION

A. Project Summary

Dewberry Consultants LLC is under contract with the National Oceanic and Atmospheric Administration (NOAA) to collect and process LiDAR for Tampa Bay, Florida. This survey will be used to evaluate the vertical accuracy of the bare-earth terrain derived from LiDAR. The project area consists of approximately 226 square miles. In support of this project Dewberry surveyed 60 points that will be used for LiDAR verification. The field work was conducted during the month of February of 2021.

Existing National Geodetic Survey (NGS) control points were located and surveyed each day to check the accuracy of the RTK/GPS survey equipment with the results shown on page 5 of this report.

As an internal QA/QC procedure and to verify that the ground control points meet the 95% confidence level approximately 50% of the points were re-observed and their corresponding coordinate differences are shown on page 11 of this report.

Final horizontal coordinates are referenced to the NAD 83 (2011 Adjustment), Universal Transverse Mercator Coordinates (Zone 17), meters, and Geographic Latitude and Longitude as derived from the Florida Permanent Reference Network (FPRN). Final vertical elevations are referenced to NAVD88 in U.S. Survey feet using Geoid model 18 (Geoid18).

B. Point of Contact

Questions regarding the technical aspects of this report should be addressed to:

Dewberry Engineers, Inc.

William D. Donley, PSM

Associate Vice President

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Orlando, Florida 32806

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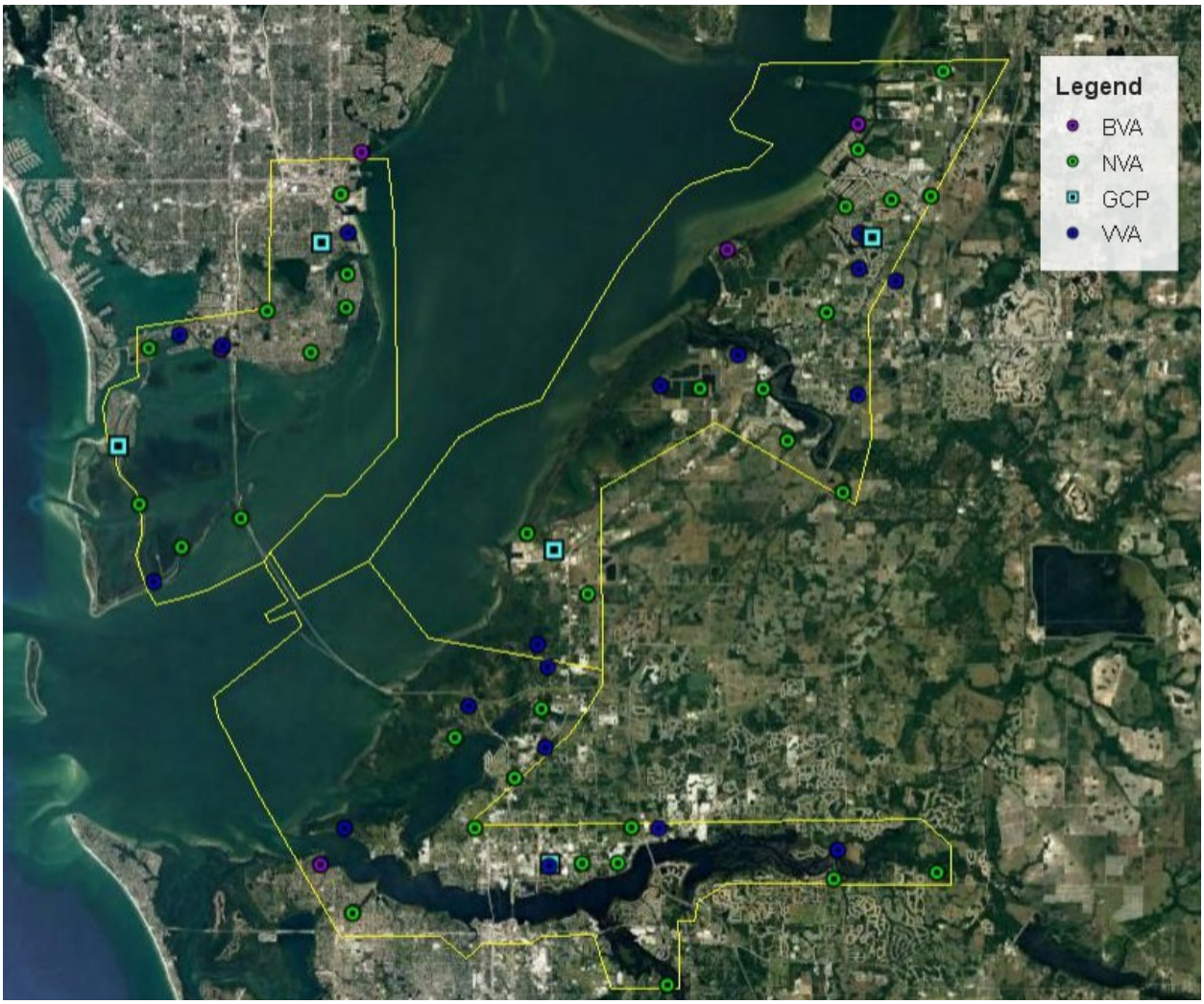
C. Project Area

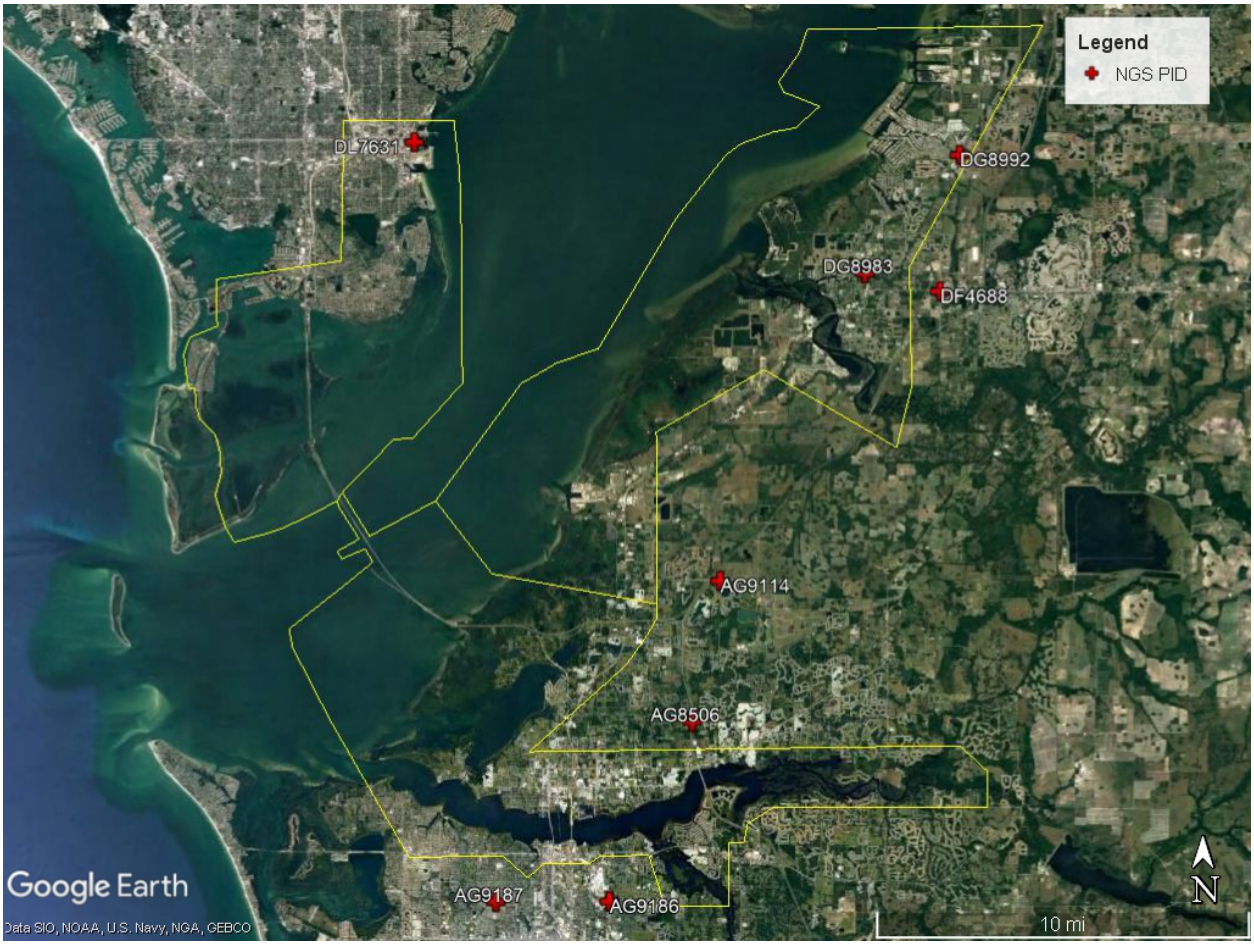


Southern Tampa Bay Project Area

2. PLAN and METHODOLOGY FORMULATION

A. Establishing Connection/ Tying to National Spatial Reference System (NSRS)

Existing National Geodetic Survey (NGS) control points were located and surveyed to check the accuracy of the RTK/GPS survey equipment with the results shown below. 8 individual NGS control points having a general spatial distribution from each other were identified and located for this project. Standard procedure being a survey crew checking to an NGS control point at the beginning and ending of a collection interval.

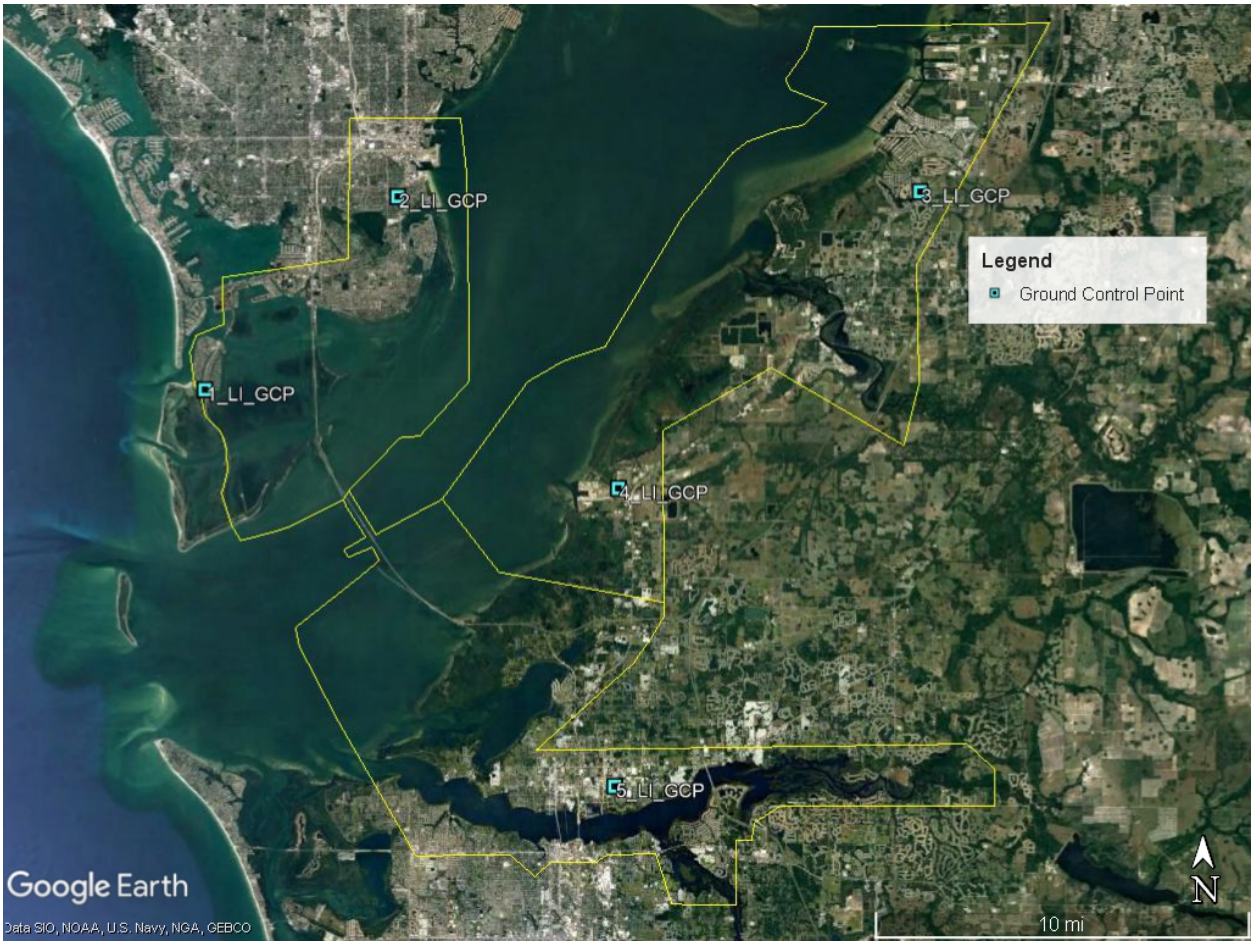


NGS Control Point Locations

NGS PT. ID	Designation	As Surveyed (ft)			Published (ft)			Differences (ft)		
		Northing	Easting	Elevation	Northing	Easting	Elevation	Δ N	Δ E	Δ Elevation
AG8506	I75 84 A44	1168302.07	490754.22	58.52	1168302.17	490754.07	58.42	0.10	-0.15	-0.10
AG9114	GIS 009	1188044.35	494782.13	26.44	1188044.30	494782.22	26.38	-0.05	0.09	-0.06
AG9186	GIS 081	1143115.23	478968.35	19.69	1143115.24	478968.28	19.72	0.01	-0.07	0.03
AG9187	M 082	1143106.28	462931.55	22.41	1143106.2	462931.6	22.36	-0.06	0.04	-0.05
DF4688	VD 224	1228524.17	525995.97	35.97	1228524.2	525996	36.01	0.01	0.06	0.04
DG8983	LANDMARK	1231095.82	515406.47	2.92	1231095.8	515406.4	2.87	-0.04	-0.04	-0.05
DG8992	HUMPHREYS	1247658.54	528859.07	11.43	1247658.6	528859.1	11.42	0.02	-0.02	-0.01
DL7631	S 733	1249755.13	451837.56	7.80	1249755.1	451837.5	7.8	-0.02	-0.02	0.00

B. Establishment of Primary Control

The 5 LiDAR Ground Control Points (GCP's) were well distributed throughout the project area by the LiDAR acquisition supplier. A sketch and photographs were made for each ground control point location and a nail & disk or an iron rod & cap were set at the point. The ground control point locations are detailed on the "Ground Control Point Documentation Report" sheets attached to this report accompanied by site photos.

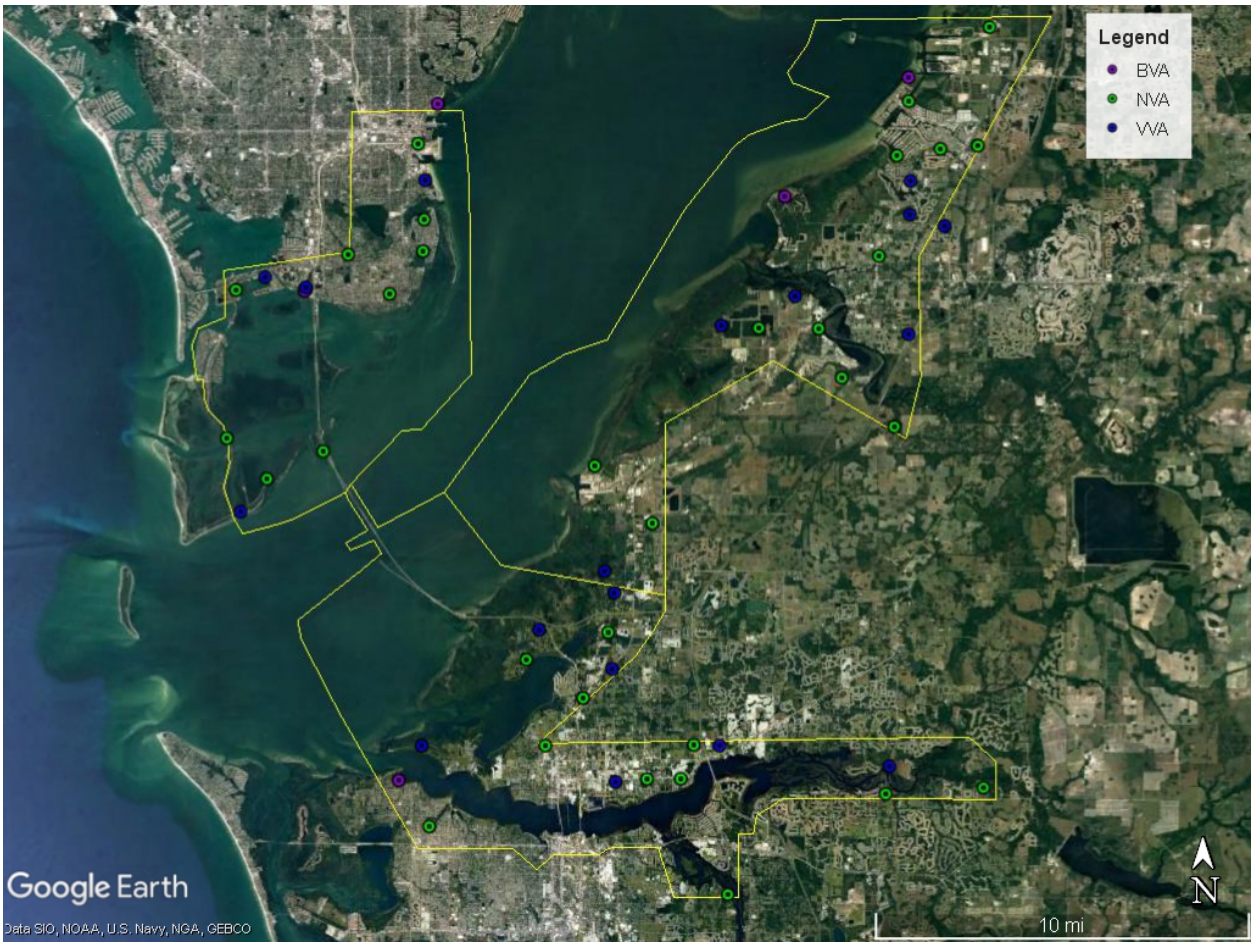


Ground Control Point Locations

Point ID	UTM Easting	UTM Northing	Ortho_Ht (m)	Elipht_(m)	HOR_RMSE	VER_RMSE	TYPE	DATE
1_LI_GCP	329824.115	3062310.572	1.714	-22.641	0.017	0.035	co_hv	1-Feb-2021
2_LI_GCP	338218.108	3070453.712	1.573	-22.932	0.006	0.011	co_hv	1-Feb-2021
3_LI_GCP	360685.188	3070381.412	2.479	-22.378	0.014	0.020	co_hv	3-Feb-2021
4_LI_GCP	347545.804	3057875.727	2.357	-22.235	0.008	0.014	co_hv	2-Feb-2021
5_LI_GCP	347230.917	3045153.262	2.376	-22.161	0.013	0.021	co_hv	2-Feb-2021

C. Establishment of Check Points

The 55 LiDAR checkpoints were distributed throughout the project area by the overlaying of a grid and targeting areas that would provide an accurate portrayal of the surrounding topography within a buffer centered on intersecting grid lines. A sketch and photographs were made for each check point location and a nail & disk or an iron rod & cap were set at the point. The check point locations are detailed on the “Check Point Documentation Report” sheets attached to this report.



Lidar Check Point Locations

C. Establishment of Check Points

Point ID	UTM Easting	UTM Northing	Ortho_Ht (m)	Elip_Ht (m)	HOR_RMSE	VER_RMSE	TYPE	acc_rep	grnd_cvr	DATE
1_LI_BVA	334068.463	3066168.021	-0.257	-24.678	0.088	0.016	ch_hv	bva	ba	9-Feb-2021
2_LI_BVA	339891.402	3074088.875	-0.347	-24.916	0.008	0.014	ch_hv	bva	ba	9-Feb-2021
3_LI_BVA	360147.697	3074970.740	-0.508	-25.397	0.008	0.014	ch_hv	bva	ba	10-Feb-2021
4_LI_BVA	354758.643	3069942.128	-0.660	-25.433	0.017	0.035	ch_hv	bva	ba	16-Feb-2021
5_LI_BVA	337853.136	3045226.224	-0.660	-25.096	0.020	0.032	ch_hv	bva	ba	12-Feb-2021
1_LI_NVA	363660.642	3077077.051	2.221	-22.724	0.009	0.017	ch_hv	nva	ua	3-Feb-2021
2_LI_NVA	360144.723	3073954.131	1.669	-23.210	0.006	0.010	ch_hv	nva	ua	3-Feb-2021
3_LI_NVA	359603.014	3071634.141	2.524	-22.330	0.007	0.014	ch_hv	nva	ua	3-Feb-2021
4_LI_NVA	361478.091	3071894.451	1.778	-23.099	0.006	0.012	ch_hv	nva	ua	3-Feb-2021
5_LI_NVA	363091.256	3072012.407	5.198	-19.697	0.017	0.030	ch_hv	nva	ua	3-Feb-2021
6_LI_NVA	339243.491	3069155.605	1.197	-23.315	0.009	0.015	ch_hv	nva	ua	12-Feb-2021
7_LI_NVA	339021.442	3072392.725	1.651	-22.885	0.006	0.015	ch_hv	nva	ua	16-Feb-2021
8_LI_NVA	335958.091	3067703.326	5.788	-18.665	0.020	0.033	ch_hv	nva	ua	8-Feb-2021
9_LI_NVA	339177.499	3067799.428	1.769	-22.733	0.006	0.012	ch_hv	nva	ua	9-Feb-2021
10_LI_NVA	358775.886	3067355.014	1.644	-23.166	0.011	0.016	ch_hv	nva	ua	4-Feb-2021
11_LI_NVA	331111.024	3066248.572	1.992	-22.388	0.020	0.035	ch_hv	nva	ua	4-Feb-2021
12_LI_NVA	337721.947	3065995.760	2.649	-21.822	0.012	0.019	ch_hv	nva	ua	8-Feb-2021
13_LI_NVA	353572.618	3064338.202	3.130	-21.585	0.007	0.010	ch_hv	nva	ua	8-Feb-2021
14_LI_NVA	356152.117	3064281.800	5.229	-19.524	0.007	0.010	ch_hv	nva	ua	4-Feb-2021
15_LI_NVA	357113.853	3062175.009	6.308	-18.446	0.009	0.013	ch_hv	nva	ua	8-Feb-2021
16_LI_NVA	330641.080	3059924.968	1.926	-22.440	0.006	0.011	ch_hv	nva	ua	4-Feb-2021
17_LI_NVA	334780.621	3059311.008	1.283	-23.136	0.018	0.034	ch_hv	nva	ua	4-Feb-2021
18_LI_NVA	346448.884	3058547.938	1.114	-23.464	0.006	0.010	ch_hv	nva	ua	11-Feb-2021
19_LI_NVA	359345.847	3060052.688	3.947	-20.825	0.010	0.017	ch_hv	nva	ua	5-Feb-2021
20_LI_NVA	332346.541	3058167.165	1.862	-22.527	0.026	0.042	ch_hv	nva	ua	4-Feb-2021
21_LI_NVA	348893.078	3056061.622	3.795	-20.809	0.019	0.029	ch_hv	nva	ua	11-Feb-2021
22_LI_NVA	343405.970	3050308.842	1.935	-22.578	0.008	0.014	ch_hv	nva	ua	11-Feb-2021
23_LI_NVA	346940.693	3051427.658	1.212	-23.347	0.006	0.010	ch_hv	nva	ua	12-Feb-2021
24_LI_NVA	345819.315	3048641.829	6.725	-17.809	0.014	0.022	ch_hv	nva	ua	11-Feb-2021
25_LI_NVA	344174.048	3046627.772	3.221	-21.288	0.007	0.012	ch_hv	nva	ua	11-Feb-2021
26_LI_NVA	339139.517	3043239.013	3.317	-21.125	0.010	0.014	ch_hv	nva	ua	12-Feb-2021
27_LI_NVA	350556.963	3046579.730	5.059	-19.521	0.010	0.014	ch_hv	nva	ua	8-Feb-2021
28_LI_NVA	348529.307	3045145.551	1.937	-22.614	0.011	0.018	ch_hv	nva	ua	12-Feb-2021
29_LI_NVA	349978.032	3045136.909	2.324	-22.242	0.010	0.016	ch_hv	nva	ua	12-Feb-2021
30_LI_NVA	351943.402	3040172.070	2.190	-22.370	0.006	0.012	ch_hv	nva	ua	9-Feb-2021
31_LI_NVA	362989.778	3044593.257	5.957	-18.761	0.017	0.025	ch_hv	nva	ua	8-Feb-2021
32_LI_NVA	358782.610	3044383.772	3.260	-21.409	0.009	0.014	ch_hv	nva	ua	8-Feb-2021
1_LI_VVA	360178.850	3070540.262	2.177	-22.675	0.008	0.015	ch_hv	vva	lg	3-Feb-2021
2_LI_VVA	339308.245	3070835.273	1.029	-23.497	0.006	0.009	ch_hv	vva	lg	9-Feb-2021
3_LI_VVA	360124.898	3069101.747	1.274	-23.567	0.006	0.012	ch_hv	vva	tr	3-Feb-2021
4_LI_VVA	361607.226	3068596.431	4.325	-20.529	0.007	0.011	ch_hv	vva	hg	4-Feb-2021
5_LI_VVA	332373.472	3066777.643	2.055	-22.345	0.008	0.013	ch_hv	vva	lg	4-Feb-2021
6_LI_VVA	334129.697	3066325.877	2.450	-21.972	0.010	0.015	ch_hv	vva	lg	4-Feb-2021
7_LI_VVA	355145.992	3065680.056	1.059	-23.688	0.023	0.030	ch_hv	vva	hg	8-Feb-2021
8_LI_VVA	351970.211	3064464.323	1.948	-22.742	0.005	0.008	ch_hv	vva	lg	8-Feb-2021
9_LI_VVA	360007.848	3063993.337	8.355	-16.449	0.006	0.011	ch_hv	vva	lg	4-Feb-2021
10_LI_VVA	331198.330	3056777.285	0.990	-23.385	0.019	0.036	ch_hv	vva	lg	4-Feb-2021
11_LI_VVA	346820.494	3054045.042	1.154	-23.414	0.020	0.033	ch_hv	vva	lg	12-Feb-2021
12_LI_VVA	347227.336	3053116.567	1.659	-22.910	0.006	0.009	ch_hv	vva	lg	12-Feb-2021
13_LI_VVA	343975.758	3051576.762	1.409	-23.114	0.006	0.011	ch_hv	vva	lg	11-Feb-2021
14_LI_VVA	347091.301	3049868.020	5.050	-19.504	0.007	0.011	ch_hv	vva	hg	12-Feb-2021
15_LI_VVA	338856.015	3046690.781	0.614	-23.839	0.017	0.029	ch_hv	vva	hg	11-Feb-2021
16_LI_VVA	358957.256	3045557.369	3.705	-20.974	0.006	0.010	ch_hv	vva	hg	8-Feb-2021
17_LI_VVA	351662.856	3046530.705	4.066	-20.526	0.008	0.015	ch_hv	vva	lg	8-Feb-2021
18_LI_VVA	347175.393	3045042.150	3.129	-21.407	0.008	0.014	ch_hv	vva	lg	12-Feb-2021

3. METHODOLOGY EXECUTION

A. Establishment of Control Points and Check Points

The Florida Permanent Reference Network (FPRN) was used for the observations being a real-time kinematic (RTK) network used to establish and verify the accuracy of the observations. The GPS units connected to the networks using a cellular connection and a virtual reference station. The RTK network provides instant access to RTK corrections utilizing a network of permanent (fixed) continuously operating reference stations. The published accuracy for the network is less than 2 centimeters. All recorded observations were within 5 centimeters of each other. All locations were occupied once with approximately 50% of the locations being re-observed. All re-observations matched the initially derived station positions within the allowable tolerance of ± 5 centimeters or within the 95% confidence level. Each occupation was approximately 1.5 minutes in duration and measured to 90 epochs. The second observation occurred at least four hours after the first observation.

B. Equipment Used

- (3) Spectra Precision - SP80 GNSS receivers
  Model #s :5520550102, 5621550431, and 5621550350
- Spectra Precision Ranger 3 Data Collector
- 2 meter fixed height Fiberglass GPS pole
- BiPod legs for Stabilization

C. Software Used

- Spectra Precision – Survey Pro (Version 6.6.2.68)
- AutoDesk – AutoCAD Civil 3D 2020
- Microsoft Office – (Excel, Word)
- ESRI – ArcGIS Pro
- Google Earth Pro (Version 7.3.3.7786 (64-bit))

After the field data is collected the information is downloaded from the data collectors. Downloaded data is processed in the office to obtain the following reports: points list, point derivations and a vector spreadsheet. The reports are reviewed for point accuracy and precision.

After review of the point data an “ASCII” or “txt” file is created. Point files are loaded into AutoCAD Civil 3D to make a visual check of the point data (Point #, Coordinates, Elevation. and Description). The point data is reviewed and point comparisons are compared the point data. The layout of the collected survey coordinates are compared to the original survey layout as well. Conversions to specified coordinates systems are then preformed and tabulated for delivery. The data is then organized using spreadsheets and imported into the report.

D. GPS Observations & Point Comparison

GPS Observation and Re-observation Schedule						
Point ID	Observation Date	Julian Date	Time of Day	Re-observation Date	Re-observation Julian Date	Re-observation Time of Day
1_LI_GCP	2/1/2021	32	14:44	N/A	N/A	N/A
2_LI_GCP	2/1/2021	32	12:14	N/A	N/A	N/A
3_LI_GCP	2/3/2021	34	9:38	2/10/2021	41	12:06
4_LI_GCP	2/2/2021	33	15:39	2/11/2021	42	10:25
5_LI_GCP	2/2/2021	33	11:16	2/12/2021	43	11:38
1_LI_NVA	2/3/2021	34	11:55	2/10/2021	41	10:08
2_LI_NVA	2/3/2021	34	13:06	2/10/2021	41	10:47
3_LI_NVA	2/3/2021	34	14:15	2/10/2021	41	11:38
4_LI_NVA	2/3/2021	34	14:01	2/16/2021	47	15:02
5_LI_NVA	2/3/2021	34	13:41	2/10/2021	41	11:22
6_LI_NVA	2/12/2021	43	14:40	2/12/2021	43	9:50
7_LI_NVA	2/16/2021	47	9:26	N/A	N/A	N/A
8_LI_NVA	2/8/2021	39	13:38	N/A	N/A	N/A
9_LI_NVA	2/9/2021	40	12:58	2/16/2021	47	11:15
10_LI_NVA	2/4/2021	35	11:23	2/10/2021	42	13:49
11_LI_NVA	2/4/2021	35	13:02	N/A	N/A	N/A
12_LI_NVA	2/8/2021	39	12:37	2/16/2021	47	12:04
13_LI_NVA	2/8/2021	39	11:09	2/16/2021	47	16:47
14_LI_NVA	2/4/2021	35	14:27	N/A	N/A	N/A
15_LI_NVA	2/8/2021	39	12:11	2/16/2021	47	13:30
16_LI_NVA	2/4/2021	35	11:34	2/8/2021	39	11:03
17_LI_NVA	2/4/2021	35	14:28	2/8/2021	39	11:50
18_LI_NVA	2/11/2021	42	10:38	N/A	N/A	N/A
19_LI_NVA	2/5/2021	36	13:22	N/A	N/A	N/A
20_LI_NVA	2/4/2021	35	10:40	2/8/2021	39	10:16
21_LI_NVA	2/11/2021	42	11:13	2/16/2021	47	12:00
22_LI_NVA	2/11/2021	42	15:10	N/A	N/A	N/A
23_LI_NVA	2/12/2021	43	11:09	N/A	N/A	N/A
24_LI_NVA	2/11/2021	42	11:40	N/A	N/A	N/A
25_LI_NVA	2/11/2021	42	10:48	N/A	N/A	N/A
26_LI_NVA	2/12/2021	43	10:18	N/A	N/A	N/A
27_LI_NVA	2/8/2021	39	15:33	N/A	N/A	N/A
28_LI_NVA	2/12/2021	43	11:08	N/A	N/A	N/A
29_LI_NVA	2/12/2021	43	10:19	N/A	N/A	N/A
30_LI_NVA	2/9/2021	40	15:41	2/12/2021	43	13:38
31_LI_NVA	2/8/2021	39	11:36	N/A	N/A	N/A
32_LI_NVA	2/8/2021	39	11:58	2/9/2021	40	10:24
1_LI_BVA	2/9/2021	40	14:10	N/A	N/A	N/A
2_LI_BVA	2/9/2021	40	15:38	N/A	N/A	N/A
3_LI_BVA	2/10/2021	41	14:23	N/A	N/A	N/A
4_LI_BVA	2/16/2021	47	14:28	N/A	N/A	N/A
5_LI_BVA	2/12/2021	43	11:03	N/A	N/A	N/A

D. GPS Observations & Point Comparison

GPS Observation and Re-observation Schedule

Point ID	Observation Date	Julian Date	Time of Day	Re-observation Date	Re-observation Julian Date	Re-observation Time of Day
1_LI_VVA	2/3/2021	34	14:50	2/10/2021	41	11:55
2_LI_VVA	2/9/2021	40	9:58	2/16/2021	47	11:36
3_LI_VVA	2/3/2021	34	15:10	2/10/2021	41	12:50
4_LI_VVA	2/4/2021	35	9:24	N/A	N/A	N/A
5_LI_VVA	2/4/2021	35	13:27	N/A	N/A	N/A
6_LI_VVA	2/4/2021	35	13:59	2/9/2021	40	13:53
7_LI_VVA	2/8/2021	39	10:37	2/16/2021	47	13:00
8_LI_VVA	2/8/2021	39	11:48	2/16/2021	47	12:40
9_LI_VVA	2/4/2021	35	13:46	2/16/2021	47	15:32
10_LI_VVA	2/4/2021	35	11:00	2/8/2021	39	8:43
11_LI_VVA	2/12/2021	43	12:25	2/16/2021	47	11:22
12_LI_VVA	2/12/2021	43	13:38	N/A	N/A	N/A
13_LI_VVA	2/11/2021	42	14:26	N/A	N/A	N/A
14_LI_VVA	2/12/2021	43	9:27	N/A	N/A	N/A
15_LI_VVA	2/11/2021	42	9:47	N/A	N/A	N/A
16_LI_VVA	2/8/2021	39	13:17	N/A	N/A	N/A
17_LI_VVA	2/8/2021	39	14:20	2/12/2021	43	9:36
18_LI_VVA	2/12/2021	43	12:15	N/A	N/A	N/A

Point Comparison Spreadsheet

PID	Δ N(m)	Δ E(m)	Δ Elevation(m)
3_LI_GCP	0.013	0.024	-0.022
4_LI_GCP	-0.001	-0.016	0.006
5_LI_GCP	-0.003	-0.011	0.012

Point Comparison Spreadsheet

PID	Δ N(m)	Δ E(m)	Δ Elevation(m)
1_LI_VVA	0.013	-0.003	0.018
2_LI_VVA	0.012	0.010	-0.002
3_LI_VVA	0.002	-0.005	-0.032
6_LI_VVA	-0.022	-0.002	-0.021
7_LI_VVA	-0.017	-0.002	-0.010
8_LI_VVA	0.034	0.002	0.035
9_LI_VVA	-0.020	0.028	0.031
10_LI_VVA	0.005	0.003	-0.039
11_LI_VVA	0.003	0.008	-0.033
17_LI_VVA	0.012	0.004	0.047

Point Comparison Spreadsheet

PID	Δ N(m)	Δ E(m)	Δ Elevation(m)
1_LI_NVA	-0.003	-0.009	-0.021
2_LI_NVA	0.004	-0.020	-0.017
3_LI_NVA	0.025	0.002	0.045
4_LI_NVA	-0.001	-0.012	-0.009
5_LI_NVA	0.002	-0.004	0.005
9_LI_NVA	-0.020	-0.005	-0.007
10_LI_NVA	-0.010	0.002	-0.015
12_LI_NVA	0.012	0.012	-0.031
13_LI_NVA	-0.009	-0.013	0.020
15_LI_NVA	-0.030	-0.032	0.015
16_LI_NVA	0.012	-0.007	-0.011
17_LI_NVA	0.007	0.012	0.024
20_LI_NVA	0.003	-0.005	0.000
21_LI_NVA	-0.027	0.020	0.035
30_LI_NVA	-0.008	0.021	0.014
32_LI_NVA	-0.003	0.016	0.034

6. SURVEY NOTES

1) Coordinates shown hereon were collected on the Florida State Plane Coordinate System, West Zone, North American Datum of 1983 (2011 Adjustment) in U.S. Survey feet and converted to meters for submittal.
2) Elevations shown hereon were collected on the North American Vertical Datum of 1988, in U.S. Survey feet and converted to meters for submittal.
3) The purpose of this survey was to establish ground control points across southern Tampa bay area to be used for LiDAR calibration.

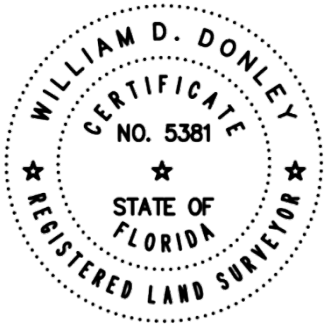
7. GLOSSARY/LEGEND

CHK	Check
ELEV	Elevation
FPRN	Florida Permanent Reference Network
ft	feet
GCP	Ground Control Point
GPS	Global Positioning System
ID	Identification
LiDAR	Light Detection and Ranging
LS	Land Surveyor
m	Meter
NAD	North American Datum
NAVD	North American Vertical Datum
NGS	National Geodetic Survey
QA/QC	Quality Assurance/Quality Control
RTK	Real Time Kinematic
RTN	Real-Time Network
SPC	State Plane Coordinate
NOAA	National Oceanic and Atmospheric Administration
VRS	Virtual Reference System
UTM	Universal Transverse Macerator
NVA	Non-vegetated Vertical Accuracy
VVA	Vegetated Vertical Accuracy
BVA	Bathymetric Vertical Accuracy

8. SURVEYOR'S CERTIFICATION

I hereby certify this survey report meets the applicable "Standards of Practice" as set forth by the Florida Board of Professional Surveyors and Mappers in rule 5J17.050-.052, Florida Administrative Code.

The electronic signature hereon is in compliance with Florida Administrative Code (FAC) 5J-17.062(3). The seal appearing on this document was authorized by William D. Donley, PSM 5381, on 03/04/2021 per FAC 5J-17.062(2).



William D. Donley

Florida Licensed Surveyor & Mapper No. LS 5381

03-04-2020

Date

This Survey is not valid without the signature and seal of a Florida Licensed Surveyor and Mapper.

Certificate of Authorization No. LB8011