

Control Report

Fashion Valley Mall
Ground Control Point (GCP) Project

Prepared By:

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Mark Jumps

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SURVEYORS STATEMENT AND SEAL

IX.	DELIVERABLE PRODUCTS:	
	A) THIS PROJECT REPORT	
	B) FVM GCP SHEETS, (X12)	
	C) FVM POINT REPORT	
	D) FVM QUALITY CONTROL REPORT	
	E) SCOPE SHEET	
	F) GCP COORDINATES DELIVERED TO EMPOWER UAV / CODE 3 DRONE	
	G) STATEMENT/SEAL	

I. Project Overview

- GTMR (Geographic Time Management Resources Company) has provided a unique service to our Fashion Valley Mall Customers; Whiting-Turner Contracting Company, Empower UAV, and Code 3 Drones.
- The project has established a Geometric Control Network within the Fashion Valley Mall Property. The Control Network will provide Ground Control Points (GCPs) for UAS (imagery) and GIS data collection efforts. It will also assist Fashion Valley Mall Managers to make informed decisions about the property and provide long term benefits to the Fashion Valley Mall.
- The product when combined with the UAS imagery (and other related GIS by-products) will ultimately produce many great benefits that managers will find quite useful.
- Scattered around the Fashion Valley Mall (in a strategic geometric method) are many Ground Control Points (Painted Chevrons {white on black background}) with durable markings at the point (Tip) of the chevron (all aligned to a Northerly direction).
- Each of these Ground Control Points now have a coordinate value (X, Y, Z) attached to them. The following sections provide information relative to this project.

II. Project Datums and Reference System

The selection of the Project Datum for the Fashion Valley Mall is based upon three criteria. The first is to make a connection to the National Spatial Reference System (NSRS). The second is to provide quality Ground Control Point (GCP) data that can be relied upon and used by other entities to provide follow on services such as UAS and GIS services. The datum also serves as a common language for the entities that may provide follow on services. These GCPs include both Horizontal and Vertical values, namely Coordinates and Elevations. The third important aspect of this control is Policy/Law and Best Practices. The GCP control network established for the Fashion Valley Mall meets and exceeds the criteria for which this product is intended: Sub-Decimeter Control @ $\leq 10\text{cm}$ (GIS and UAS); Reference is also made to the GIS/LIS addendum to the Report of the Task Force on the NCEES Model Law for Surveying. (See section VII ~ Accuracy; Local and Networks)

The Coordinate information provided is associated with the North American Datum of 1983; NAD83(NSRS2007) and (NAD83)2011, Epoch2010. The National Spatial Reference System (NSRS) is a **consistent coordinate system** that defines latitude, longitude, height, scale, gravity, and orientation throughout the United States. The system is maintained by the National Geodetic Survey (NGS). (Please see section IV for the description of the NSRS network). The Orthometric Elevations associated with this system are computed based upon Ellipsoid Heights (Geoid 18) which are associated with the North American Vertical Datum of 1988 (NAVD88). The Ground Control Points (GCPs) in this Control Network are therefore tied into the National Spatial Reference System (NSRS).

III. Geometric Coordinates of Controlling Stations

- Final coordinates are listed in the State Plane Coordinate System (SPC) in U. S. Survey Feet Units (California Zone 6). This is in furtherance of information sharing and common practices. See Table below: (This table [**Point Report**] is provided as a stand-alone document within the project report).

Project Information		User Information	Coordinate System
Name:	Fashion Valley Mall	Field operator: RLH/MJ	Name: US State Plane 1983
Size:		Office operator: RLH	Datum: NAD83 (CONUS)
Modified:			Zone: California Zone 6 0406
Reference #:	SR#20101		Geoid: 2018
Description: (A)	NAD83(2011)[EPOCH 2010]		Vertical datum: NAVD 88
Description: (B)	NAD83(NSRS2007) EPSG: 3500		Vertical datum: NAVD 88

Point List				
ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (Orthometric) (Geoid 18) US Ft.	GCP Description
(A) NAD83(2011) [EPOCH 2010]				
(Stamping)				(Painted Chevron/w)
FVM1	1859668.21	6278784.97	29.09	PK & Washer
FVM2	1860517.45	6279078.50	68.64	L&Tag
FVM3	1860501.24	6280935.63	34.54	PK & Washer
FVM4	1860901.72	6281142.12	38.82	PK & Washer
FVM5	1861240.81	6281076.02	42.28	PK & Washer
FVM6	1860847.89	6280793.14	61.37	L&Tag
FVM7	1860516.71	6279790.97	91.62	12 Inch Tile
FVM8	1861033.50	6280111.18	38.42	PK & Washer
FVM9	1860898.87	6279397.38	58.64	L&Tag
FVM10	1860635.13	6278563.16	42.39	PK & Washer
FVM11	1860130.96	6280179.02	37.80	L&Tag
FVM12	1859869.25	6279695.10	64.08	L&Tag

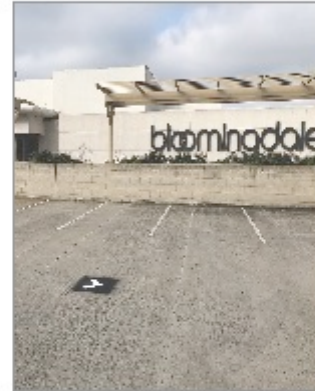
Point List				
ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (Orthometric) (Geoid 18) US Ft.	GCP Description
(B) NAD83(NSRS2007)				
(Stamping)				(Painted Chevron/w)
FVM1	1859667.88	6278785.24	29.09	PK & Washer
FVM2	1860517.12	6279078.77	68.64	L&Tag
FVM3	1860500.91	6280935.90	34.54	PK & Washer
FVM4	1860901.40	6281142.39	38.82	PK & Washer
FVM5	1861240.49	6281076.29	42.28	PK & Washer
FVM6	1860847.56	6280793.41	61.37	L&Tag
FVM7	1860516.38	6279791.24	91.62	12 Inch Tile
FVM8	1861033.17	6280111.45	38.42	PK & Washer
FVM9	1860898.54	6279397.65	58.64	L&Tag
FVM10	1860634.80	6278563.43	42.39	PK & Washer
FVM11	1860130.63	6280179.29	37.80	L&Tag
FVM12	1859868.92	6279695.37	64.08	L&Tag

FVM POINT REPORT 2018 NAD832011EPOCH2010.xlsx

- Additionally, there is a **Monument Data Sheet** for each Ground Control Point (GCP) set during this project. Each Monument Data Sheet lists values and shows pictures of the individual point.

Control Point ID:

FVM6



NAD_83 (2011) (Epoch 2010)

State Plane Coordinates, California, Zone 6

US Feet

Vertical Datum NAVD_88 (Geoid 18)

US Feet

Description: L&Tag

NAD_83 (NSRS 2007)

State Plane Coordinates, California, Zone 6

US Feet

Northing

1860847.89

Easting

6280793.14

Elevation

61.37

Northing

1860847.56

Easting

6280793.41



FASHION VALLEY MALL, SAN DIEGO, CA

Date: MARCH 13, 2020

GTMR Surveys www.gtmr-surveys.com

IV. Network Descriptions

The Fashion Valley Mall project used the NSRS network of permanently marked points. The NSRS network includes a consistent, accurate, and up-to-date network of Continuously Operating Reference Stations (CORS) which supports three-dimensional positioning activities. Below is a list of the CORS that were used in the establishment of the Ground Control Points (GCPs) for the Fashion Valley Mall, along with their reported values at the time of the observations.

CORS Base Points Used (NAD83 (2011) (Epoch 2010))				
Base Point	Latitude	Longitude	Height (Ellip.)	Report Date
AF9684 BILL LAKE SKINNER	N333441.663	W 1170352.513	470.788	3/11/2020
DH7054 SCGN CS1999	N335127.463	W 1173632.062	301.019	3/11/2020
DG8353 P480 VALLECITO	N325833.570	W 1162054.679	436.796	3/11/2020
DN7404 P500 ALLAMERICN	N324124.153	W 1151759.705	-19.780	3/11/2020
DL7683 CAT3 SCGN	N332644.729	W 1182858.772	5.858	3/11/2020
DN5633 DSSC DSSC SCGN	N334359.979	W 1164243.475	1661.621	3/11/2020
DN5820 GISA ESRI GISA	N340409.474	W 1171305.731	344.196	3/11/2020
DG9734 P474 FALLBROOK	N332118.680	W 1171455.242	183.661	3/11/2020
DH4519 P066 JACUMBA AP	N323659.475	W 1161011.188	823.665	3/11/2020
DG8356 P483 JULIANBIN	N330332.976	W 1163409.522	1376.328	3/11/2020
DL7680 CAT2 SCGN	N331841.808	W 1182001.690	477.965	3/11/2020
DN7476 POTR POTRERO PARK	N323706.269	W 1163527.059	731.043	3/11/2020
DK4141 TRAK BOMMER CANYON	N333704.554	W 1174812.318	116.832	3/11/2020
DG8350 P478 VALLEYCNTR	N331408.560	W 1170417.677	372.330	3/11/2020
AF9708 PIN1 PINON 1 PGGA	N333643.749	W 1162729.330	1258.666	3/11/2020
AF9696 DHLG DURMID HILL	N332323.287	W 1154716.855	-82.151	3/11/2020
DG9795 P482 LAKE HENSHA W	N331424.631	W 1164017.036	879.475	3/11/2020
				NAD 83 (2011) (Epoch 2010)

- Each of the above points are qualified by Network accuracy estimates per FGDC Geospatial Positioning Accuracy Standards. An excerpt of a portion of one of the Station Reports is as follows: (GTMR retains archived data sheets for each station)

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National Geodetic Survey, Retrieval Date = MARCH 16, 2020
*****
AF9708 CORS - This is a GPS Continuously Operating Reference Station.
AF9708 DESIGNATION - PINON 1 PGGA CORS ARP
AF9708 CORS_ID - PIN1
AF9708 PID - AF9708
AF9708 STATE/COUNTY - CA/RIVERSIDE
AF9708 COUNTRY - US
AF9708 USGS QUAD - TORO PEAK (2018)
AF9708
AF9708 *CURRENT SURVEY CONTROL
AF9708
AF9708 NAD 83(2011) POSITION- 33 36 43.74989(N) 116 27 29.33078(W) ADJUSTED
AF9708 NAD 83(2011) ELLIP HT- 1258.666 (meters) (06/??/19) ADJUSTED
AF9708 NAD 83(2011) EPOCH - 2010.00
AF9708
AF9708 GEOID HEIGHT - -31.477 (meters) GEOID18
AF9708 NAD 83(2011) X - -2,369,518.646 (meters) COMP
AF9708 NAD 83(2011) Y - -4,761,289.544 (meters) COMP
AF9708 NAD 83(2011) Z - 3,511,397.328 (meters) COMP
AF9708
AF9708 Network accuracy estimates per FGDC Geospatial Positioning Accuracy
AF9708 Standards:
AF9708 FGDC (95% conf, cm) Standard deviation (cm) CorrNE
AF9708 Horiz Ellip SD_N SD_E SD_h (unitless)
AF9708 -----
AF9708 NETWORK 0.16 0.43 0.08 0.05 0.22 0.00756400
AF9708 -----
AF9708
AF9708 The coordinates were established by GPS observations
AF9708 and adjusted by the National Geodetic Survey in June 2019.
AF9708
AF9708 NAD 83(2011) refers to NAD 83 coordinates where the reference frame has
AF9708 been affixed to the stable North American Tectonic Plate.

```

95% conf. cm

V. Adjustment & Analysis

The procedures for adjusting the data collected for the Ground Control Point (GCP) Network at the Fashion Valley Mall, primarily used NGS OPUS (National Geodetic Survey ~ One Positioning User Service) Methods.

GTMR used OPUS Rapid Static Methods to complete the GCP control network. Two different observations (2X = 2 Times), each of minimum 20 minute (to 30+ minute) durations were performed at the Ground Control Points (GCPs). The observations were separated by a minimum of 45 minutes sidereal time to allow for satellite geometry changes and to assist in the achievement of best practices guidelines. **Rapid-Static:** Files that are 15 minutes to 2 hours in duration are processed using RSGPS rapid-static software.

VI. DATA COLLECTION, PROCESSING AND EQUIPMENT

Data collection commenced on 3/05/2020. The hours of data collection were primarily between 10:00pm and 6:00am. There were extenuating circumstances, including rainy weather, locked gates due to contractor working hours, parking structures (motion), roof access, which on occasion caused minor variations in the observation program.

Preparation

The general locations for the Ground Control Points (GCPs) were initially provided by the Contractor (Empower UAV / Code 3 Drone / Whiting-Turner). GTMR then established the specific locations in the following manner:

- Location is appropriate to **Open Sky** view for both UAV and Survey (GPS/GNSS) operations.
- Preparation of surface: Cleaned / Black Paint Background / White Paint Chevron Foreground
- At the tip of each Chevron GTMR set a durable PK Nail and Washer or L&Tag
- Each durable washer is stamped with the name of the GCP; i.e. "FVM 1", "FVM 2", etc.
- GCP No. 7 is a roof top location and a 12"x12" linoleum tile was used (adhered to surface)

Equipment

Following the placement of a dozen GCPs, a campaign to collect GPS data was commenced. The equipment used during this project consisted of Dual Frequency GNSS/GPS receivers: CHC X90D OPUS and CHC X91 Receivers.

Data Collection Criteria

The following criteria were established according to the recommendation of the GNSS Surveying Standards and Specifications and followed by GTMR during the data collection campaign: (See references below)

- 1) The beginning and ending times for each occupation
- 2) The name of the receiver operator performing the occupation
- 3) The receiver and antenna identifiers (make, model, serial number)
- 4) The centering device identifier
- 5) All antenna height measurements (in meters and feet)
- 6) The station identifier (name and/or survey point [GCP] number)
- 7) A description of the monument and center mark
- 8) Digital photograph of monument (& location)
- 9) Any problems encountered during the logging of session

Additional Data Collection Criteria

In addition to that, the following criteria was met or achieved for the Horizontal & Vertical 5cm-10cm columns as shown in the table below.

California Land Surveyors Association
California Spatial Reference Center
December 10, 2014

GNSS Surveying Standards and Specifications, ver. 1.1

			✓			✓
<i>Data Collection</i>	Horizontal	Horizontal	Horizontal	Vertical	Vertical	Vertical
Spatial Accuracy Classification	.5 cm-2 cm	2 cm-5 cm	5 cm-10 cm	.5 cm-2 cm	2 cm-5 cm	5 cm-10 cm
Repeat Station Observations			✓			✓
percent of number of stations						
Two times:	100%	100%	80%	100%	100%	80%
Three or more times:	10%	10%	0%	50%	25%	0%
Sidereal time displacement between occupations (start time to next start):	60 min.	45 min.	30 min.	120 min.	60 min.	45 min.
Satellite Observations			✓			✓
Minimum number of satellites observed during 75% of occupation:	7	6	5	8	7	5
Maximum PDOP during 75% of occupation:	3	4	5	3	4	5
Antenna Setup			✓			✓
Maximum centering error (measured and phase center):	3 mm (0.010')	5 mm (0.016')	7 mm (0.023')	5 mm (0.016')	5 mm (0.016')	7 mm (0.023')
Independent plumb point check (rotating plummet, 2 nd level bubble, etc.):	Y	Y	N	Y	N	N
Maximum height error (measured and phase center):	5 mm (0.016')	5mm (0.016')	5 mm (0.016')	3 mm (0.010')	5 mm (0.016')	5 mm (0.016')
Number of independent antenna height measurements per occupation:	2	2	2	2	2	2
Digital Photograph (location and close up) for each mark occupation:	Y	Y	✓ Y	Y	Y	✓ Y
Fixed Height Tripod Recommended:	N/A	N/A	N/A	Y	Y	Y

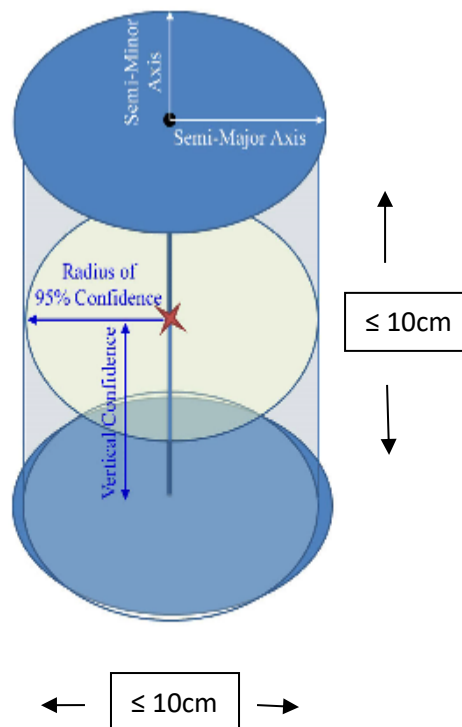
The data collected has been evaluated and meets Positional Tolerance recommendations for Geographic Information Systems (GIS) data collection (See Accuracy Section). This ensures that the location aspect is known and that a Quality Control procedure was used to create a Positional / Geographically correct product.

VII. ACCURACY: LOCAL & NETWORK

The volume space for positional accuracy is a simplified model representing horizontal and vertical confidence. It is centered on the adjusted point, scaled to 95% confidence, and bounded by upper and lower planes of vertical confidence of a given height component and the radius of the horizontal confidence.

For most practical purposes, the semi-major axis of the error ellipse can be adopted as the horizontal radius of confidence.

Since horizontal and vertical are correlated dimensions derived from the GNSS Cartesian coordinate frame, the cylindrical volume space is statistically conservative.



Geographic Time Management Resources (GTMR) set a goal to meet the accepted Accuracy standards for the 5cm – 10cm (Horizontal) and the 5cm – 10cm (Vertical) control which are in conformance with the requirements of the GNSS Surveying Standards and Specifications Document Version 1.1, as Endorsed and listed as Appropriate Practices by the Board of Directors of the California Land Surveyors Association and also by the Executive Committee of the California Spatial Reference Center (CSRC), approved December 10, 2014. (See Website address: www.csrc.ucsd.edu/docs).

For this project, Geographic Time Management Resources (GTMR) adheres to the “GIS/LIS Addendum to the Report of the Task Force on the NCEES Model Law for Surveying (dated October 20, 2000) which was prepared by the following organizations: American Society of Civil Engineers (ASCE), American Society for Photogrammetry and Remote Sensing (ASPRS), Management Association for Private Photogrammetric Surveyors (MAPPS), National Society of Professional Surveyors (NSPS), National States Geographic Information Council (NSGIC), and the Urban and Regional Information Systems Association (URISA).

For this project, also please refer to Appendix D, Section B, of said document, which lists “**Activities Excluded from Surveying Practice**” and states the following: A distinction must be made in the use of electronic systems between making or documenting original measurements in the creation of survey products, versus the copying, interpretation, or

representation of those measurements in such systems. Further, a distinction must be made according to the intent, use, or purpose of measurement products in electronic systems to determine a definitive location versus the use of those products as a locational reference for planning, infrastructure management, and general information.

The following items are not to be included as activities within the definition of surveying:

Reference **Sub-Section 6** states: Inventory maps and databases created by any organization, in either hardcopy or electronic form, of physical features, facilities or infrastructure that are wholly contained within properties to which they have rights or for which they have management responsibility. The distribution of these maps and/or data bases outside the organization must contain appropriate metadata describing, at a minimum, the accuracy, method of compilation, data source(s) and date(s), and disclaimers of use clearly indicating that the data are not intended to be used as a survey product.

VIII. Appendix / References

- Contract / Surveying Services Agreement
- Scope of Work
- Proposal for Cost Information
- Control Information for Fashion Valley Mall.

Information about the NSRS: <https://oceanservice.noaa.gov/facts/nsrs.html>

Information about the NGS: <https://www.ngs.noaa.gov/>

Information about the NGS CORS: <https://www.ngs.noaa.gov/CORS/>

Information about NGS OPUS: <https://www.ngs.noaa.gov/OPUS/>

Information re: CSRC/CLSA standards: www.csrc.ucsd.edu/docs

STATEMENT: THIS PROJECT DOES NOT INVOLVE LAND SURVEYING (California Business & Professions Code &&8726-8727).

All Maps, Diagrams, and Documents created by Geographic Time Management Resources Company herein after referred to as GTMR are made exclusively for Geographic Information System, Asset Inventory, and Landscaping purposes (California Business & Professions Code &&8727). All Maps and Diagrams created by GTMR do not involve the determination of any property line, and as such do not constitute Land Surveying (California Business & Professions Code &&8726-8727). In addition, GTMR Services, Maps and Diagrams do not constitute Civil Engineering (California Business & Professions Code &&6702-6704), and thus should not be used for studies or activities defined as Civil Engineering (California Business & Professions Code &&6731). **All Maps and Diagrams created by GTMR are intended to be used as a reference for decision and design of landscape and should not be considered a substitute for the services of a licensed Engineer or Land Surveyor.** GTMR makes every reasonable effort to ensure the accuracy of the information found in our Maps and Diagrams. In the event that an error is found on a Map, Diagram, or Document, GTMR's liability is limited to the amount of the fee paid to GTMR. See GTMR Control data for further information regarding accuracy and positional information relative to this project

SURVEYOR'S STATEMENT:

The GIS/Survey Control data as shown on the Quality Control Report, and Point Report Dated 03/22/2020, by Geographic Time Management Resources Company (GTMR) Survey Job No. SR20101, correctly represents a GIS Control Survey made by me or under my direction in conformance with the "GIS/LIS Addendum to the Report of the Task Force on the NCEES Model Law for Surveying (dated October 20, 2000)". For quality control purposes, special attention was given to the requirements of the GNSS Surveying Standards and Specifications Document Version 1.1, as Endorsed and listed as Appropriate Practices for GIS Surveys by the Board of Directors of the California Land Surveyors Association and also by the Executive Committee of the California Spatial Reference Center, said document approved December 10, 2014.

This Geographic Information Survey was completed at the request of the Fashion Valley Mall Customers; Whiting-Turner Contracting Company, Empower UAV, and Code 3 Drones.

For Geodetic GIS/Survey Control:

Surveying in compliance with the California Business and Professions Code § Chapter 15, Professional Land Surveyors Act, Section 8726(f), and the California Public Resources Code § Division 8, Chapters 1, 4, and 5, California State Plane Coordinates, California Geodetic Coordinates, California Orthometric Heights, Sections 8801-8819, 8870-8880, and 8890-8902.

ROBERT L. HAGLER, PLS 8255

Document Signed: rlh

