



Ground Survey Report (Control Network)

College Station, TX
312020312

April 2020

Executive Summary

[The City of College Station, TX](#) contracted with [The Sanborn Map Company, Inc.](#) (Sanborn) to provide ground survey in the support of aerial surveys of lidar for the College Station, TX project. A network of ground control points has been designed and implemented into the project process to establish common basis for geo-referencing of the lidar and photography data products. A total of thirty-two (32) points were established (7 Ground Control Points (GCP) + 20 Non-vegetated Vertical Accuracy (NVA) + 5 Vegetated Vertical Accuracy (VVA)), all GCP will serve for lidar calibration.

The survey of ground control and check points meets a final adjusted RMS 1/3 of the required product accuracy for both Lidar (USGS – QL1).

The local network was designed, processed and adjusted using Trimble Business Center (TBC) version 5.20. Final horizontal coordinates are projected in both NAD83 (2011), State Plane Texas Central (FIPS 4203), NAVD88 (Geoid12B), U.S. Survey Feet and NAD83 (2011), UTM Zone 14 North, NAVD88 (Geoid12B), Meters.

CORS: TXBX

NGS Monument(s): BM0038, BM0048

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Introduction

This report contains the technical write-up of the differential GPS surveys performed in support of lidar products.

Sanborn oversaw the survey team(s) for execution of the survey, all fieldwork including reconnaissance of existing control points, establishment of additional control points, GPS surveys. All GPS data processing and reductions were performed in support of the College Station, TX project. **Figure 1** illustrates the initial survey plan within the project Area of Interest (AOI).

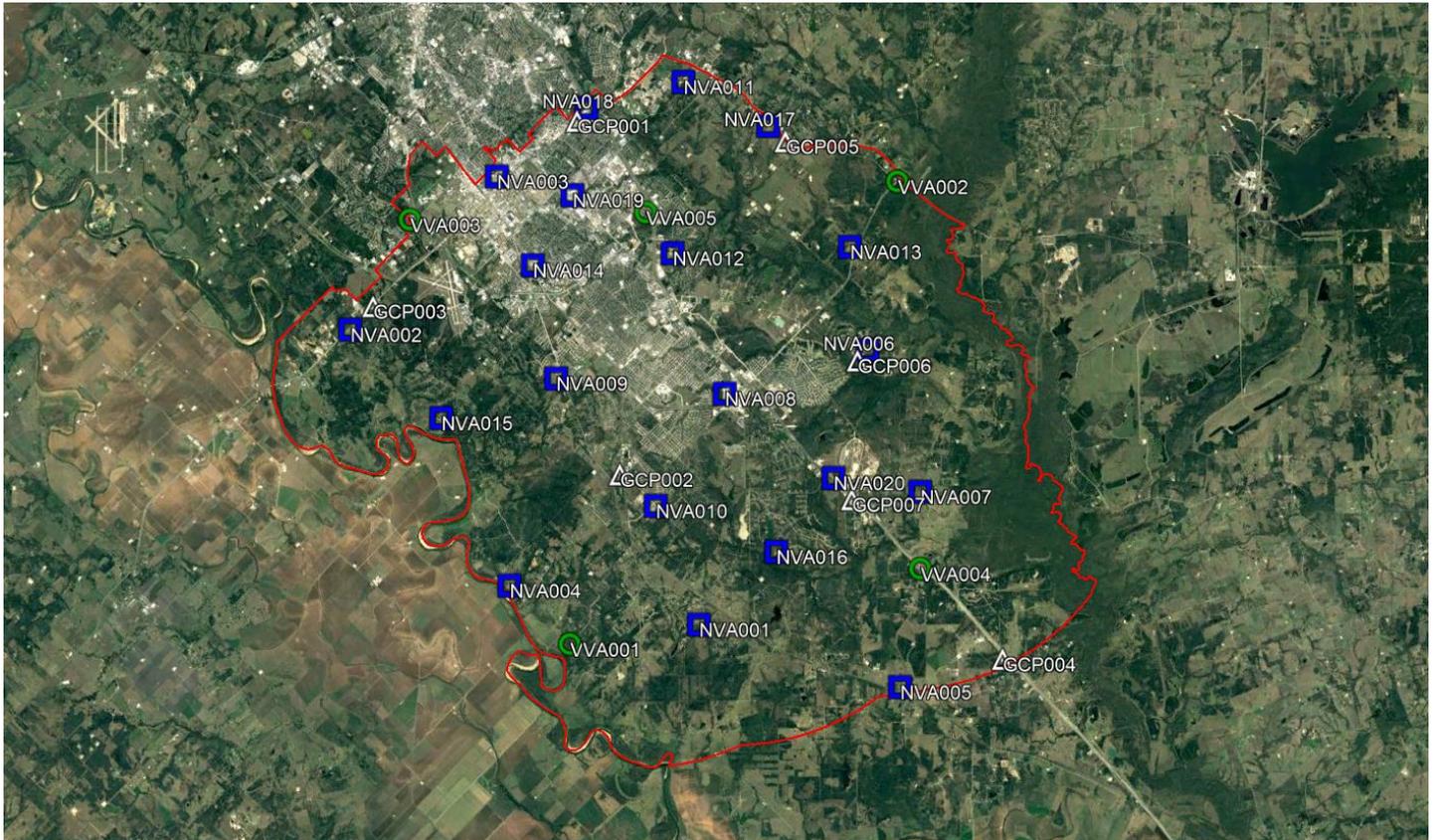


Figure 1: Survey Plan and AOI

Survey Purpose

The GPS Network Survey includes three (3) control point(s): CORS (TXBX) and NGS Monument(s) (BM0038, BM0048). The control points are tied to seven (7) Ground Control Points: GCP001 – GCP007, twenty (20) Non-vegetated Vertical Accuracy: NVA001 – NVA020, and five (5) Vegetated Vertical Accuracy: VVA001 – VVA005; for the GPS Log Sheets of the observed points see **Attachment A**. The NGS Data Sheets, OPUS Reports, and Trimble CenterPoint RTX Reports referenced for the control points can be found in **Attachment B**. **Attachment C** contains the TBC Baseline Processing Reports. **Attachment D** contains the photos of the observed points in the GPS Network Survey. The sketches of the observed points can be found in **Attachment E**. The ground control points were strategically positioned to satisfy aerial survey requirements for the area of interest (AOI).

Duration/Time Period

The ground control survey was performed from March 9th, 2020 to March 11th, 2020.

Equipment

The ground control survey was performed using survey grade Trimble R8 L1/L2 GPS Antennas attached to 2 meter fixed height rods, leveled over each point in the center of the targets.

Field Procedures

A careful reconnaissance was undertaken prior to the monumentation and subsequent GPS survey. The satellite window provided a minimum of 4 hour constellation coverage; GPS observation sessions were scheduled between 08:00 and 18:00 local time. All baseline processing, analysis, and preliminary reductions were performed upon receiving the data for quality control. No difficulties were experienced during this survey.

Personnel navigated to points using local maps, or GPS navigation. The field crews had approximate geodetic coordinates loaded for the required observation points. Upon arriving at the desired location the field personnel initiated a search for the point locations. The receiver was set on the 2 meter fixed height rod and leveled over the point. The GPS survey was set up as FastStatic connected via session to the established base station. Field crew members followed a session schedule established by office personnel to facilitate observation location and duration.

The survey data sheet was produced with the following information: Point ID, Stamping (if available), Date, Observer Name, Antenna Height Measurement Point, Antenna Height, Start Time and End Time. Digital photographs were taken at each point showing the control point surveyed and its relationship to its surroundings.

Processing

All static baselines and vectors for the College Station, TX project were processed using Trimble Business Center (TBC) version 5.20 software. Fixed solutions were adopted for all baselines using the broadcast ephemeris.

NAD83 (2011) was utilized and incorporated into the reductions, thereby allowing rigorous interpolation of the geoidal undulation values at each point in the network. This provides a useful method of estimating the elevations at all points in the network. The Survey Network Diagrams (Appendix A) and the Final Adjusted Coordinates (Appendix B) can be found below.

Accuracy

Lidar Category	Value
RMSE _z (m)	≤0.100
@ 95-Percent Confidence Level (m)	≤0.196

Table 1: Lidar Absolute Accuracy Requirements

The final survey networked coordinates yielded station levels of 0.018m horizontally (X, Y) and 0.052m vertically (Z) at 2 σ or (95-Percent Confidence Level) meeting and/or exceeding project requirements.

Coordinate Reference System

Horizontal Datum: North American Datum of 1983 (2011)
Projection: State Plane Texas Central (FIPS 4203)
Vertical Datum: North American Vertical Datum of 1988
Geoid Model: Geoid12B
Units: U.S. Survey Feet

Horizontal Datum: North American Datum of 1983 (2011)
Projection: Universal Transverse Mercator Zone 14 North
Vertical Datum: North American Vertical Datum of 1988
Geoid Model: Geoid12B
Units: Meters

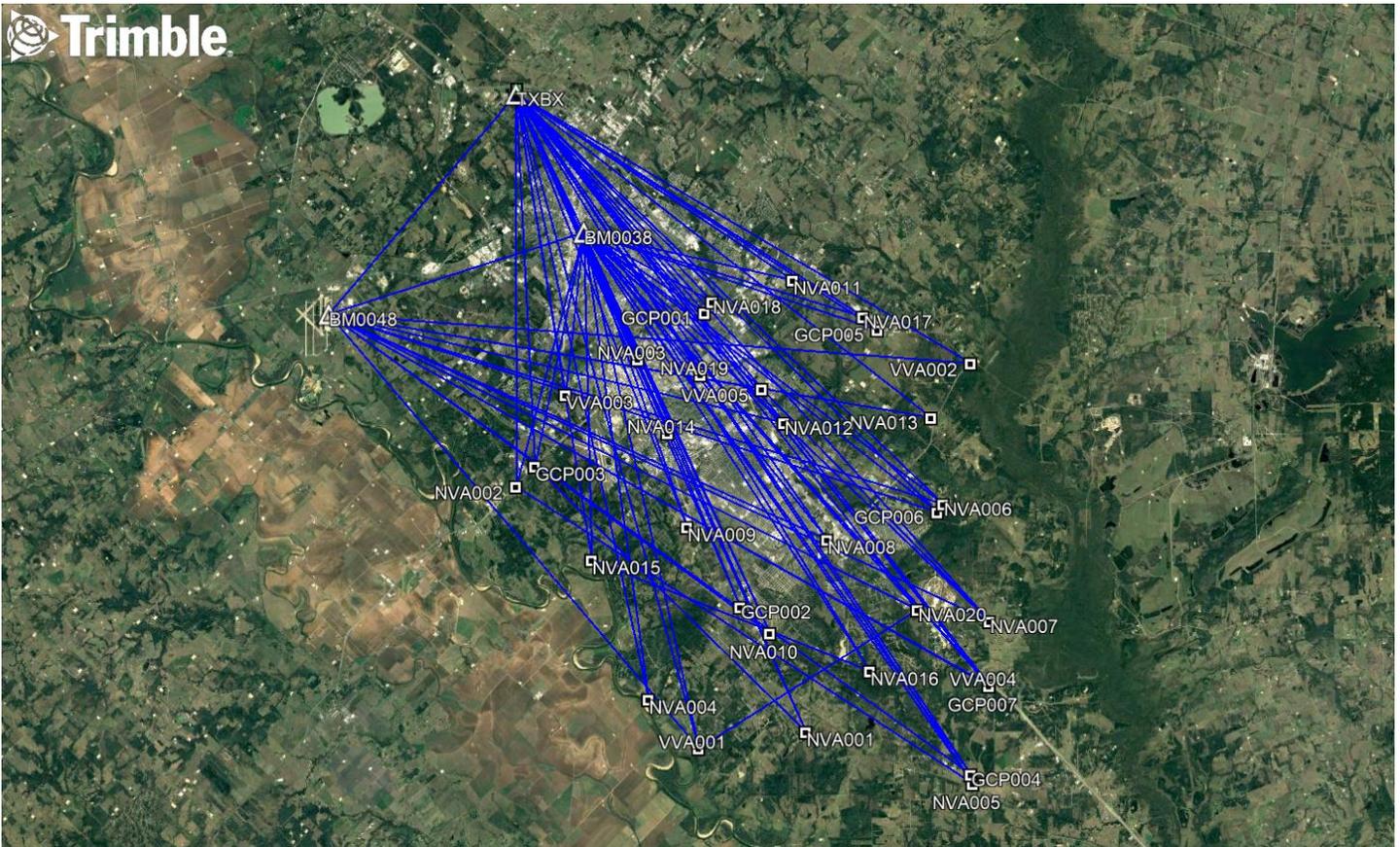
Contact Information

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

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Appendix A - Survey Network Diagram



Appendix B – Adjusted Coordinates

ID	Easting (US survey foot)	Northing (US survey foot)	Elevation (US survey foot)	Feature Code	Projection Scale Factor	Height Scale Factor	Combined Scale Factor	Meridian convergence angle
BM0038	3542958.444	10228825.147	376.623	NGS	0.9998985881	0.9999861463	0.9998847358	2°02'32.6"
BM0048	3509576.705	10216867.104	260.697	NGS	0.9999017115	0.9999916887	0.9998934010	1°59'13.4"
GCP001	3559340.081	10218824.693	289.535	GCP	0.9999016525	0.9999903294	0.9998919828	2°04'07.0"
GCP002	3565443.550	10180322.035	315.804	GCP	0.9999150354	0.9999891024	0.9999041388	2°04'34.8"
GCP003	3537609.147	10197837.883	294.852	GCP	0.9999082105	0.9999900794	0.9998982909	2°01'54.6"
GCP004	3596739.563	10159388.398	316.529	GCP	0.9999241960	0.9999890999	0.9999132967	2°07'34.4"
GCP005	3582283.469	10217414.812	309.974	GCP	0.9999023353	0.9999893645	0.9998917009	2°06'21.9"
GCP006	3591065.687	10193734.561	234.903	GCP	0.9999103514	0.9999929794	0.9999033315	2°07'08.5"
GCP007	3598715.922	10171139.482	231.019	GCP	0.9999192134	0.9999931860	0.9999123999	2°07'48.6"
NVA001	3574715.098	10164212.763	273.836	NVA	0.9999217528	0.9999911282	0.9999128817	2°05'25.9"
NVA002	3535215.914	10195108.607	298.092	NVA	0.9999091376	0.9999899254	0.9998990639	2°01'39.9"
NVA003	3550731.667	10212429.868	344.250	NVA	0.9999035292	0.9999877103	0.9998912406	2°03'15.0"
NVA004	3553734.132	10167741.339	227.359	NVA	0.9999199420	0.9999933406	0.9999132831	2°03'23.2"
NVA005	3597039.968	10158185.651	304.320	NVA	0.9999247318	0.9999896853	0.9999144179	2°07'35.9"
NVA006	3591801.939	10194820.564	245.873	NVA	0.9999099702	0.9999924540	0.9999024249	2°07'13.1"
NVA007	3598471.676	10179628.582	228.935	NVA	0.9999157825	0.9999932794	0.9999090625	2°07'49.0"
NVA008	3576608.311	10189593.220	291.493	NVA	0.9999116703	0.9999902652	0.9999019363	2°05'42.5"
NVA009	3558030.378	10190578.906	308.455	NVA	0.9999110599	0.9999894429	0.9999005037	2°03'53.3"
NVA010	3569483.741	10177027.919	297.592	NVA	0.9999163898	0.9999899787	0.9999063694	2°04'57.8"
NVA011	3570851.179	10223540.902	295.492	NVA	0.9999003776	0.9999900472	0.9998904258	2°05'15.9"
NVA012	3570351.823	10204738.668	276.980	NVA	0.9999062586	0.9999909461	0.9998972056	2°05'08.9"
NVA013	3589797.806	10206126.064	253.215	NVA	0.9999060338	0.9999920936	0.9998981281	2°07'03.7"
NVA014	3555020.408	10202862.832	310.243	NVA	0.9999067024	0.9999893469	0.9998960503	2°03'38.2"
NVA015	3545573.972	10185797.086	233.986	NVA	0.9999126668	0.9999930057	0.9999056731	2°02'39.0"
NVA016	3582901.337	10172518.216	258.711	NVA	0.9999184061	0.9999918503	0.9999102571	2°06'15.8"
NVA017	3580335.745	10219046.279	313.424	NVA	0.9999018165	0.9999891972	0.9998910147	2°06'10.8"
NVA018	3560297.675	10220301.106	271.188	NVA	0.9999012201	0.9999912072	0.9998924282	2°04'13.0"
NVA019	3559101.355	10210682.483	288.253	NVA	0.9999041800	0.9999903961	0.9998945770	2°04'03.9"
NVA020	3588900.362	10180803.635	257.778	NVA	0.9999151824	0.9999918922	0.9999070752	2°06'52.9"
TXBX	3533317.442	10246692.160	365.553	CORS	0.9998939160	0.9999866613	0.9998805787	2°01'39.5"
VVA001	3560616.708	10161542.834	217.967	VVA	0.9999226800	0.9999937979	0.9999164784	2°04'02.4"
VVA002	3594768.912	10213458.710	236.883	VVA	0.9999037119	0.9999928731	0.9998965857	2°07'34.6"
VVA003	3541323.468	10207372.757	346.637	VVA	0.9999050433	0.9999875953	0.9998926398	2°02'18.5"
VVA004	3598788.127	10171204.150	225.002	VVA	0.9999191878	0.9999934740	0.9999126623	2°07'49.0"
VVA005	3567258.660	10209073.926	265.695	VVA	0.9999047934	0.9999914815	0.9998962758	2°04'51.6"

NAD83 (2011), State Plane Texas Central (FIPS 4203), NAVD88 (Geoid12B), U.S. Survey Feet

ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	Feature Code	Projection Scale Factor	Height Scale Factor	Combined Scale Factor	Meridian convergence angle
BM0038	752178.547	3395742.054	114.795	NGS	1.0003848720	0.9999861463	1.0003710130	1°20'35.5"
BM0048	741955.402	3392220.135	79.461	NGS	1.0003225000	0.9999916887	1.0003141861	1°17'13.9"
GCP001	757136.553	3392631.591	88.250	GCP	1.0004160587	0.9999903294	1.0004063841	1°22'05.0"
GCP002	758853.694	3380867.989	96.257	GCP	1.0004270161	0.9999891024	1.0004161139	1°22'16.9"
GCP003	750431.846	3386313.280	89.871	GCP	1.0003740434	0.9999900794	1.0003641191	1°19'45.9"
GCP004	768318.423	3374366.770	96.478	GCP	1.0004886451	0.9999890999	1.0004777397	1°25'05.2"
GCP005	764127.678	3392116.073	94.480	GCP	1.0004610628	0.9999893645	1.0004504224	1°24'17.7"
GCP006	766717.253	3384861.955	71.599	GCP	1.0004780499	0.9999929794	1.0004710260	1°24'54.0"
GCP007	768965.364	3377942.830	70.415	GCP	1.0004929328	0.9999931860	1.0004861154	1°25'24.1"
NVA001	761620.385	3375920.869	83.465	NVA	1.0004448059	0.9999911282	1.0004359302	1°23'00.7"
NVA002	749691.900	3385490.021	90.859	NVA	1.0003694748	0.9999899254	1.0003593965	1°19'30.3"
NVA003	754487.721	3390713.717	104.928	NVA	1.0003993261	0.9999877103	1.0003870315	1°21'10.9"
NVA004	755235.911	3377075.736	69.299	NVA	1.0004040535	0.9999933406	1.0003973914	1°21'01.4"
NVA005	768405.497	3373998.861	92.757	NVA	1.0004892228	0.9999896853	1.0004789031	1°25'06.2"
NVA006	766945.843	3385190.373	74.942	NVA	1.0004795560	0.9999924540	1.0004720064	1°24'58.9"
NVA007	768922.796	3380532.522	69.780	NVA	1.0004926463	0.9999932794	1.0004859224	1°25'28.0"
NVA008	762293.015	3383653.251	88.847	NVA	1.0004491473	0.9999902652	1.0004394081	1°23'27.4"
NVA009	756631.629	3384023.426	94.017	NVA	1.0004128667	0.9999894429	1.0004023052	1°21'40.1"
NVA010	760073.324	3379848.335	90.706	NVA	1.0004348334	0.9999899787	1.0004248077	1°22'38.3"
NVA011	760664.308	3394026.830	90.066	NVA	1.0004386145	0.9999900472	1.0004286573	1°23'14.9"
NVA012	760441.850	3388295.129	84.424	NVA	1.0004371907	0.9999909461	1.0004281329	1°23'00.4"
NVA013	766376.999	3388645.501	77.180	NVA	1.0004758044	0.9999920936	1.0004678942	1°24'54.4"
NVA014	755759.756	3387780.429	94.562	NVA	1.0004073449	0.9999893469	1.0003966875	1°21'30.1"
NVA015	752815.429	3382611.980	71.319	NVA	1.0003888606	0.9999930057	1.0003818636	1°20'24.9"
NVA016	764147.931	3378422.744	78.855	NVA	1.0004612141	0.9999918503	1.0004530606	1°23'53.3"
NVA017	763539.812	3392620.852	95.532	NVA	1.0004572313	0.9999891972	1.0004464235	1°24'07.4"
NVA018	757434.061	3393078.231	82.658	NVA	1.0004179485	0.9999912072	1.0004091520	1°22'11.4"
NVA019	757033.378	3390149.645	87.860	NVA	1.0004154069	0.9999903961	1.0004057990	1°21'58.6"
NVA020	766008.433	3380926.804	78.571	NVA	1.0004733920	0.9999918922	1.0004652804	1°24'33.3"
TXBX	749305.162	3401225.960	111.421	CORS	1.0003670719	0.9999866613	1.0003537283	1°19'49.9"
VVA001	757311.284	3375159.768	66.436	VVA	1.0004171921	0.9999937979	1.0004109874	1°21'37.5"
VVA002	767920.362	3390863.034	72.202	VVA	1.0004859852	0.9999928731	1.0004788548	1°25'27.9"
VVA003	751600.043	3389206.789	105.655	VVA	1.0003812817	0.9999875953	1.0003688722	1°20'13.1"
VVA004	768987.626	3377962.279	68.581	VVA	1.0004930807	0.9999934740	1.0004865515	1°25'24.5"
VVA005	759514.825	3389628.676	80.984	VVA	1.0004312364	0.9999914815	1.0004227143	1°22'45.1"

NAD83 (2011), UTM Zone 14 North, NAVD88 (Geoid12B), Meters

Attachment A – GPS Log Sheets

(Electronically Attached)

Attachment B – Data Sheets

(Electronically Attached)

Attachment C – Baseline Processing Reports

(Electronically Attached)

Attachment D – Photos

(Electronically Attached)

Attachment E – Sketches

(Electronically Attached)