Fugro USA Land, Inc.
CPRA Lidar 2019
Ground Control and Checkpoints
Area Of Interest 2
Survey Completed on:
April 30, 2019

Submitted to:
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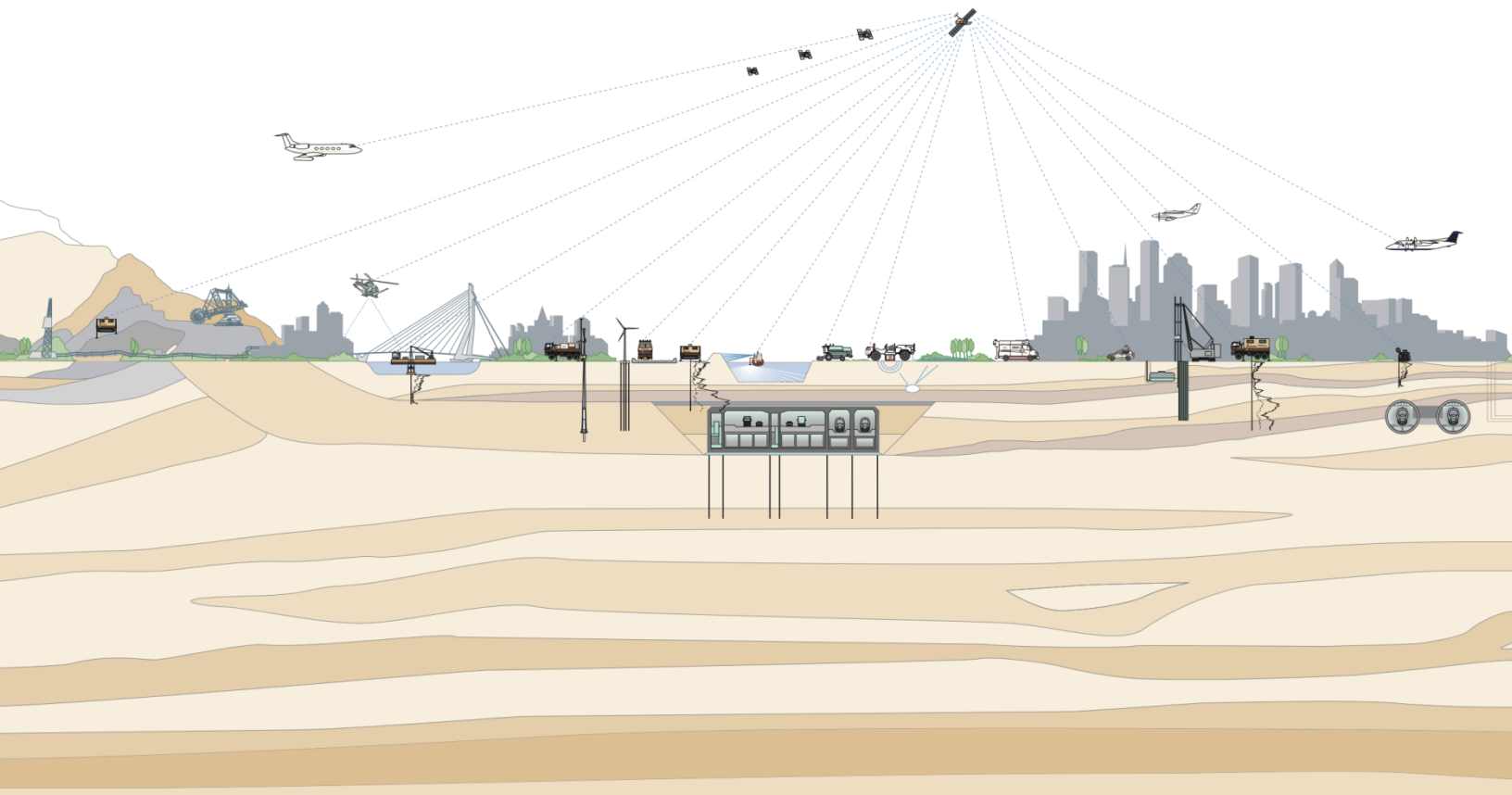
FUGRO Job No. 04.33780163



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1 COMPANY INFORMATION

Fugro is an internationally-acclaimed consulting firm that specializes in the provision of technical data and information required to design, construct, and maintain large structures and infrastructure in a safe, reliable, and efficient manner. We have been at the forefront of providing geospatial knowledge for over 50 years. Our complete geospatial approach assists our clients through the entire life span of a project: We begin with feasibility and continue through to post-construction and maintenance. Our comprehensive, integrated survey services have been used by a diverse set of industries including oil and gas, rail, electric utility, and government agencies. Access to Fugro's global resources allows us to deliver optimal solutions for projects of every scale.

Fugro is a global company with approximately 10,500 employees in 60 countries, including an active office in Lafayette, Louisiana. Fugro USA Land, Inc. is a wholly-owned subsidiary of Fugro NV, a Dutch corporation whose shares are publicly traded on the Amsterdam Mid-Cap Exchange. Throughout the world the multiple Fugro offices work as One Fugro to provide the most experience and best possible solutions for our clients. Fugro holds a strong market position due to in-house developed technologies, high value services, and a strong international and regional presence. Our highly-qualified specialists work with modern technologies and systems at locations all over the world.

John Chance Land Surveys, Inc. was established in 1957 under the name "John E. Chance & Associates" and joined the Fugro Family of Companies in 1992. Our mission is to serve as a purveyor of geospatial knowledge and to provide customized geospatial solutions designed to accurately measure and characterize the earth for customer projects. We have continuously provided survey services within the Gulf Coast region for 60 years.

Fugro provides registered, licensed Professional Land Surveyors in Louisiana, Alabama and Texas. We provide an ecological and regulatory services group able to conduct wetland delineations, oyster assessments, threatened and endangered species surveys, and other ecological studies. In addition, this group is able to obtain necessary federal, state, and local permits. Fugro also offers hydrographic survey services for underwater projects such as oyster assessments, bathymetric hazard surveys, and coastal restoration projects. Furthermore, we provide high-precision FLI-MAP aerial LiDAR technology for linear projects such as rail, pipeline, and transmission line route surveys. As needed, 3D laser scanning services are also available.

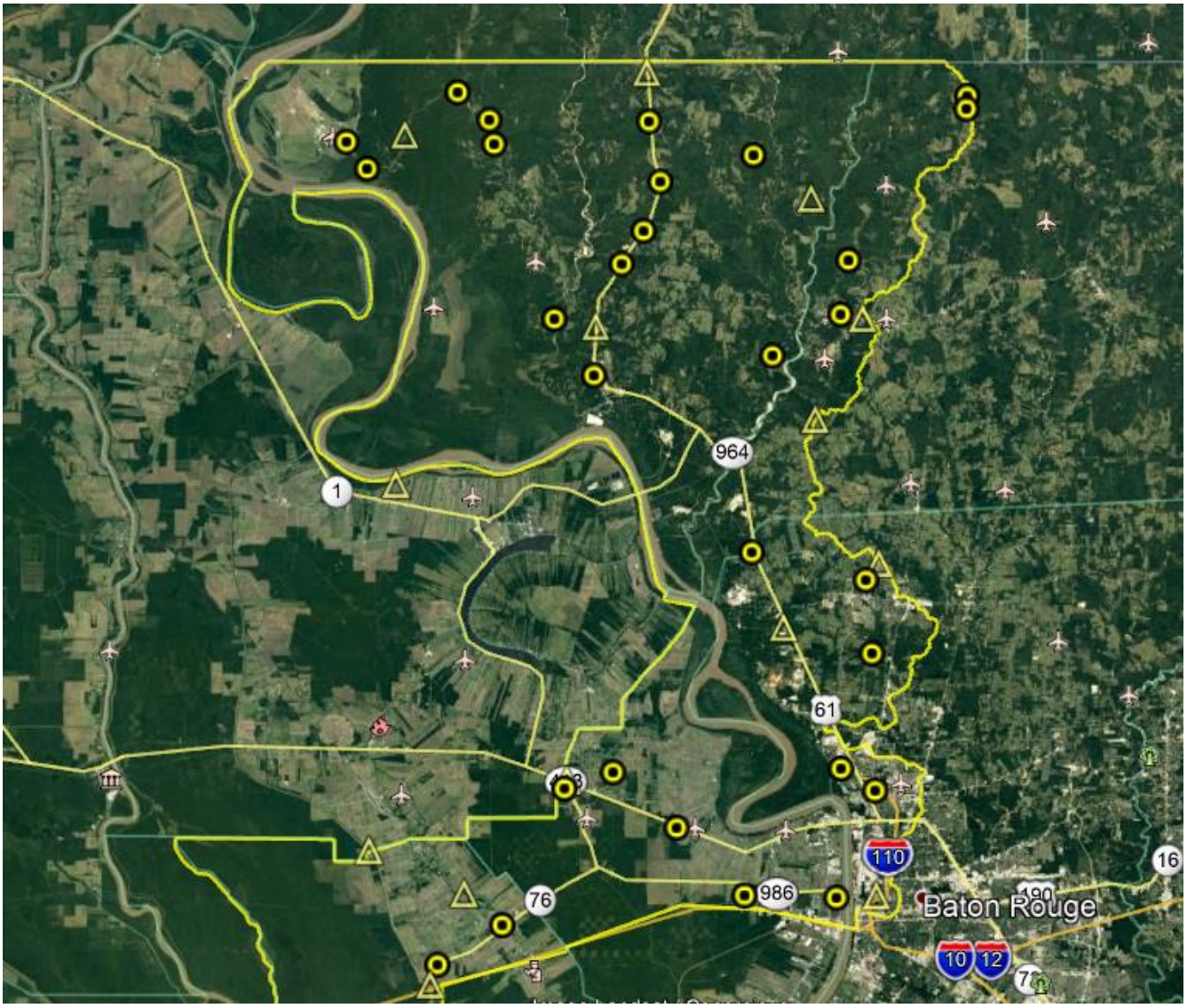
2 PROJECT OVERVIEW

2.1 Project Purpose

Fugro USA Land, Inc. of Lafayette, LA was tasked by Fugro USA Land, Inc. of Fredrick, MD to perform a ground control and checkpoint survey in support of LiDAR data collection of the for the CPRA LiDAR 2019 project. All data and information were conducted under the supervision of a Louisiana RPLS.

A total of 11 ground control points and 29 checkpoints were collected over the course of 5 days.

2.2 Project Location



Area of Interest 2

3 SURVEY METHODOLOGY

3.1 Global Positioning System

Global Positioning System (GPS) was used in Static Differential mode and 20+minute fast static sessions were collected for the required ground control and checkpoints. Post Processing Kinematics (PPK) was used to process the precise positions of the required control and checkpoints by adjusting to the nearest Continuously Operating Reference Stations (CORS) using a single baseline adjustment. OPUS was used as an independent verification to ensure that that the transformation from WGS84 to NAD83(2011) is correct.

3.2 Trimble Business Center

Trimble Business Center (TBC) was used to process the baseline adjustment from the collected points to the CORS.

TBC's provided results are reported at 95% confidence horizontally and vertically.

3.3 Survey Control Coordinate Systems

Horizontal Datum	Vertical Datum	Geoid Model	Projection	Units
Geographic NAD83(2011)	Ellipsoidal	N/A	N/A	DD.DDDD
NAD83(2011)	NAVD88	Geiod12b	Universal Transverse Mercator (Zone 15 North)	Meters

3.4 Results - Adjusted Lidar Ground Control Points coordinates

3.4.1 NAD83(2011) Geographic Coordinates (DD.dddd)

Point ID	NAD83(2011) Latitude (DD.DDDDDD)	NAD83(2011) Longitude (DD.DDDDDD)	Ellipsoid Height (Meters)	Feature Code
1070	30.82859689	-91.38549750	31.132	AOI-2-GCP1
1067	30.91114860	-91.22308103	38.523	AOI-2-GCP2
1083	30.72617178	-91.53619692	-16.706	AOI-2-GCP3
1076	30.99249047	-91.34752494	71.383	AOI-2-GCP4
1080	30.95240689	-91.52994472	2.086	AOI-2-GCP5
1061	30.83376571	-91.18475300	45.904	AOI-2-GCP6
1060	30.76822441	-91.22013091	21.367	AOI-2-GCP7
1057	30.67498167	-91.17242807	5.330	AOI-2-GCP8
1058	30.63364869	-91.24426132	-1.281	AOI-2-GCP9
1047	30.53451957	-91.40700069	-20.598	AOI-2-GCP10
1052	30.45972647	-91.17450253	-11.580	AOI-2-GCP12

3.4.2 NAD83(2011) Universal Transverse Mercator (Zone 15 North) (Meters)

Point ID	NAD83(2011) UTM15N Northing (Meters)	NAD83(2011) UTM15N Easting (Meters)	NAVD88 Geiod12b Elevation (Meters)	Feature Code
1070	3411721.524	654414.963	58.334	AOI-2-GCP1
1067	3421107.948	669805.486	65.660	AOI-2-GCP2
1083	3400170.370	640148.572	10.576	AOI-2-GCP3
1076	3429941.476	657777.998	98.403	AOI-2-GCP4
1080	3425254.057	640417.349	29.172	AOI-2-GCP5
1061	3412589.108	673608.254	73.120	AOI-2-GCP6
1060	3405269.596	670339.825	48.611	AOI-2-GCP7
1057	3395007.430	675074.372	32.550	AOI-2-GCP8
1058	3390316.070	668263.563	25.924	AOI-2-GCP9
1047	3379096.380	652820.643	6.651	AOI-2-GCP10
1052	3371144.218	675262.346	15.525	AOI-2-GCP12

3.5 Results - Adjusted Lidar Check Points coordinates

3.5.1 NAD83(2011) Geographic Coordinates (DD.dddd)

Point ID	NAD83(2011) Latitude (DD.DDDDDD)	NAD83(2011) Longitude (DD.DDDDDD)	Ellipsoid Height (Meters)	Feature Code
1082	30.94012481	-91.56867986	-6.555	AOI-2-NVA-1
1078	30.96299794	-91.46509903	37.049	AOI-2-NVA-2
1066	30.94032475	-91.26563350	55.161	AOI-2-NVA-3
1064	30.97005286	-91.10482969	70.789	AOI-2-NVA-4
1074	30.92302034	-91.33596065	58.169	AOI-2-NVA-5
1072	30.86974481	-91.36505354	47.881	AOI-2-NVA-6
1069	30.79770581	-91.38594616	24.172	AOI-2-NVA-7
1062	30.83710357	-91.20004232	41.187	AOI-2-NVA-8
1063	30.87240083	-91.19387931	52.828	AOI-2-NVA-9
1059	30.68326799	-91.26733974	3.178	AOI-2-NVA-10
1056	30.66516297	-91.18127041	4.417	AOI-2-NVA-11
1055	30.61775875	-91.17667200	-1.817	AOI-2-NVA-12
1048	30.54079742	-91.37152882	-21.351	AOI-2-NVA-13
1045	30.44172958	-91.45483391	-21.370	AOI-2-NVA-14

1039	30.41583903	-91.50345043	-22.379	AOI-2-NVA-15
1051	30.45946788	-91.20361436	-19.194	AOI-2-NVA-16
1054	30.54311748	-91.20010690	-6.427	AOI-2-NVA-17
6002	30.93076030	-91.55513805	5.747	AOI-2 VVA-FOR-18
1077	30.94635393	-91.46074544	17.109	AOI-2-VVA-FOR-19
1075	30.96172803	-91.34390038	67.197	AOI-2-VVA-FOR-20
1065	30.97832311	-91.10415811	73.005	AOI-2-VVA-FOR-21
1071	30.83419692	-91.41585861	4.412	AOI-2-VVA-FOR-22
1068	30.81044666	-91.25144867	15.087	AOI-2-VVA-FOR-23
1046	30.52972642	-91.40762864	-20.732	AOI-2-VVA-FOR-24
1053	30.52883143	-91.17441168	-9.006	AOI-2-VVA-FOR-25
1084	30.46090669	-91.27266459	-22.093	AOI-2-VVA-FOR-26
1079	30.98078326	-91.48900387	38.909	AOI-2-VVA-NONFOR-27
1073	30.89191012	-91.34783815	46.271	AOI-2-VVA-NONFOR-28
1049	30.50490031	-91.32380414	-20.353	AOI-2-VVA-NONFOR-29

3.5.2 NAD83(2011) Universal Transverse Mercator (Zone 15 North) (Meters)

Point ID	NAD83(2011) UTM15N Northing (Meters)	NAD83(2011) UTM15N Easting (Meters)	NAVD88 Geiod12b Elevation (Meters)	Feature Code
1082	3423844.506	636734.551	20.553	AOI-2-NVA-1
1078	3426511.572	646595.813	64.116	AOI-2-NVA-2
1066	3424278.028	665688.172	82.251	AOI-2-NVA-3
1064	3427823.775	680996.602	97.856	AOI-2-NVA-4
1074	3422257.413	658997.378	85.272	AOI-2-NVA-5
1072	3416310.954	656303.769	75.040	AOI-2-NVA-6
1069	3408296.846	654421.469	51.399	AOI-2-NVA-7
1062	3412935.449	672139.809	68.400	AOI-2-NVA-8
1063	3416857.624	672666.028	80.012	AOI-2-NVA-9
1059	3395781.737	665966.646	30.409	AOI-2-NVA-10
1056	3393905.305	674244.800	31.631	AOI-2-NVA-11
1055	3388657.874	674770.679	25.368	AOI-2-NVA-12
1048	3379840.833	656213.944	5.879	AOI-2-NVA-13
1045	3368748.033	648372.079	5.908	AOI-2-NVA-14
1039	3365815.677	643741.196	4.920	AOI-2-NVA-15
1051	3371070.750	672467.382	7.927	AOI-2-NVA-16
1054	3380348.108	672656.294	20.716	AOI-2-NVA-17

6002	3422823.237	638041.794	32.862	AOI-2 VVA-FOR-18
1077	3424672.435	647037.164	44.193	AOI-2-VVA-FOR-19
1075	3426536.710	658174.859	94.255	AOI-2-VVA-FOR-20
1065	3428741.653	681045.134	100.059	AOI-2-VVA-FOR-21
1071	3412300.692	651501.997	31.616	AOI-2-VVA-FOR-22
1068	3409902.541	667269.018	42.315	AOI-2-VVA-FOR-23
1046	3378564.266	652767.898	6.517	AOI-2-VVA-FOR-24
1053	3378804.226	675147.178	18.117	AOI-2-VVA-FOR-25
1084	3371126.841	665834.567	5.069	AOI-2-VVA-FOR-26
1079	3428451.715	644285.688	65.958	AOI-2-VVA-NONFOR-27
1073	3418792.102	657913.435	73.407	AOI-2-VVA-NONFOR-28
1049	3375929.111	660851.780	6.847	AOI-2-VVA-NONFOR-29

3.6 Ground Control Points Photographs

3.6.1 AOI-2 Ground Control Point 001

AOI-2 GCP 001 Asphalt road

AOI-2 GCP 001 Asphalt road

3.6.2 AOI-2 Ground Control Point 002

AOI-2 GCP 002 Asphalt road

AOI-2 GCP 002 Asphalt road

3.6.3 AOI-2 Ground Control Point 003

AOI-2 GCP 003 Gravel road

AOI-2 GCP 003 Gravel road

3.6.4 AOI-2 Ground Control Point 004

AOI-2 GCP 004 Asphalt road

AOI-2 GCP 004 Asphalt road

3.6.5 AOI-2 Ground Control Point 005

AOI-2 GCP 005 Gravel

AOI-2 GCP 005 Gravel road

3.6.6 AOI-2 Ground Control Point 006

AOI-2 GCP 006 Asphalt road

AOI-2 GCP 006 Asphalt road

3.6.7 AOI-2 Ground Control Point 007

AOI-2 GCP 007 Asphalt road

AOI-2 GCP 007 Asphalt road

3.6.8 AOI-2 Ground Control Point 008

AOI-2 GCP 008 Asphalt road

AOI-2 GCP 008 Asphalt Road

3.6.9 AOI-2 Ground Control Point 009

AOI-2 GCP 009 Asphalt road

AOI-2 GCP 009 Asphalt road

3.6.10 AOI-2 Ground Control Point 010

AOI-2 GCP 010 Concrete

AOI-2 GCP 010 Concrete

3.6.11 AOI-2 Ground Control Point 012

AOI-2 GCP 012 Asphalt road

AOI-2 GCP 012 Asphalt road

3.7 Checkpoints Photographs

3.7.1 AOI-2 NVA 001

AOI-2 NVA 001 Concrete road

AOI-2 NVA 001 Concrete road

3.7.2 AOI-2 NVA 002

AOI-2 NVA 002 Asphalt road

AOI-2 NVA 002 Asphalt road

3.7.3 AOI-2 NVA 003

AOI-2 NVA 003 Asphalt road

AOI-2 NVA 003 Asphalt road

3.7.4 AOI-2 NVA 004

AOI-2 NVA 004 Asphalt road

AOI-2 NVA 004 Asphalt road

3.7.5 AOI-2 NVA 005

AOI-2 NVA 005 Asphalt road

AOI-2 NVA 005 Asphalt road

3.7.6 AOI-2 NVA 006

AOI-2 NVA 006 Asphalt road

AOI-2 NVA 006 Asphalt road

3.7.7 AOI-2 NVA 007

AOI-2 NVA 007 Asphalt road

AOI-2 NVA 007 Asphalt road

3.7.8 AOI-2 NVA 008

AOI-2 NVA 008 Concrete road

AOI-2 NVA 008 Concrete road

3.7.9 AOI-2 NVA 009

AOI-2 NVA 009 Concrete

AOI-2 NVA 009 Concrete

3.7.10 AOI-2 NVA 010

AOI-2 NVA 010 Gravel road

AOI-2 NVA 010 Gravel road

3.7.11 AOI-2 NVA 011

AOI-2 NVA 011 Asphalt road

AOI-2 NVA 011 Asphalt

3.7.12 AOI-2 NVA 012

AOI-2 NVA 012 Asphalt road

AOI-2 NVA 012 Asphalt road

3.7.13 AOI-2 NVA 013

AOI-2 NVA 013 Asphalt road

AOI-2 NVA 013 Asphalt road

3.7.14 AOI-2 NVA 014

AOI-2 NVA 014 Asphalt road

AOI-2 NVA 014 Asphalt road

3.7.15 AOI-2 NVA 015

AOI-2 NVA 015 Asphalt road

AOI-2 NVA 015 Asphalt road

3.7.16 AOI-2 NVA 016

AOI-2 NVA 016 Asphalt road

AOI-2 NVA 016 Asphalt road

3.7.17 AOI-2 NVA 017

AOI-2 NVA 017 Asphalt road

AOI-2 NVA 017 Asphalt road

3.7.18 AOI-2 VVA-FOR 018

AOI-2 VVA-FOR 018 Short grass near tree line

AOI-2 VVA-FOR 018 Short grass near tree line

3.7.19 AOI-2 VVA-FOR 019

AOI-2 VVA-FOR 019 Short grass near tree line

AOI-2 VVA-FOR 019 Short grass near tree line

3.7.20 AOI-2 VVA-FOR 020

AOI-2 VVA-FOR 020 Short grass near tree line

AOI-2 VVA-FOR 020 Short grass near tree line

3.7.21 AOI-2 VVA-FOR 021

AOI-2 VVA-FOR 021 Grass near tree line

AOI-2 VVA-FOR 021 Grass near tree line

3.7.22 AOI-2 VVA-FOR 022

AOI-2 VVA-FOR 022 Grass near tree line

AOI-2 VVA-FOR 022 Grass near tree line

3.7.23 AOI-2 VVA-FOR 023

AOI-2 VVA-FOR 023 Grass near tree line

AOI-2 VVA-FOR 023 Grass near tree line

3.7.24 AOI-2 VVA-FOR 024

AOI-2 VVA-FOR 024 Grass near tree line

AOI-2 VVA-FOR 024 Grass near tree line

3.7.25 AOI-2 VVA-FOR 025

AOI-2 VVA-FOR 025 Short grass near tall trees

AOI-2 VVA-FOR 025 Short grass near tall trees

3.7.26 AOI-2 VVA-FOR 026

AOI-2 VVA-FOR 026 Short grass near tall trees

AOI-2 VVA-FOR 026 Short grass near tall trees

3.7.27 AOI-2 VVA-NONFOR 027

AOI-2 VVA-NONFOR 027 Short grass

AOI-2 VVA-NONFOR 027 Short grass

3.7.28 AOI-2 VVA-NONFOR 028

AOI-2 VVA-NONFOR 028 Short grass in median

AOI-2 VVA-NONFOR 028 Short grass in median

3.7.29 AOI-2 VVA-NONFOR 029

AOI-2 VVA-NONFOR 029 Short grass in road median

AOI-2 VVA-NONFOR 029 Short grass in road median

3.8 Baseline Processing Report (CORS data) (meters) (95%)

Baseline Processing Report

Processing Summary

Observation	From	To	Solution Type	H. Prec. (Meter)	V. Prec. (Meter)	Geodetic Az.	Ellipsoid Dist. (Meter)	ΔHeight (Meter)
1LSU --- 1039 (B53)	1LSU	1039	Fixed	0.01037	0.02757	271°48'12"	31068.52597	-17.16849
1LSU --- 1058 (B54)	1LSU	1058	Fixed	0.00880	0.01627	346°15'10"	25821.51529	3.92975
1LSU --- 1057 (B55)	1LSU	1057	Fixed	0.00808	0.01597	1°26'54"	29671.90129	10.54116
1LSU --- 1056 (B56)	1LSU	1056	Fixed	0.00875	0.01500	359°48'17"	28574.02485	9.62780
1LSU --- 1055 (B57)	1LSU	1055	Fixed	0.00879	0.01418	0°50'38"	23321.00315	3.39442
1LSU --- 1054 (B58)	1LSU	1054	Fixed	0.00868	0.01708	352°46'59"	15163.87209	-1.21611
1LSU --- 1051 (B61)	1LSU	1051	Fixed	0.01099	0.02084	338°45'14"	6191.11563	-13.98332
1LSU --- 1049 (B63)	1LSU	1049	Fixed	0.00975	0.01813	308°07'39"	17517.49288	-15.14165
1LSU --- 1048 (B64)	1LSU	1048	Fixed	0.01063	0.01705	308°53'03"	23579.31065	-16.14016
1LSU --- 1047 (B65)	1LSU	1047	Fixed	0.01258	0.01668	302°57'55"	25935.32131	-15.38729

1LSU --- 1045 (B67)	1LSU	1045	Fixed	0.00810	0.02436	278°16'28"	26652.48279	-16.15939
1LSU --- 1053 (B59)	1LSU	1053	Fixed	0.02676	0.04931	2°23'07"	13471.48226	-3.79548
1LSU --- 1052 (B60)	1LSU	1052	Fixed	0.01561	0.03869	5°26'29"	5825.02477	-6.36852
1LSU --- 1084 (B95)	1LSU	1084	Fixed	0.01150	0.02594	303°45'52"	10675.49580	-16.88233
FOLK --- 1073 (B93)	FOLK	1073	Fixed	0.00820	0.01807	293°02'08"	15997.57041	-1.83933
FOLK --- 1072 (B68)	FOLK	1072	Fixed	0.00948	0.01811	283°05'01"	16808.03435	-0.22915
FOLK --- 1071 (B69)	FOLK	1071	Fixed	0.00853	0.01517	269°39'20"	21238.59355	-43.69814
FOLK --- 1070 (B70)	FOLK	1070	Fixed	0.00785	0.01577	267°38'44"	18350.15072	-16.97781
FOLK --- 1069 (B71)	FOLK	1069	Fixed	0.00794	0.01383	257°11'39"	18852.38086	-23.93759
FOLK --- 1068 (B72)	FOLK	1068	Fixed	0.01650	0.02914	243°13'36"	6172.33191	-33.02291
FOLK --- 1067 (B73)	FOLK	1067	Fixed	0.01011	0.01940	341°34'21"	8836.14406	-9.58705
FOLK --- 1066 (B74)	FOLK	1066	Fixed	0.00868	0.01758	329°26'52"	13492.88822	7.05144

FOLK --- 1065 (B75)	FOLK	1065	Fixed	0.01501	0.02692	28°25'19"	18003.72291	24.89523
FOLK --- 1064 (B76)	FOLK	1064	Fixed	0.00803	0.01454	29°41'32"	17171.31641	22.67908
FOLK --- 1063 (B77)	FOLK	1063	Fixed	0.00845	0.01293	359°58'36"	4086.83188	4.71843
FOLK --- 1062 (B78)	FOLK	1062	Fixed	0.00228	0.00366	286°21'30"	616.19908	-6.92314
FOLK --- 1061 (B79)	FOLK	1061	Fixed	0.00262	0.00430	102°42'23"	893.32433	-2.20580
FOLK --- 1060 (B80)	FOLK	1060	Fixed	0.00774	0.01539	198°37'25"	7874.89063	-26.74284
FOLK --- 1059 (B81)	FOLK	1059	Fixed	0.00685	0.01480	202°38'30"	18288.69593	-44.93199
FOLK --- 1074 (B92)	FOLK	1074	Fixed	0.00830	0.01885	305°33'18"	16694.46084	10.05938
FOLK --- 1075 (B91)	FOLK	1075	Fixed	0.01094	0.02816	314°19'21"	20037.29563	19.08657
FOLK --- 1076 (B90)	FOLK	1076	Fixed	0.01102	0.01514	319°52'15"	22771.67114	23.27269
FOLK --- 1077 (B89)	FOLK	1077	Fixed	0.00845	0.01369	295°46'40"	28321.06960	-31.00078
FOLK --- 1078 (B88)	FOLK	1078	Fixed	0.01463	0.01850	298°39'27"	29531.86159	-11.06110

FOLK --- 1079 (B87)	FOLK	1079	Fixed	0.00764	0.01288	299°47'27"	32486.17283	-9.20076
FOLK --- 1080 (B86)	FOLK	1080	Fixed	0.01444	0.03535	292°02'49"	34646.75333	-46.02358
FOLK --- 1082 (B84)	FOLK	1082	Fixed	0.00640	0.01297	288°01'29"	37667.61024	-54.66494
FOLK --- 1083 (B83)	FOLK	1083	Fixed	0.00731	0.01138	249°46'57"	34940.23655	-64.81563
FOLK --- 6002 (B111)	FOLK	6002	Fixed	0.00895	0.01311	287°05'09"	36122.49156	-42.36261

3.9 Online positioning user service (OPUS) results

Accuracy

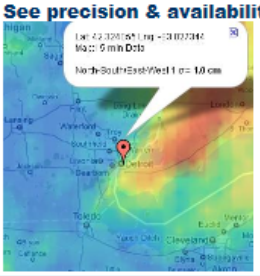
How accurate is it?

Under normal conditions, most positions can be resolved to within a few centimeters. Estimating the accuracy for a specific solution is difficult, however, as formal error propagation is notoriously optimistic for GPS reductions. Systematic errors, such as misidentification of antenna or height, are not detected. Local multipath or adverse atmospheric conditions may also negatively impact your solution.

Static: Static processing provides "peak-to-peak" errors for each coordinate (X, Y, Z, Φ, λ, h, and H). These describe the error range, the disagreement between the 3 baseline solutions, as shown above.

One advantage of peak-to-peak errors is that they include any error from the CORS reference coordinates.

See precision & availability



Rapid static: Absent any warning messages, the best estimates of coordinate accuracy are the standard deviations reported by single baseline analysis. Our experiments indicate that the actual error is less than these estimated accuracies more than 95 percent of the time.

Source: https://www.ngs.noaa.gov/OPUS/about.jsp

3.9.1 OPUS results for Point 1046 (AOI-2 VVA-FOR 024)

```
FILE: 27721121.19o OP1556053261508

                        NGS OPUS-RS SOLUTION REPORT
                        ========================

All computed coordinate accuracies are listed as 1-sigma RMS values.
For additional information: https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

      USER: lcastille@fugro.com                    DATE: April 23, 2019
RINEX FILE: 2772112n.19o                           TIME: 21:03:20 UTC


  SOFTWARE: rsgps  1.38 RS75.prl 1.99.3          START: 2019/04/22 13:10:13
 EPHEMERIS: igr20501.eph [rapid]                  STOP: 2019/04/22 13:31:30
  NAV FILE: brdc1120.19n                      OBS USED:  1998 /  2223   :  90%
  ANT NAME: TRMR8_GNSS3     NONE            QUALITY IND.  13.22/  8.77
ARP HEIGHT: 2.000                       NORMALIZED RMS:        0.437


 REF FRAME: NAD_83(2011)(EPOCH:2010.0000)             IGS08 (EPOCH:2019.30563)

         X:      -135075.702(m)   0.005(m)          -135076.534(m)   0.005(m)
         Y:     -5496982.846(m)   0.021(m)         -5496981.363(m)   0.021(m)
         Z:      3221083.084(m)   0.021(m)          3221082.900(m)   0.021(m)

       LAT:   30 31 47.01511      0.010(m)        30 31 47.03408      0.010(m)
```

E LON:	268 35 32.53690	0.005(m)	268 35 32.50432	0.005(m)
W LON:	91 24 27.46310	0.005(m)	91 24 27.49568	0.005(m)
EL HGT:	-20.732(m)	0.028(m)	-22.085(m)	0.028(m)
ORTHO HGT:	6.517(m)	0.030(m)	[NAVD88 (Computed using GEOID12B)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 15)	SPC (1702 LA S)
Northing (Y) [meters]	3378564.266	224989.034
Easting (X) [meters]	652767.898	992870.127
Convergence [degrees]	0.80905833	-0.03714722
Point Scale	0.99988791	0.99996821
Combined Factor	0.99989117	0.99997147

US NATIONAL GRID DESIGNATOR: 15RXP5276778564(NAD 83)

3.9.2 Opus results for point number 1068 compared to results provided from single point baseline processing

Details	
Grid azimuth:	160°22'55"
Grid distance:	0.01591 m
Δ Elevation:	0.01211 m
Geodetic azimuth:	161°16'40"
Forward:	161°16'40"
Backward:	341°16'40"
Ellipsoid distance:	0.01591 m
Ground distance	
Geodetic:	0.01591 m
Δ Height:	0.01211 m

1068	3409902.541	667269.018	42.315	AOI-2-VVA-FOR-23

```
FILE: 2772113A.19o OP1556114698261

 2005   NOTE:  The IGS precise and IGS rapid orbits were not available
 2005   at processing time.  The IGS ultra-rapid orbit was/will be used to
 2005   process the data.
 2005
                            NGS OPUS-RS SOLUTION REPORT
                            ==========================

All computed coordinate accuracies are listed as 1-sigma RMS values.
For additional information: https://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

      USER: lcastille@fugro.com                    DATE: April 24, 2019
RINEX FILE: 2772113s.19o                           TIME: 14:06:36 UTC


  SOFTWARE: rsgps  1.38 RS95.prl 1.99.3          START: 2019/04/23 18:47:56
 EPHEMERIS: igu20502.eph [ultra-rapid]            STOP: 2019/04/23 19:09:30
  NAV FILE: brdc1130.19n                       OBS USED:  1170 /  1764   :  66%
  ANT NAME: TRMR8_GNSS3     NONE             QUALITY IND.   3.03/  1.14
ARP HEIGHT: 2.000                         NORMALIZED RMS:        0.412


 REF FRAME: NAD_83(2011)(EPOCH:2010.0000)             IGS08 (EPOCH:2019.30902)

         X:      -119745.207(m)   0.008(m)          -119746.041(m)   0.008(m)
```

Y:	-5481490.213(m)	0.052(m)	-5481488.732(m)	0.052(m)
Z:	3247869.693(m)	0.039(m)	3247869.512(m)	0.039(m)
LAT:	30 48 37.60848	0.017(m)	30 48 37.62778	0.017(m)
E LON:	268 44 54.78461	0.008(m)	268 44 54.75203	0.008(m)
W LON:	91 15 5.21539	0.008(m)	91 15 5.24797	0.008(m)
EL HGT:	15.075(m)	0.063(m)	13.726(m)	0.063(m)
ORTHO HGT:	42.303(m)	0.064(m)	[NAVD88 (Computed using GEOID12B)]	

	UTM COORDINATES UTM (Zone 15)	STATE PLANE COORDINATES SPC (1702 LA S)
Northing (Y) [meters]	3409902.556	256111.091
Easting (X) [meters]	667269.013	1007835.954
Convergence [degrees]	0.89581389	0.04094444
Point Scale	0.99994515	1.00002535
Combined Factor	0.99994278	1.00002298

US NATIONAL GRID DESIGNATOR: 15RXQ6726909902(NAD 83)

4 QUALITY ASSURANCE

Fugro has a totally integrated Quality Assurance System that is documented, implemented, and under the control of a Quality Manager. Certification and compliance of this system to the ISO standards listed below verifies our commitment to meet customer needs by providing the proper policies, procedures, and resources. The Quality Assurance System is used to provide job control and promote optimal client communication during all stages of a project – from the initial proposal to final invoicing. Implementation of our Quality Assurance System assures compliance with all applicable regulatory and ecological requirements. For data management, the Fugro Quality System provides checks to validate and confirm that all survey data and processed data are interpreted and stored as required. The effectiveness of these business and operational processes are monitored, measured and analyzed as part of our compulsory quarterly Management Review of the Quality Assurance System which includes surveillance audits and certification renewal audits.

Fugro has qualified for and applied the following standards to our business and operational activities:

Quality Management System:
ISO 9001:2008
Certificate NO. UQA 4000406/AB
Approved by: Lloyd's Register Quality Assurance
Provision of Advanced Surveying, Mapping, Regulatory and Ecological Services for Land Applications and Airborne LIDAR data Collection and Interpretation

Environmental Management System:
ISO 14001:2004
Certificate NO. UQA 4000406/CB
Approved by: Lloyd's Register Quality Assurance
Provision of Advanced Surveying, Mapping, Regulatory and Ecological Services for Land Applications and Airborne LIDAR data Collection and Interpretation

Occupational Health & Safety Management System:
OHSAS 18001:2007
Certificate NO. UQA 4000406/BB
Approved by: Lloyd's Register Quality Assurance
Provision of Advanced Surveying, Mapping, Regulatory and Ecological Services for Land Applications and Airborne LIDAR data Collection and Interpretation

If desired, Fugro can develop and implement a specific project Quality Assurance/Quality Control (QA/QC) plan for this project. Fugro ensures that all surveys and associated documentation will be accurate and will comply with accepted Industry Standards.

5 SAFETY

Fugro has developed and implemented an Occupational Health & Safety (OH&S) and Environmental Management System (EMS) to satisfy the needs of our customers, employees, shareholders, and community. We continually strive to improve our employee and company performance in the areas of health, safety, and protection of the environment. Fugro assures that ALL required safety equipment and gear including personal protective equipment (PPE) were utilized on this project.

Fugro also strives to prevent wasteful and inefficient operations, avoid damage to property and equipment, show respect for the environment, and, foremost, to protect the safety and well-being of all employees. Fugro employees received all safety training as specified in the contract.

The schedule of safety meetings and drills executed for this project included but were not limited to:

- Pre-job safety meetings;
- Pre-job vessel health, safety, and environmental orientation including man overboard, fire, and abandon ship drills;
- Daily tailgate safety meetings prior to each day's operations;
- When a new procedure or piece of equipment is introduced, including a written Job Safety Analysis; and
- Document a Near Miss accident or Injury.

Fugro ensures compliance with all applicable rules, regulations, orders, standards and interpretations promulgated under the Occupational Safety and Health Act (1997) and all other applicable laws, ordinances, rules, regulations and orders of anybody having jurisdiction over safety and health of persons or property or the protection of same to protect them from injury, illness, damage or loss. The Fugro Survey Project Manager or his designee conducted and documented a daily safety meeting at the beginning of each work day. A copy of the daily safety meeting minutes will be furnished upon request.

Fugro ensures that Personal Protective Equipment (PPE) will be utilized and maintained in accordance with the written PPE program. Training in the proper use, maintenance and inspection of PPE is provided to all Fugro employees prior to beginning work. Fugro will supply all required PPE required at the work site. Unless otherwise specified, the minimum PPE includes:

- Hard hats
- Safety glasses with side shields or side impact protection as necessary
- Safety toe shoes/boots (steel/composite toe or approved toe caps)
- Protective clothing with high visibility vest
- Task appropriate gloves

6 CONTACT INFORMATION

By use of these specific contact points, Fugro ensures quality control and prompt action with respect to all project-related issues.

Morgan Reed: For all corporate, legal, and contractual issues

David Cormier, PLS: For all operational QA/QC issues from mobilization through final product delivery and for final project responsibility

CONTACT INFORMATION			
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This geodetic survey was conducted under my direct supervision.

5/13/19

STATE OF LOUISIANA
DAVID LESLIE CORMIER
LICENSE NO. 4715
PROFESSIONAL
LAND SURVEYOR

David L. Cormier
Professional Land Surveyor
Louisiana Registration No. 4715
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