

# Ground Control Point Survey Report

Prepared for:  
**Everglades National Park LiDAR**

**United States Geological Survey (USGS)**  
**USGS Contract: G16PC00020**  
**Task Order Number: G16PD01224**



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	Including:	
	a) In-field photographs for each surveyed point	
	b) Ground Control Point documentation Report for each surveyed point	
	c) Documentation for the NGS Monuments used for tie-in	

# 1. INTRODUCTION

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## *1.1 Project Summary*

Dewberry Consultants LLC is under contract to the United States Geological Survey (USGS) to provide a ground control point (GCP) survey in the Everglades National Park located in South Florida. This survey will be used for LiDAR calibration. The project area consists of approximately 3,136 square kilometers (1,211 square miles). The field work for the check points was conducted from March 21, 2017 – April 03, 2017.

Published National Geodetic Survey (NGS) control points were surveyed to verify the accuracy of the equipment and survey data. The results are shown in Section 2.4 of this report.

To verify that the GCP survey meets the 5-cm at 95% confidence level approximately 50% of the points were re-observed and their corresponding coordinate differences are shown in Section 4 of this report.

A map showing the overall project area is shown in section 1.3. All coordinates are in meters. The horizontal coordinates are referenced to the Universal Transverse Mercator (UTM), Zone 17N. The vertical coordinates are referenced to the North American Vertical Datum of 1988 (NAVD88) using Geoid model 2012B (Geoid12B).

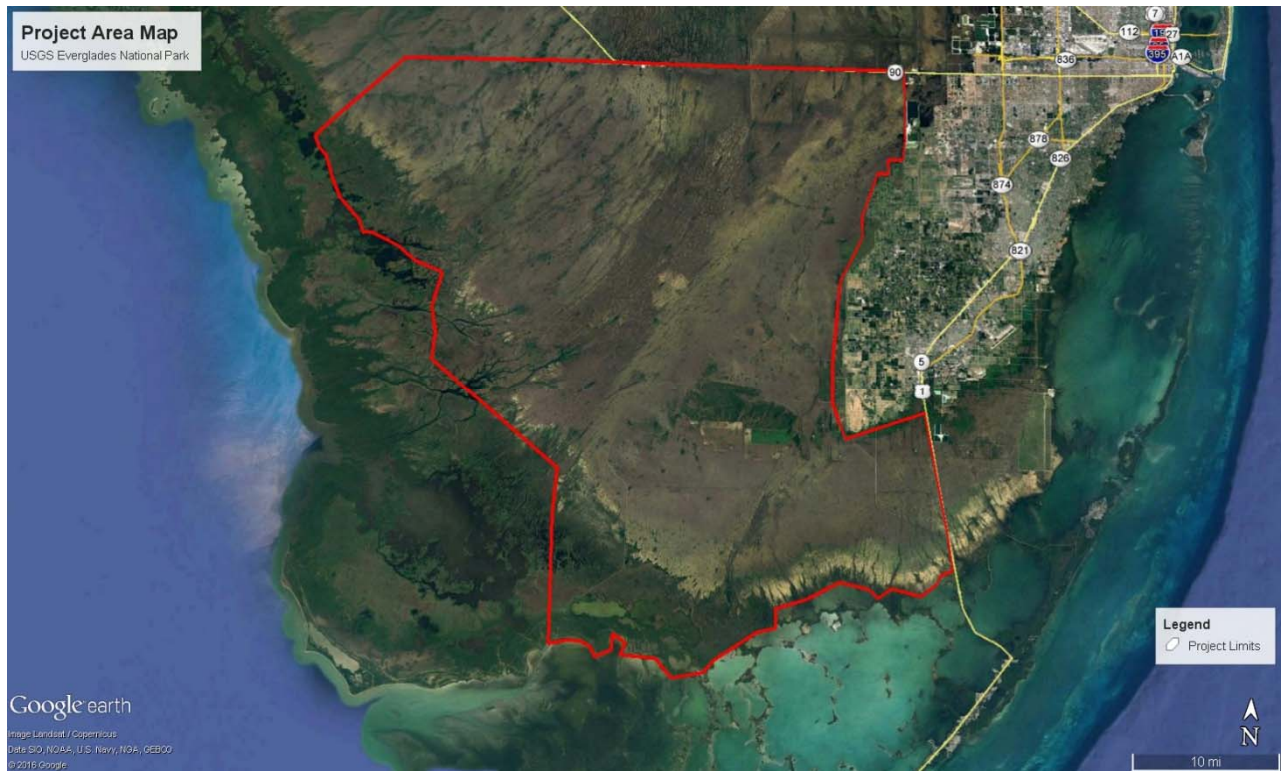
## *1.2 Point of Contact*

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

**Dewberry Engineers, Inc.**

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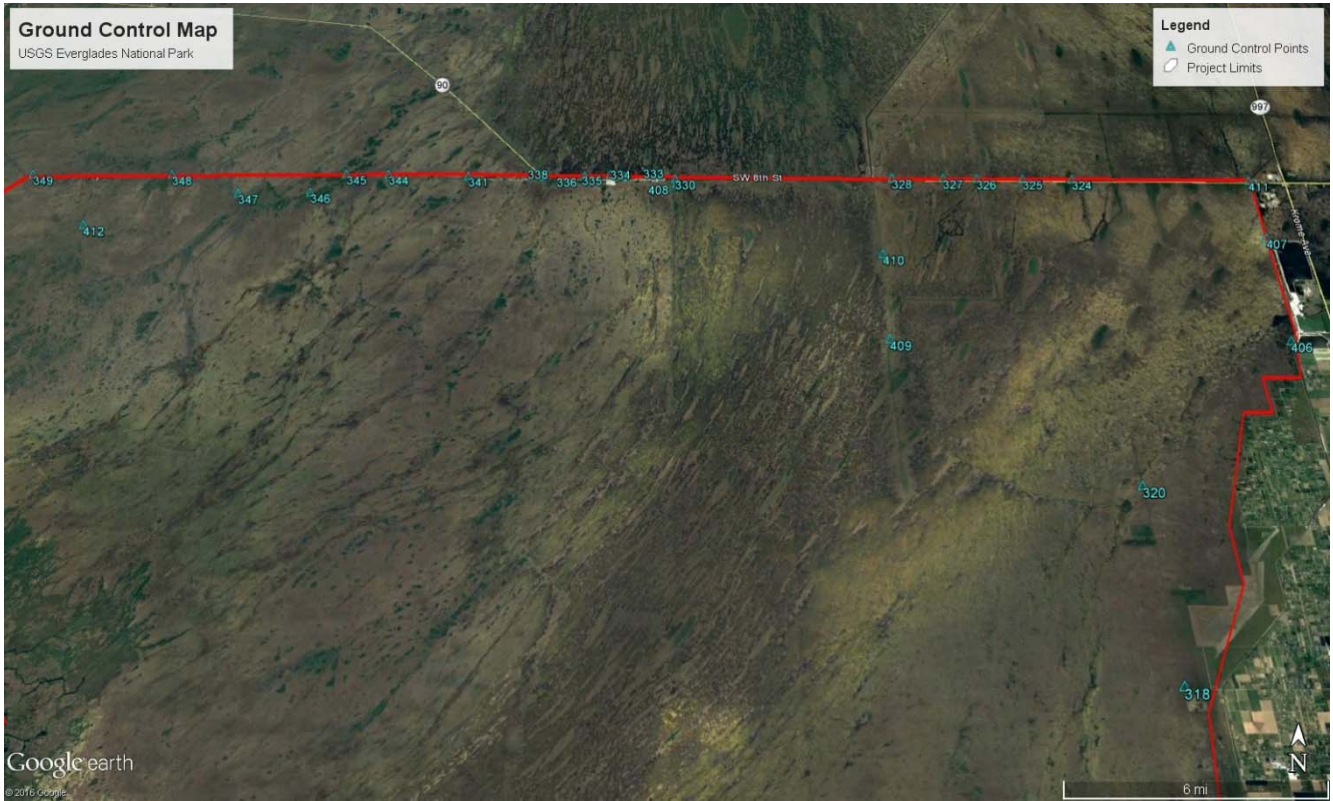
### 1.3 Project Area



**Overall Project Limits**



### 1.3 Project Area (continued)



**Ground Control Point Map (North)**



**Ground Control Point Map (South)**

## **2. PROJECT DETAILS**

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### ***2.1 Survey Equipment***

To perform the survey observations, a Spectra Precision SP80 GPS receiver was used. A two-meter fixed height GPS pole and bi-pod legs were used to mount and stabilize the receiver. A Spectra Precision Ranger 3 Data-Collector was used to read and store the data. The SP80 GPS unit is a geodetic- quality dual-frequency GPS receiver.

### ***2.2 Survey Point Details***

The LiDAR GCP's were well distributed throughout the project area by pre-selecting them in the office using aerial imagery. The American Society for Photogrammetry and Remote Sensing (ASPRS) guidelines were followed for point selection as closely as possible by maintaining a spaced interval of at least 10 percent of the diagonal distance across the dataset and at least 20 percent of the points in each quadrant of the dataset. The National Parks Service (NPS) provided a helicopter for access to the points that were within the remote areas of the Everglades.

A sketch was made for each location and a nail & disk or 60d nail was set at a point where allowable in urban areas. Nothing was set or left behind in rural areas per NPS guidelines. The check point locations are detailed on the "Ground Control Point Documentation Report" sheets attached to this report.

### ***2.3 Network Design***

Two real-time kinematic (RTK) networks were used to establish and verify the accuracy of the observations. The Trimble VRS Now network was used for the first observation and the Florida Permanent Reference Network (FPRN) was used for the second observation. The GPS units connected to the networks using a cellular connection and a virtual reference station. The RTK networks provide instant access to RTK corrections utilizing a network of permanent (fixed) continuously operating reference stations. The published accuracy for the networks are less than 2cm. All recorded observations were within 5-cm of each other. These observations were averaged to produce the final coordinate value for the ground control points.

## 2.4 Field Survey Procedures

The GCP locations were observed twice. All re-observations matched the initially derived station position within the allowable tolerance of  $\pm 5\text{cm}$  or within the 95% confidence level. Each observation was approximately 3 minutes in duration and measured to 180 epochs. The second observation was taken immediately after the first observation for this project due to the access constraints of the Everglades. The GPS observations are detailed on the “Ground Control Point Documentation Reports” submitted as part of this report.

Eleven (11) published National Geodetic Survey (NGS) control points with horizontal and vertical coordinates were observed during the survey. A map of the NGS control points surveyed is on the following page. The NGS control was used as an additional QA/QC process to check the accuracy of the observations. A NGS control point was observed at the beginning and end of each day of the survey. The surveyed average coordinates compared with the published NGS coordinates were all within the  $\pm 5\text{cm}$  tolerance as shown below.

NGS PT. ID	Designation	As Surveyed (M)			Published (M)			Differences (M)		
		Northing	Easting	Elev	Northing	Easting	Elev	$\Delta N$	$\Delta E$	$\Delta Elev$
AC4738	J 407	2849367.056	549835.667	1.960	2849367.069	549835.673	1.953	-0.013	-0.006	0.007
AC3931	KROME	2835754.558	550443.221	4.087	2835754.536	550443.212	4.069	0.022	0.009	0.018
AC1157	DA 124 RESET	2814686.088	552574.419	1.245	2814686.090	552574.428	1.249	-0.002	-0.009	-0.004
AB2362	EG 2	2809719.727	544434.178	2.763	2809719.737	544434.172	2.777	-0.010	0.006	-0.014
AC4350	DAWAL 3	2801610.986	547765.057	1.245	2801610.985	547765.014	1.235	0.001	0.043	0.010
AB2368	L 432	2810619.984	537670.175	1.393	2810619.986	537670.169	1.382	-0.002	0.006	0.011
AB2372	Q 432	2812159.709	531779.110	1.505	2812159.713	531779.099	1.522	-0.004	0.011	-0.017
AB2374	S 432	2813179.874	528102.224	1.357	2813179.893	528102.220	1.398	-0.019	0.004	-0.041
AB2378	W 432	2811021.252	522054.873	1.008	2811021.274	522054.879	1.011	-0.022	-0.006	-0.003
AB2382	A 433	2805890.618	518368.706	0.836	2805890.645	518368.715	0.876	-0.027	-0.009	-0.040
AB2386	E 433	2800379.832	520294.307	0.658	2800379.837	520294.305	0.687	-0.005	0.002	-0.029



## 2.4 Field Survey Procedures and Analysis (continued)



**NGS Control Map**



## **2.5    *Adjustment***

Adjustment is not necessary for the survey data collected using the RTK GPS Trimble VRS Now Network. The system is designed to provide final processed coordinates, enabling high-accuracy positioning in real time across a geographic region. Trimble VRS Now uses real-time data streams from the system user and generates correction models for high-accuracy RTK GPS corrections throughout the network. These corrections are applied to the points as they are being collected, negating the need for a post-process adjustment.

## **2.6    *Data Processing Procedures***

After field data is collected the information is downloaded from the data collectors into Trimble Business Center (TBC). Downloaded data is run through TBC 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 check the point data (Point #, Northing, Easting, Elevation, Description). The data is then organized using spreadsheets and imported into the final products.

### 3. FINAL COORDINATES

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<b>USGS EVERGLADES LiDAR POINTS</b>			
<b>GROUND CONTROL POINTS</b>			
<b>POINT ID.</b>	<b>NORTHING (UTM17 Meters)</b>	<b>EASTING (UTM17 Meters)</b>	<b>ELEV. (Meters)</b>
GCP-300	2788034.78	513849.39	1.10
GCP-302	2791439.94	518915.38	1.05
GCP-303	2794732.58	520299.67	0.90
GCP-304	2798228.87	520299.11	0.97
GCP-305	2802768.08	518645.76	1.03
GCP-306	2807015.56	518949.93	0.97
GCP-307	2809820.74	521261.73	1.17
GCP-309	2812364.74	528070.62	0.81
GCP-311	2809133.99	534577.49	1.57
GCP-312	2807455.32	539248.84	1.40
GCP-313	2808653.00	541739.32	1.40
GCP-314	2806533.26	552212.71	1.30
GCP-315	2811431.22	541273.10	2.35
GCP-316	2816117.06	541219.44	2.53
GCP-317	2820364.80	542820.03	3.50
GCP-318	2825889.07	542771.51	3.52
GCP-320	2833991.36	542606.38	2.40
GCP-321	2800345.88	547852.70	0.78
GCP-322	2798878.54	550992.59	1.05
GCP-324	2849188.48	541989.34	2.18
GCP-325	2849260.11	539660.34	2.49
GCP-326	2849255.01	537386.87	2.46
GCP-327	2849251.58	535988.08	2.46
GCP-328	2849246.62	533629.88	2.45
GCP-330	2849095.84	523464.49	2.39
GCP-333	2849301.04	522635.97	3.16
GCP-334	2849215.86	521065.03	2.80
GCP-335	2849316.39	520419.13	3.89
GCP-336	2849207.62	519210.43	2.73
GCP-338	2849196.13	517230.22	2.81
GCP-341	2849175.99	513797.78	2.61
GCP-344	2849252.51	510105.45	2.15
GCP-345	2849245.26	508084.22	2.57
GCP-346	2848187.16	506542.61	2.10

### 3. FINAL COORDINATES (CONTINUED)

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<b>USGS EVERGLADES LiDAR POINTS</b>			
<b>GROUND CONTROL POINTS</b>			
<b>POINT ID.</b>	<b>NORTHING (UTM17 Meters)</b>	<b>EASTING (UTM17 Meters)</b>	<b>ELEV. (Meters)</b>
GCP-347	2847731.78	504289.63	2.45
GCP-348	2849144.44	499416.89	2.07
GCP-349	2849145.99	493187.81	1.88
GCP-400	2806640.44	538008.76	0.71
GCP-401	2807599.48	547760.57	1.85
GCP-403	2781091.18	507575.82	1.46
GCP-404	2785618.36	510683.21	1.02
GCP-405	2802738.79	551014.16	1.46
GCP-406	2840759.17	550284.18	4.38
GCP-407	2846100.71	550420.70	4.63
GCP-408	2848815.62	523526.74	2.72
GCP-409	2840670.72	532830.82	3.54
GCP-410	2845038.19	532865.02	3.81
GCP-411	2849283.86	550298.64	2.93
GCP-412	2846318.48	496428.72	0.98

#### 4. POINT COMPARISON REPORT

LiDAR QA/QC				
GROUND CONTROL POINTS				
POINT ID	CHECK POINT ID	Δ NORTH	Δ EAST	Δ ELEV
GCP-300	GCP_CHK-300	0.00	-0.02	-0.03
GCP-302	GCP_CHK-302	0.00	-0.01	-0.02
GCP-303	GCP_CHK-303	0.01	-0.02	-0.01
GCP-304	GCP_CHK-304	0.00	0.00	-0.01
GCP-305	GCP_CHK-305	0.00	-0.01	-0.01
GCP-306	GCP_CHK-306	0.00	0.01	0.03
GCP-307	GCP_CHK-307	0.00	0.00	0.03
GCP-309	GCP_CHK-309	0.01	0.00	0.02
GCP-311	GCP_CHK-311	0.01	0.02	0.05
GCP-312	GCP_CHK-312	0.00	0.01	0.05
GCP-313	GCP_CHK-313	-0.01	0.01	-0.02
GCP-314	GCP_CHK-314	0.00	-0.02	0.02
GCP-315	GCP_CHK-315	0.02	-0.02	-0.03
GCP-316	GCP_CHK-316	-0.01	0.00	-0.02
GCP-317	GCP_CHK-317	-0.01	0.02	-0.04
GCP-318	GCP_CHK-318	0.00	0.00	0.01
GCP-320	GCP_CHK-320	-0.02	0.01	0.01
GCP-321	GCP_CHK-321	0.01	-0.02	-0.03
GCP-322	GCP_CHK-322	-0.02	-0.02	-0.01
GCP-324	GCP_CHK-324	0.00	0.00	0.03
GCP-325	GCP_CHK-325	0.01	0.01	0.02
GCP-326	GCP_CHK-326	0.02	0.02	-0.01
GCP-327	GCP_CHK-327	-0.01	0.01	-0.01
GCP-328	GCP_CHK-328	0.00	-0.01	0.04
GCP-330	GCP_CHK-330	0.01	-0.01	-0.01
GCP-333	GCP_CHK-333	0.01	-0.02	0.00
GCP-334	GCP_CHK-334	-0.02	-0.01	0.01
GCP-335	GCP_CHK-335	0.01	-0.02	0.00
GCP-336	GCP_CHK-336	-0.01	0.01	-0.05
GCP-338	GCP_CHK-338	0.01	0.00	-0.01
GCP-341	GCP_CHK-341	0.00	-0.01	-0.02
GCP-344	GCP_CHK-344	0.01	-0.01	-0.01
GCP-345	GCP_CHK-345	-0.01	-0.01	0.01
GCP-346	GCP_CHK-346	0.00	-0.01	-0.02
GCP-347	GCP_CHK-347	0.00	-0.01	0.00
GCP-348	GCP_CHK-348	0.01	0.00	-0.04



## 5. POINT COMPARISON REPORT (CONTINUED)

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LiDAR QA/QC				
GROUND CONTROL POINTS				
POINT ID	CHECK POINT ID	$\Delta$ NORTH	$\Delta$ EAST	$\Delta$ ELEV
GCP-349	GCP_CHK-349	0.01	-0.01	-0.02
GCP-400	GCP_CHK-400	-0.01	-0.01	0.05
GCP-401	GCP_CHK-401	-0.02	0.00	-0.03
GCP-403	GCP_CHK-403	0.01	-0.01	0.01
GCP-404	GCP_CHK-404	0.01	-0.01	-0.02
GCP-405	GCP_CHK-405	-0.01	0.00	0.01
GCP-406	GCP_CHK-406	0.00	0.00	0.02
GCP-407	GCP_CHK-407	0.00	0.01	0.00
GCP-408	GCP_CHK-408	-0.01	-0.01	0.02
GCP-409	GCP_CHK-409	0.01	0.02	-0.02
GCP-410	GCP_CHK-410	0.01	0.01	-0.02
GCP-411	GCP_CHK-411	0.00	0.00	-0.01
GCP-412	GCP_CHK-412	0.00	-0.01	-0.02

## 6. SURVEY NOTES

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- 1) Coordinates shown hereon are in meters and based on the Universal Transverse Mercator Coordinate System, Zone 17N.
- 2) Elevations shown hereon are in meters and based on the North American Vertical Datum of 1988.
- 3) The purpose of this survey was to establish ground control points within the Everglades National Park to be used for LiDAR calibration.

## 7. LEGEND

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CHK	Check
CORS	Continuously Operating Reference Station
ELEV	Elevation
FPRN	Florida Permanent Reference Network
GCP	Ground Control Point
GPS	Global Positioning System
ID	Identification
LiDAR	Light Detection and Ranging
LS	Land Surveyor
NAD	North American Datum
NAVD	North American Vertical Datum
NGS	National Geodetic Survey
NPS	National Park Service
NVA	Non-Vegetated Vertical Accuracy Point
QA/QC	Quality Assurance/Quality Control
RTK	Real Time Kinematic
RTN	Real-Time Network
SPC	State Plane Coordinate
TBC	Trimble Business Center
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VRS	Virtual Reference System
VVA	Vegetated Vertical Accuracy Point

## 8. SURVEYOR'S CERTIFICATION

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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.

06-01-2017

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William D. Donley  
Florida Licensed Surveyor & Mapper No. LS 5381

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Date

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