

# KY **Block2 Block3 Block1** TN Block1 MS AL



Contract # G16PC00022 Task Order # 140G0219F0060



Contractor Woolpert Project # 79576

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# 1. Overview

#### About

This project contains a comprehensive outline of the 140G0219F0060TN West TN Lidar 2019 D19 task order issued by the United States Geological Survey's National Geospatial Technical Operations Center (USGS-NGTOC). This task order called for the acquisition and processing of QL2 data over three blocks that total approximately 7,961 square miles in western Tennessee.

This report encompasses the Lot 7 Block 3 area of interest. This AOI totals approximately 4,542 square miles and includes the following counties:

- Chester
- Crockett
- Dyer
- Gibson
- Haywood
- Lake

- Lauderdale
- Madison
- Obion
- Tipton
- Weakley

#### Purpose

The purpose of this project was to collect data to be used for the following: terrain mapping, conservation planning and design, support of easement/land stewardship programs, support of special emphasis programs, support of soil projects, fill gaps in existing lidar, and water resource management.

#### **Specifications**

Data for this task order was acquired and produced to meet USGS Lidar Base Specification v1. standards and the American Society of Photogrammetry and Remote Sensing (ASPRS) Positional Accuracy Standards for Digital Geospatial Data (Edition 1, Version 1.0).

#### **Spatial Reference**

Geospatial data products were produced using the following horizontal and vertical spatial data reference system.

Table	1-1. Spatial	Reference	System
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Area of Interest		
Horizontal	EPSG Code	6576
	Datum	NAD83 (2011)
	Projection	State Plane Tennessee (FIPS Zone 4100)
	Units	US Survey Feet
Vertical	Datum	NAVD88
	Geoid	GEOID12B
	Units	US Survey Feet
	Height Type	Orthometric

### Task Order Deliverables

All data products produced as part of this task order are listed below. All tiled deliverables had a tile size of 7,000-feet x 4,000-feet. Tile names are derived from the guidance provided by the State of Tennessee Department of Finance and Administration.

Table 1	-2. De	eliverat	oles
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Lidar Data		
Classified lidar point cloud data	Tiles in .las v1.4 formatClasses• 1 - Processed, not Classified• 9 - Water• 2 - Ground• 17 - Bridge Decks• 6 - Buildings• 18 - High Noise• 7 - Noise• 20 - Ignored Ground	
Breaklines used for hydro- flattening	<ul> <li>Lake and River features as feature classes in an Esri file geodatabase</li> <li>Water bodies greater than 2 acres as PolygonZ feature classes</li> <li>Rivers 30.5 meters / 100 feet and greater in width as PolylineZ features</li> <li>Bridges used in DEM generation as PointZ feature classes in Esri shapefile format</li> </ul>	
Hydro-flattened bare earth digital elevation model (DEM)	2.5-foot pixel size, 32-bit floating-point; no bridges or overpass structures ERDAS .img format	
Intensity Imagery	2.5-foot pixel size, 8-bit gray-scale (linear rescaling from 16-bit intensity) GeoTIFF format	
Control Data		
Lidar calibration points	Esri shapefile format	
Lidar NVA checkpoints	Esri shapefile format	
Lidar VVA checkpoints	Esri shapefile format	
Other Data		
Building footprints	Esri File Geodatabase format	
Spatial Metadata		
Data extent	Esri shapefile format	
Tile index	Esri shapefile format	
Interswath and intraswath results	Esri shapefile format	
Swath polygons	Georeferenced, polygonal representation of the detailed extents of each lidar swath; Polygon feature class in an Esri file geodatabase	
Maximum height separation rasters	2.5-foot pixel size, 32-bit floating-point, JPEG format	
Swath separation images	5-foot pixel size, 8-bit, GeoTIFF format	

#### Table 1-2. Deliverables (continued)

Metadata and Reports	
Metadata	Product-level FGDC CSDGM/USGS MetaParser Compliant metadata in .xml format
Lidar Project Report	Project report with flight logs in .pdf format
Survey Report	Survey report in .pdf format

#### Figure 1-1. Project Area



#### Figure 1-1. Project Area - Block 3



# 2. Acquisition

## Flight Planning

Aerial lidar data was collected using the specifications listed below.

#### Table 2-1. Acquisition Requirements

Specification	Target
Resolution	<ul> <li>2 points per square meter</li> <li>0.7-meter nominal point spacing</li> </ul>
Overlap	At contractor's discretion, but enough to ensure there are no data gaps between usable portions of the swath and nominal point density is achieved
Acquisition Window	At a period of annual minimal water level in the spring 2019 leaf off window
Acquisition Conditions	<ul> <li>Cloud and fog-free between the aircraft and ground</li> <li>Snow free</li> <li>Ground has no unusual flooding or inundation, except in cases where the goal of the collection is to map the inundation</li> <li>Preference of vegetation is leaf-off</li> </ul>
Data Voids	<ul> <li>Not allowed except</li> <li>Where caused by water bodies</li> <li>Where caused by areas of low near infra-red (NIR) reflectivity (i.e. asphalt or composition roofing)</li> <li>Where appropriately filled-in by another swath</li> </ul>
Control	Airborne Global Positioning System (ABGPS) and Inertial Measurement Unit (IMU) data to be used along with differentially-corrected GPS ground control points

Lidar data acquisition was slowed and eventually halted due to historic and widespread rainfall throughout 2018 and into 2019 throughout many areas in Tennessee including within the western AOI of the West TN lidar project. This resulted in unsuitable data acquisition conditions due to varying degrees of flooding and ponding conditions along rivers, streams, and within fields across the remainder of the yet to be acquired western AOI.

#### Lidar Sensor Information

Aerial lidar data was acquired using the Leica ALS70 and Leica TerrainMapper lidar sensor systems. A total of 257 flight lines were collected for the Block 3 AOI.

Table 2-2. Leica ALS70 Sensor Info

System Performance		
Maximum Flying Height (m AGL)	3,500	
Maximum Measurement Rate (kHz)	500	
Field of view (degrees)	0 - 75 (full angle, user adjustable)	
Roll stabilization (automatic adaptive, degrees)	70 - active FOV	
Scan patterns (user selectable)	sine, triangle raster	
Maximum Scan Rate (Hz) • Scan • Triangle • Raster	• 200 • 158 • 120	
Number of Returns	unlimited	
Number of intensity measurements	3 (first, second, third)	
Physical Specifications		
Size (cm), Weight (kg) • Scanner • Control Electronics	• 45 W x 47 D x 36 H • 45 kg	
Operating Temperature Scanner Control Electronics	0 - 40°C	
Flight Management	FCMS	
Power Consumption	910 W @ 22.0 – 30.3 VDC	

Source: Leica ALS70-HP Product Specifications

https://w3.leica-geosystems.com/downloads123/zz/airborne/ALS70/brochures/Leica\_ALS70\_6P\_BRO\_en.pdf

					-
Table 0.2	laiaa	Torrain	Mannar	Sancar	Info
	Leica	renam	MODDEL	SEUSOL	

Sensor Specifications	
Operating Altitude (m AGL)	300 - 5,500 at 10% reflective target
Maximum Measurement Rate (kHz)	2,000
Scan Angle	20 - 40
Scan Width	Up to 70% of flight altitude
Scan Frequency	Programmable up to 125 Hz (7,500 RPM), 250 scan lines per second
Number of Returns	15
Number of intensity measurements	15
Pulse Mode(s)	Up to 35 pulses in air
Laser Specifications	
Laser Beam Divergence	0.25 mrad (1/e)
Laser Classification	Class 4 laser product
Accuracy	
Range Resolution	< 1 cm RMS
Elevation Accuracy	< 5 cm 1 σ
Horizontal Accuracy	< 13 cm 1 σ
Physical Specifications	
Size (cm), Weight (kg) • Scanner • Control Electronics	• 37 W x 68 L x 26 H cm, 47 kg • 45 W x 47 D x 25 H cm, 33 kg
Operating Temperature • Scanner • Control Electronics	<ul> <li>0 - 40°C cabin-side temperature</li> <li>0 - 40°C</li> </ul>
Flight Management	Leica FlightPro
Power Consumption	922 W @ 22.0 – 30.3 VDC

Source: Leica TerrainMapper Data Sheet

https://leica-geosystems.com/en-US/products/airborne-systems/topographic-lidar-sensors/leica-terrainmapper

## **GNSS and IMU Equipment**

Prior to mobilizing to the project site, flight crews coordinated with the necessary air traffic control personnel to ensure airspace access. Crews were on-site, operating a Global Navigation Satellite System (GNSS) Base Station for the airborne GPS support.

Flight navigation during acquisition was performed using IGI CCNS (Computer Controlled Navigation System). The pilots are skilled at maintaining their planned trajectory, while holding the aircraft steady and level. If atmospheric conditions are such that the trajectory, ground speed, roll, pitch and/or heading cannot be properly maintained, the mission is aborted until suitable conditions occur.

Base stations were set by acquisition staff and was used to support the aerial data acquisition. See the table below for stations operated during acquisition.

Station Name	Latitude (DMS)	Longitude (DMS)	Ellipsoid Height L1 Phase Center (Meters)
COLB_CORS	39° 57′ 35.11256"	83° 02′ 44.74693"	186.508
PAR_KCHA_Base	35° 01′ 56.91115"	85° 12′ 23.60732"	177.269
TN22_CORS	35° 23′ 25.71880"	84° 22′ 40.97004"	207.543
TN23_CORS	35° 55′ 10.68490"	84° 59′ 57.56518"	527.522
TN24_CORS	36° 08' 03.69715"	85° 29′ 57.81747"	309.655
TN26_CORS	35° 26′ 35.11875"	84° 37′ 48.33555"	258.117
TN28_CORS	35° 42′ 05.60618"	85° 44′ 43.51172"	271.52
TN40_CORS	35° 38′ 50.61711"	88° 24′ 04.31175"	126.737
TN43_CORS	35° 13′ 42.85127"	88° 36′ 14.10607"	122.415
TN44_CORS	35° 38′ 25.50233"	88° 55′ 08.62787"	92.437

#### Table 2-4. GNSS Base Stations

#### Timeline

Lidar data was collected on February 8, 2019 through January 17, 2021 for the Block 3 AOI. Acquisition specifications are listed in the table below. An initial quality control process was immediately performed on to review the data coverage, airborne GPS data, and trajectory solution.

Settings	Leica ALS70	Leica TerriainMapper
Max. Number of Returns	4	15
Nominal Point Spacing	0.71 m	0.71 m
Nominal Point Density	2.56 ppsm	2 ppsm
Flying Height Above Ground Level	1,392 m	2,500 m
Flight Speed	120 knots	150 knots
Scan Angle	40°	40°
Scan Rate Used	52.2 Hz	90 Hz
Pulse Rate Used	190.8 kHz	600 kHz
Multi-Pulse in Air	Enabled	Enabled
Swath Width	1,013 m	1,819 m
Swath Overlap	35%	25.5%

Table 2-5. Project Acquisition Specifications

For more information, see the Flight Logs in Appendix 1.

#### **Acquisition Quality Assurance**

Woolpert developed a quality assurance and validation plan to ensure the acquired lidar data meets the USGS Base Specification Version 1.3. For quality assurance purposes, the lidar data was processed immediately following acquisition to verify the coverage has appropriate density, distribution, and no unacceptable data voids. Accompanying GPS data was post processed using differential and Kalman filter algorithms to derive a best estimate of trajectory. The quality of the solution was verified to be consistent with the accuracy requirements of the task order. Any required re-flights were scheduled at the earliest opportunity.

The spatial distribution of the geometrically usable first return lidar points was reviewed for density requirements as well as regular and uniform point distribution - verifying the lidar data is spaced so that 90% of the cells in a 2\*NPS grid placed over the data contain at least one lidar point. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath. Additionally, the data was reviewed for unacceptable data voids – verifying no area greater than or equal to (4 x ANPS)<sup>2</sup> exhibited data coverage gaps.

# 3. Processing

#### **Processing Summary**

Once the lidar data passed initial QC, the dataset was corrected for aircraft orientation and movement. This process used airborne inertial, orientation, and GPS data collected during acquisition along with ground-based GPS data. The data went through a geometric calibration that further corrected each laser point. This calibrated data set was used to create the LAS point cloud. The LAS point data was initially classified into "ground" and "non-ground", then further refined using the classes specified in this task order. Breaklines were drawn to denote hydrological features. After the hydro-flattening process, the final deliverables products were created.

Note: Data from this new dataset was referenced to existing USGS projects in Tennessee as tie-edges.

### **GNSS-IMU Trajectory Processing**

Kinematic corrections for the aircraft position were resolved using aircraft GPS and static ground GPS (1-Hz) for each geodetic control (base station) for three subsystems: inertial measurement unit (IMU), sensor orientation information, and airborne GPS data.

Post-processing of the IMU system data and aircraft position with attitude data was completed to compute an optimally accurate, blended navigation solution based on Kalman filtering technology, or the smoothed best estimate of trajectory (SBET).

Software: POSPac Software v. 5.3, IPAS Pro v.1.35., Novatel Inertial Explorer v8.60.6129

#### **Trajectory Quality**

The GNSS trajectory and high-quality IMU data are key factors in determining the overall positional accuracy of the final sensor data. Within the trajectory processing, there are many factors that affect the overall quality, but the most indicative are the combined separation, the estimated positional accuracy, and the positional dilution of precision (PDOP).

#### **Combination Separation**

Combined separation is a measure of the difference between the forward-run and the backward-run solution of the trajectory. The Kalman filter was processed in both directions to remove the combined directional anomalies. In general, when these two solutions match closely, an optimally accurate and reliable solution is achieved.

The data for this task order was processed with a goal to maintain a combined separation difference of less than ten (10) centimeters.

#### **Estimated Positional Accuracy**

Estimated positional accuracy plots the standard deviations of the east, north, and vertical directions along a time scale of the trajectory. It illustrates loss of satellite lock issues, as well as issues arising from long baselines, noise, and/or other atmospheric interference.

#### PDOP

The PDOP measures the precision of the GPS solution in regard to the geometry of the satellites acquired

and used for the solution.

The data for this task order was processed with a goal to maintain an average PDOP value below 3.0. Brief periods of PDOP over 3.0 are acceptable due to the calibration and control process if other metrics are within specification.

#### **Geometric Calibration**

After the initial phase was complete, a formal reduction process was performed on the data. Laser point position was calculated by associating the SBET position to each laser point return time, scan angle, intensity, etc. Raw laser point cloud data was created for the whole project area in LAS format. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift. Statistical reports were generated for comparison and used to make the necessary adjustments to remove any residual systematic error.

Software: Proprietary Software, TerraMatch v20, Leica CloudPro 1.2.4

### Lidar Data Classification

LAS data was classified as ground and non-ground points with additional filters created to meet the task order classification specifications. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Based on the statistical analysis, the lidar data was then adjusted to reduce the vertical bias when compared to the survey ground control of higher accuracy.

Calibrated LAS files were imported into the task order tiles and initially filtered to create a ground and non-ground class. Then additional classes were filtered as necessary to meet the following client-specified classes:

- Class 1 Default / Processed, but not Classified
- Class 2 Bare Earth Ground
- Class 6 Buildings
- Class 7 Low Noise
- Class 9 Water
- Class 17 Bridge Decks
- Class 18 High Noise
- Class 20 Ignored Water

Classified LAS files were evaluated through a series of manual QA/QC steps as well as a peer-based review to eliminate remaining artifacts from the ground class. This included a review of the DEM surface to remove artifacts and ensure topographic quality.

**Software:** Proprietary Software, TerraScan v20

### Hydrologic Flattening

The lidar task order required compilation of breaklines defining the following types of water body features:

Lakes, reservoirs, ponds	Minimum of 2-acres or greater
	Compiled as closed polygons, collected at a constant elevation
Rivers, streams	Nominal width of 30.5 meters / 100 feet
	Compiled in direction of flow, with both sides maintaining an equal elevation gradient
Bridge breaklines	Breaklines used to enforce a logical terrain surface below a bridge

Woolpert utilized the following steps to hydrologically flatten the water bodies and for gradient hydrologic flattening of the double line streams within the existing lidar data:

- 1. The newly acquired lidar data was utilized to manually compile the hydrologic features in a 2D environment using the lidar intensity and bare earth surface. Open Source imagery was used as reference when necessary.
- 2. An integrated software approach was applied to combine the lidar data and 2D breaklines. This process "drapes" the 2D breaklines onto the 3D lidar surface model to assign an elevation. A monotonic process is performed to ensure the streams are consistently flowing in a gradient manner. A secondary step within the program verifies an equally matching elevation of both stream edges. The breaklines that characterize the closed water bodies are draped onto the 3D lidar surface and assigned a constant elevation at or just below ground elevation.
- 3. All classified ground points from inside the hydrologic feature polygons were reclassified to water, class nine (9).
- 4. All classified ground points were reclassified from within a buffer along the hydrologic feature breaklines to buffered ground, class twenty (20). The buffer distance was approximately the task order designed nominal pulse spacing distance.
- 5. Breaklines used for bridge removal during the hydrologic flattening were included with the hydrologic breakline geodatabase deliverable. The purpose of these breaklines is for a more aesthetically pleasing DEM appearance.
- 6. The lidar ground points and breaklines were used to generate a digital elevation model (DEM).
- 7. QA/QC for this task was performed by reviewing the hydrologically flattened DEM and hydrologic breakline features. Additionally, a combined approach utilizing commercial off the shelf software and proprietary methods were used to review the overall connectivity of the hydrologic breaklines.

TerraScan was used to add the hydrologic breakline vertices and export the lattice models.

Breaklines defining the water bodies greater than 2-acres were provided as a PolygonZ feature class. Rivers and streams with a nominal minimum width of 30.5 meters (100 feet) were provided as a PolylineZ feature class. All lake and river breaklines compiled as part of the flattening process were provided in an Esri file geodatabase. Breaklines used for DEM generation were provided as PointA features in Esri shapefile format.

Software: TerraScan v18, TerraModeler v18, Esri ArcMap v10.4, LP360 v2018.1.57.4

#### **Digital Elevation Model**

TerraScan was used to add the hydrologic breakline vertices and export the lattice models. Class 2 (ground) lidar points in conjunction with the hydro breaklines and bridge breaklines were used to create 2.5-foot hydro-flattened bare-earth raster DEM files. Using automated scripting routines within ArcMap, an 32-bit floating point raster ERDAS .img file was created for each tile. Files were produced to the full tile extents. Each surface is reviewed using Global Mapper to check for any surface anomalies or incorrect elevations found within the surface.

Software: TerraScan v20

#### Flooding and Low Confidence Polygons

Due to historic rainfall periods in the western portion of Tennessee from 2018 through 2020, lidar data acquisition for the TN West Tennessee Lidar B19 – 140G0219F0060 project required repeated attempts to complete across three acquisition seasons, beginning in 2019 and concluding in 2021. While the vast majority of the project AOI was unaffected by flooding, several small areas throughout Block 3 required patch flights to maximize the ground surface available for the digital elevation model.

The first acquisition occurred February 2019 through April 5, 2019 and concluded upon leaf-on conditions. During this season it was determined several areas had excessive flooding and were deemed inappropriate for data acquisition. An example of excessive flooding occurring during this flight season can be seen in image 3.1.

Image 3-1 Flooding Conditions in April 2019



The second acquisition resumed in December 2019 and continued through February 2020, concluding in March 2020 upon leaf-on conditions. During this season it was determined several areas had excessive flooding and were deemed inappropriate for data acquisition. An example of excessive flooding occurring during this flight season can be seen in image 3.2.

#### Image 3-2 Flooding Conditions in March 2020



Acquisition resumed in December 2020 and was completed in January 2021.

Due to the level of flooding present across the three acquisition attempts Woolpert worked to balance the requirements to collect as much data as possible each year for a temporally consistent dataset while avoiding flooded areas. Despite these best efforts, during data production some areas were still affected by ponding and saturation. Low confidence polygons outlining the extent of these areas have been generated and are included as part of this delivery. Within these delineated areas, ground density is sparse and in some cases low vegetation and water may be misclassified as ground. Bare earth DEMs in these areas are likely to have significantly degraded accuracy and reliability. An Example of this flooding is shown in Figure 3.1. The sizes of the areas are shown in Table 3.1 and their distribution throughout the blocks is shown in Figure 3.2.

#### Figure 3-1 Flooding AOI 7



#### Table 3-1 Low Confidence Polygon Area

NAME	Square Miles
Flooding_AOI_1	0.07
Flooding_AOI_2	0.24
Flooding_AOI_3	0.87
Flooding_AOI_4	0.24
Flooding_AOI_5	3.66
Flooding_AOI_6	5.03
Flooding_AOI_7	0.69
Flooding_AOI_8	1.20
Flooding_AOI_9	1.67
Flooding_AOI_10	3.12
Flooding_AOI_11	1.23

#### Figure 3-2 Low Confidence Polygon Locations



#### Intensity Imagery

Lidar intensity data derived from the acquired lidar data was linearly rescaled from 16-bit intensity and provided as 2.5-foot pixel, 8-bit, 256 gray scale GeoTIFF format intensity imagery files. Files were produced to the full tile extents.

Software: TerraScan v20

#### **Building Footprints**

Automated feature extraction was performed using proprietary Woolpert software. The raw lidar and bare earth model datasets were processed to extract and attribute building and vegetation features. Automated extraction was followed by detailed Q/C to verify completeness and accuracy of extraction. Final Q/C'ed features were attributed with geometrically derived attributes based on feature extents, reflective surface DEM and bare earth DEM. Extracted and attributed features were reviewed for completeness and consistency. Projection information and metadata were added to final vector data files.

Software: Proprietary Software, Esri ArcMap v10.7

#### Metadata

FGDC CSDGM/USGS MetaParser-compliant metadata was produced in XML format. The metadata includes a complete description of the task order client information, contractor information, project purpose, lidar acquisition and ground survey collection parameters, lidar acquisition and ground survey collection dates, spatial reference system information, data processing including acquisition quality assurance procedures, GPS and base station processing, geometric calibration, lidar classification, hydrologic flattening, intensity imagery development, and final product development.

Other metadata deliverables included Esri shapefiles of the ground control and QA/QC points and delivery tile index. A georeferenced, polygonal representation of the detailed extents of each acquired lidar swath was produced as a Polygon feature class in an Esri file geodatabase.

# 4. Accuracy Statement

### Horizontal Accuracy

The data sets was produced to meet ASPRS "Positional Accuracy Standards for Digital Geospatial Data" (2014) for a 18.6 cm RMSEx / RMSEy Horizontal Accuracy Class which equates to Positional Horizontal Accuracy = +/- 45.4 cm at a 95% confidence level.

#### **Raw Lidar Swath Testing**

This project required the lidar point cloud swath to be produced to meet a Non-Vegetated Vertical Accuracy (NVA) value of 19.6 cm at a 95% confidence level using an RMSEz target value of 10 cm x 1.9600.

## **Digital Elevation Model Testing**

This project required DEM data to be produced to meet a Non-Vegetated Vertical Accuracy (NVA) value of 19.6 cm at a 95% confidence level using an RMSEz target value of 10 cm x 1.9600 and a Vegetated Vertical Accuracy (VVA) value of 0.294 cm at the 95th percentile error.

# Appendix 1: Flight Logs

				L	idar	' Ac	qui	isiti	on Lo	bg							
				Project	Info								D	ate			
Project#			Projec	t Name				U	nique ID		Fligh	t Date	(UTC)	Day o	f Year	Flight#	
79576			Wool per	t TN West			Day39_SHSN7178					2/08/20	)19	3	9	_	
Cr	'ew		1	Eau	ipment						Time				Ai	rports	
Pi	ilot		Aircrat	t Make/Mo	hel	Δir	Aircraft Tail # Hobb			s Start		lStart	UTC S	tart	Departing		
	aka		Anoru				85DE		11055		2000	lotart	0100	-turt		parting	
	anc		Comos	· Maka/Mad			0.01 E		llahk	o Fred		l End		- n d	•	which a second	
Ope	rator		Senso		lei	Sen	sor Se	erial #	HOD	os Ena						rriving	
Ot	ther		A	ALS70 HP			SN/17	8									
M/ind Dir						C	Condit	tions									
	<b>C</b> ,	Wind	Speed (kts)	Visibility	y (mi)	Ceiliı	ng (ft)	CI	oud Cover	r Tem	p. (°C)	Dev	v Point (	(°C)	Press	sure ("Hg)	
Air Spe	ed (kts)	)	Altitude	AGL (ft)	A	ltitude	MSL	(ft)	Airfield	d Elevatio	on (ft)						
1	30					6,5	500										
							Settin	ngs	-			_					
Point Spaci	ng (m)	Poir	nt Density (pp	osm) S	can Ang	le/FOV	/ (°)	Sca	an Freque	ncy (Hz)	Puls	e Rate	(kHz)	Las	ser Po	wer (%)	
					4	0											
										V	erifv S-	Turns	Before I	Nissio	on	Ives	
		_	Start Time	End Time	Ti	me					, , , , , , , , , , , , , , , , , , ,					1,63	
Line#	Direct	tion	(UTC)	(UTC)	On-	Line	Sat	ellite	PDOF			Line N	lotes/Co	omme	ents		
243			19:39:00	19:43:00	00:0	4:00											
242			19:46:00	19:51:00	00:0	5:00											
241			19:54:00	19:58:00	00:0	4:00											
240			20:01:00	20:05:00	00:0	4:00											
239			20:08:00	20:12:00	00:0	4:00											
238			20:15:00	20:20:00	00:0	5:00											
237			20:23:00	20:27:00	00:0	4:00											
236			20:30:00	20:34:00	00:0	4:00											
235			20:37:00	20:41:00	00:0	4:00											
234			20:43:00	20:48:00	00:0	5:00											
233			20:51:00	20:54:00	00:0	3:00											
232			20:58:00	21:03:00	00:0	5:00											
231			21:05:00	21:08:00	00:0	3:00				_							
230			21:11:00	21:14:00	00:0	03:00 14:00											
229			21:18:00	21:22:00	00:0	4:00											
220			21.23.00	21.29:00	00:0	4.00											
227			21.32.00	21.30.00	00.0	5.00											
225			21:48:00	21:52:00	00.0	4:00											
223			21:56:00	22:01:00	00:0	5:00											
223			22:03:00	22:08:00	00:0	5:00											
222			22:11:00	22:17:00	00:0	6:00											
					1												
							Page	ə 1		\	/erify S	-Turns	After M	lissio	n	Ives	
Additional C	ommen	ts								Dr	ive#						

				L	idar A	Acqui	siti	on Lo	g					
				Project	Info							Dat	te	
Project#			Projec	t Name		_	U	nique ID		Fligh	t Date	(UTC) Da	y of Yea	Flight#
								-		02	2/09/20	)19	40	-
Cr	'ew			Eaui	ipment					Time			A	irports
Pi	ilot		Aircraf	t Make/Mod	lel	Aircraft Tail # Hob			Start	Loca	l Start	UTC Sta	rt D	eparting
BI	ako					8SPE	un <i>n</i>				- Otari			
One			Sanaa	Maka/Mad			riol #	Habba	End	1.000	J End		d (	rriving
Ope	rator		Senso			Sensor Se		HODDS	Епа	LOCa		UIC EN	u 4	Arriving
Ot	ner		A	LS/0 HP		SN/1/	8							
Wind Dir	<b>1</b> 0					Condit	ions		1 -		-			
	<b>(</b> ,	Wind	Speed (kts)	Visibility	/ (mi) C	eiling (ft)	CI	oud Cover	Tem	p. (°C)	Dev	v Point (°C	;) Pres	sure ("Hg)
Air Spe	ed (kts)	)	Altitude	AGL (ft)	Altit	ude MSL	(ft)	Airfield	Elevatio	n (ft)				
1	30					6,500								
					-	Settir	igs	_			_			
Point Spacing	ng (m)	Poir	nt Density (pp	osm) So	can Angle/	FOV (°)	Sca	an Frequenc	y (Hz)	Puls	e Rate	(kHz)	Laser Po	ower (%)
					40									
									Ve	erify S-	Turns	Before Mi	ssion	Ives
			Start Time	End Time	Time					-				
Line#	Direc	tion	(UTC)	(UTC)	On-Lin	e Sat	ellite	PDOP			Line N	lotes/Con	nments	
208			17:34:00	17:45:00	00:11:0	00								
209			17:17:00	17:31:00	00:14:0	00								
210			17:03:00	17:14:00	00:11:0	00								
211			16:48:00	16:59:00	00:11:0	00								
212			16:32:00	16:43:00	00:11:0	00								
213			16:22:00	16:29:00	00:07:0	00								
214			16:13:00	16:19:00	00:06:0	00								
215			16:03:00	16:10:00	00:07:0	00								
216			15:54:00	16:00:00	00:06:0	00								
217			15:44:00	15:51:00	00:07:0	00			_					
218			15:33:00	15:41:00	00:08:0	0								
219			15:24:00	15:21:00	00:00:0	0			-					
220			15:07:00	15.12.00	00:00:0	0								
221			15.07.00	13.12.00	00.05.0	,0			-					
									+					
									_					
						_								
						Bacc	1		1	orify S	Turne	Aftor Mia	sion	Ivec
Additional C	ommor	ite				raye				enny S	- i ui lis	AILEI WIS	31011	1105
Auditional C	Sumen	1.3								v Cff				

Lidar Acquisition Log															
				Project I	nfo							D	ate		
Project#			Projec	t Name			U	nique ID		Fligh	t Date	(UTC)	Day o	f Year	Flight#
79576			Wool pert	TN West			Day4	4 SHSN717	78	02/13/2019			4	4	
Cr	'ew			Equip	oment		-	_		Time				Ai	rports
Pi	ilot	-	Aircraf	t Make/Mod	el Ai	Aircraft Tail # Hobbs			Start	Loca	l Start	UTC S	start	De	parting
Bl	ake					85PE						13.1	7		
One	rator		Sonso	Mako/Mode	J Sol	Sor So	rial #	Hobbs	End		l End		- nd	Δ	rivina
	han		Jenson			SN717	0	110003	Liiu						Inving
01	ner		A	LS/0 HP		SIN / 1 /	0					10:3	50		
Wind Dir	• ( •					Condit	lons						(1-)		<i></i>
wind Di	<b>(</b> ,	Wind	Speed (kts)	Visibility	(mi) Ceil	ing (ft)	CI	oud Cover	Tem	p. (°C)	Dev	v Point (	(°C)	Press	sure ("Hg)
Air Spe	ed (kts)		Altitude	AGL (ft)	Altitud	e MSL	(ft)	Airfield	Elevatio	n (ft)					
1	30				5,	000									
		-			-	Settir	ngs	-			_				
Point Spaci	ng (m)	Poir	nt Density (pp	sm) Sc	an Angle/FO	<b>V</b> (°)	Sca	an Frequenc	y (Hz)	Puls	e Rate	(kHz)	Las	ser Po	wer (%)
					40										
									Ve	erify S-	Turns	Before I	Missio	on	lves
		_	Start Time	End Time	Time						laine	2010101			1703
Line#	Direct	ion	(UTC)	(UTC)	On-Line	Sat	ellite	PDOP			Line N	lotes/Co	omme	ents	
207			19.33.00	19:45:00	00.12.00				-						
207			19:48:00	20.02.00	00.12.00										
200			20:04:00	20:18:00	00:14:00				-						
203			20:21:00	20:36:00	00:15:00										
203			20:38:00	20:52:00	00:14:00										
202			20:56:00	21:11:00	00:15:00										
201			21:14:00	21:29:00	00:15:00										
200			21:32:00	21:47:00	00:15:00										
199			21:52:00	22:10:00	00:18:00										
									_						
									-						
						<u> </u>									
						Page	1		V	erify S	-Turns	After M	lissio	n	lves
Additional C	ommen	ts							Dri	ve#					
									-						

Woolpert Lidar Acquisition Log													
			Project	Info						Da	ate		
Project#		Projec	t Name			U	nique ID	Flig	jht Date	(UTC) D	ay of	Year	Flight#
79576		West TN S	outh Block			Day3	41_90511_A		12/07/2019 341				A
Cr	.ew		Equi	pment		-		Tim	Time Airpor				
Pi	ilot	A	ircraft Make	/ Model / Tai	il #		Hobbs S	tart Lo	UTC St	tart	De	parting	
N	ico		Cessna 404 Ti	tan - N532NN	1		440.7	14	:51:00	20:51:	:00		NOA
Ope	rator	Se	ensor Make/	Model / Seria	al #		Hobbs E	nd Lo	cal End	UTC E	nd	A	rivina
Ry	van	I	eica Terrain	Mapper - 905	11		444 3	12	.37.00	23.37.	00		NOA
n,	Juli	-		() (	Conditi	ions	111.5	1,		25.57	00		
Wind Dir	(°. Wind	Sneed (kts)	Visibility	(mi) Ceili	ng (ft)	CI	oud Cover	Temp. (°C	) Dev	v Point (	°C)	Press	ure ("Ha)
310	310 5 7						Clear	12	, 20.	6	-, .		3026
Air Spc	od (kts)			Altitude		ft)		evation (ft)		0			/020
	50	Ailitude			270	ity			-				
1	30	0,2	200	0,	Sottin	20		19		_	-	-	
Daint Crack		nt Donaitu (nu				iys Sec		(II=) D.	las Dete	(1-11-)	1.000		(0/)
	Spacing (m) Point Density (ppsm) Scan Angle/FOV (*) Scan Freque						an Frequency	(HZ) Pu		(KHZ)	Lase		Ner (%)
0.7				40			90		600			10(	J
					1			Verify	S-Turns	Before N	lissior	ן ו	lves
Line#	Direction	Start Time	End Time	Time	Sate	ellite	PDOP		Line N	Notes/Co	mmer	nts	
		(UIC)	(UIC)	On-Line			1.0						
80	S	20:51:00	21:03:00	00:12:00	2	20	1.2						
79	N	21:06:00	21:18:00	00:12:00	4	20	1.2						
78	S N	21.21.00	21.33.00	00.12.00	20		1.2						
76	S	21:50:00	22:03:00	00:12:00	1	8	1.7						
75	N	22:06:00	22:19:00	00:13:00	2	20	1.1						
74	S	22:22:00	22:33:00	00:11:00	2	22	1.1						
73	N	22:38:00	22:51:00	00:13:00	2	21	1.2						
72	S	22:53:00	23:06:00	00:13:00	2	22	1.3						
71	N	23:08:00	23:21:00	00:13:00	2	24	1.2						
70	S	23:24:00	23:37:00	00:13:00	2	24	1.3						
					Page	1		Verifv	S-Turns	After Mi	ission	1	[ves
Additional C	omments				-			· · · · · ·					

			Woolp	oert Lid	ar Ao	q	uisitior	l Log						
			Project	Info						[	Date			
Project#		Projec	t Name			U	nique ID	Flig	ght Date	(UTC)	Day o	f Year	Flight#	
79576		West TN N	North Block		Γ	Day3	45_90511_A		12/11/2019				A	
Cr	'ew		Equ	ipment				Tim	e			A	irports	
Pi	ilot	A	ircraft Mak	e/ Model / Ta	Model / Tail # Hobbs St			tart Lo	cal Start	UTC	Start	De	parting	
N	ico	_	Cessna 404 ]	Titan - N532NN	n - N532NM 444.2			1	:33:00	17:3	3:00	$\frac{1}{100}$ NOA		
One	rator	Se	nsor Make	Model / Seria	al #		Hobbs F	nd Lo	cal Fnd	UTC	End	Δ	rrivina	
R	van		eica Terrair	Mapper - 905	11		451.3	11	7·14·00	23.1	4.00	-	NOA	
, Kj	yull	<u> </u>		i Mapper - 905	Condition	16	451.5	1	.14.00	25.1	1.00		110/1	
Wind Dir	'(°. Wir	nd Sneed (kts)	Visibilit	v (mi) Ceili	ng (ft)		oud Cover	Temp (°C		w Point	ന്ദാ	Pres	sure ("Ha)	
210	• • • • • •		10	y (iiii) Ceiii	iig (ii)		Clear	5 S	,	-4	(0)	1103	2050	
210 Air Spa	ad (kto)							yation (ft)					3039	
		Altitude		Aillude	270		Airlieiu Ei		-					
1	50	8,2	200	8,	379		3	19		-	-	-		
	<u> </u>				Settings	•		<u></u>		<i></i>			(0.1)	
Point Spacin	ng (m) Po	oint Density (pp	osm) S	can Angle/FO	<b>V</b> (°)	Sca	an Frequency	(Hz) Pu	Ise Rate	e (kHz)	Las	ser Po	wer (%)	
0.7				40			90		600			10	0	
	_	_						Verify	S-Turns	Before	Missi	on	Ives	
Line#	Direction	Start Time	End Time	Time	Satelli	ite	PDOP		Line	Notes/C	omm	ents		
		(UTC)	(UTC)	On-Line							•			
89	N	17:33:00	17:37:00	00:04:00	20		1.4							
88	S	17:40:00	17:50:00	00:10:00	21		1.1							
87	N	17:53:00	18:03:00	00:10:00	24		1							
86	S	18:06:00	18:16:00	00:10:00	22		1.1							
85	N S	18:19:00	18:29:00	00:10:00	20	_	1.2							
83	N N	18:31:00	18:54:00	00:10:00	19		1.3							
82	S	18:57:00	19:06:00	00:09:00	22	_	1.2							
81	N	19:10:00	19:20:00	00:10:00	21	_	1.2							
80	S	19:23:00	19:33:00	00:10:00	19		1.2							
79	N	19:35:00	19:45:00	00:10:00	16		1.4							
78	S	19:48:00	19:59:00	00:11:00	18		1.2							
77	N	20:02:00	20:13:00	00:11:00	18		1.2							
76	S	20:15:00	20:28:00	00:13:00	19		1.1							
75	N	20:31:00	20:45:00	00:14:00	19		1.1							
74	S	20:48:00	21:01:00	00:13:00	18		1.2							
73	N S	21:04:00	21:18:00	00:14:00	18		1.2							
72	S N	21:27:00	21.34.00	00:13:00	15	_	1.0							
70	S	21:53:00	22:06:00	00:13:00	10	_	1.2							
69	N	22:09:00	22:23:00	00:14:00	19	_	1.1							
68	S	22:26:00	22:39:00	00:13:00	19		1.2							
67	N	22:42:00	22:58:00	00:16:00	19		1.3							
66	S	23:00:00	23:14:00	00:14:00	22		1.2							
					Page 1			Verify	S-Turns	s After I	Missio	n	Ives	
Additional C	omments													

			Woolp	ert Lic	lar <i>I</i>	Acq	uisitior	n Log					
			Project	Info						D	ate		
Project#		Projec	t Name			U	nique ID	Flig	ght Date	(UTC)	Day of	Year	Flight#
79576		West TN S	outh Block			Day	357_90513_1		12/23/20	019	35	7	1
Cr	ew		Equi	pment				Tim	ne	ł		Α	irports
Pi	ilot	A	ircraft Make	/ Model / T	ail #		Hobbs S	tart Lo	Local Start UTC		tart	De	parting
La R	ocque		Cessna 404 T	itan - N7079	an - N7079F			2 11	:49:00	17:49	:00		MKL
Ope	rator	Se	ensor Make/	Model / Sei	ial #		Hobbs E	nd Lo	Local End UTC End				
Ken	nedy	Ι	Leica Terrain	Mapper - 90	513		2478.3	3 15	5:56:00	21:56	:00		MKL
		•			Condi	tions	•			•			
Wind Dir	ີ (ື, Winc	I Speed (kts)	Visibility	(mi) Cei	ling (ft)	CI	oud Cover	Temp. (°C	) Dev	v Point (	°C)	Pres	sure ("Hg)
40		7	10				Clear	16		8		,	30.06
Air Spe	ed (kts)	Altitude	AGL (ft)	Altitud	de MSL	(ft)	Airfield El	evation (ft)					
1	50	8,2	200	8	3,397		4	34					
				<u>.</u>	Setti	ngs							
Point Spaci	ng (m) Poi	nt Density (pp	osm) Sc	an Angle/FC	<b>) V</b> (°)	Sca	an Frequency	(Hz) Pu	Ise Rate	(kHz)	Las	er Po	wer (%)
0.7				40			90		600			10	0
								Verify	S-Turns	Before M	Aissio	n	Ives
1.1	Direct	Start Time	End Time	Time		- 11°4	<b>DDC</b> 2			1		- 4 -	
Line#	Direction	(UTC)	(UTC)	On-Line	Sat	tellite	PDOP		Line	Notes/Co	omme	nts	
81	N	18:07:00	18:20:00	00:13:00		19	1.2						
82	S	18:23:00	18:35:00	00:12:00		20	1.1						
83	N	18:38:00	18:51:00	00:13:00		19	1.1						
84	S	18:54:00	19:06:00	00:12:00		18	1.2						
85	N	19:09:00	19:22:00	00:13:00		18	1.4						
80 87	S N	19:23:00	19:37:00	00:12:00		20	1.4						
88	S	19:56:00	20:09:00	00:13:00	+	19	1.1						
89	N	20:11:00	20:24:00	00:13:00	+	18	1.2						
90	S	20:27:00	20:39:00	00:12:00		16	1.6						
91	N	20:42:00	20:55:00	00:13:00		16	1.7						
92	S	20:58:00	21:11:00	00:13:00		18	1.3						
93	N	21:14:00	21:27:00	00:13:00		18	1.2						
94	5	21:30:00	21:42:00	00:12:00		20	1.1						
					+								
					+								
					+								
					+								
					+								
					Page	e 1		Verify	S-Turns	s After M	issior	)	Ives
Additional C	omments												

			Woolp	ert Lid	ar A	٩cd	uisitior	ı Loç	3				
			Project	Info						Da	ite		
Project#		Projec	t Name			U	nique ID	F	light Date	(UTC) D	ay of Y	ear F	light#
79576		West TN S	South Block			Day	358_90513_1		12/24/20	)19	358		1
Cr	ew		Equi	pment				Ti	me			Airpo	orts
Pi	ilot	A	ircraft Make	/ Model / Ta	il #		Hobbs St	tart L	ocal Start	UTC St	art	Depa	rting
La R	ocque		Cessna 404 T	itan - N7079I	7		2478.7	7	10:00:00	16:00:	00	MK	L
Оре	rator	Se	ensor Make/	Model / Seria	al #		Hobbs E	nd I	Local End	UTC EI	nd	Arriv	ing
Ken	nedy	I	Leica Terrain	Mapper - 905	13		2482.7	7	14:15:00	20:15:	00	MK	J.
	-				Condit	ions					_		
Wind Dir	່ (°, Wind	d Speed (kts)	Visibility	(mi) Ceili	ing (ft)	CI	oud Cover	Temp. (	(°C) Dev	v Point (°	C)   P	ressur	e ("Hg)
0		0	10				Clear	9		6		30.	12
Air Spe	ed (kts)	Altitude	AGL (ft)	Altitude	e MSL (	(ft)	Airfield El	evation (	ft)				
1	50	8,2	200	8,	397		4	34	- -				
				· · · · ·	Settir	gs					_	_	-
Point Spaci	ng (m) Poi	nt Density (pr	osm) Sc	an Angle/FO	<b>V</b> (°)	Sca	an Frequency	(Hz) F	Pulse Rate	(kHz)	Laser	Power	r (%)
0.7		2		40	( )		90	. ,	600	. ,		100	
								Verif	v S-Turns	Before M	ission	Ive	c.
		Start Time	End Time	Time					, • • • • • • •	_0.010 10		100	2
Line#	Direction	(UTC)	(UTC)	On-Line	Sat	ellite	PDOP		Line	Notes/Co	mment	S	
95	N	16:19:00	16:33:00	00:14:00		21	1.2						
96	S	16:35:00	16:49:00	00:14:00	2	21	1.1						
97	N	16:52:00	17:07:00	00:15:00	2	21	1						
98	S	17:10:00	17:25:00	00:15:00	1	9	1.1						
99	N	17:29:00	17:46:00	00:17:00	1	8	1.2						
100	S	17:49:00	18:06:00	00:17:00		20	1.2						
101	N	18:08:00	18:25:00	00:17:00		21	1.1						
102	N N	18:48:00	19:05:00	00.17.00		6	1.1						
103	S	19:07:00	19:24:00	00:17:00		6	1.5						
105	N	19:27:00	19:44:00	00:17:00	1	7	1.4						
106	S	19:46:00	20:06:00	00:20:00	1	7	1.3						
			ļ		<u> </u>								
	1		1	1	Page	1	1	Veri	fv S-Turne	SAfter Mi	ssion	Ivo	·s
Additional C	omments								.,			110	3

			Woolp	ert Lida	ar Ac	;qı	uisitior	n Log					
			Project I	nfo						D	ate		
Project#		Projec	t Name			U	nique ID	FI	ight Date	(UTC)	Day of	Year	Flight#
79576		West TN S	South Block		D	ay3	64_90513_1		12/30/20	019	364	1	1
Cr	ew		Equip	oment				Tir	ne			Ai	rports
Pi	lot	A	ircraft Make	/ Model / Tai	l #		Hobbs S	tart Lo	ocal Start	UTC S	tart	De	parting
LaRo	ocque		Cessna 404 T	Titan - N7079F	:		2487.3	3 1	3:01:00	19:01	:00		MKL
Оре	rator	Se	nsor Make/	Model / Seria	al #		Hobbs E	nd L	ocal End	UTC E	nd	Α	riving
Ken	nedy	L	eica Terrain N	Mapper - 9051	13		2488.9	9 1	4:34:00	20:34	:00		MKL
				C	Condition	IS							
Wind Dir	ີ (°, Wind	l Speed (kts)	Visibility	(mi) Ceili	ng (ft)	Clo	oud Cover	Temp. (°	C) Dev	v Point (	(°C)	Press	ure ("Hg)
240		16	10				Clear	9		2			29.9
Air Spe	ed (kts)	Altitude	AGL (ft)	Altitude	MSL (ft)		Airfield El	evation (f	:)				
1:	50	8,2	200	8,5	397		4	34					
				-	Settings	5							
Point Spacin	ng (m) Poi	nt Density (pp	osm) Sc	an Angle/FO∖	/ (°)	Sca	in Frequency	(Hz) <b>P</b>	ulse Rate	(kHz)	Lase	er Po	<i>N</i> er (%)
0.7				40			90		600			100	)
								Verify	S-Turns	Before I	Missior	ן ו	ves
Line#	Direction	Start Time (UTC)	End Time (UTC)	Time On-Line	Satelli	te	PDOP		Line	Notes/Co	ommer	nts	
107	N	19:20:00	19:37:00	00:17:00	17		1.3						
108	S	19:40:00	19:52:00	00:12:00	18	_	1.2						
69	N	20:08:00	20:21:00	00:13:00	15		1.6	freau	ent cloud	ls/floodi	na on t	he ai	round
						_							
						_							
						_							
						_							
					Page 1			Verif	y S-Turns	After M	lission		ves
Additional C	omments												

			Woolp	ert I	Lida	ar A	Acd	uisitio	n Lo	bg					
			Project	Info								0	)ate		
Project#		Projec	t Name				U	Inique ID		Fligh	t Date	(UTC)	Day o	f Year	Flight#
79576		West TN N	North Block				Day3	365 90513 1		12	/31/20	)19	30	55	1
Cr	rew		Equi	pment			-			Time				Ai	rports
Pi	ilot	A	ircraft Make	/ Mode	l / Tai	#		Hobbs S	Start	Loca	l Start	UTCS	Start	De	parting
LaR	ocque		Cessna 404 T	itan - N	7079F			2488	9	09.0	4.00	15.04	1.00		MKL
One	rator	Se	nsor Make/		Soria	nl #		Hobbs	End		I End		End	Δ	rriving
Ken	medu		aica Terrain	Manner	0051	3		2/01	6	11.4	8.00	17.49	2.00		MKI
Kell	incuy			Mapper	- 9031	Sondit	lana	2491	.0	11.4	10.00	1/.40	5.00		WIKL
Wind Dir	(°			(		onalt	ions	10	Tam		Dev	Daint	(°O)	Duese	(111.1.1.1)
	V, Wind	Speed (kts)	Visibility	(mi)	Cellir	ng (ft)	CI	oud Cover	Tem	p. (°C)	Dev	V Point	(°C)	Press	sure ("Hg)
280		16	10					Clear		4		-3			30.1
Air Spe	eed (kts)	Altitude	AGL (ft)	AI	titude	MSL (	(ft)	Airfield E	levatio	n (ft)					
1	50	8,2	200		8,3	397		4	434						
		_		_		Settin	ngs	_							
Point Spaci	ng (m) Poi	nt Density (pp	osm) So	an Ang	le/FOV	/ (°)	Sca	an Frequency	/ (Hz)	Puls	e Rate	(kHz)	Las	ser Po	wer (%)
0.7				4	0			90			600			10	0
									Ve	erifv S-	Turns	Before	Missio	on	Ives
Line#	Direction	Start Time	End Time	Tin On-l	ne ine	Sat	ellite	PDOP		<b>, , , ,</b>	Line N	lotes/C	omme	ents	1105
65	N	15.19.00	15.34.00	00.1	5.00	1	7	15	1	nodera	te floo	ding or	grou	nd all	lines
64	S	15:37:00	15:51:00	00:14	4:00		21	1.1		noueru		ung on	grou	iia, aii	
63	N	15:54:00	16:08:00	00:14	4:00	1	18	1.3	+						
62	S	16:21:00	16:25:00	00:04	4:00	2	20	1							
61	N	16:28:00	16:43:00	00:1	5:00		20	1	1						
60	S	16:46:00	17:00:00	00:14	4:00	2	21	1							
59	N	17:03:00	17:17:00	00:14	4:00	1	8	1.3							
58	S	17:20:00	17:34:00	00:14	4:00	1	8	1.2							
				ļ											
	C C														
	5														
								i							
									1						
						Page	1		V	erify S	-Turns	After N	lissio	n	Ives
Additional C	comments														

			Woolp	ert Lid	ar Ac	;q	uisitior	n Log					
			Project	Info						Da	ate		
Project#		Projec	t Name			U	nique ID	Flig	ht Date	(UTC) D	ay of	Year	Flight#
79576		West TN N	North Block		Г	ay0	33 90513 1		)2/02/20	020	033	3	1
Cr	ew		Equi	pment				Tin	e			Ai	rports
Pi	lot	Α	ircraft Make	/ Model / Tai	il #	_	Hobbs S	tart Lo	cal Start	UTC St	art	De	parting
Sw	vain		Cessna 404 Ti	tan - N532NN	1		460.7	00	2:46:00	15:46:	00	-	MKL
Ope	rator	Se	nsor Make/	Model / Seria	- al #		Hobbs F	nd Lo	cal End		nd	Δ	rrivina
Ken	nedv	I	eica Terrain	Manner - 905	13		465.7		.47.00	20.47.	00		MKI
Ren	neuy				Condition		-105.7	I -		20.47.	00		
Wind Dir	(° Winc	Spood (kts)	Vieibility	(mi) Coili	ng (ft)			Tomp (°C		v Point (°		Droce	ure ("Ha)
220	VVIIIC	12	10				Clear	12	,	1	<u>, , , , , , , , , , , , , , , , , , , </u>	1033	
220 Air Spa	ad (ktc)			Altitude				<sup>12</sup>		1		2	.9.98
Air Spe		Ailitude			207	_	Airlieiu Ei		-				
1.	50	8,2	200	8,	397 <b>O</b> attin na		4.	34		_	_		
Deliat Oraci					Settings	0		(11-)		(111)			(0/)
Point Spacin	ng (m) Poi	nt Density (pp	osm) So	an Angle/FO	<b>V</b> (°)	Sca	in Frequency	(Hz) Pu	Ise Rate	(KHZ)	Lase	er Pov	<i>ver</i> (%)
0.7		_		40		_	90		600			100	)
								Verify	S-Turns	Before M	issior	<u>ו</u>	lves
Line#	Direction	Start Time	End Time	Time	Satelli	te	PDOP		Line I	Notes/Co	mmer	nts	
		(UTC)	(UTC)	On-Line									
57	N	16:01:00	16:16:00	00:15:00	16		1.3						
56	S	16:19:00	16:34:00	00:15:00	17		1.2						
55	N	16:37:00	16:51:00	00:14:00	19		1.2						
53	S N	16:54:00	17:09:00	00:15:00	19		1.3						
52	N S	17:11:00	17:20:00	00.15.00	21	_	1.1						
51	N	17:46:00	18:00:00	00:13:00	18	_	1.2						
50	S	18:03:00	18:18:00	00:15:00	21	_	1.2						
49	N	18:20:00	18:34:00	00:14:00	21		1.2						
48	S	18:37:00	18:51:00	00:14:00	21		1.2						
47	N	18:54:00	19:08:00	00:14:00	20		1.4						
46	S	19:11:00	19:26:00	00:15:00	23		1.1						
45	N	19:28:00	19:42:00	00:14:00	23		1.2						
44	S N	19:45:00	20:00:00	00:15:00	23		1.2						
43	N S	20.03.00	20.17.00	00.14.00	22	_	1.1						
12		20.19.00	20.31.00	00.15.00	21	_	1.1						
		I	1		Page 1			Vorify	S-Turne	Aftor Mi	ssion		Ivos
Additional C	omments							veniy	J-Turns		551011		IVES

			Woolp	ert Li	dar /	٩cq	uisitior	ו Lo	g					
			Project	Info							D	ate		
Project#		Projec	t Name			U	Inique ID		Flight	t Date	(UTC)	Day o	f Year	Flight#
79576		West TN N	North Block			Day(	033_90513_2		02	/02/20	020	0	33	2
Cr	ew		Equi	pment					Time				Ai	rports
Pi	ilot	A	ircraft Make	/ Model / 1	fail #		Hobbs S	tart	Local	l Start	UTC S	Start	De	parting
Sw	vain		Cessna 404 Ti	itan - N5321	NM		465.7	7	15:4	8:00	21:48	3:00		MKL
Ope	rator	Se	ensor Make/	Model / Se	erial #		Hobbs E	Ind	Loca	l End	UTC I	End	Α	rriving
Ken	nedy	I	eica Terrain.	Mapper - 90	0513		467.9	)	18:0	3:00	00:03	3:00		MKL
					Condi	tions								
Wind Dir	່ (°, Winc	I Speed (kts)	Visibility	(mi) Ce	eiling (ft)	CI	oud Cover	Temp	. (°C)	Dew	v Point	(°C)	Press	sure ("Hg)
210		10	10				Clear	2	1		2		,	29.88
Air Spe	ed (kts)	Altitude	AGL (ft)	Altitu	de MSL	(ft)	Airfield El	levation	(ft)					
1	50	8,2	200		8,397		4	-34						
					Setti	ngs								
Point Spaci	ng (m) Poi	nt Density (pp	osm) So	an Angle/F	<b>OV</b> (°)	Sca	an Frequency	' (Hz)	Pulse	e Rate	(kHz)	Las	ser Po	wer (%)
0.7				40			90			600			10	0
					_			Ver	rify S-1	Turns I	Before I	Missio	on	Ives
Line#	Direction	Start Time (UTC)	End Time (UTC)	Time On-Line	Sat	tellite	PDOP			Line N	lotes/C	omme	ents	
41	N	22:04:00	22:19:00	00:15:00	0	23	1.1							
40	S	22:21:00	22:36:00	00:15:00	0	21	1.3							
39	N S	22:39:00	22:54:00	00:15:00	)	23	1.2	<u> </u>						
37	N N	22:30:00	23.11.00	00:15:00	<u> </u>	19	1.1							
36	S	23:32:00	23:46:00	00:14:00	0	19	1.3							
					_									
					_									
					_									
					_			<u> </u>						
					_									
	1			1	Page	e 1		Ve	erify S-	-Turns	After N	lissio	n	Ives
Additional C	omments				-			-	-					

			Woolp	ert Lid	ar Acc	uisitio	n Log	·			
			Project	Info					Date	)	
Project#		Projec	t Name		ι	Jnique ID	Fliç	jht Date	(UTC) Day	of Y	'ear' Flight#
79576		West T	N Lidar		Day?	345_91557_A	. !	12/10/20	)20	345	A
Cı	rew		Equi	pment			Tin	ie			Airports
Pi	ilot	Ai	ircraft Make	/ Model / Tai	il #	Hobbs S	Start Loc	cal Start	UTC Star	t	Departing
Dar	r Perl		Reims 400	6 - N406SD		576.7	7 11	:38:00	17:38:00	, –	KMKL
Ope	rator	Se	nsor Make/	Model / Seri	al#	Hobbs F	End Lo	cal End	UTC End	1	Arriving
R	van	L	eica Terrain	Mapper - 915	57	583.3	3 16	56:00	22:56:00	,	KMKL
	, 				Conditions						
						1		T		-	
200		8	10			Clear	17		4	+	3005
Air Spe		Altitude			MSI (ft)		levation (ft)				5005
1	50	8	200	8	207		134				
1	50		200		Sottings	<u> </u>	134				
Boint Spaci	na (m) Poi	-t Doneity (n	> Sc	an Angle/FO\			· (Ц=) Du	las Pate	(121-3)	csor	Dowor (%)
				40			(ПZ) Fui	Se Raie		.8561	100
0.7		<u>۲</u>		40		90	Varifie		Defere Mie	alan	100 Vac
							Verity s	3-1 urns	Betore wits:	sion	Y es
Line#	Direction	Start Time (UTC)	End Time (UTC)	Time On-Line	Satellite	PDOP		Line N	Notes/Com	ment	S
1	N	17:38:00	17:40:00	00:02:00	23	1.2					
2	N	17:49:00	17:57:00	00:08:00	23	1.2	PAV error	rs start/ r	rotation ran	ige &	stabilization
3	S	18:01:00	18:10:00	00:09:00	22	1.1					
4	N	18:14:00	18:23:00	00:09:00	22	1.1					
5	S	18:28:00	18:37:00	00:09:00	21	1.3					
6	N	18:41:00	18:50:00	00:09:00	19	1.3	ļ				
7	S	18:54:00	19:03:00	00:09:00	20	1.2	<u> </u>				
8	N	19:06:00	19:16:00	00:10:00	21	1.5	<b> </b>				
9 10	D N	19:22.00	19:33.00	00:11.00	22	1.5					
10	S N	19:57.00	20.03.00	00:11.00	19	1.5					
12	N N	20.07:00	20.03.00	00.11:00	12	1.5					
12	S	20:22:00	20:33:00	00:11:00	16	1.9					
14	N N	20:37:00	20:48:00	00:11:00	16	1.8					
15	S	20:53:00	21:04:00	00:11:00	21	1.1					
16	N	21:08:00	21:23:00	00:15:00	19	1.3	<u> </u>				
17	S	21:26:00	21:41:00	00:15:00	17	1.5					
18	N	21:45:00	21:59:00	00:14:00	18	1.3					
19	S	22:04:00	22:18:00	00:14:00	19	1.2					
20	N	22:22:00	22:37:00	00:15:00	19	1.2	<u> </u>				
21	S	22:40:00	22:56:00	00:16:00	17	1.4	<u> </u>				
	<u> </u>	ļ′	'	<u> </u> !	<b> </b>	<u> </u>					
		'	'	<b>├</b> ────┦		<del> </del>					
		'	'								
			<u>.                                    </u>		Page 1	<u> </u>	Verify	S-Turns	s After Miss	ion	Yes
Additional (	Comments						<u> </u>				
Errors: Mou	int rotation r	ange obstruct	ed and Stabi	lization perfo	ormance low	. Errors rem	ained the er	ntire flig	ht.		

			Woolp	ert Lida	ar Acqu	uisition	Log				
			Project I	nfo					Da	ite	
Project#		Projec	t Name		ι	Jnique ID	FI	ight Date	(UTC) D	ay of \	Year! Flight#
79756		West TN S	outh Block		Day	353_90511_A		12/18/20	020	353	А
Cı	rew		Equi	pment			Tin	ne	<u>_</u>		Airports
P	ilot	A	ircraft Make	/ Model / Tai	#	Hobbs S	tart Lo	ocal Start	UTC St	art	Departing
Ha	igan		Cessna 404 T	itan - N7079F	7	3025	1	2:58:00	18:58:0	00	OLV
Ope	rator	Se	ensor Make/	Model / Seria	al #	Hobbs E	nd L	ocal End	UTC Er	nd	Arriving
De	Hart	I	eica Terrain	Manner - 905	11	3029	7 0	4.41.00	22.29.	00	OLV
De	11411				Conditions	5027.	/	.41.00	22.29.	00	OLV
Wind Di	r(°) Min	d Spood (kto)	Vicibility	(mi) Coili		aud Covor	Tomp (°		v Point (%	C) [	Proceduro ("Ha)
120							10			C) F	20.27
120		9		12			10	、 —	2		30.37
Air Spe	ed (Kts)	Altitude		Altitude	9 MSL (π)	Airtield El	evation (π	.)			
1	50	7,9	198	8,	400	4	-02				
					Settings						
Point Spaci	ng (m) Po	int Density (pp	sm) SC	an Angle/FOV	Sc Sc	an Frequency	(Hz) P	ulse Rate	(kHz)	Lase	r Power (%)
0.35		10		40		89		600			100
							Verify	S-Turns	Before M	ission	Yes
Line#	Direction	Start Time (UTC)	End Time (UTC)	Time On-Line	Satellite	PDOP		Line N	lotes/Cor	nmen	ts
108	N	18:58:00	19:12:00		20	1.3		S	South Blo	ck	
107	S	19:18:00	19:37:00		17	1.3					
106	N	19:41:00	19:49:00	00:08:00	16	1.4					
105	S	19:53:00	19:56:00	00:03:00	15	1.9					
103	N	19:59:00	20:02:00	00:03:00	15	1.8					
102	S	20:13:00	20:15:00	00:02:00	16	1.7					
98	N	20:21:00	20:23:00	00:02:00	19	1.2					
97	S N	20:27:00	20:29:00	00:02:00	19	1.1					
95	S	20:35:00	20:58:00	00:12:00	19	1.2					
94	N	21:02:00	21:13:00	00:11:00	17	1.5					
93	S	21:20:00	21:32:00	00:12:00	21	1.2					
92	N	21:36:00	21:47:00	00:11:00	21	1.2					
91	S	21:51:00	22:03:00	00:12:00	22	1.2					
90	N	22:10:00	22:16:00	00:06:00	18	1.3					
89	S	22:21:00	22:29:00	00:08:00	19	1.3					
					Page 1		Verif	y S-Turns	After Mi	ssion	Yes
Additional C	omments										

			Woo	olper	t Lida	ar A	lcqu	uisition	Log	J					
			Pro	ject Inf	0							D	)ate		
Project#		Projec	t Name				U	Inique ID		Flight	Date (	(UTC)	Day o	of Year	r! Flight#
79576		West TN S	outh Blo	ck			Day3	57_90511_A		12/	22/20	20	3:	57	A
Cr	ew			Equipm	ent	-				Time				Α	irports
Pi	ilot	A	ircraft I	/lake/ M	odel / Tai	l #		Hobbs S	tart	Local	Start	UTCS	Start	De	parting
На	gan		Cessna	404 Tita	n - N7079H	7		3031.	1	10:14	4:00	16:14	1:00		OLV
One	rator	S	ensor M	ake/ Mo	del / Seria	al #		Hobbs F	nd		Fnd	UTC	Fnd	Δ	rrivina
De	Hart	1	eica Te	rain Ma	opper - 905	11		3036.9	2	03.07	7.00	21.02	7.00		
DC	11411	-			(pper - 705	1 1 Conditi	one	5050.0	5	05.0	7.00	21.07	.00		OL V
Wind Di	-/º) \\/;	ad Speed (kto)	Vicil	silits/ (mo				and Cover	Tomp	നവ	Dow	Doint	ഗ്രാ	Droc	ouro ("Ha)
			VISI						remp	. ( C)	Dew	Point	(0)	Fies	
0		0		10	12	,000		Clear		(60)		6			30.3
Air Spe	ed (kts)	Altitude	AGL (ft	)	Altitud		(ft)	Airfield El	evation	(π)					
l:	50	7,9	998		8,	400		4	02						
				0	Angle/EQ	Settin	gs								
Point Spaci	ng (m) P	oint Density (pp	osm)	Scan	Angle/FO	<b>،</b> (°,	Sc	an Frequency	(Hz)	Pulse	Rate	(kHz)	La	ser Po	wer (%)
0.35		10			40			89			600			10	0
									Ver	rify S-T	'urns E	Before	Missi	on	Yes
Line#	Direction	Start Time (UTC)	End T (UT)	ime C)	Time On-Line	Sat	ellite	PDOP		l	Line N	otes/C	omme	ents	
88	N	16:14:00	16:22	:00			23	1.3			S	outh B	lock		
87	S	16:26:00	16:37	:00			21	1.2							
86	N	16:41:00	16:54	:00	00:13:00		20	1.4							
85	S	16:56:00	17:08	:00	00:12:00		23	1.2							
84	N	17:11:00	17:24	:00	00:13:00		22	1.1							
83	S	17:27:00	17:33	:00	00:06:00		21	1.1							
82	N	17:41:00	17:54	:00	00:13:00		20	1.2							
81	S N	17:38:00	18:10	:00	00:12:00		18 21	1.5							
69	S	18:30:00	18.25	·00	00.00.00		$\frac{21}{20}$	1.2							
68	N N	16:48:00	19:03	:00	02:15:00		20	1.2							
67	S	19:05:00	19:19	:00	00:14:00		16	1.2							
66	N	19:26:00	19:40	:00	00:14:00		16	1.2							
65	S	19:43:00	19:58	:00	00:15:00		15	1.6							
64	N	20:00:00	20:15	:00	00:15:00		17	1.1							
63	S	20:17:00	20:32	:00	00:15:00		16	1.2							
62	N	20:35:00	20:49	00	00:14:00	<u> </u>	16	1.2			D + 7 1			1	
61	S	20:52:00	21:07	:00	00:15:00		18	1.3			PAV	motor o	overlo	ad	
		-				<u> </u>									
						Page	91		Ve	rify S-	Turns	After N	lissio	n	Yes
Additional C	omments														
Prealocating	ADQ mem	ory failed ongro	und star	tup once	e we landed	1									

				Wo	olp	ert	Lida	ar A	Acqu	Jisi	tion	Lo	g					
				Pro	oject l	nfo									[	Date		
Project#			Project	t Name					U	Jnique	e ID		Flight	t Date (	(UTC)	Day o	f Yea	r! Flight#
79576			West TN S	outh Bl	ock				Day3	362_90	511_A		12/	/27/20	20	3	52	A
Cr	rew				Equi	pment							Time		<u> </u>		Α	irports
Pi	ilot		Α	ircraft	Make	/ Mode	I / Tail	#		н	lobbs S	tart	Local	Start	UTC	Start	De	parting
На	ıgan			Cessna	404 T	`itan - N	√7079F				3037.4	1	10:0	1:00	16:0	1:00		OLV
Ope	rator		Se	ensor M	/lake/	Model	/ Seria	<b> </b> #		ŀ	lobbs E	nd	Loca	l End	UTC	End	A	rriving
De	Hart		I	eica To	errain	Mapper	r - 9051	1			3041.8	3	01:2	2:00	19:22	2:00		OLV
						11	С	onditi	ons	I			-		-			
Wind Di	r(°)	Nind	Sneed (kts)	Vis	ihility	(mi)	Ceili	na (ft)	CI	oud Co	over	Temr	o. (°C)	Dew	Point	(°C)	Pres	sure ("Ha)
190	.,, .		12	10	10	()	12	000		Clea	r		7	2011	0	( • /		30.07
Air Spo	od (kte)		Altitudo		¥)	<b>^</b>	ltitude	MSL	(f+)		fiold El	ovation	/ / (f+)		0		-	50.07
	50	_	7.0		IJ	-		100	(11)				(11)					
1.	30	_	7,9	98			0,4	+00			4	02						_
Doint Ones'		De!	at Donalts (	om)	Sc	an Ang	ile/FOV	Settin	ys Oc	on <b>F</b>		(Ц_)	Dula	Data	(141-)	1 -		(0/)
Point Spaci	ng (m)	POI	it Density (pp	sm)			40	<b>`</b> )	SC	an ⊢re	quency	(HZ)	Pulse	e Kate	(KHZ)	La	ser Po	wer (%)
0.35		_	10				10				89			600			10	0
	-	_										Ve	erity S-1	lurns l	Before	Missi	on	Yes
Line#	Direction	on	Start Time (UTC)	End (U1	Time ГC)	Ti On-	me Line	Sat	ellite	Р	DOP			Line N	otes/C	omme	ents	
60	S		16:01:00	16:2	0:00				23		1.2			S	outh B	lock		
59	N		16:23:00	16:3	8:00				22		1.3	-						
58	S		16:42:00	17:0	2:00	00:2	20:00		24		1.2							
57	N		17:04:00	17:1	8:00	00:1	4:00		24		1.1							
56	S N		17:22:00	17:4	1:00	00:1	14:00	-	21		1.4							
54	N S	_	17:43:00	17:5	9.00	00:1	19.00		19 77		1.5							
53	N N	_	18.00.00	18.3	$\frac{5.00}{5.00}$	00.1	4.00		19		1.2							
52	S		18:37:00	18:5	7:00	00:2	20:00		17		1.4							
51	N		18:59:00	19:1	3:00	00:1	4:00		17		1.3							
50	S		19:21:00	19:2	2:00	00:0	)1:00		15		1.8	C	louds n	noving	in, PA	V mo	tor ove	erload
										<u> </u>								
		_																
										<u> </u>								
								Page	<u> </u>			V	orify C	Turne	After	lieeio	n	Vac
Additional C	omma=1-							raye	7 1			V	enny 3-	iums	Anter	113510		I CS
			foils 1 -	، 1	at	n o c -	1or - 1											
Prealocating	ADQ me	mory	y lalled ongro	una sta	rtup oi	nce we	ianded											

			Woolr	bert L	idar /	۱po	Jisition	Loç	3					
			Project	t Info							D	ate		
Project#		Projec	t Name			U	Jnique ID		Flight	t Date (	(UTC) [	Day o	f Year	! Flight#
79576		West TN S	outh Block			Day?	363_90511_A		12/	/28/20	20	36	53	Α
Cr	rew		Equ	ipment					Time				Ai	rports
Pi	ilot	A	vircraft Mak	e/ Model	/ Tail #		Hobbs S	tart	Local	Start	UTC S	start	De	parting
На	ıgan		Cessna 404	Titan - N	7079F		3041.8	8	10:3	6:00	16:36	:00		KMKL
Оре	rator	Se	ensor Make	/ Model /	Serial #		Hobbs E	Ind	Loca	l End	UTC E	Ind	<b>A</b>	rriving
De	Hart	I	Leica Terrair	1 Mapper	- 90511		3045.2	2	01:2	.9:00	19:29	:00	]	KMKL
					Conditi	ons								
Wind Di	r(°) Wi	nd Speed (kts)	Visibility	y (mi)	Ceiling (ft)	CI	oud Cover	Temp	. (°C)	Dew	Point (	(°C)	Press	sure ("Hg)
350		9	10		12,000	<u> </u>	Overcast	6	j	_	-1		3	30.35
Air Spe	∋ed (kts)	Altitude	+ AGL (ft)	Alf	titude MSL	(ft)	Airfield El	evation	(ft)					
1:	50	7,9	<del>)</del> 98		8,400		4	-02						
					Settin	gs								
Point Spaci	ng (m) P	oint Density (pp	osm) S	Scan Angle	୬/FOV (°,	Sc	an Frequency	(Hz)	Pulse	e Rate	(kHz)	Las	ser Po	wer (%)
0.35		10		4(	0		89			600			100	<u>)</u>
								Ver	rify S-T	Γurns I	Before N	Vissio	on	Yes
Line#	Directior	Start Time (UTC)	End Time (UTC)	Tim On-L	ie Sat	ellite	PDOP			Line N	otes/Co	omme	ents	
50	S	16:36:00	16:51:00	1		22	1.3			S	outh Bl	ock		
49	N	16:54:00	17:09:00			22	1.3							
48	S	17:13:00	17:27:00	00:14	1:00	20	1.3							
4′/	N	17:29:00	17:45:00	00:10	5:00	19	1.4	<u> </u>						
40	N N	1/:4/:00	18:01:00	00:14	5.00	18	1.4							
44	S	18:21:00	18:36:00	00:15	5:00	17	1.3							
43		18:39:00	18:54:00	00:15	5:00	17	1.1							
42	S	18:56:00	19:11:00	00:15	5:00	13	1.8	<u> </u>						
41	N	19:14:00	19:29:00	00:15	5:00	13	1.8			PAV	motor o	overlo	ad	
	<u> </u>	/	<b></b>	<u> </u>			<u> </u>	<u> </u>						
				+										
				+										
	+	+ +		+			1							
	<u> </u>	!	<b> </b>	<u> </u>			<u> </u>	<u> </u>						
				+			<u> </u>							
				+										
				+			+							
	<u> </u>	+ +		+			<u> </u>	<u> </u>						
					Page	)1		Ve	rify S-	Turns	After M	lissio	n	Yes
Additional C	omments													
Upon second	boot, interr	al PAV Error												

			Woolp	ert L	.idar /	Acqu	Jisition	Log					
			Project	Info						D	ate		
Project#		Projec	t Name			U	Jnique ID	FI	ight Date	(UTC) C	Jay o	f Year!	Flight#
79576		West TN S	Jouth Block			Day3	363_90511_B		12/28/20	020	36	3	В
Cr	ew		Equi	pment				Tin	ne			Air	ports
Pi	ilot	A	ircraft Make	/ Model /	/ Tail #	'	Hobbs S	tart Lo	ocal Start		tart	Dep	arting
Ha	igan	<u> </u>	Cessna 404	Titan - N/	079F	'	3045.2	2 0	2:09:00	20:09:	:00	ĸ	MKL
Upe		50	ensor Make	Model / 3	Serial #	!					ind		
De	Hart		.elca Terrain	Маррег -	· 90511		3046.0	<u>j</u> 0	2:35:00	20:35:	:00	n.	MKL
Wind Di	win	d Spood (kte)	Vieibility	(mi)	Colling (ft)		laud Cover	Temp (°		Point (	(°C)	Drass	uro ("Ha)
350				(m)	12 000			6		-1		716220	
Air Spr	eed (kts)				titude MSI	` (ft)		evation (ft		-1			J.35
1	50	7.9	998		8.400	(11)	4	02	,				
-		.,.		L	Settir	nas	· · · · ·	02					
Point Spaci	na (m) Po	int Density (pr	osm) Sr	can Angle	ə/FOV (°,	Sc	an Frequency	(Hz) P	ulse Rate	(kHz)	La	ser Pov	ver (%)
0.35		10		40	, ,	+	89	(,	600			100	)
								Verify	/ S-Turns	Before N	Missi	on	Yes
Line#	Direction	Start Time (UTC)	End Time (UTC)	Tim On-L	ie Sa	tellite	PDOP		Line 1	Notes/Co	omme	ents	
66	N	20:09:00	20:13:00	ļ		17	1.1	╀────	;	South Bl	ock		
65	S	20:18:00	20:23:00			15	1.2	<u> </u>			50.		
64	N	20:26:00	20:35:00	00:09	):00	17	1.2	[	PAV	motor o	verlo	ad	
		<u> </u> !											
	<u> </u>	ļ/	<u> </u>				<u> </u>	<u> </u>					
							<u> </u>	<u> </u>					
		+											
		<u> </u>		<u> </u>			<u> </u>	<u> </u>					
	<b></b>	Ţ!	Ē				<u> </u>	<b>[</b>					
	<u> </u>	'	<u> </u>				<u> </u>	<u> </u>					
		!	<u> </u>					<u> </u>					
		+	L										
		<u> </u>											
	<u> </u>	<u> </u> '	<b></b>	<u> </u>			<u> </u>	<u> </u>					
	<u> </u>	'	<u> </u>				<u> </u>	───					
			<u> </u>	<u> </u>									
		+ +		+									
					Pag	e 1		Verif	y S-Turns	SAfter M	issio	n `	Yes
Additional C	omments d boot, interna	al PAV Error											

			Woolp	ert Lid	ar Ac	qu	uisition	Log	J					
			Project I	nfo							D	ate		
Project#		Projec	t Name			U	nique ID		Flight	Date (	(UTC)	Day o	of Yea	ar! Flight#
79576		West TN S	outh Block		C	DayO	06_90515_A		01/	06/20	21	0	06	A
Cr	ew		Equi	pment	<u>.</u>			1	Гime		<u> </u>		F	Airports
Pi	ilot	A	ircraft Make	/ Model / Tai	l #	_	Hobbs S	tart	Local	Start	UTC S	Start	D	eparting
На	gan		Cessna 404 T	itan - N532N	N		781.5		12:58	3:00	18:58	3:00		MKL
Ope	rator	Se	ensor Make/	Model / Seria	al #		Hobbs E	nd	Local	End	UTC	End		Arriving
Del	Hart	L	eica Terrain I	Mapper - 905	15		785		03:36	6:00	21:36	6:00		MKL
		<b>.</b>		(	Conditions	\$								
Wind Di	r(°) Win	d Speed (kts)	Visibility	(mi) Ceil	ing (ft)	Clo	oud Cover	Temp.	(°C)	Dew	Point	(°C)	Pres	ssure ("Hg
100		8	10	12	.000		Broken	. 8	. ,		-1	. ,		30.21
Air Spe	ed (kts)	Altitude	AGL (ft)	Altitud	e MSL (ft)		Airfield El	evation	(ft)					
1	50	7.9	998	8	400	_	4	02	(,					
					Settings	_			_	-	_	-		
Point Spacir	na (m) Po	int Density (pr	sm) Sc	an Angle/FO		Sca	an Frequency	(Hz)	Pulso	Rate	(kH7)	la	sor P	
0.25			·5m)	40	• )	000		(112)	i uise	600	(KI 12)	La	1	
0.35		10		40			09	Vor	IL C T	000	Poforo	Missi		J0
		Of a f Time	E. J.T.	Time	_	-		ver	iiy 3-11	ums	Selore	VIISSI	on	res
Line#	Direction	(UTC)	End Time (UTC)	On-Line	Satellit	te	PDOP		L	ine N	otes/C	omme	ents	
40	N	18:58:00	19:13:00		19		1.1			S	South B	lock		
39	S	19:16:00	19:32:00		19	_	1.1							
38	N	19:35:00	19:49:00	00:14:00	18		1.3							
3/	S N	19:52:00	20:07:00	00:15:00	20		1.1							
35	S S	20.13.00	20.27.00	00.14.00	21	_	1.2							
34	N	20:49:00	21:02:00	00:13:00	21	_	1.2							
33	S	21:05:00	21:21:00	00:16:00	22		1.2							
32	N	21:23:00	21:36:00	00:13:00	20		1.2	Cl	ouds b	uildin	g at no	rth 5 i	miles	of line
						_								
						_								
						_								
						_								
						_								
						_								
					Page 1			Ve	rifv S-1	Turns	After N	lissio	'n	Yes
Additional Co	omments								<b>,</b> -					100
Prealocating	ADQ memor	y failed ongrou	ind startup or	nce we landed	3									

Woolpert Lidar Acquisition Log													
					Date								
Project#		Projec	t Name		Unique ID	Fli	Flight Date (UTC) Day of Yea				! Flight#		
79576		Wes	Da	y012_90515_A		01/12/2020 012			12	A			
Cr	rew		Equipment Time						<u>+</u>		Ai	rports	
Pi	ilot	A	Aircraft Make	/ Model / Tai	l #	Hobbs	Start Lo	cal Start	UTC St	tart	De	parting	
Dar	Perl		Cessna 404 T	itan - N532NN	A	784.	9 1	1:11:00	17:11:	:00	]	KMKL	
Ope	rator	S	ensor Make/	Model / Seria	al #	Hobbs	End Lo	ocal End	UTC E	nd	Α	rriving	
De	Hart		Leica Terrain	Mapper - 905	15	790.	3 0	3:40:00	21:40:	:00	1	KMKL	
				11	Conditions								
Wind Di	r(°) Wi	nd Speed (kts)	Visihility	(mi) Ceil	ing (ft)	Cloud Cover	Temp. (°	C) Dev	v Point (	°C)	Press	sure ("Ha)	
230	.,	3	10	12		Clear	-1		-4	-,		30.4	
Air Spc	od (kte)				,000 0 MSL (ft)		lovation (ft)		· · ·			50.4	
	50	Aititude	Aititude AGL (ft)     Aititude MSL (ft)     Airrieid Elevation (ft)       7.009     8.400     402										
1.	150 7,998 8,400 402												
Deint Onesi	n n (m)		Sc	an Angle/FO\		<b>-</b>	· (11-) D	las Data	(1-11-)	1		(0()	
Point Spaci	ng (m) P	bint Density (pp	osm) oc		· ( ) · · · · ·	can Frequency	/ (HZ) PI	lise Rate	(KHZ)	Las	ser Po	wer (%)	
0.35		10		40		89		600			10	5	
	r			r	T	-	Verify	S-Turns	Before N	lissi	on	Yes	
Line#	Direction	Start Time (UTC)	End Time (UTC)	Time On-Line	Satellite	PDOP		Line Notes/Comm			ents		
22	N	17:11:00	17:26:00		22	1.3			North Blo	ock			
23	S	17:29:00	17:43:00		21	1.4							
24	N	17:46:00	18:01:00	00:15:00	20	1.3							
25	S	18:04:00	18:19:00	00:15:00	15	1.8							
26	N	18:22:00	18:38:00	00:16:00	19	1.1							
27	N N	18:41:00	18:36:00	00:15:00	17	1.2							
28	S	19:18:00	19.32.00	00:13:00	16	1.2							
30	N	19:35:00	19:51:00	00:16:00	18	1.3							
31	S	19:54:00	20:09:00	00:15:00	20	1.3							
32	N	20:12:00	20:27:00	00:15:00	17	1.4							
33	S	20:31:00	20:46:00	00:15:00	17	1.4							
34	N	20:49:00	21:04:00	00:15:00	18	1.2							
35	S	21:08:00	21:22:00	00:14:00	17	1.3							
36	N	21:26:00	21:40:00	00:14:00	15	1.6							
						-							
					Page 1		Verify	/ S-Turns	After Mi	issio	n	Yes	
Additional C	omments												
Upon second	l boot, intern	al PAV Error											

Woolpert Lidar Acquisition Log														
					Date									
Project#		Projec	t Name	U	Jnique ID	(UTC) D	Day of Year! Flight#							
79576		Wes	st TN		1	Day	J13_90515_A		01/13/20	020	0	013 A		
Cr	ew		Equ	uipment				Tir	ne			Α	irports	
Pi	ilot	4	Aircraft Mak	.e/ Model / Ta	ail #		Hobbs S	itart Le	ocal Start	UTC St	tart	De	parting	
Dar	Perl	_	Cessna 404	Titan - N532N	M		790.3	3 1	0:44:00	16:44:	.00		KMKL	
Ope	rator	S	ensor Make	/ Model / Ser	ial #		Hobbs F	nd L	ocal End	UTC E	nd	A	rriving	
De	Hart	1	Leica Terraiı	n Mapper - 90!	515		795.4	4 (	03:09:00	21:09:	:00		KMKL	
				11	Conditic	ons					Ì			
Wind Di	r(°) W	ind Speed (kts)	Visibilit	v (mi) Cei	iling (ft)	C	loud Cover	Temp. (	C) Dev	v Point (°	°C)	Pres	sure ("Ha)	
220		6	10		2 000		Clear			<u></u>			20.17	
Air Sp(	and (kts)	Altitude			2,000   	£+\			<u>۵</u>		30.17			
						<b>U</b>			)					
1.	50	/,:	<del>1</del> 98	0	5,400	'	4	02						
				Soon Angle/EC	Setting	s	_					_		
Point Spacin	ng (m) P	oint Density (pp	usm) usm)		ν(,	Sca	an Frequency	(Hz) P	ulse Rate	(kHz)	Las	ser Po	Power (%)	
0.35		10		40			89		600	600 100				
								Verify	/ S-Turns	Before M	lissi	on	Yes	
Line#	Directior	א Start Time ו (UTC)	End Time (UTC)	Time On-Line	Sate	llite	PDOP		Line Notes/Comments					
57	N	16:44:00	16:51:00		2	0	1.2	<u> </u>		North Blc	ock			
58	S	16:54:00	17:01:00	<u> </u>	1	9	1.4							
59	N	17:05:00	17:11:00	00:06:00	1	9	1.3							
60	S	17:15:00	17:22:00	00:07:00	1	9	1.2							
61	N	17:26:00	17:34:00	00:08:00	2	.0	1.1				_			
62	S	17:37:00	17:45:00	00:08:00		8	1.2	<u> </u>						
63	N	17:48:00	17:57:00	00:09:00	1	4	1.7	ļ						
40		10.16.00	19.21.00	00.15.00	+1	-	1.0	───	(	C+h Blc	-1,-			
47		18:10:00	18:51:00	00.13.00	+ 1	<u> </u>	1.0			South Die	)СК			
30	S S	18:54:00	19:06:00	00:12:00	$+$ $\frac{1}{1}$	8 7	1.2	┼───						
29	N N	19:10:00	19:21:00	00:11:00	1	7	1.2							
28	S	19:24:00	19:35:00	00:11:00	1	<del>/</del> 9	1.1							
27	N	19:38:00	19:49:00	00:11:00	1	9	1.2							
26	S	19:52:00	20:02:00	00:10:00	2	0	1.2	1						
25	N	20:05:00	20:16:00	00:11:00	2	.1	1.2	<u> </u>						
24	S	20:19:00	20:29:00	00:10:00	1	9	1.3							
23	N	20:31:00	20:42:00	00:11:00	1	6	1.4							
22	S	20:45:00	20:56:00	00:11:00	2	.1	1.2							
21	N	20:58:00	21:09:00	00:11:00	2	.1	1.2	<u> </u>						
<b> </b>	<u> </u>		<u> </u>		<u> </u>	'	<u> </u>	<u> </u>						
<b> </b> '	<b> </b>	'	<u> </u>		<u> </u>	'	<u> </u>	───						
<b> </b> '			<del> </del>			'	<del> </del>							
l'	<u> </u>		<u> </u>		+	'		┼───						
<b> </b>					Page	1		Verif	v S-Turns	× After Mi	issic	n	Ves	
Additional C	omments				1 491	<u> </u>	'	•••••	<b>y o</b> 1 a				103	
Hunon second	boot inter	nal PAV Error												
Upon second	000t, Interi	lal PAV EITOI												
1														
1														

Woolpert Lidar Acquisition Log															
				Date											
Project#		Projec	t Name	U	Jnique ID	F!	light Date	UTC) [	Day o	of Year	! Flight#				
79576		Wes	1	Day(	)17_90515_A		01/17/2	.021	01	17	Α				
Cr	rew		Equ	ipment				Tir	me			Ai	irports		
Pi	ilot	4	Aircraft Make/ Model / Tail # Hobbs Start Local Start UTC						UTCS	Start	De	parting			
Dar	r Perl	_	Cessna 404 T	ritan - N532Nf	M		800.5	5 1	12:13:00	18:13	3:00	1	KMKL		
Оре	rator	Se	ensor Make/	Model / Seri	al #		Hobbs F	End L	_ocal End	UTCF	End	A	rriving		
De	Hart	<u>1</u>	Leica Terrain	Mapper - 905	15		804.7	1 (	03:03:00	21:0?	3:00		KMKL		
				(	Conditio	ns						<u> </u>			
Wind Di	r(°) Wi	nd Speed (kts)	Visibility	(mi) Ceil	ing (ft)	CI	oud Cover	Temp. (	°C) Dev	w Point	(°C)	Pres	sure ("Hg)		
260		10	10	12	,000		Clear	8		-3			29.92		
Air Spr	eed (kts)					<u>н</u>		levation (f	+)						
1	50			8	400	<u>,                                    </u>		102	·)						
1.	30		198		400			02							
Daint Casal	(	int Density (n)	S	can Angle/FO	Setting:	; 			Cales Deta	- (1-11-)		De	(0/)		
Point Spacin	ng (m) Pr	bint Density (pp	ism)		<u>' ( )</u>	508	an Frequency	(Hz) P	UISE Kate	(KHZ)	Las	Ser Pov	wer (%)		
0.35		10		40			89		600			100	0		
								Verity	/ S-Turns	Before I	Missia	on	Yes		
Line#	Direction	Start Time (UTC)	End Time (UTC)	Time On-Line	Satel	lite	PDOP		Line Notes/Comments						
20	S	18:13:00	18:23:00		18	<u>,                                    </u>	1.1		ç	South Bl	lock				
19	N	18:26:00	18:36:00		17	!	1.1								
18	S	18:40:00	18:49:00	00:09:00	16	. <u> </u>	1.2								
17	N r	18:52:00	19:03:00	00:11:00	16	<u> </u>	1.2	[							
16	S N	19:06:00	19:12:00	00:06:00	21	'	1.2	<u> </u>							
15	N C	19:15:00	19:21:00	00:06:00	21	,'	1.2								
14	N N	19:24.00	19:29.00	00:03.00	23	,′	1.2								
13	S	19:33:00	19.30.00	00:05:00	23	<u></u>	1.3								
11	N	19:50:00	19:54:00	00:04:00	2?	,/	1.3								
10	s	19:59:00	20:04:00	00:05:00	21	/	1.3								
9	N	20:07:00	20:12:00	00:05:00	19	,	1.4								
8	S	20:14:00	20:18:00	00:04:00	21		1.4	<u> </u>							
7	N	20:22:00	20:26:00	00:04:00	21		1.2								
6	S	20:28:00	20:32:00	00:04:00	20	)	1.3								
5	N	20:35:00	20:38:00	00:03:00	20	<u>ر</u>	1.3								
4	S	20:41:00	20:44:00	00:03:00	21	<u>.                                    </u>	1.4	<u> </u>							
3	N C	20:48:00	20:51:00	00:03:00	21		1.5								
<u> </u>	N N	20:54:00	20:57:00	00:03:00	20	<u>/</u>	1.0								
1	IN .	21:00.00	21:03.00	00:05.00	- 20	<u>'</u> '	1.0								
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