



Horizon's, Inc.
LiDAR Acquisition/Processing/Quality Control
J070327 Yavapai, AZ

LiDAR Acquisition

LiDAR Acquisition. LiDAR acquisition for this project was performed by Horizons Inc. in a Cessna 310 N94HC equipped with an LH System ALS50-Serial #0036 LiDAR system including an inertial measuring unit (IMU) and a dual frequency GPS receiver. Acquisition was accomplished between 4/28/07 & 5/3/07. Maps identifying the flight lines and LiDAR collection log sheets containing information regarding flights, times, conditions, etc are included in the Appendix. The LiDAR flight specifications follow:

Field of View	30 Degrees
Altitude	4100 feet AMT
Scan Rate	42 Hz
Pulse Rate	62 kHz
Airspeed	135 knots
Average Post Spacing	1 meters
Average Swath Width	2362 feet
Intensity Mode	4+3
Total Flight Lines:	180
Number of Lifts	6

GPS Data Collection

GPS Data Collection. A GPS receiver was in constant operation over a National Geodetic Survey control point during flight acquisition. The base station identification and location are listed in the following table. Base station information is also included in the Appendix.

<u>Station</u>	<u>Location</u>
KSEZ	Sedona Airport

GPS base station

GPS Data Processing

GPS Data Processing. All GPS phase data was post processed with continuous kinematic survey techniques using "On the Fly" (OTF) integer ambiguity resolution. The GPS data was processed with forward and reverse processing algorithms. The results from each process, using the data collected at the airport, were combined to yield a single fixed integer phase differential solution of the aircraft trajectory. Plots of altitude and the forward and reverse GPS solution residuals are included in the Appendix. The differences between the forward to reverse solution within the project area were within project specifications (<10cm) in both the horizontal and vertical components, indicating a valid and accurate solution.

IMU Data Processing

IMU Data Processing. An IMU was used to record precise changes in position and orientation of the LIDAR scanner at a rate of 200 Hz. All IMU data was processed post flight with a filter to integrate inertial measurements and precise phase differential GPS positions. The resulting solution contains geodetic position, omega, phi, kappa, and time for subsequent merging with the laser ranging information.

LiDAR Data Processing

LIDAR Data Preprocess.

Flight Line Data Acquisition/Quality Control Check. LiDAR data and the IMU files were processed together using LIDAR processing software. The data set for each flight line was checked for project area coverage, data gaps between overlapping flight lines, and tension/compression areas (areas where data points are more or less dense than the average project specified post spacing). Based on this check it appears the entire project area is covered without gaps. LiDAR Coverage Check and Line Overlap Check Diagrams are included in Appendix.

Boresighting Process. Pre-processing of LiDAR corrects for rotational, atmospheric, and elevation differences that are inherent to LiDAR data sets. This process is called boresighting. LiDAR data was collected for bi- and cross-directional flight lines over the airport prior to and after acquisition of the project area. Using an iterative process that involves analyzing raster difference calculations the Omega, Phi, Kappa angle corrections of the LiDAR instrument were determined. The corrections were applied to the LiDAR data set for the project area.

Vertical Accuracy Check. Extensive comparisons were made of vertical and horizontal positional differences between points common to two or more LiDAR flight lines. This was done for the airport bore-sight testing area and the project area. All flight lines (airport and project) were within project specifications for vertical accuracy.

LiDAR Intensity Check. An intensity raster for each flight line was generated. The raster was checked and verified that intensity was recorded for each LiDAR point.

Project Coordinate System. LiDAR preprocessing software outputs data to its corresponding UTM zone in meters and a GRS80 ellipsoidal height. LiDAR data was transformed to a project coordinate system of NAD83 AZ Central State Plane NAVD88 Geoid 2003 IF.

Vertical Bias Correction. LiDAR has a consistent vertical offset. LiDAR ground points were compared to independently surveyed and positioned ground control points at both the airport bore-sight area and the project area. Based on the results of these comparisons, the LiDAR data was vertically biased down to the ground.

Project Ground Control Check. Comparisons between on-site ground survey control points and LiDAR data yielded the following results:

Vertical Accuracy (RMSE)	0.242
Standard Deviation	0.246
Mean Difference	-0.018
Number of Points	30

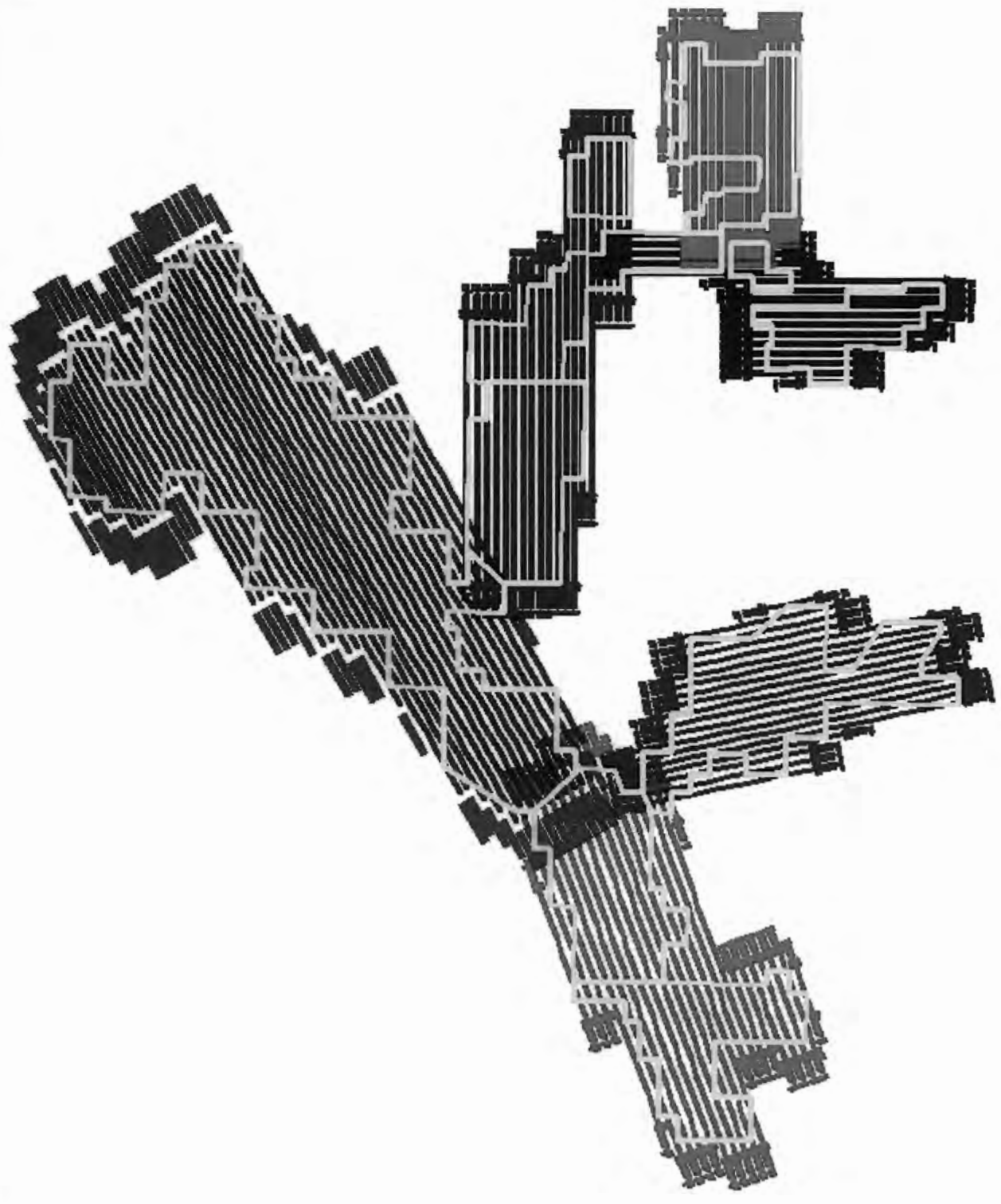
LiDAR Data Surfacing Process.

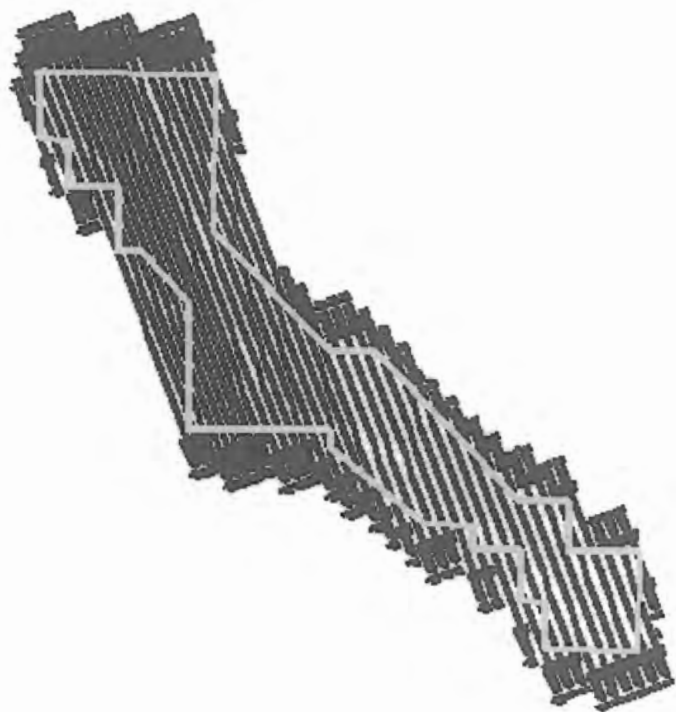
Raw LiDAR Data Set. LiDAR data in overlap areas of project flight lines was removed and data from all swaths was merged into a single data set. The data set was trimmed to the digital project boundary including an additional buffer zone (buffer zone assures adequate contour generation from the DEM). Resulting data set is the Raw LiDAR data. The Raw LiDAR data set was processed through a minimum block mean algorithm and points were classified as either bare earth or non-bare earth. User developed "macros" that factor mean terrain angle and height from the ground, were used to determine bare earth point classification.

LiDAR Surfacing Process. The surfacing process is a 2D-edit procedure that ensures the accuracy of the automated feature classification. Editors used a combination of imagery, intensity of the LiDAR reflection and tin-editing software to assess points. The resulting data set is 2D Surfaced Bare Earth. The LiDAR data is filtered using a quadric error metric to remove redundant points. This method leaves points where there is a change in the slope of surfaces (road ditches) and eliminates points from evenly sloped terrain (flat field) where the points do not affect the TIN LiDAR data. The resulting data set is 2D Surfaced/Filtered Bare Earth

Appendix Items.

Flight Map





Lift01

LIDAR Collection Logsheet



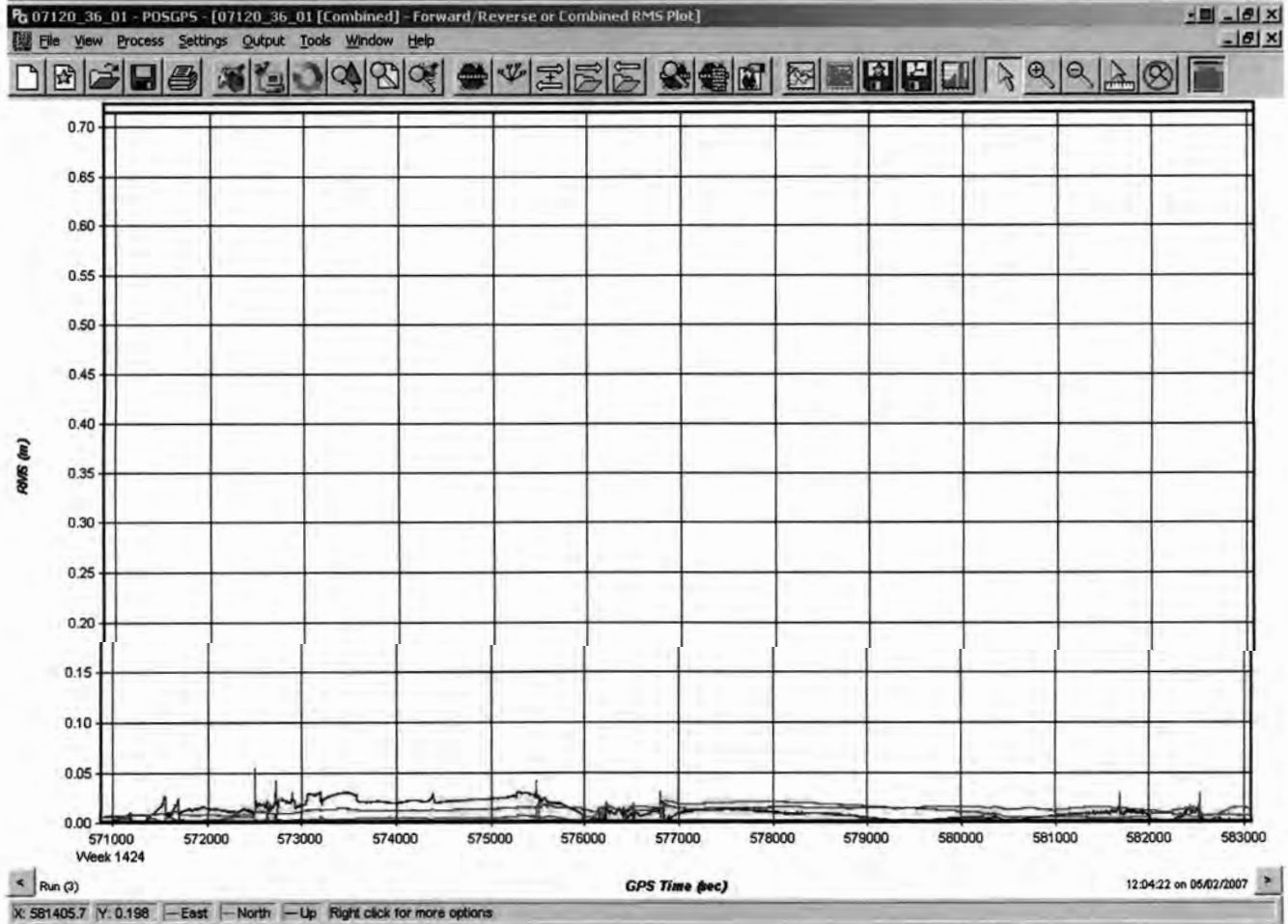
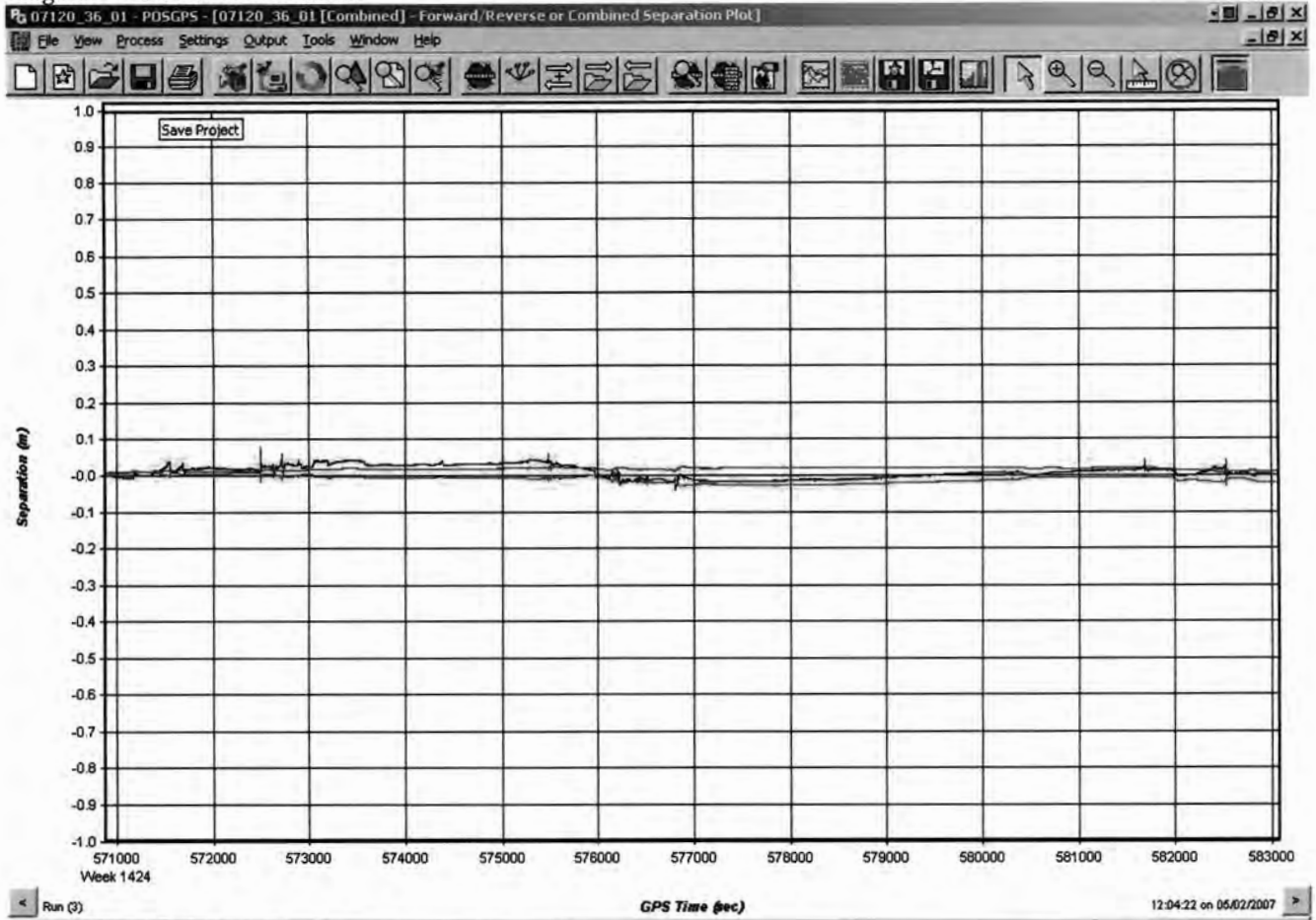
Lift	Airport	Checks Out	Airport	Checks In	Duration	3.5 Hrs.	Ramp	Activity
1	KSEZ	14:26	KSEZ	18:00	3:34	3.6		Production
2								
3								
4								

Horizons
ALS FlightLog

Horizons Job # J07-0327	Client's Job #	Lidar S/N 36	Mode 4-3	IMU Start 14:34	Shipping Track Number 8588 7488 1474	Operator Eric Mueller			Wx	Start	End
Project Name YAVAPAI, AZ		IMU S/N 22	AGC #1 & #2 12 & 3	IMU Stop 17:58	Airport ID KSEZ	Pilot Chuck Lutz			GND Temp	22C	29C
Mission ID (P-#) (S-#) (M-#) 11836J07032701		AMT 4100	Range Gate 1200	Laser Pulse Rate 64000	GND Station ID KSEZ	Aircraft N94HC	FMS CCNS3	Air Temp	18C	15C	
Date 28-Apr-07	GPS Date 07-118	UTC Offset MST -7	Flight Plan BLOCK A	Attenuator 0.3	H.D. # 5	USGS PID # ES1033(SEZC)	GPS Ant. Ht. 2.0 M	UTM Zone	Altitude Setting	30.17	30.18

HZN Line #	Direction	From WPT	To WPT	Beginning GPS Time	Ending GPS Time	FOV	Scan Rate	Speed (Kts)	Comments / Conditions	SVs	VDOP	HDOP
A01	159	4	2	150131	1502	30	42	140	SMOOTH/CLEAR SKIES	12	1.8	1.0
A02	339	1	6	150538	1506	30	42	144		12	1.7	1.0
A03	159	6	1	151007	1511	30	42	139		12	1.7	1.0
A04	339	1	9	151458	1516	30	42	142		12	1.2	0.7
A05	159	9	1	151951	1521	30	42	142		12	1.2	0.7
A06	339	1	10	152525	1527	30	42	140		12	1.1	0.7
A07	159	10	1	153037	1532	30	42	137		11	1.2	0.8
A08	339	1	10	153624	1538	30	42	131		11	1.2	0.8
A09	159	11	1	154146	1544	30	42	136		10	1.3	0.8
A10	339	1	12	154736	1550	30	42	139		10	1.2	0.8
A11	159	11	1	155300	1555	30	42	138		10	1.2	0.8
A12	339	1	10	155920	1601	30	42	141		11	1.0	0.8
A13	159	11	1	160415	1606	30	42	140		11	1.0	0.8
A14	339	1	10	161008	1612	30	42	146		11	1.0	0.8
A15	159	11	1	161506	1617	30	42	144		10	1.2	1.0
A16	339	1	11	162033	1622	30	42	147		9	1.6	1.1
A16	159	11	5	162549	1627	30	42	140	CALIBRATION LINE	9	1.7	1.1
A17	159	11	1	163248	1634	30	42	140		9	1.8	1.1
A42	85	1	10	163821	1640	30	42	118	CROSS LINE	9	1.8	1.2
A18	339	1	10	164455	1646	30	42	140	LOWERED PULSE RATE TO 62000	9	1.9	1.1
A19	159	10	1	165049	1652	30	42	136		9	1.9	1.1
A21	339	1	21	165659	1700	30	42	144	MODERATE TURBULANCE	9	1.8	1.1
A20	159	4	1	170408	1705	30	42	135		9	1.8	1.0
A22	159	21	1	171029	1714	30	42	134		10	1.5	0.9
A23	339	1	20	171843	1722	30	42	144		10	1.5	0.8
A40	252	11	7	172705	1728	30	42	144	CROSS LINE	10	1.4	0.8
A41	89	6	16	173158	1734	30	42	135	CROSS LINE	11	1.1	0.7

Diagram - GPS Solution Residuals



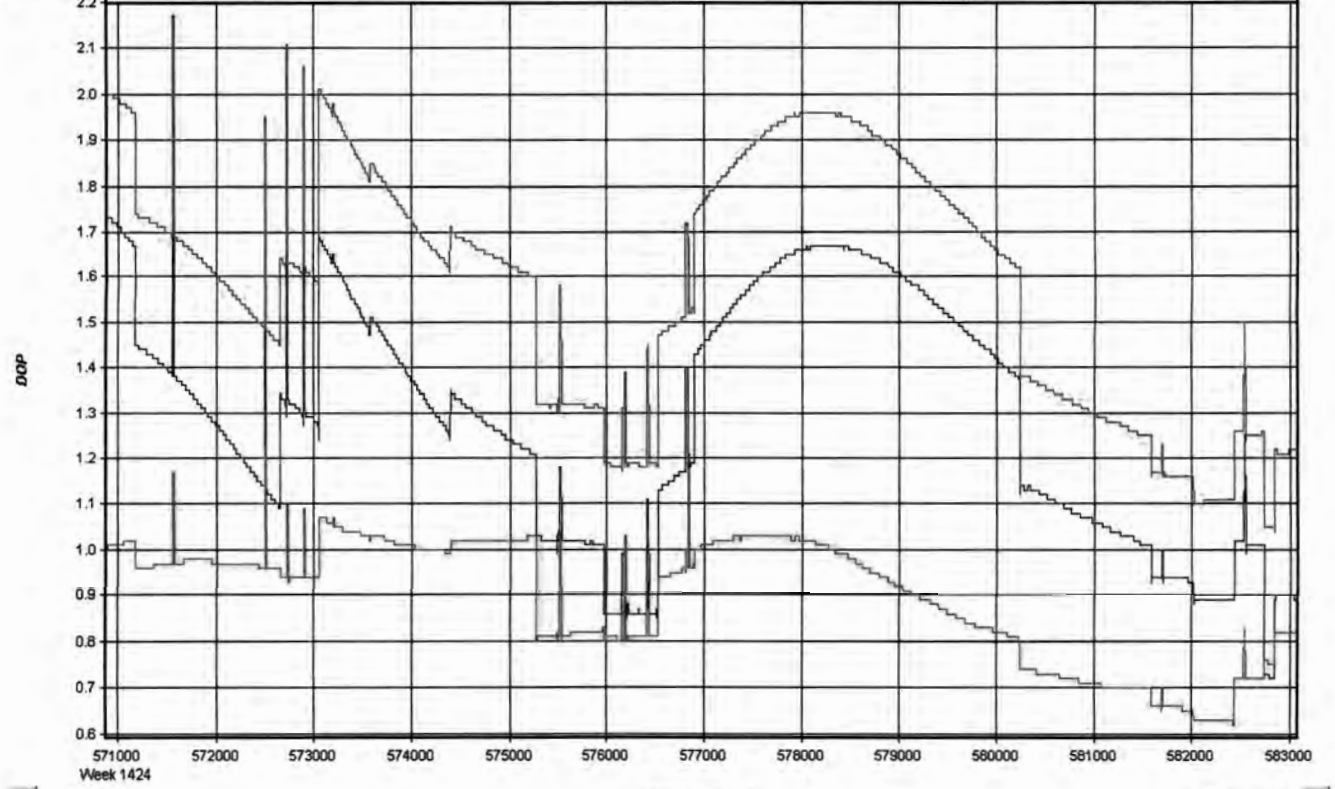


Diagram – Aircraft Trajectory Plot

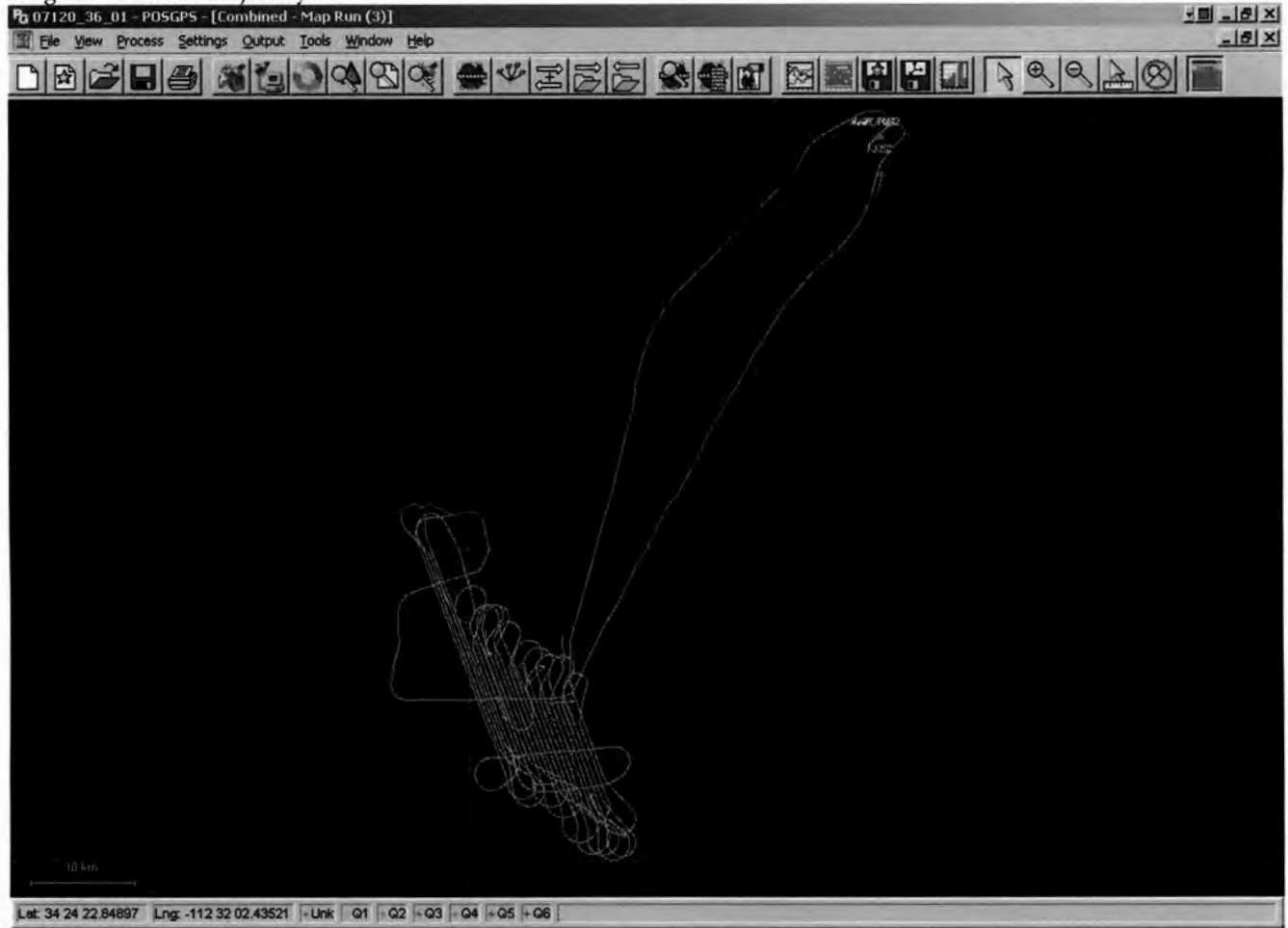
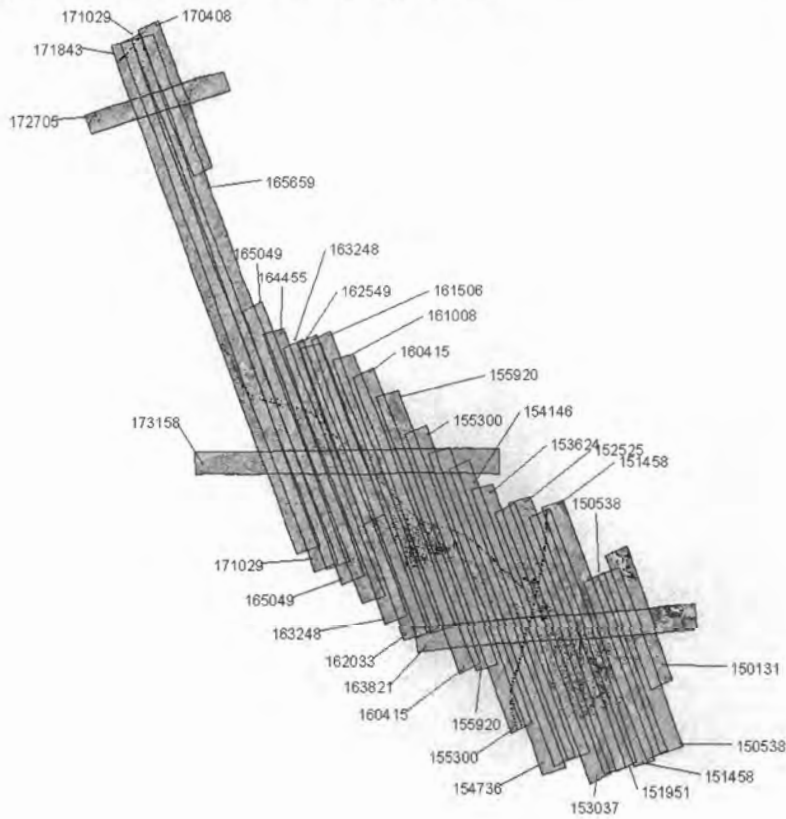


Diagram – LiDAR Coverage Check for Project Lines



Lift02

LIDAR Collection Logsheet


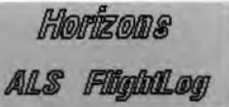
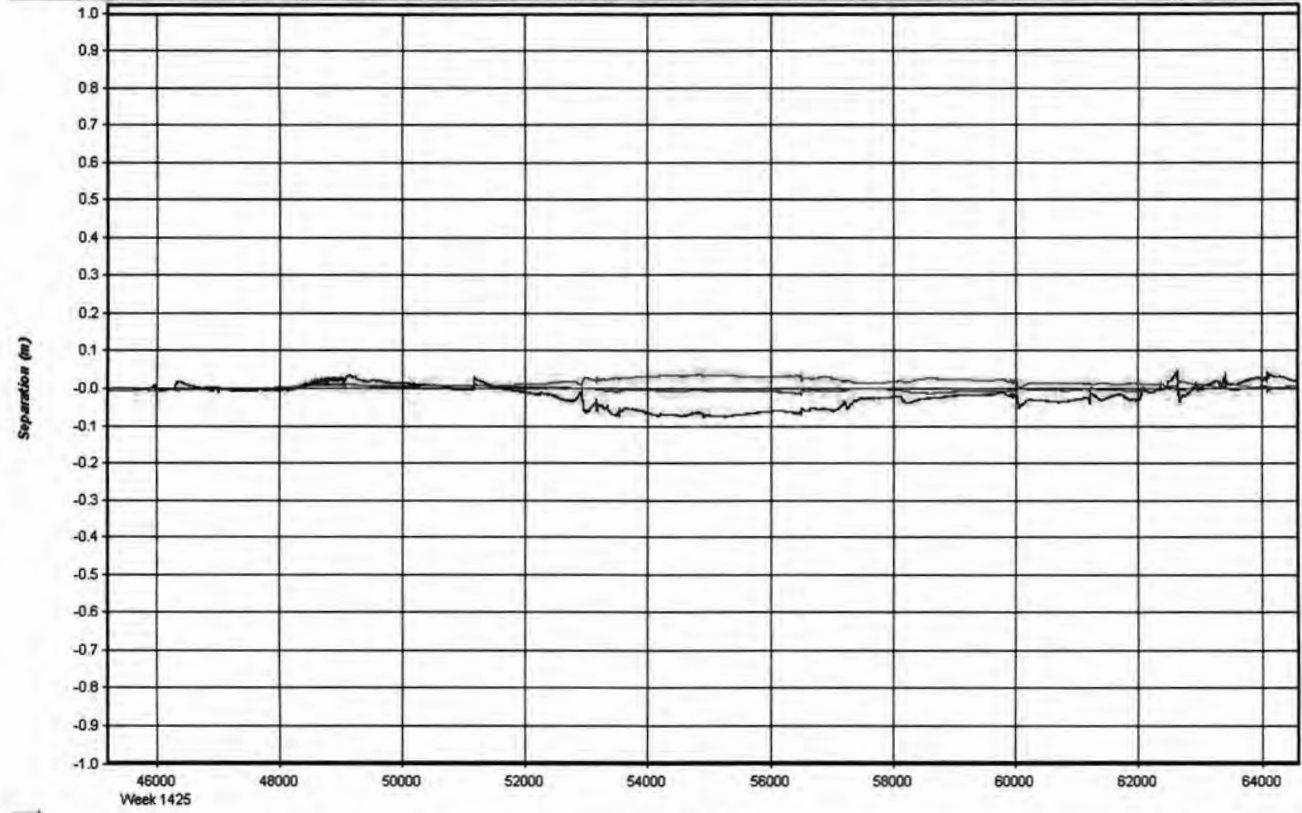
				Lift	Airport	Checks Out	Airport	Checks In	Duration	5.5 Hrs.	Ramp	Activity			
				1	KSEZ	12-26	KSEZ	17-57	5:31	5.5		Production			
				2											
				3											
				4											
Horizons Job # J07-0327		Client's Job #		Lidar S/N 36	Mode 4-3	IMU Start 12:33	Shipping Track Number 8588 7488 1474		Operator Eric Mueller		Wx.	Start	End		
Project Name YAVAPAI, AZ		IMU S/N 22		AGC # 1 & # 2 12 & 3	IMU Stop 17:56	Airport ID KSEZ		Pilot Chuck Lutz		GND Temp	14C	23C			
Mission ID (Pulsed/Static) 11936J07032702		AMT 4100		Range Gate 1200	Laser Pulse Rate 62000	GND Station ID KSEZ		Aircraft NS4HC	FMS CCNS3	Alt Temp	11C	14C			
Date 29-Apr-07	GPS Date 07-119	UTC Offset MST -7	Flight Plan BLOCK A/B	Attenuator 0.3	H.D. # 5	USGS PID # E51033(SEZC)		GPS Ant. Ht. 2.0M	UTM Zone	Altm Setting	30.18	30.18			
HZN Line #	Direction	From WPT	To WPT	Beginning GPS Time	Ending GPS Time	FOV	Scan Rate	Speed (Kts)	Comments / Conditions			SVs	VDOP	HDOP	
A29	339	1	19	133037	1334	30	42	136				9	1.9	1.2	
A30	159	19	1	133722	1340	30	42	143				9	2.0	1.2	
A30	339	1	5	134430	1345	30	42	138	CALIBRATION LINE			9	2.1	1.1	
A31	339	1	19	135042	1354	30	42	137				9	2.1	1.1	
A32	159	20	1	135717	1400	30	42	145				10	1.5	0.9	
A33	339	1	20	140415	1408	30	42	134				10	1.6	0.9	
A34	159	19	1	141110	1414	30	42	144				10	1.8	0.9	
A35	339	1	19	141759	1421	30	42	134				11	1.8	0.9	
A36	159	19	1	142455	1428	30	42	138				11	2.0	0.9	
A41	89	1	10	143220	1434	30	42	135				12	1.7	0.9	
A37	339	4	10	143909	1440	30	42	129				12	1.8	0.9	
A38	159	7	2	144333	1444	30	42	145				12	1.8	0.9	
A39	339	4	6	144841	1449	30	42	126				12	1.8	0.9	
A40	72	1	11	145303	1455	30	42	148	CROSS LINE			12	1.8	1.0	
B01	340	2	5	150645	1507	30	42	140	BLOCK B			12	1.6	1.0	
B02	160	7	1	151152	1513	30	42	140				12	1.2	0.7	
B03	340	1	7	151626	1518	30	42	143				12	1.2	0.7	
B04	160	7	1	152129	1522	30	42	141				11	1.2	0.8	
B05	340	1	7	152629	1527	30	42	146				11	1.2	0.8	
B06	160	6	1	153132	1532	30	42	140	LIGHT CHOP			11	1.2	0.8	
B07	340	1	6	153612	1537	30	42	144				10	1.3	0.8	
B08	340	1	3	153835	1539	30	42	143				10	1.2	0.8	
B09	160	19	3	154232	1545	30	42	136				10	1.2	0.8	
B10	340	5	21	154858	1552	30	42	147				10	1.2	0.8	
B11	160	23	1	155457	1559	30	42	138				11	1.0	0.8	
B12	340	1	24	160230	1606	30	42	148				11	1.0	0.8	
B13	160	25	1	160939	1614	30	42	136				11	1.0	0.8	
B14	340	1	25	161718	1621	30	42	148				9	1.6	1.1	
B15	160	25	1	162500	1629	30	42	136				9	1.7	1.1	
B15	340	1	8	163230	1633	30	42	146	CALIBRATION LINE			9	1.8	1.2	
B16	340	1	24	163919	1643	30	42	145				9	1.9	1.2	
B17	159	24	1	164622	1651	30	42	135				9	1.9	1.1	
B18	340	1	24	165354	1658	30	42	140				9	1.8	1.1	
B19	159	23	1	170123	1705	30	42	138				9	1.7	1.0	
B20	340	2	22	170820	1712	30	42	141				10	1.5	0.9	
B21	159	21	8	171452	1717	30	42	137				10	1.4	0.8	
B22	340	1	14	172030	1723	30	42	144				10	1.4	0.8	
B23	159	9	1	172556	1728	30	42	135	TURBULANCE			11	1.1	0.7	
B25	62	1	13	173047	1733	30	42	141	CROSS LINE			11	1.1	0.7	
B24	237	11	1	173729	1739	30	42	137	CROSS LINE			12	1.1	0.7	

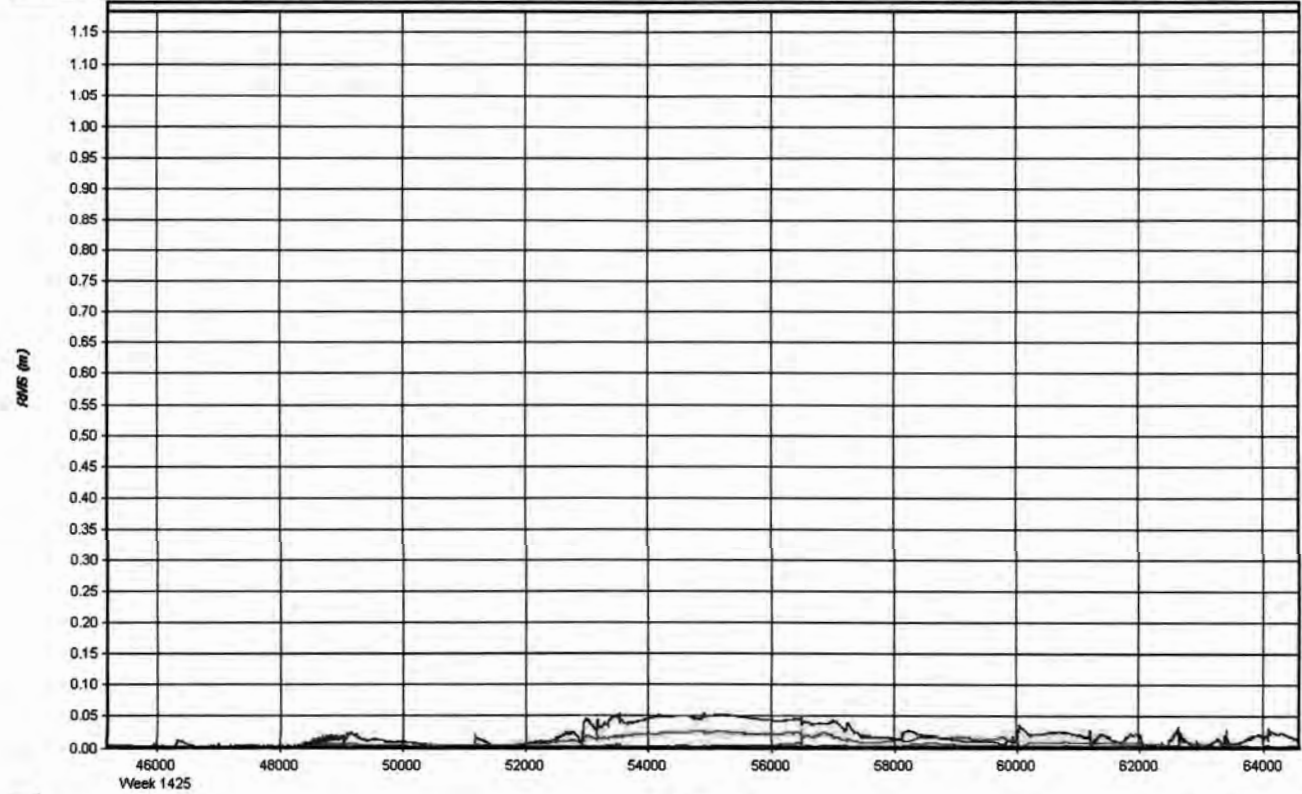
Diagram – GPS Solution Residuals

07119_36_02 - POSGPS - [07119_36_02 [Combined] - Forward/Reverse or Combined Separation Plot] File View Process Settings Output Tools Window Help



Run (4) GPS Time (sec) 12:39:49 on 05/02/2007
X: 45999.1 Y: 0.057 — East — North — Up Right click for more options

07119_36_02 - POSGPS - [07119_36_02 [Combined] - Forward/Reverse or Combined RMS Plot] File View Process Settings Output Tools Window Help



Run (4) GPS Time (sec) 12:39:40 on 05/02/2007
X: 60847.6 Y: 1.054 — East — North — Up Right click for more options

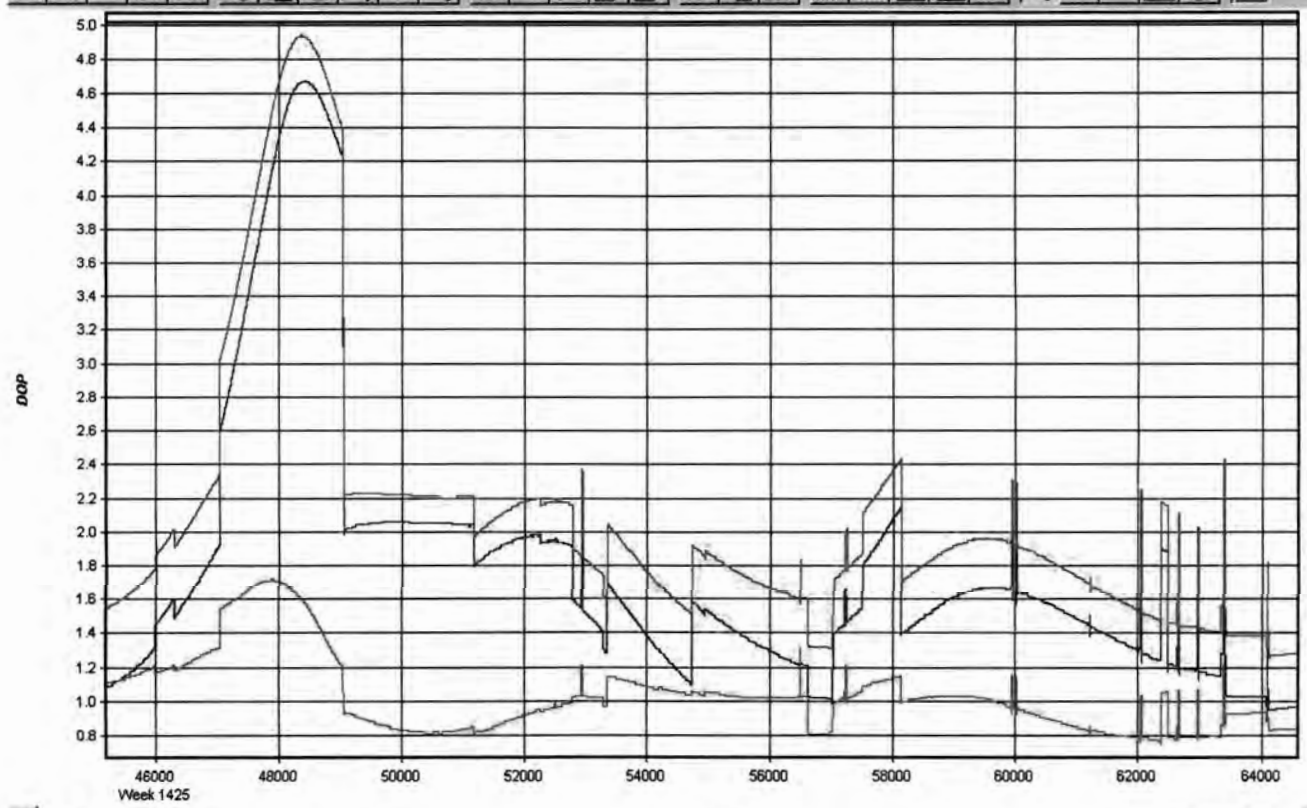
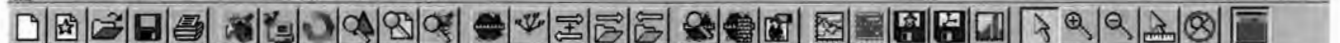
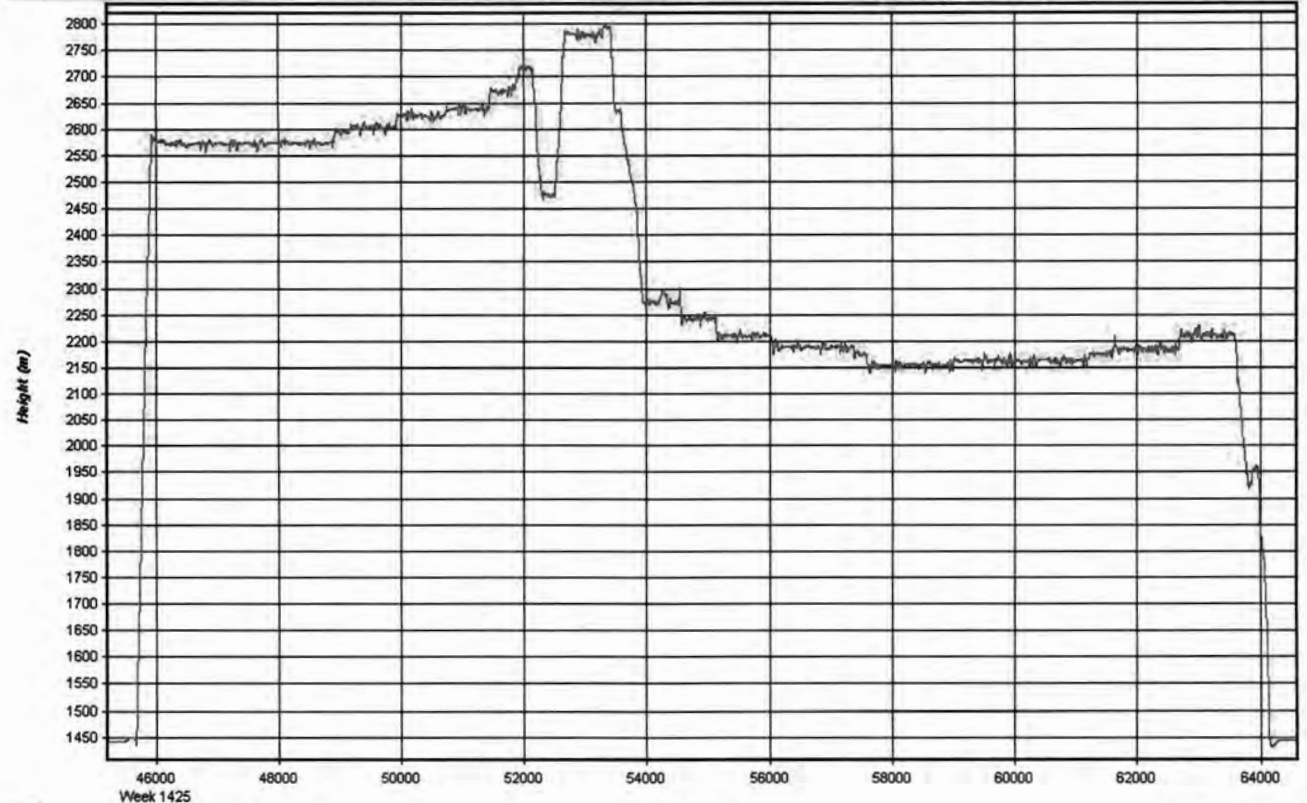


Diagram – Aircraft Trajectory Plot

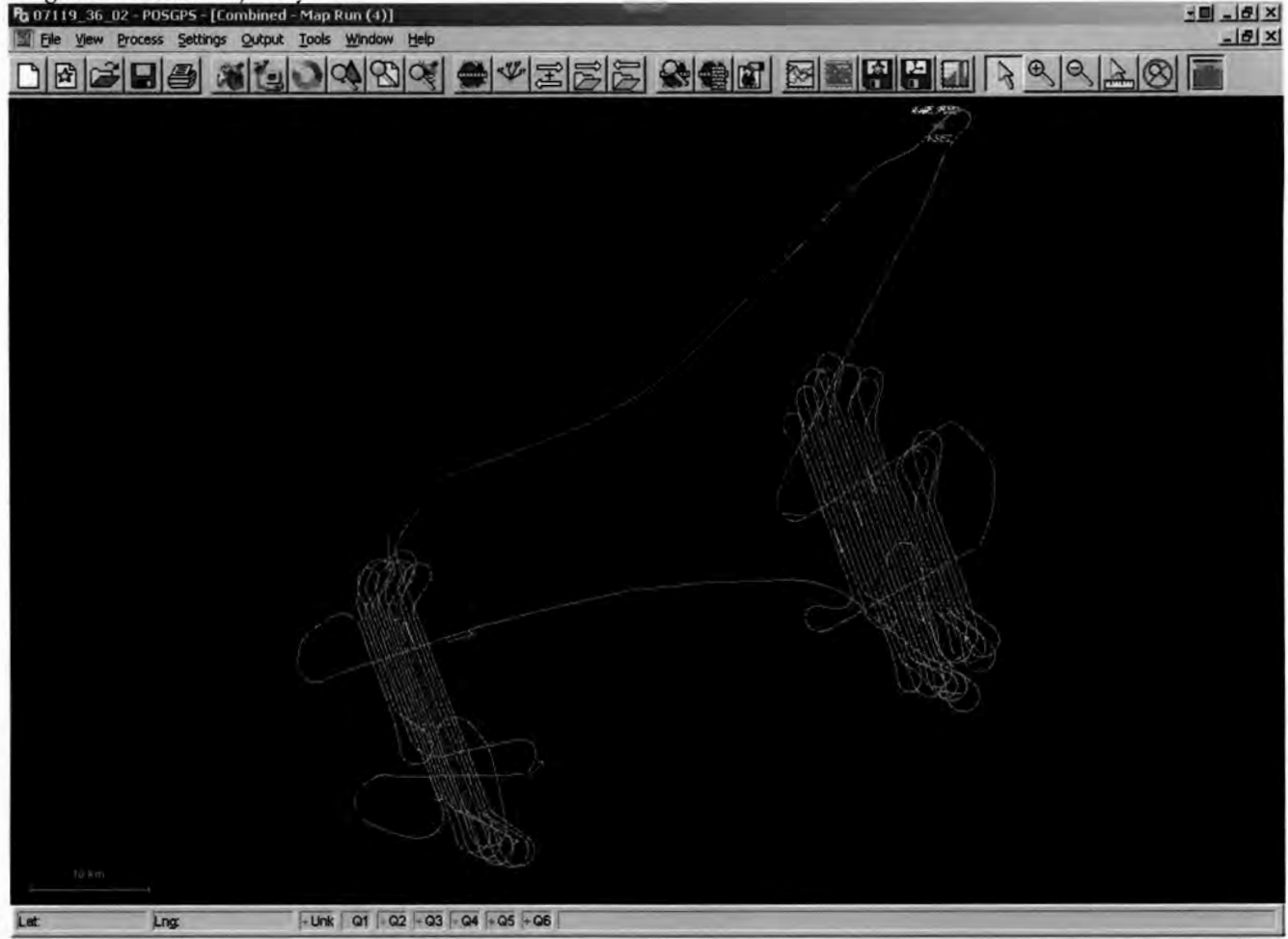
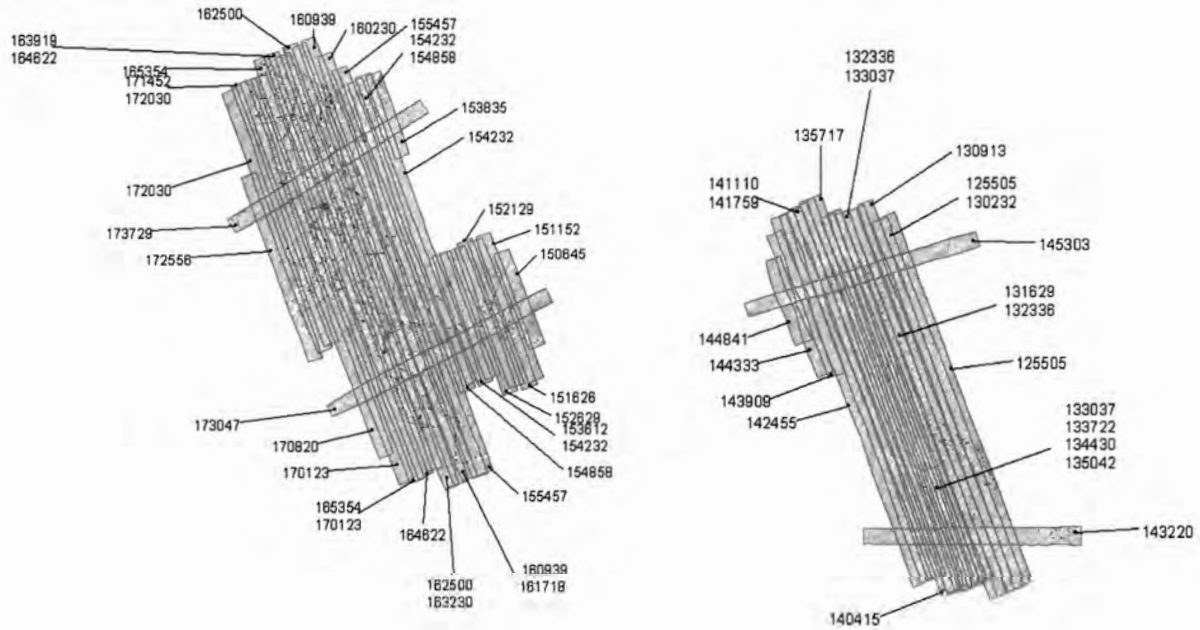


Diagram – LiDAR Coverage Check for Project Lines



Lift03

LiDAR Collection Logsheet

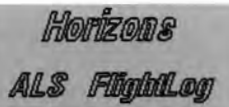
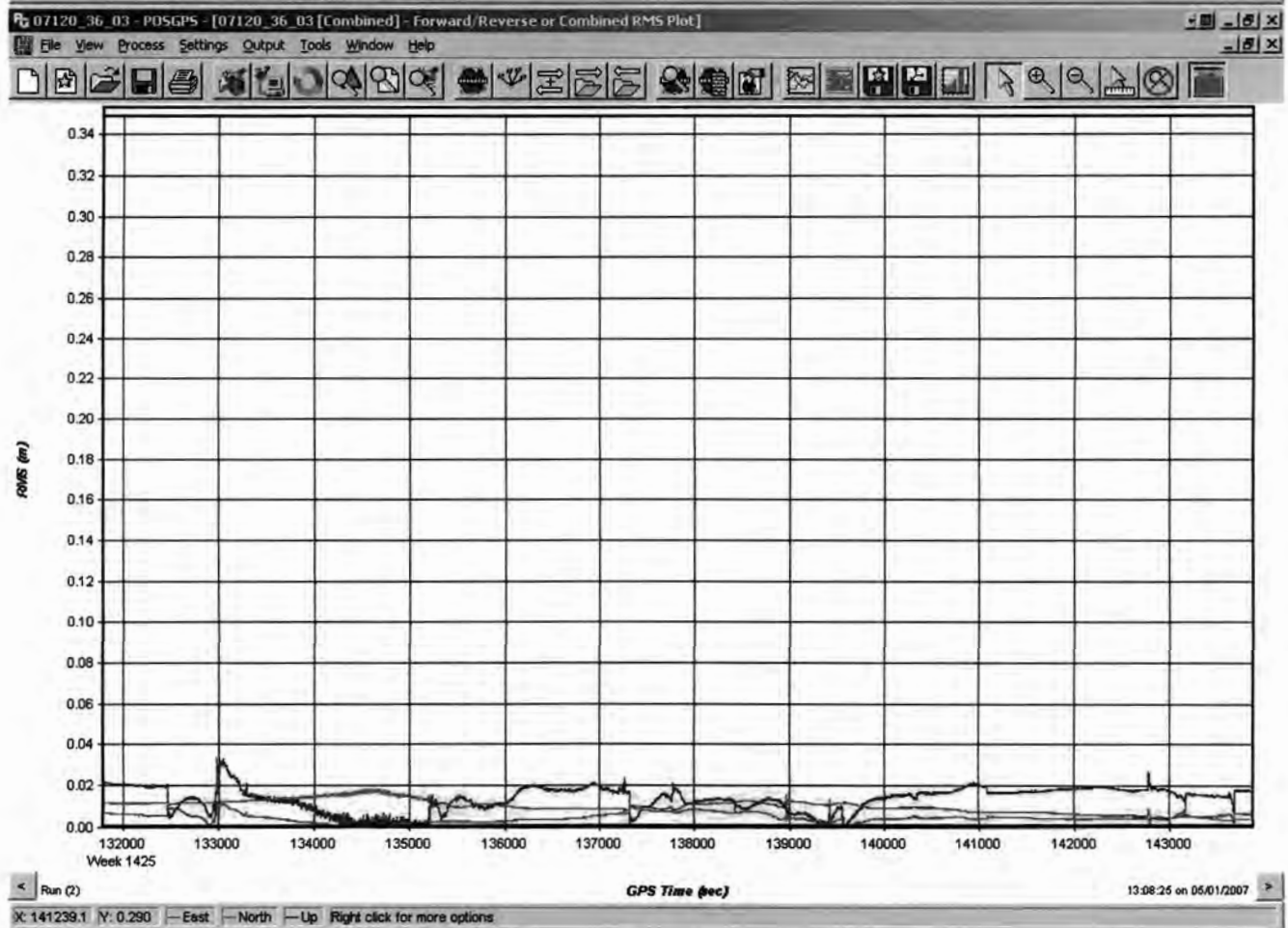
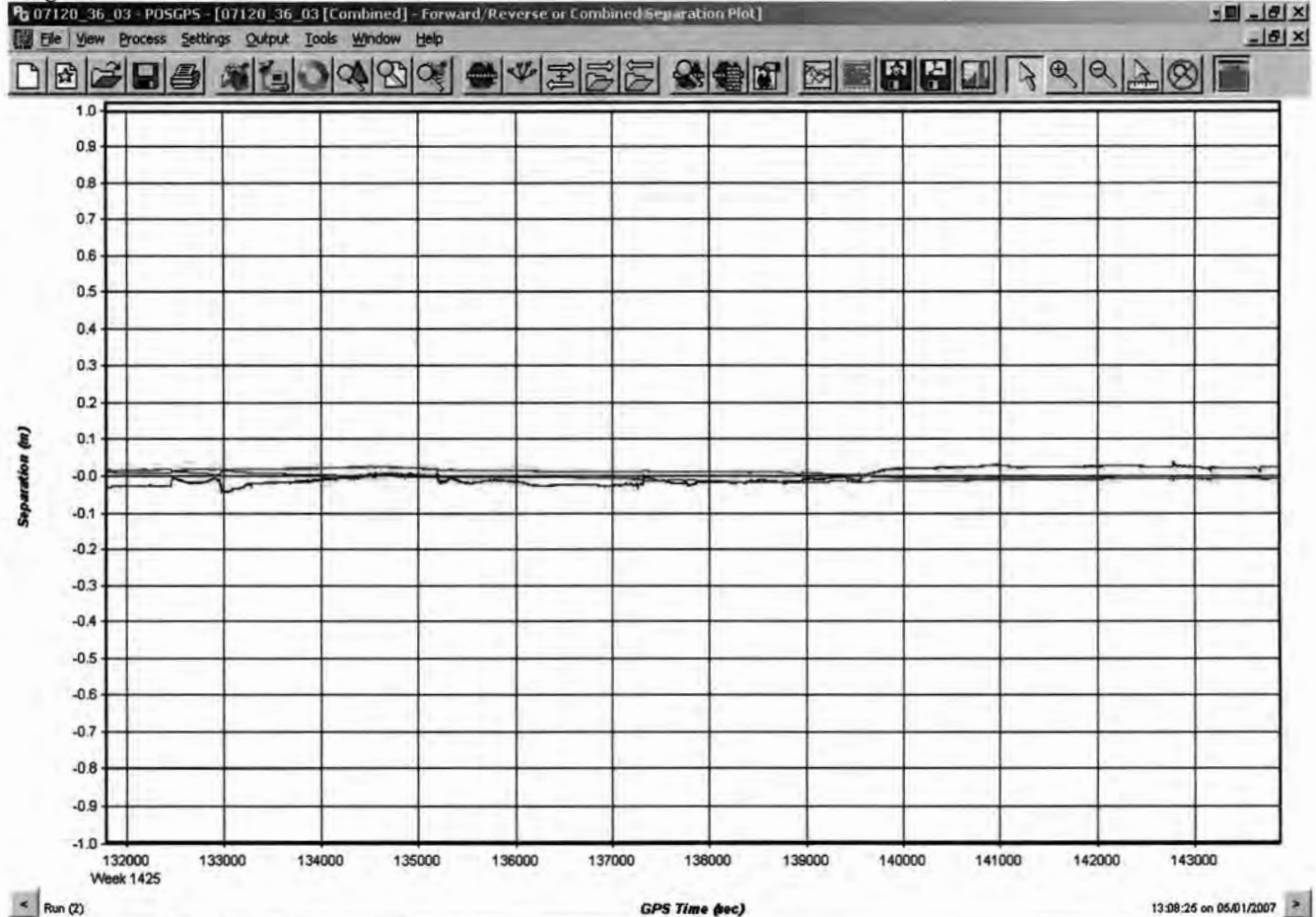
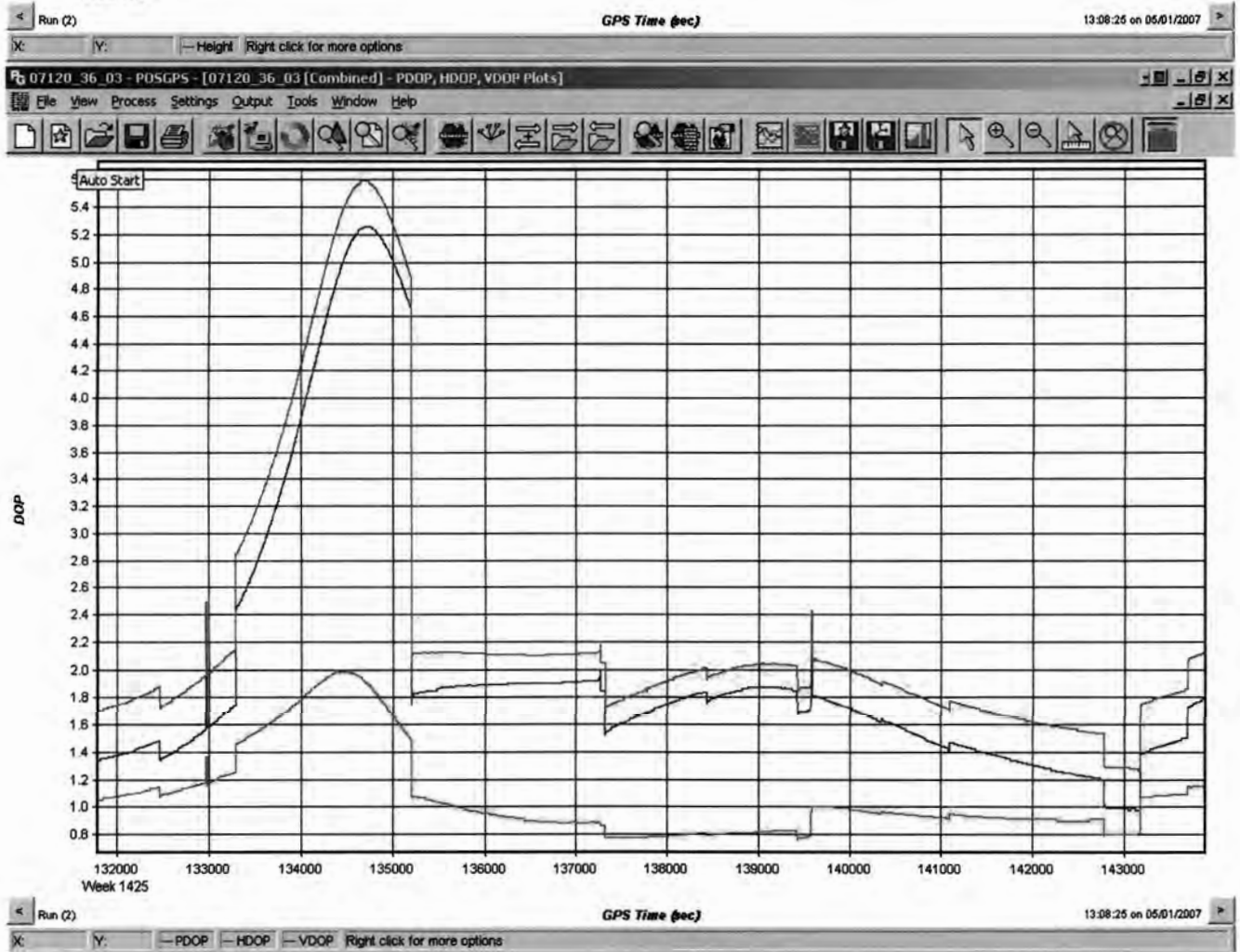
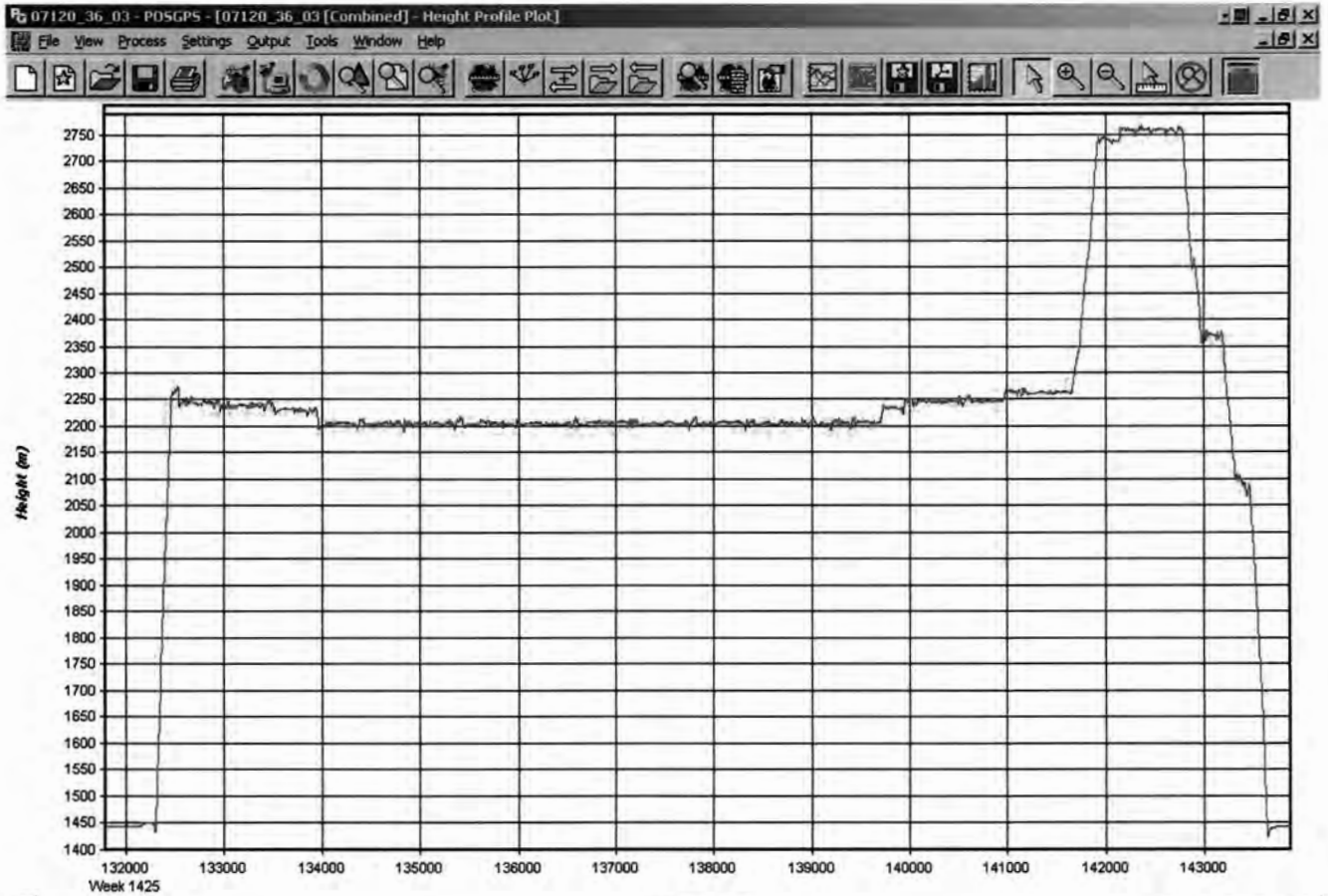
Lift		Airport	Checks Out	Airport	Checks In	Duration	3.5 Hrs.	Ramp	Activity			
1	KSEZ	12:30	KSEZ	16:00	3:30	3.5			Production			
2												
3												
Horizons Job # J07-0327		Client's Job #		Lidar S/N 36	Mode 4+3	IMU Start 12:36	Shipping Track Number 8588 7488 1463	Operator Eric Mueller		Wx.	Start	End
Project Name YAVAPAI, AZ		IMU S/N 22		AGC #1 & #2 12 & 3	IMU Stop 15:58	Airport ID KSEZ	Pilot Chuck Lutz		GND Temp	12C	19C	
Mission ID (B4455555/11111) 12036J07032703		AMT 4100		Range Gate 1200	Laser Pulse Rate 62000	GND Station ID KSEZ	Aircraft N94HC	FMS CCNS3	Alt Temp	12C	14C	
Date 30-Apr-07	GPS Date 07-126	UTC Offset MST -7	Flight Plan BLOCK A/B	Attenuator 0.3	H.D. # 5	USGS PID # ESI033(SEZC)	GPS Ant. Ht. 2.0M	UTM Zone	Altm Setting	30.18	30.18	
HZN Line #	Direction	From WPT	To WPT	Beginning GPS Time	Ending GPS Time	FOV	Scan Rate	Speed (Kts)	Comments / Conditions	SVs	VDOP	HDOP
D01	329	8	21	125146	1254	30	42	141	BLOCK D-FAIRLY SMOOTH SKIES	9	1.7	1.3
D02	149	23	1	125754	1302	30	42	146		9	1.9	1.3
D03	330	1	25	130524	1310	30	42	128		9	2.1	1.4
D04	149	25	1	131327	1318	30	42	142		10	1.2	1.0
D05	330	1	26	132140	1326	30	42	130		9	1.9	1.2
D06	149	28	1	132915	1334	30	42	140		9	2.0	1.2
D07	329	1	29	133759	1343	30	42	127	LIGHT CHOP	9	2.1	1.1
D08	149	37	1	134733	1354	30	42	139		9	2.1	1.1
D09	329	1	38	135745	1405	30	42	132		10	1.6	0.9
D10	149	38	1	140747	1414	30	42	142		10	1.8	0.9
D11	329	1	38	141757	1425	30	42	135		11	1.9	0.9
D12	149	38	1	142742	1434	30	42	141		12	1.7	0.9
D12	329	1	7	143802	1439	30	42	128	CALIBRATION LINE	12	1.8	0.9
D13	329	2	38	144441	1451	30	42	130		12	1.9	1.0
D14	149	37	2	145439	1501	30	42	145		12	1.8	1.0
D15	329	2	36	150431	1511	30	42	130		12	1.6	1.0
D16	149	35	1	151401	1520	30	42	144	POS/AV REJECTED	12	1.2	0.8
D40	239	10	1	154322	1545	30	42	132	SET PULSE RATE TO 60000	10	1.2	0.8

Diagram - GPS Solution Residuals





Lift04

LiDAR Collection Logsheet


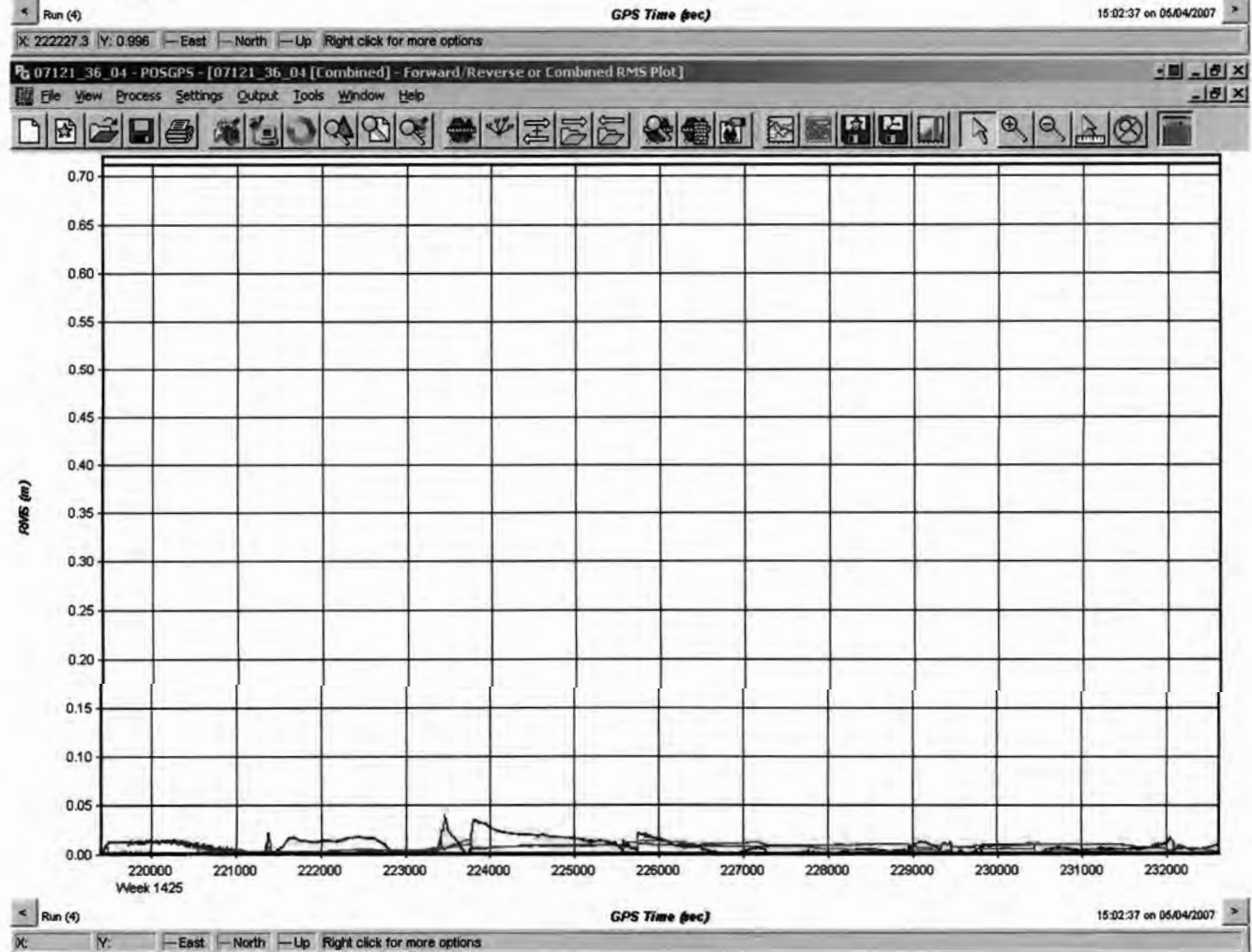
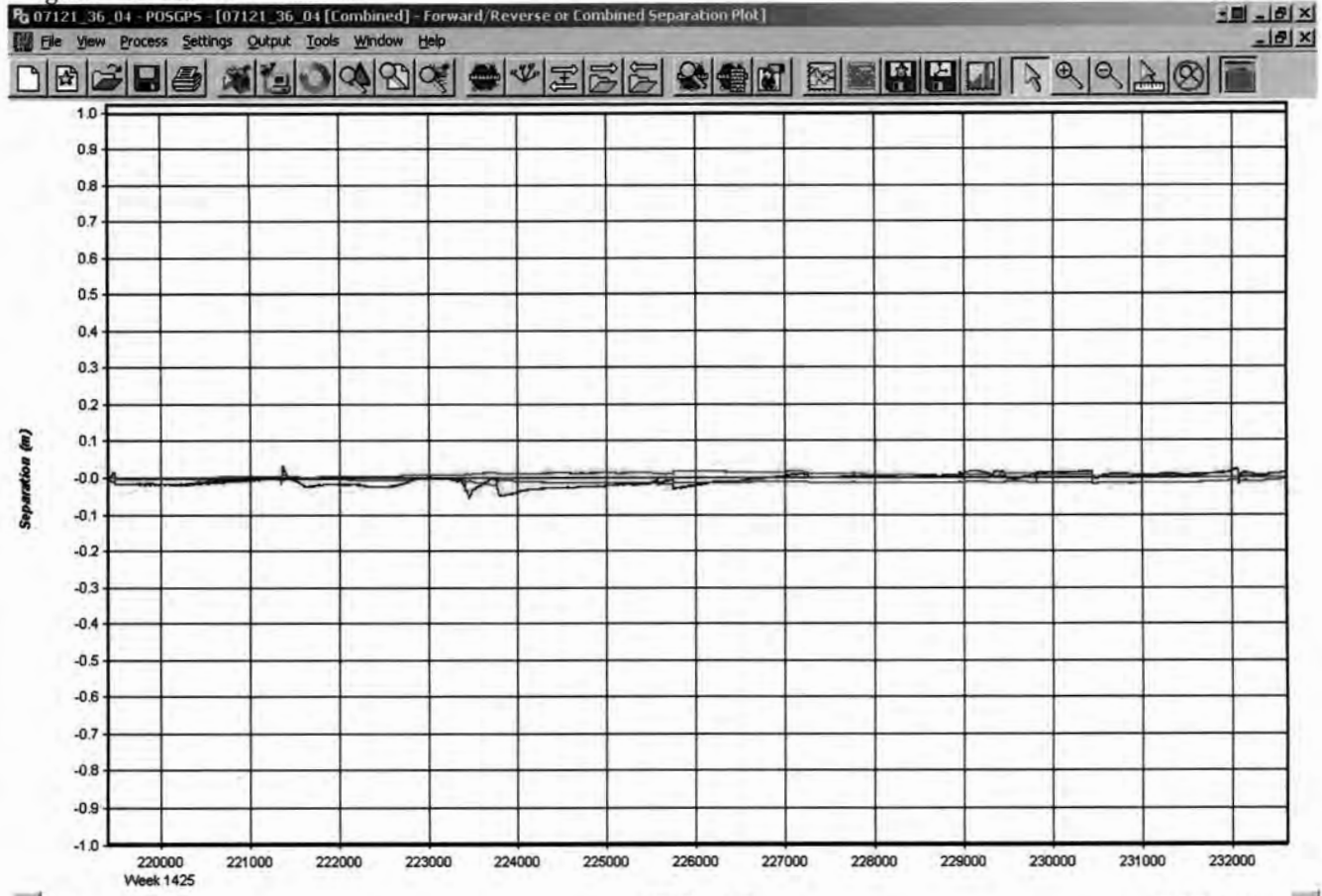
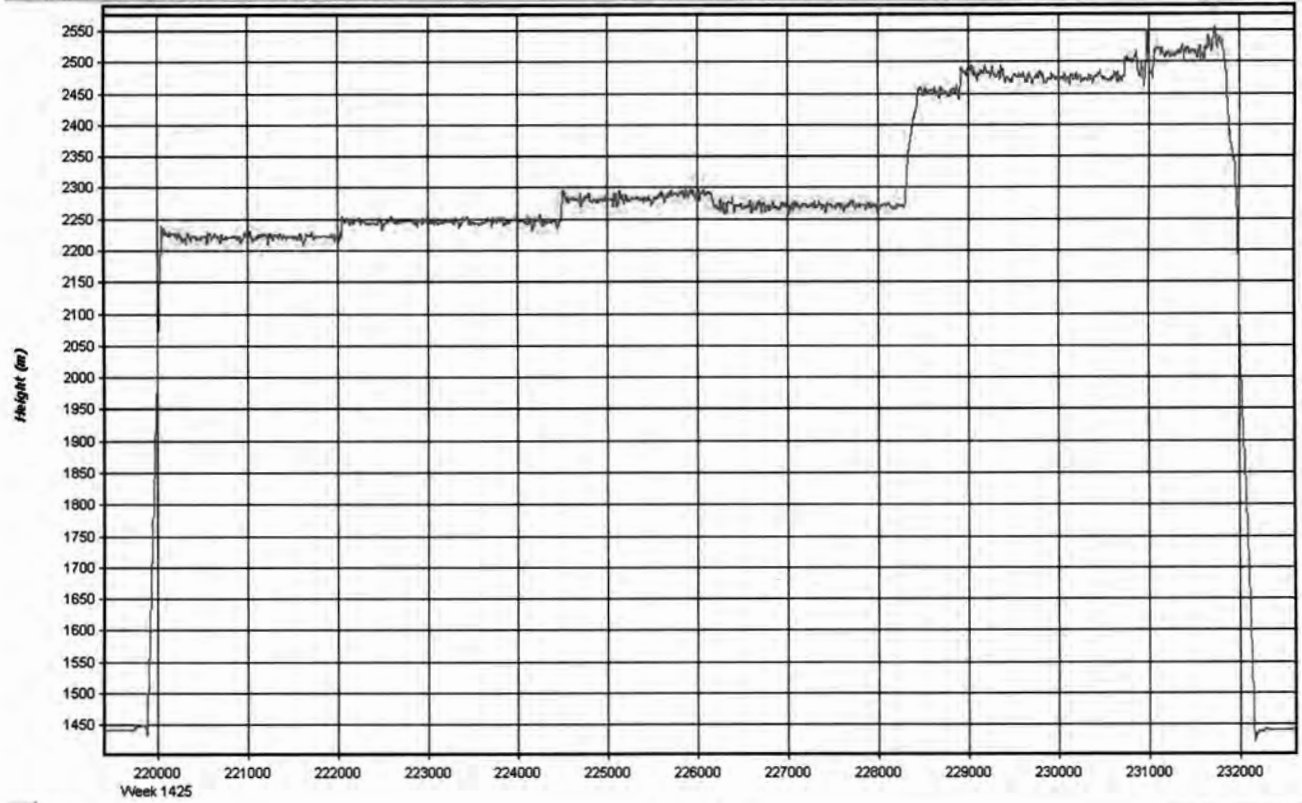
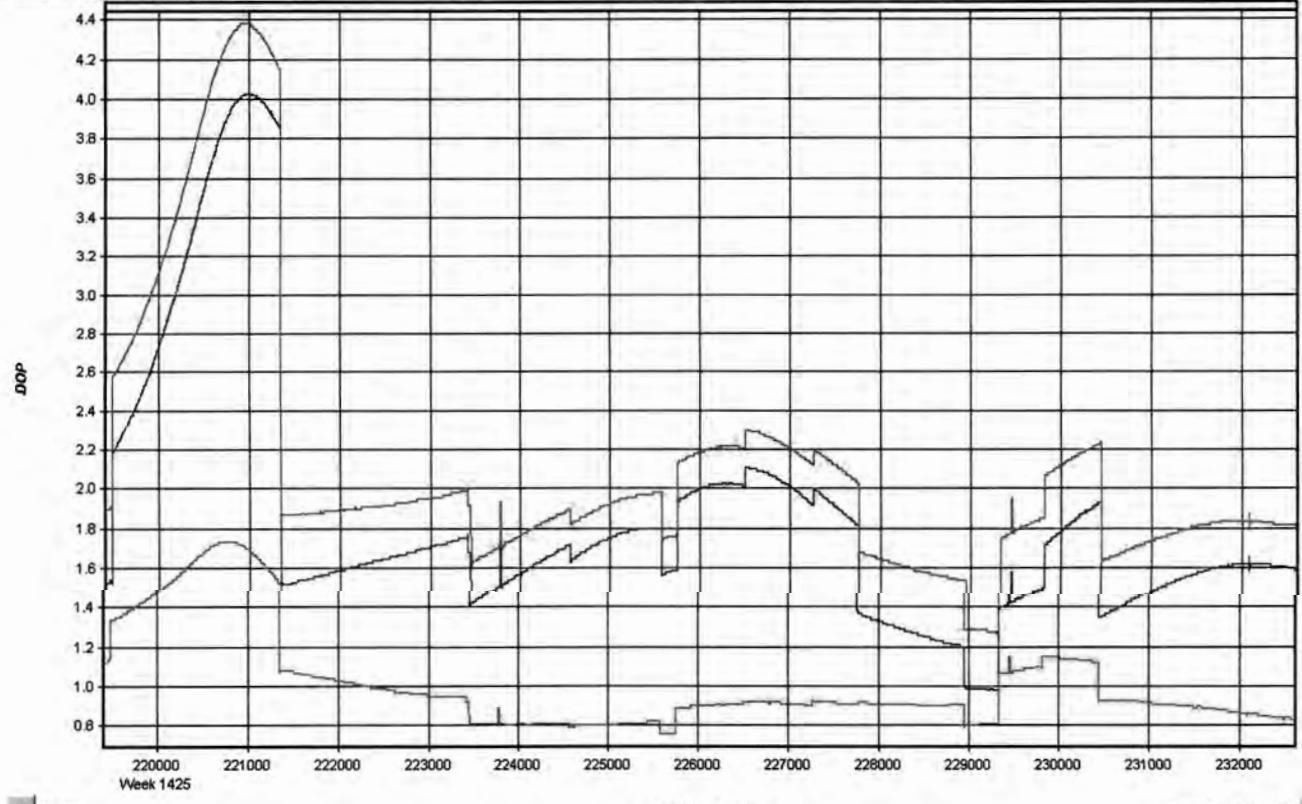
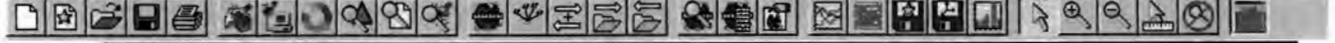
				Lift	Airport	Checks Out	Airport	Checks In	Duration	3.8 Hrs.	Ramp	Activity	<i>Horizons ALS FlightLog</i>		
				1	KSEZ	12:50	KSEZ	16:39	3:49	3.8		Production			
				2											
				3											
				4											
Horizons Job # J07-0327		Client's Job #		Lidar S/N 36	Mode 4-3		IMU Start 12:56		Shipping Track Number		Operator Eric Mueller		Wx	Start	End
Project Name YAVAPAI, AZ				IMU S/N 22	AGC #1 & #2 12 & 3		IMU Stop 16:37		Airport ID KSEZ		Pilot Chuck Lutz		GND Temp	18C	22C
Mission ID (P4GXXXXXXJ4114) 12136J07032784				AMT 4100	Range Gate 1200		Laser Pulse Rate 62000		GND Station ID KSEZ		Aircraft N94HC	FMS CCNS3	Alt Temp	14C	14C
Date 01-May-07	GPS Date 07-121	UTC Offset MST -7	Flight Plan BLOCK A/B		Attenuator 0.3		H.D. # 5		USGS PID # ES1033(SEZC)		GPS Ant. Ht. 2.0M	UTM Zone	Alt Setting	30.07	30.02
HZN Line #	Direction	From VPT	To VPT	Beginning GPS Time	Ending GPS Time	FOV	Scan Rate	Speed (Kts)	Comments / Conditions			SVs	VDOP	HDOP	
C01	78	1	11	131314	1315	30	42	140	BLOCK C-OVERCAST/FAIRLY SMOOTH			10	1.2	1.0	
C02	258	11	1	131845	1320	30	42	139	OCCASIONAL MIST/LIGHT SHOWER			9	1.9	1.2	
C03	78	1	11	132433	1326	30	42	141				9	2.0	1.2	
C04	258	13	1	132959	1332	30	42	142				9	2.0	1.2	
C05	78	1	20	133609	1340	30	42	137				9	2.1	1.1	
C06	258	20	1	134329	1347	30	42	147				9	2.1	1.1	
C07	78	1	20	135047	1354	30	42	143				10	1.5	0.9	
C08	258	20	3	135750	1401	30	42	140	LIGHT CHOP			10	1.7	0.9	
C09	78	1	17	140454	1408	30	42	144				11	1.6	0.9	
C10	258	17	1	141126	1414	30	42	140				11	1.8	0.9	
C10	78	1	10	141819	1420	30	42	140	CALIBRATION LINE			11	2.0	0.9	
C11	78	2	17	142733	1430	30	42	139				12	1.7	0.9	
C12	258	18	2	143333	1436	30	42	140				12	1.8	0.9	
C13	78	1	17	144033	1443	30	42	144				12	1.9	0.9	
C14	258	17	1	144706	1450	30	42	136	LIGHT TURBULANCE			12	1.8	1.0	
C15	78	1	15	145355	1456	30	42	146				12	1.7	1.0	
C16	258	10	1	150015	1502	30	42	139				11	2.2	1.1	
C17	78	1	10	150537	1507	30	42	142				12	1.2	0.7	
C18	258	10	1	151041	1512	30	42	140				12	1.2	0.8	
C19	78	1	3	151620	1517	30	42	148				11	1.2	0.8	
C20	167	12	1	152115	1523	30	42	143	CROSS LINE			11	1.2	0.8	
G01	270	7	1	153517	1536	30	42	135	BLOCK G			10	1.2	0.8	
G02	90	1	7	154040	1542	30	42	146				10	1.2	0.8	
G03	270	7	1	154542	1547	30	42	138				11	1.0	0.8	
G04	90	1	7	155051	1552	30	42	137				11	1.0	0.8	
G05	270	10	1	155806	1558	30	42	134				11	1.0	0.8	
G06	90	1	11	160140	1603	30	42	144				10	1.2	1.0	
G07	270	11	1	160709	1609	30	42	134				10	1.2	1.1	
G08	90	1	12	161303	1615	30	42	144				9	1.7	1.1	
F03	360	1	7	162314	1624	30	42	151	CROSS LINE			9	1.8	1.2	

Diagram - GPS Solution Residuals





X: 222499.0 Y: 2559.301 --Height Right click for more options



X: Y: --PDOP --HDOP --VDOP Right click for more options

Diagram – Aircraft Trajectory Plot

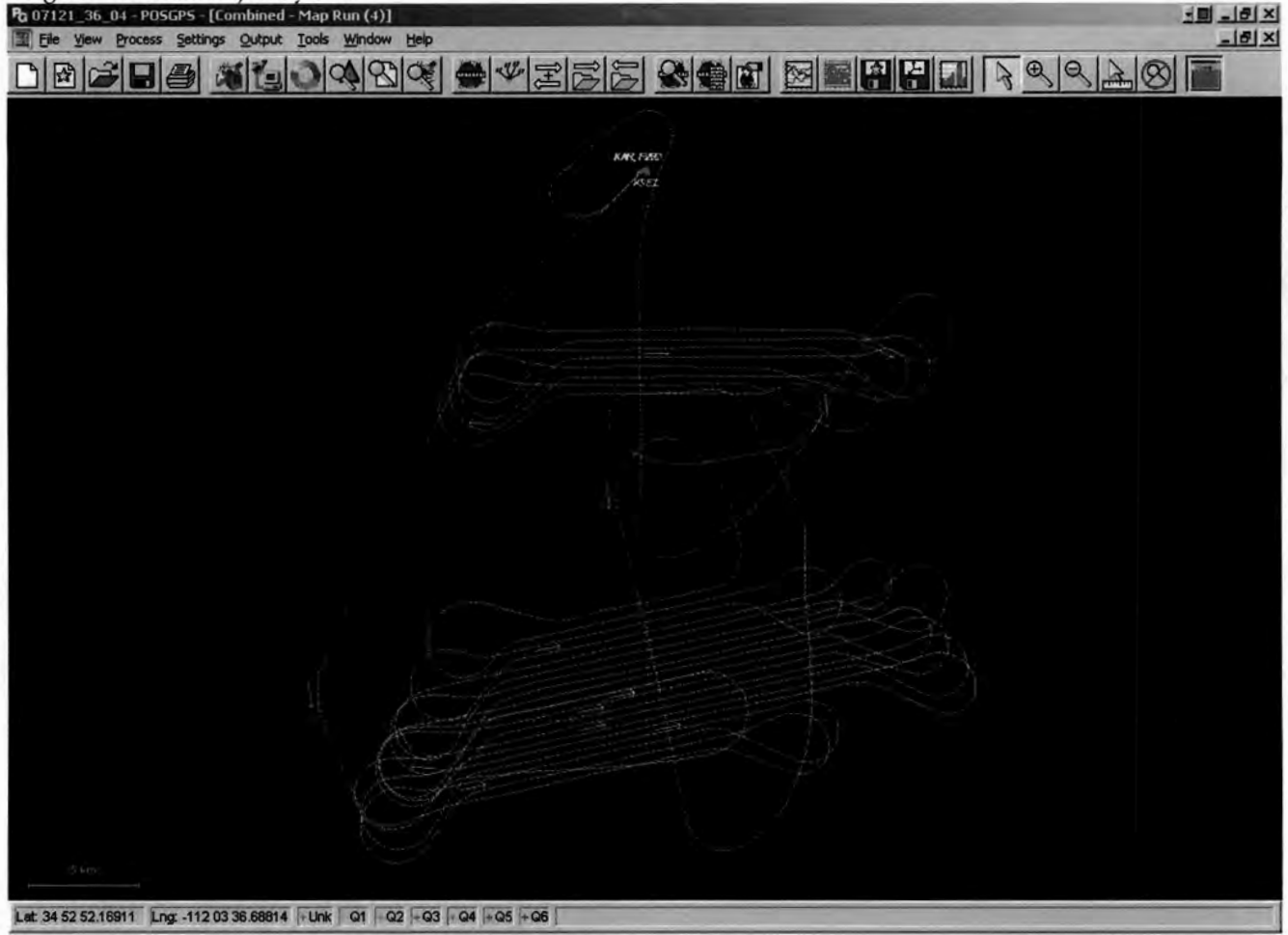
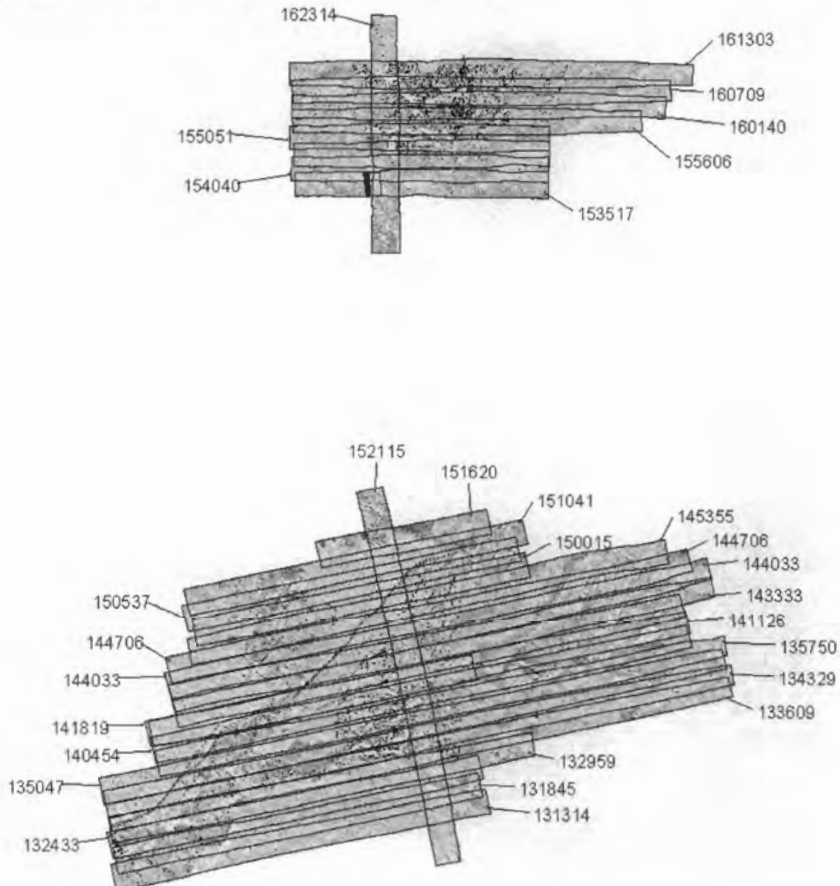


Diagram – LiDAR Coverage Check for Project Lines



Lift05

LiDAR Collection Logsheet


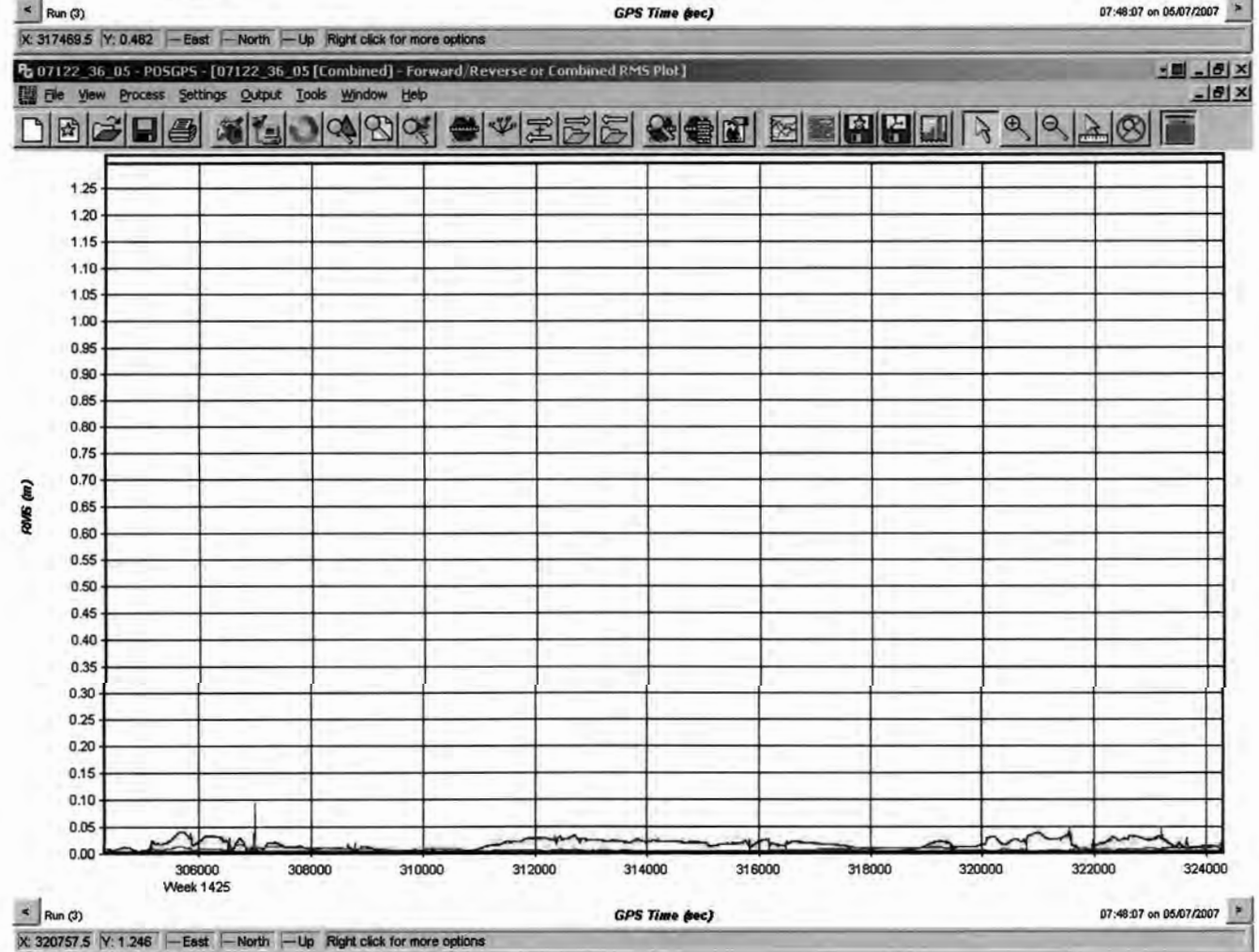
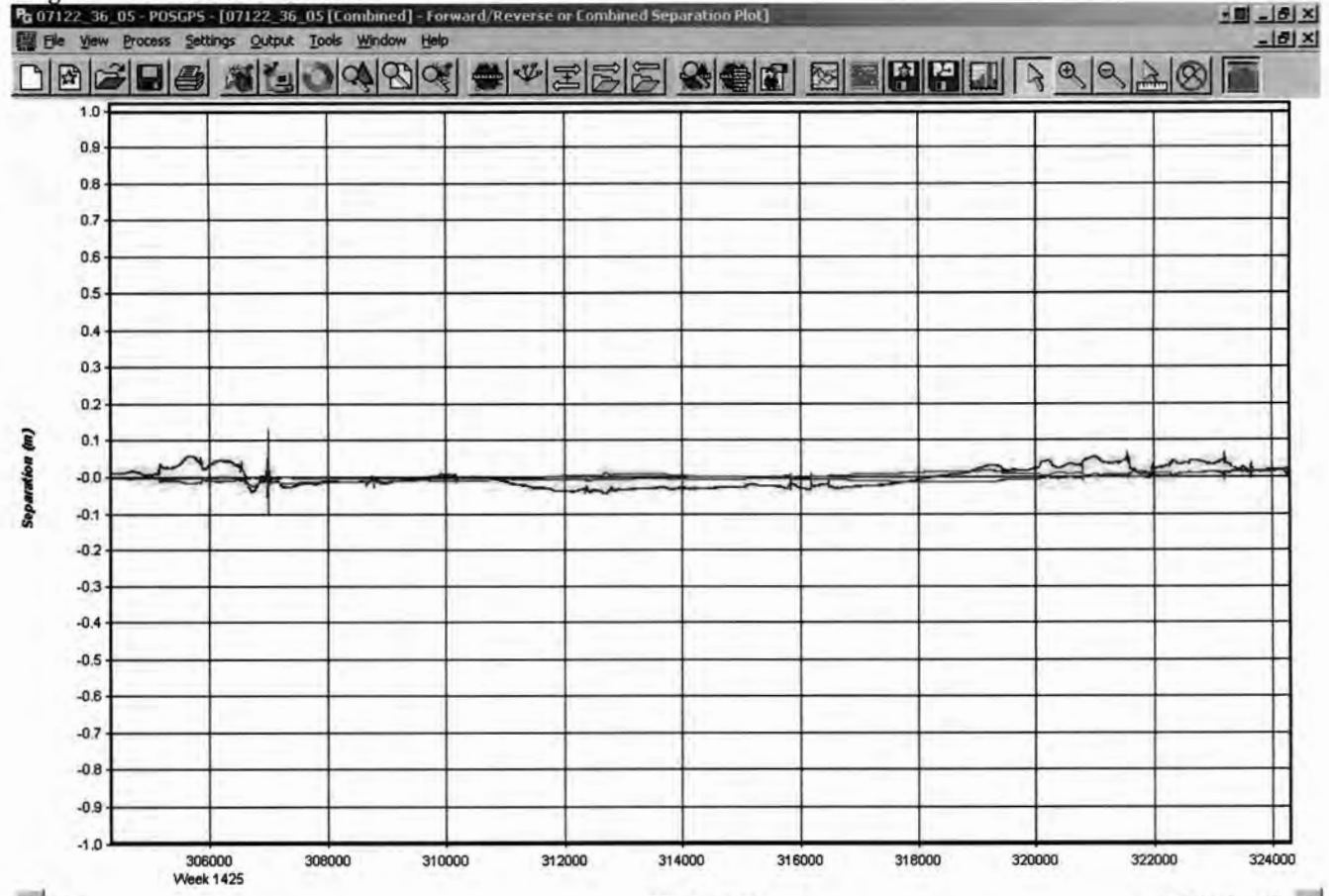
				Lift	Airport	Checks Out	Airport	Checks In	Duration	5.1 Hrs.	Ramp	Activity	<i>Horizons</i> <i>ALS FlightLog</i>		
				1	KSEZ	12:24	KSEZ	18:06	5:42	5.7		Production			
				2											
				3											
				4											
Horizons Job # J07-0327		Client's Job #		Lidar S/N 36	Mode 4+3		IMU Start 12:31		Shipping Track Number		Operator Eric Mueller		Wx	Start	End
Project Name YAVAPAI, AZ				IMU S/N 22	AGC #1 & #2 12 & 3		IMU Stop 18:05		Airport ID KSEZ		Pilot Chuck Lutz		GND Temp	14C	17C
Mission ID (B-47XXXXX-AddID) 12236J07032705				AMT 4100	Range Gate 1200		Laser Pulse Rate 62000		GND Station ID KSEZ		Aircraft N94HC	FMS CCNS3	Alt Temp	8C	12C
Date 02- Mag- 07	GPS Date 07-122	UTC Offset MST -7	Flight Plan BLOCK G/F/E	Attenuator 0.3		I.D. # 5		USGS PID # ES1033(SEZC)		GPS Ant. Ht. 2.0M	UTM Zone	Alt Setting	30.02	30.02	
HZN Line #	DIR	From WPT	To WPT	Beginning GPS Time	Ending GPS Time	FOV	Scan Rate	Speed (Kts)	Comments / Conditions			SVs	VDDP	HDOP	
G09	270	12	1	124720	1249	30	42	134	BLOCK G-OVERCAST/LIGHT CHOP			9	1.8	1.3	
G10	90	1	12	125321	1255	30	42	149				9	2.0	1.4	
G11	270	13	2	125918	1301	30	42	135				9	2.1	1.5	
G12	90	7	19	130503	1307	30	42	143				10	1.2	1.0	
G13	270	11	1	131215	1314	30	42	136				10	1.3	1.0	
E15	179	16	1	170822	1711	30	42	140	LIGHT TURBULANCE			10	1.4	0.9	
E16	359	1	16	171437	1717	30	42	145				11	1.1	0.7	
E17	179	16	1	172049	1724	30	42	136				11	1.1	0.7	
E18	359	1	16	172704	1730	30	42	148				12	1.1	0.7	
E19	179	9	1	173317	1736	30	42	140				12	1.1	0.6	
E21	80	10	1	174025	1742	30	42	142	CROSS LINE			10	1.3	0.8	
E20	236	14	1	174750	1750	30	42	137	CROSS LINE			9	1.4	0.9	

Diagram - GPS Solution Residuals



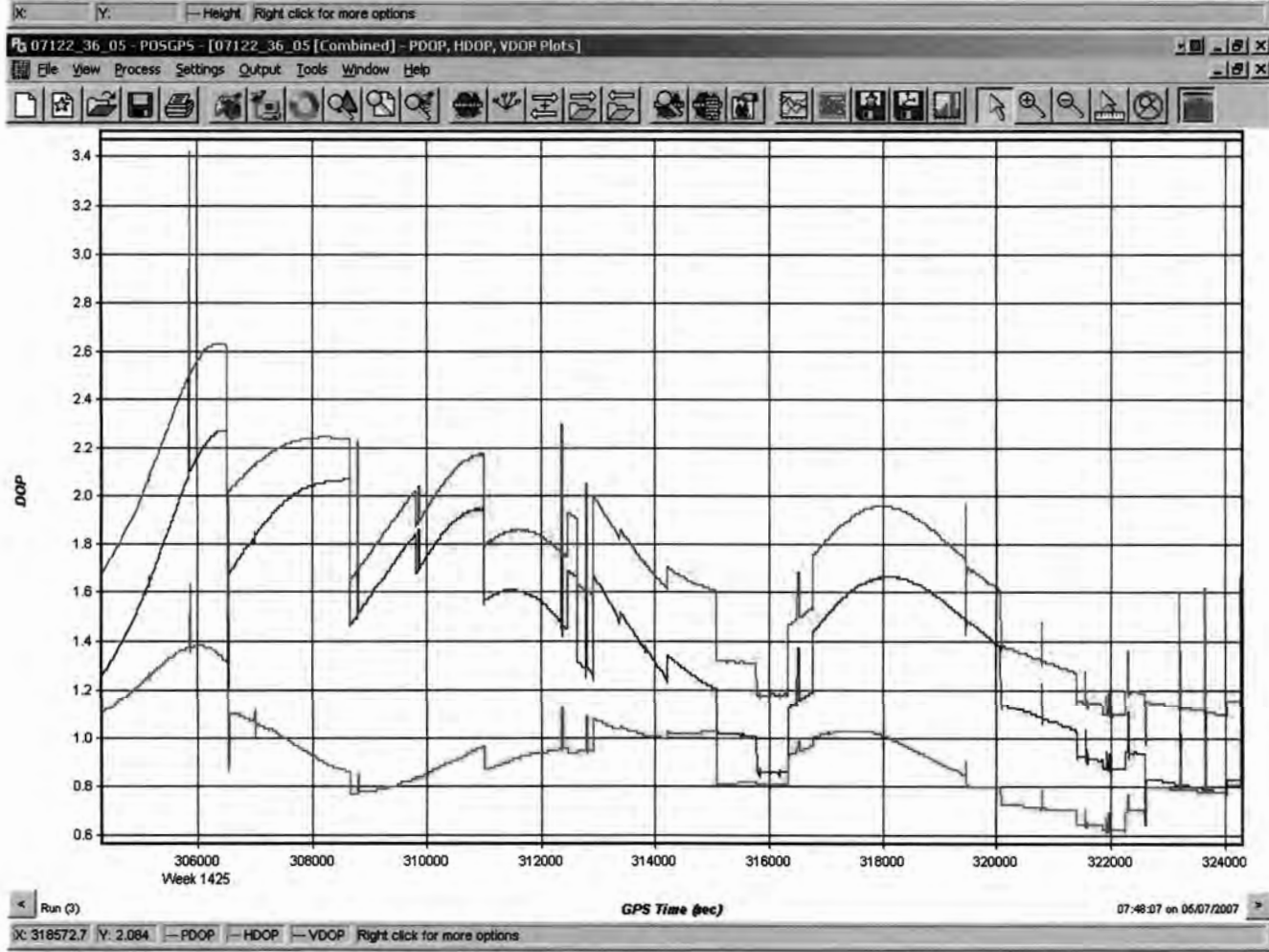
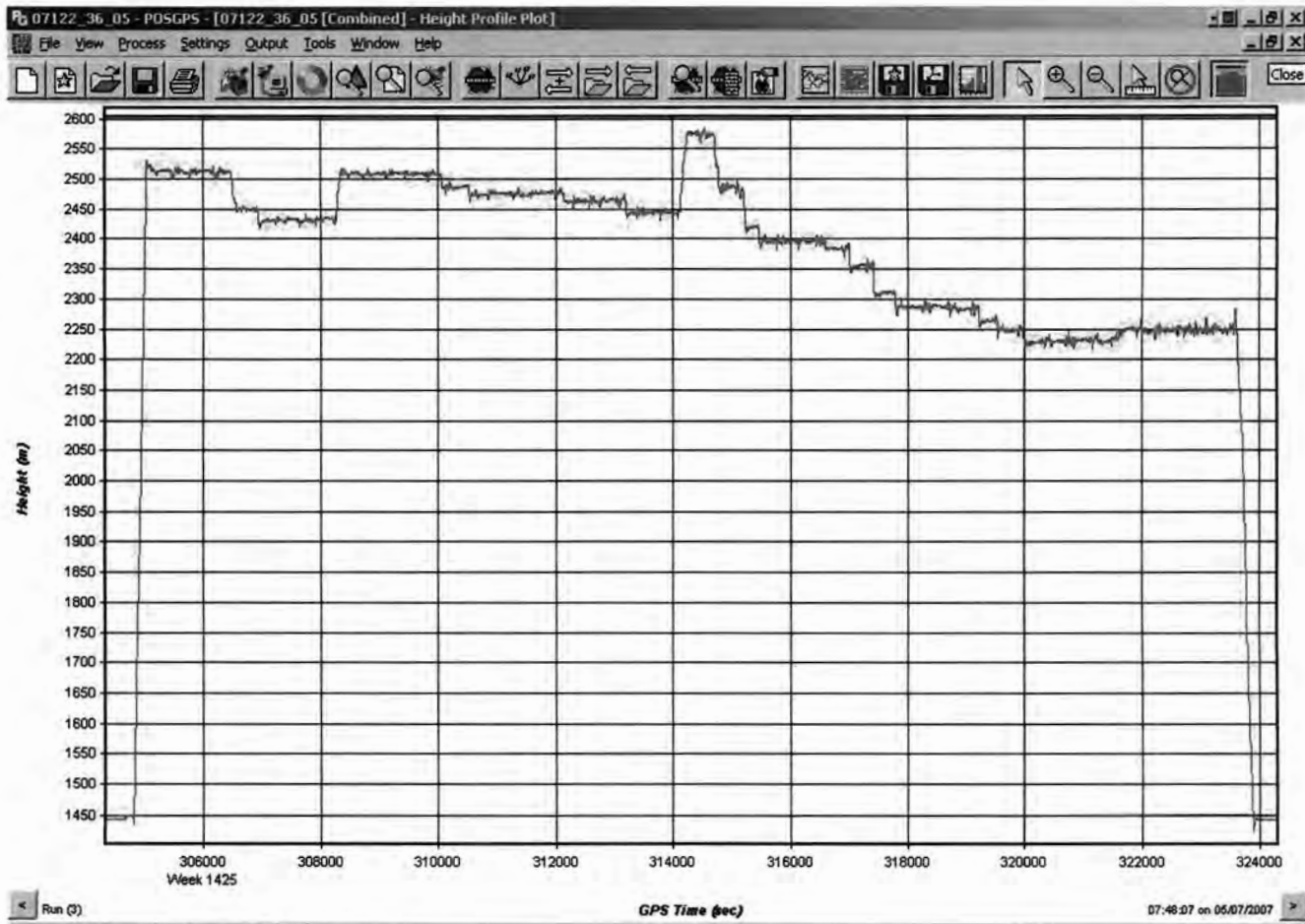


Diagram – Aircraft Trajectory Plot

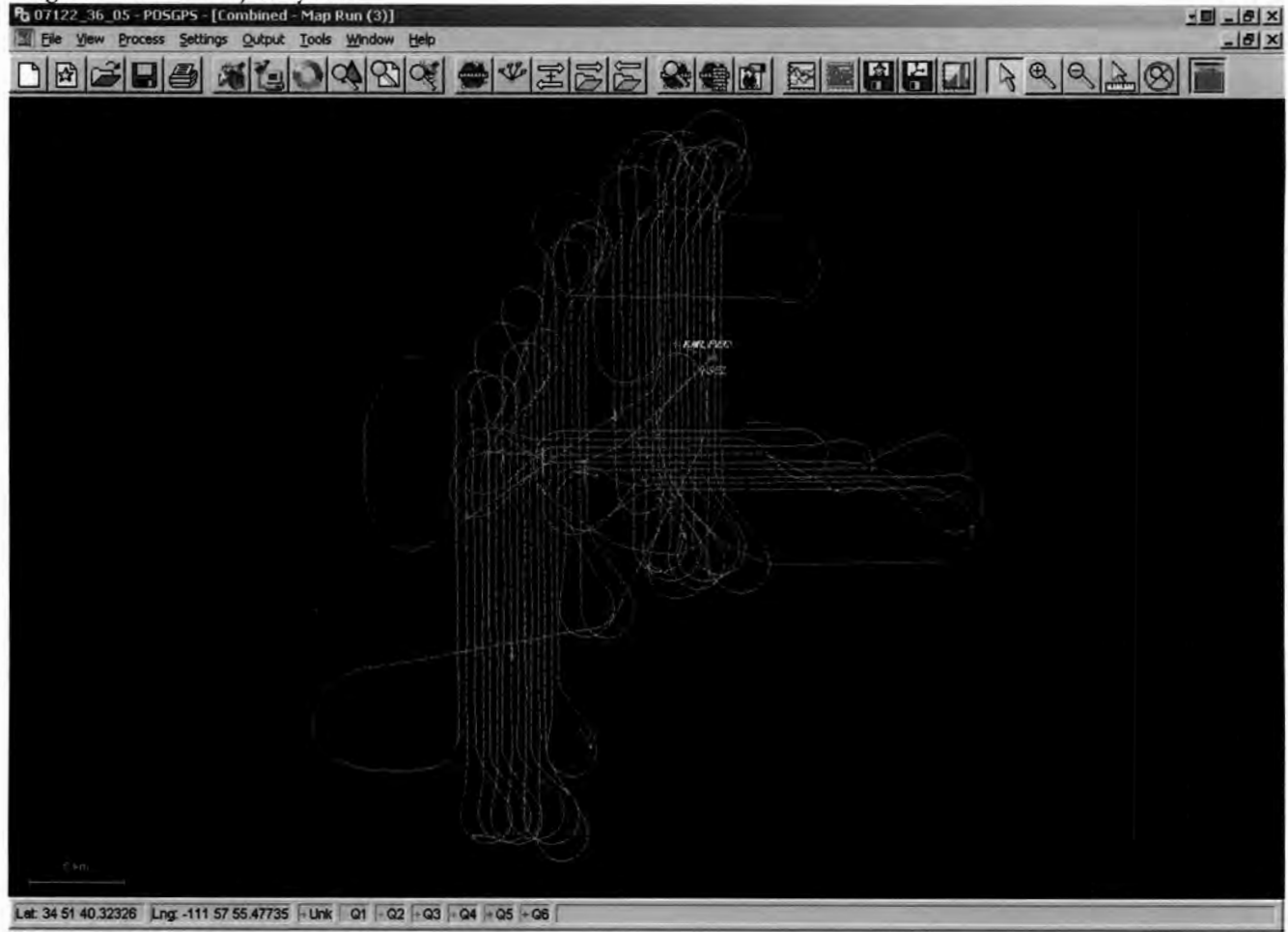
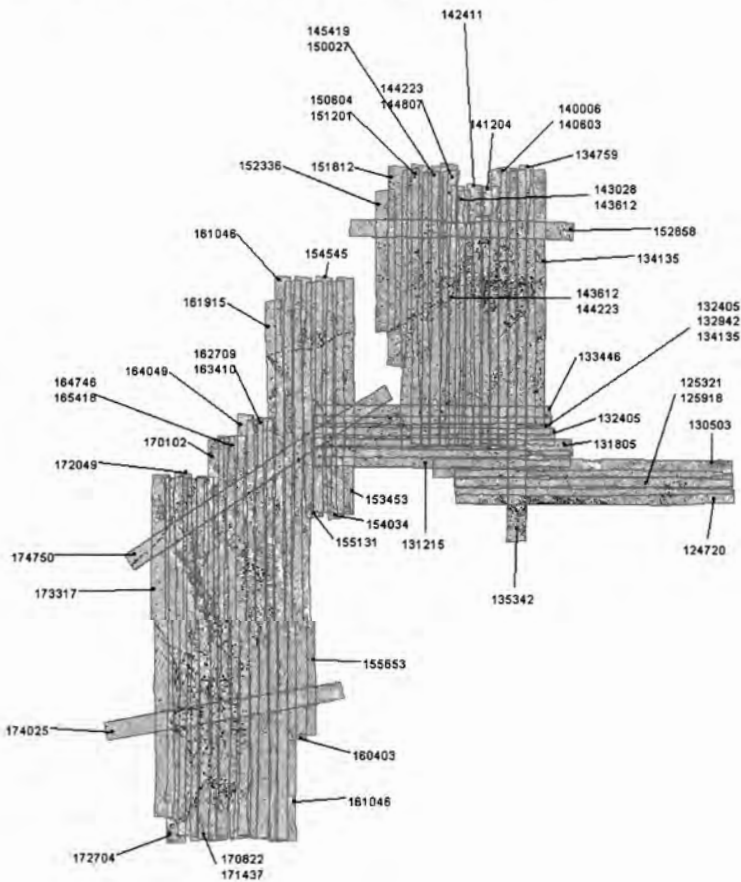


Diagram – LiDAR Coverage Check for Project Lines



Lift06

LiDAR Collection Logsheet

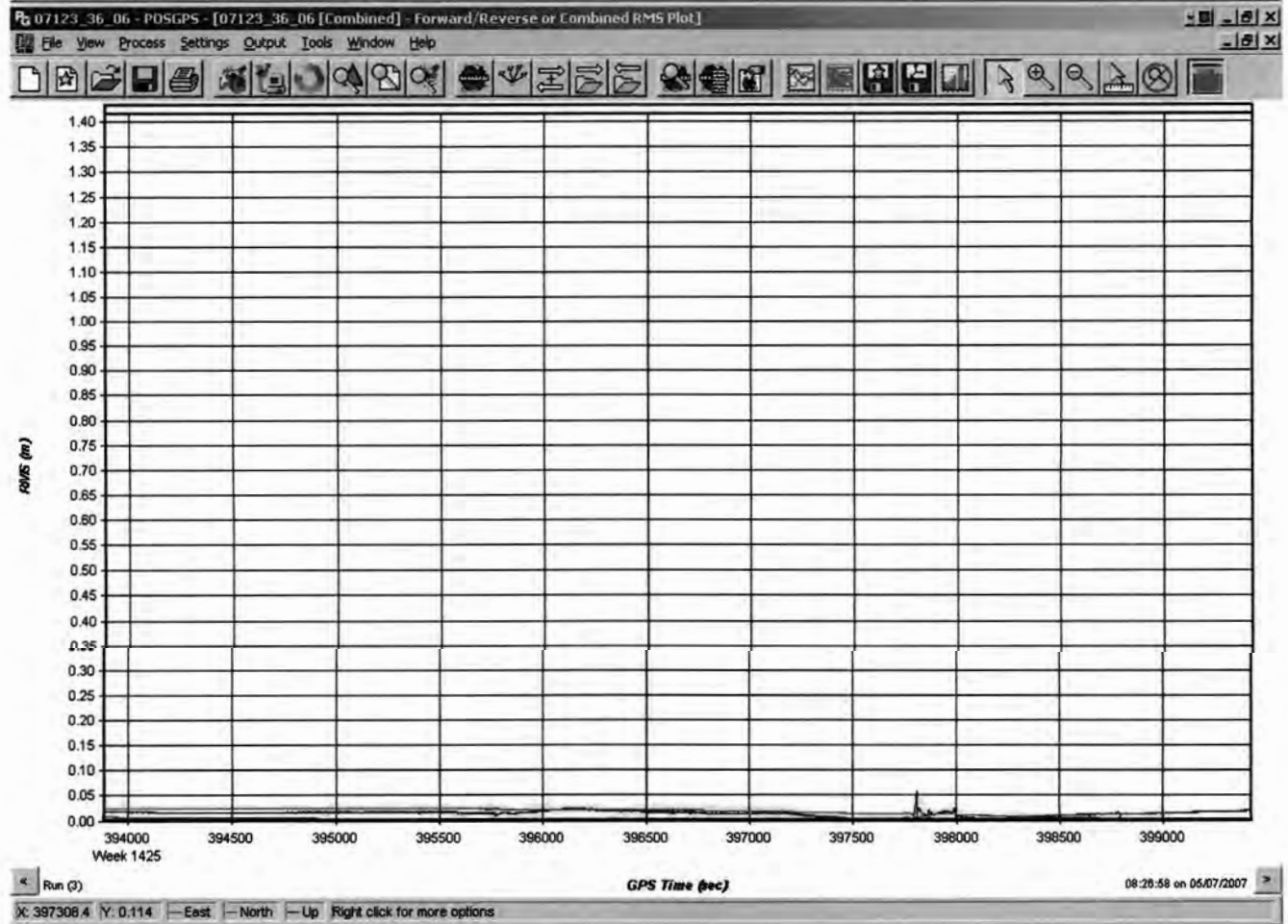
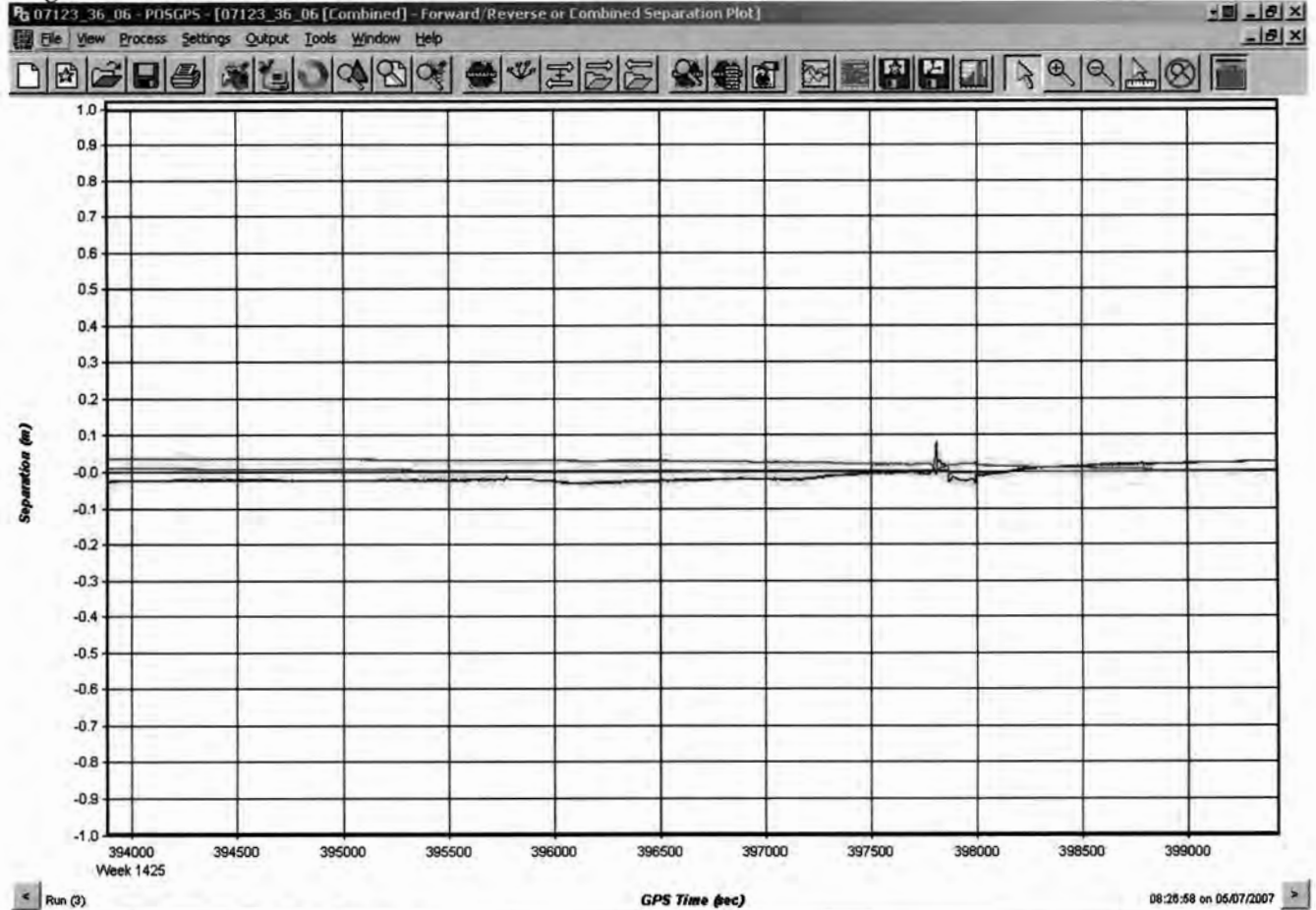


Lift	Airport	Checks Out	Airport	Checks In	Duration	1.7 Hrs.	Ramp	Activity
1	KSEZ	13:18	KSEZ	14:59	1:41	1.7		Production
2								
3								
4								

HORIZONS
ALS FlightLog

Horizons Job # J07-0327		Client's Job #		Lidar S/N 36	Mode 4-3	IMU Start 13:24	Shipping Track Number	Operator Eric Mueller		Wx.	Start	End
Project Name YAVAPAI, AZ				IMU S/N 22	AGC #1 & #2 12 & 3	IMU Stop 14:57	Airport ID KSEZ	Pilot Chuck Lutz		GND Temp	16C	15C
Mission ID (XXXXXXXXXX) 12336J07032706				AMT 4100	Range Gate 1200	Laser Pulse Rate 62000	GND Station ID KSEZ	Aircraft N94HC	FMS	Alt Temp	10C	10C
Date 03-May-07	GPS Date 07-123	UTC Offset MST -7	Flight Plan BLOCK D	Attenuator 0.3	H.D. # 5	Download "Firewire" PD007	USGS PID # ES1033(SEZC)	GPS Ant. Ht. 2M	UTM Zone	Altm Setting	29.91	29.94
HZN Line #	Direction	From WPT	To WPT	Beginning GPS Time	Ending GPS Time	FOV	Scan Rate	Speed (Kts)	Comments / Conditions	SVs	VDOP	HDOP
D17	329	7	34	134345	1349	30	42	143	BLOCK D-CLEAR/LT TO MOD TURBLLANCE	10	1.6	0.9
D18	149	32	9	135240	1357	30	42	130		10	1.7	0.9
D19	329	4	27	140030	1404	30	42	149		11	1.8	0.9
D20	149	23	1	140853	1413	30	42	141		11	2.0	0.9
D21	329	1	22	141611	1420	30	42	152		12	1.7	0.9
D22	149	22	4	142435	1428	30	42	132	1000' HIGH @ S END DUE TO TURBLLANCE	12	1.8	0.9
E21	260	16	24	143941	1441	30	42	117	CROSS LINE	12	1.8	1.0

Diagram - GPS Solution Residuals



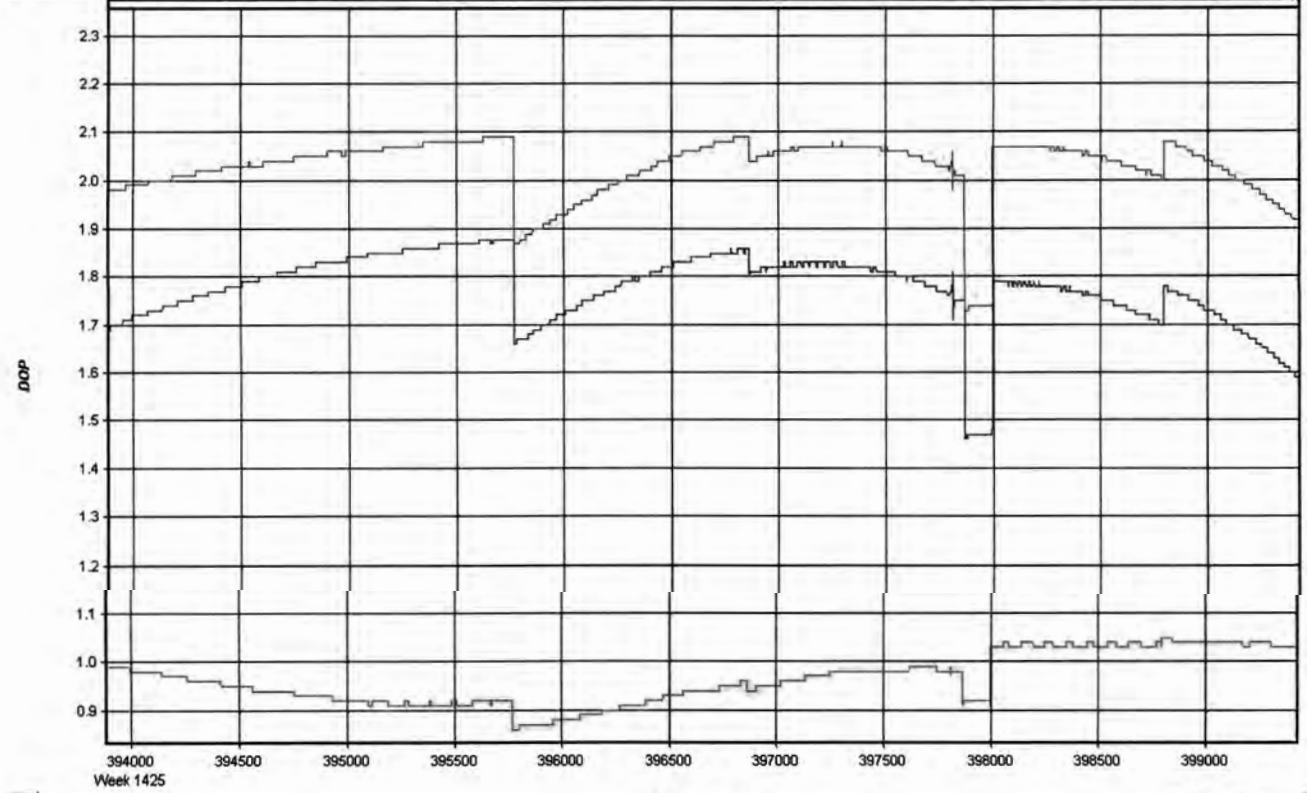
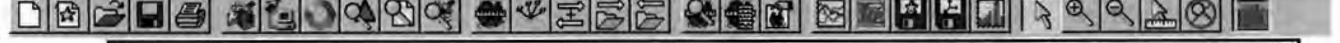
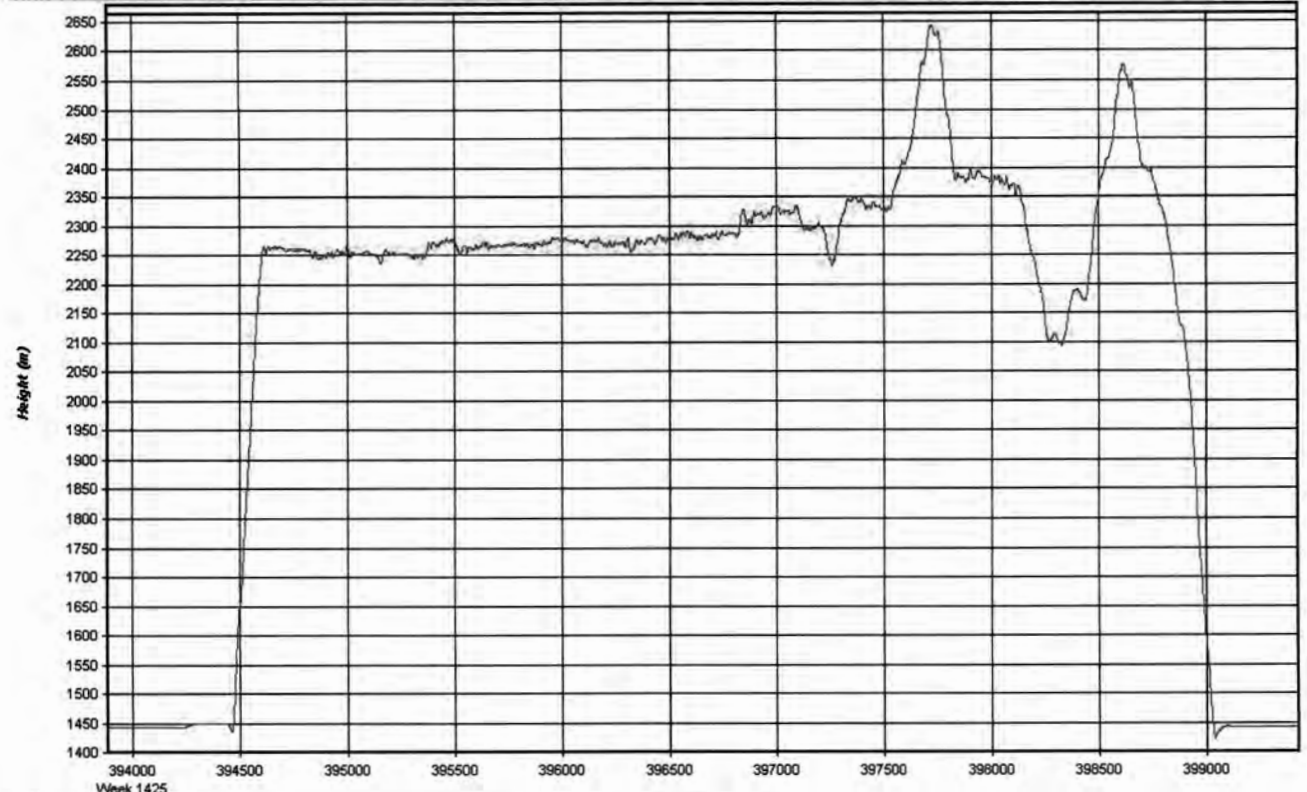


Diagram – Aircraft Trajectory Plot

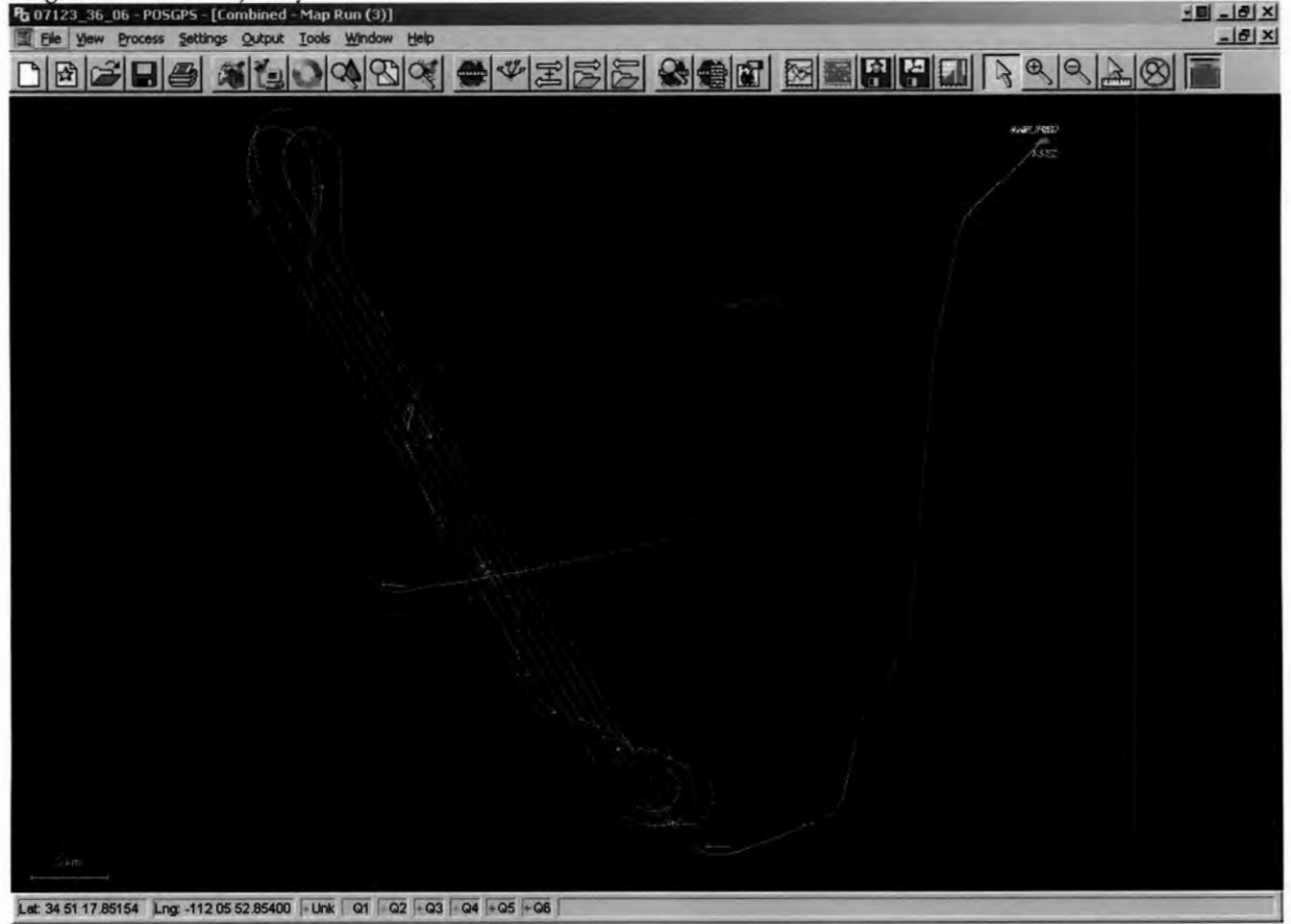
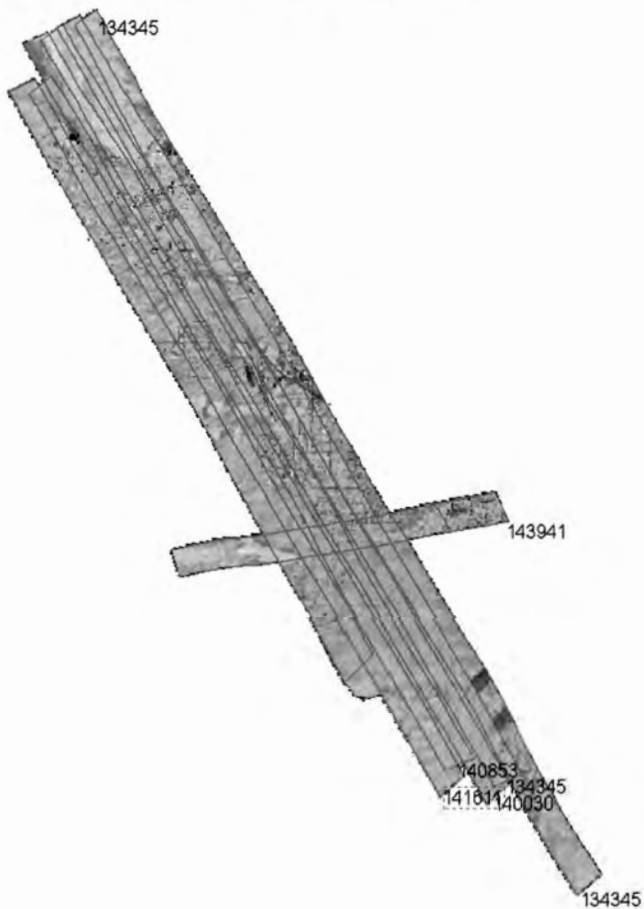


Diagram – LiDAR Coverage Check for Project Lines

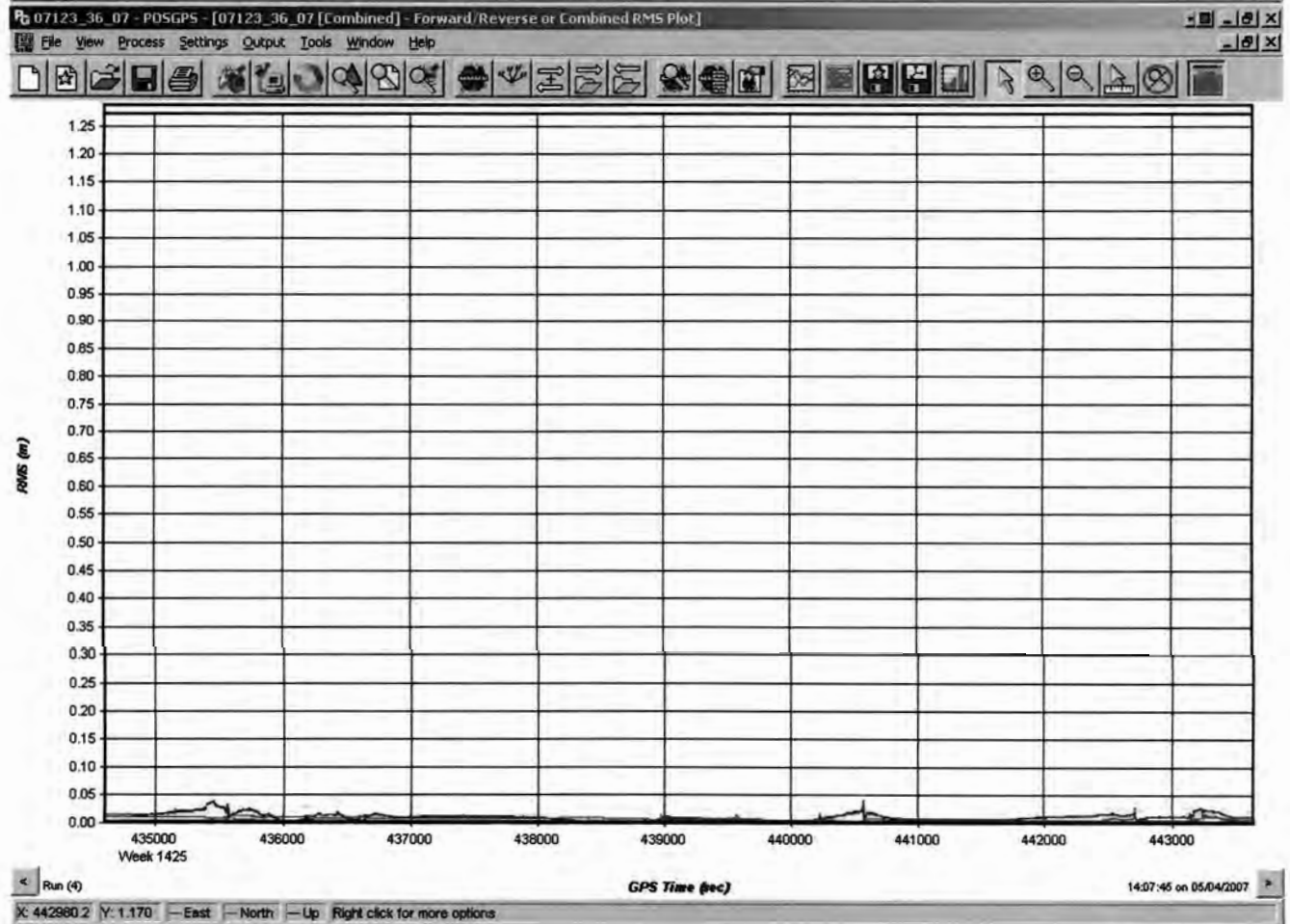
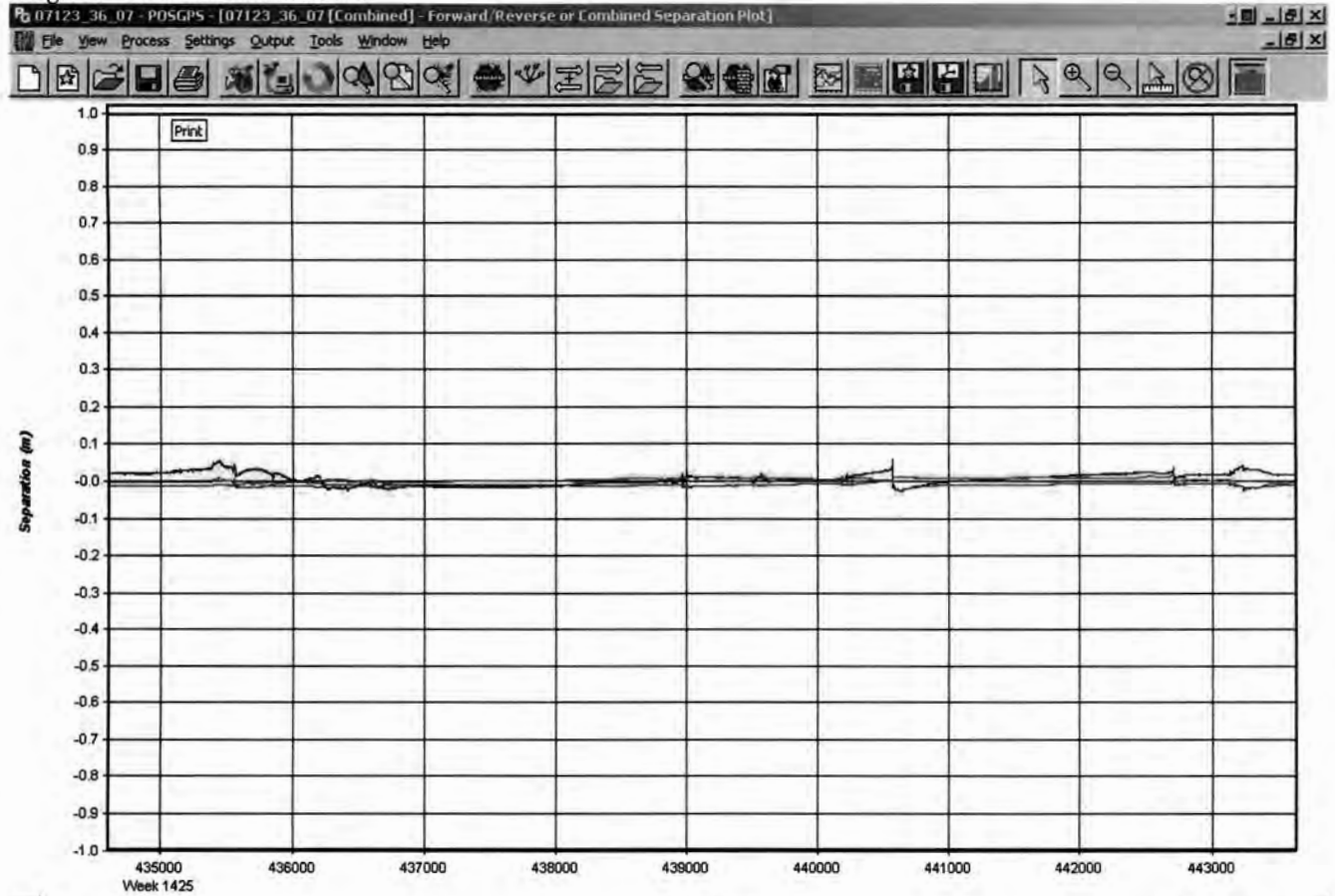


Lift07

LiDAR Collection Logsheet

Lift		Airport	Checks Out	Airport	Checks In	Duration	2.7 Hrs.	Ramp	Activity	Horizons ALS FlightLog				
1	KSEZ	0:37	KSEZ	3:17	2:40	2.7		Production						
2														
3														
4														
Horizons Job #		Client's Job #		Lidar S/N	Mode	IMU Start	Shipping Track Number		Operator		Wx	Start	End	
J07-0327				36	4-3	0:43			Eric Mueller					
Project Name				IMU S/N	AGC #1 & #2	IMU Stop	Airport ID		Pilot		GND Temp	22C	17C	
YAVAPAI, AZ				22	12 & 3	3:14	KSEZ		Chuck Lutz					
Mission ID (Bundled Mission)				AMT	Range Gate	Laser Pulse Rate	GND Station ID		Aircraft	FMS	Alt Temp	12C	12C	
12336J07032707				4100	1200	62000	KSEZ		N94HC					
Date	GPS Date	UTC Offset	Flight Plan	Attenuator	H.D. #	Download "Firewire"	USGS PID #	GPS Ant. Ht.	UTM Zone	Altm Setting	29.85	29.87		
03- May- 07	07-123	MST -7	BLOCK D	0.3	5	PD#12	ES1033(SEZC)	2M						
HZN Line #	Direction	From WPT	To WPT	Beginning GPS Time	Ending GPS Time	FOV	Scan Rate	Speed (Kts)	Comments / Conditions			SVx	VDOP	HDOP
D22	149	22	4	005938	0103	30	42	147	BLOCK D-OVERCAST/LIGHT TO MOD. TURB.			8	1.3	1.1
D23	329	2	18	010611	0109	30	42	155				8	1.3	1.1
D24	149	18	1	011220	0115	30	42	144				9	1.2	0.9
D25	329	1	18	011849	0122	30	42	143				9	1.3	0.9
D26	149	18	8	012516	0127	30	42	142				8	1.7	1.1
D26	329	8	13	013122	0132	30	42	152	CALIBRATION LINE			8	1.7	1.1
D27	329	2	12	013712	0139	30	42	154				8	1.8	1.1
D28	149	13	2	014200	0144	30	42	138				8	1.9	1.1
D39	329	1	3	014831	0149	30	42	156				8	1.9	1.1
D38	149	6	1	015250	0154	30	42	141	POS/AV FAILURE			8	1.9	1.1
D37	329	2	8	015759	0159	30	42	146				8	1.9	1.1
D36	149	9	1	020242	0204	30	42	139				9	1.8	1.1
D35	329	1	9	020756	0209	30	42	145				9	1.8	1.1
D34	149	10	1	021338	0215	30	42	145				9	1.5	1.0
D33	329	1	11	021906	0221	30	42	146				9	1.5	1.0
D32	149	11	1	022503	0227	30	42	145				9	1.5	0.9
D29	329	1	12	023016	0232	30	42	149				9	1.5	0.9
D30	149	11	1	023552	0237	30	42	142				9	1.4	0.9
D31	329	1	11	024108	0243	30	42	152				9	1.4	0.9
D41	59	1	17	024952	0252	30	42	184	CROSS LINE-DESCENDING ALT. LOST RETURNS			9	1.3	0.9
E21	260	20	24	025720	0258	30	42	143	CROSS LINE			9	1.2	0.9

Diagram - GPS Solution Residuals



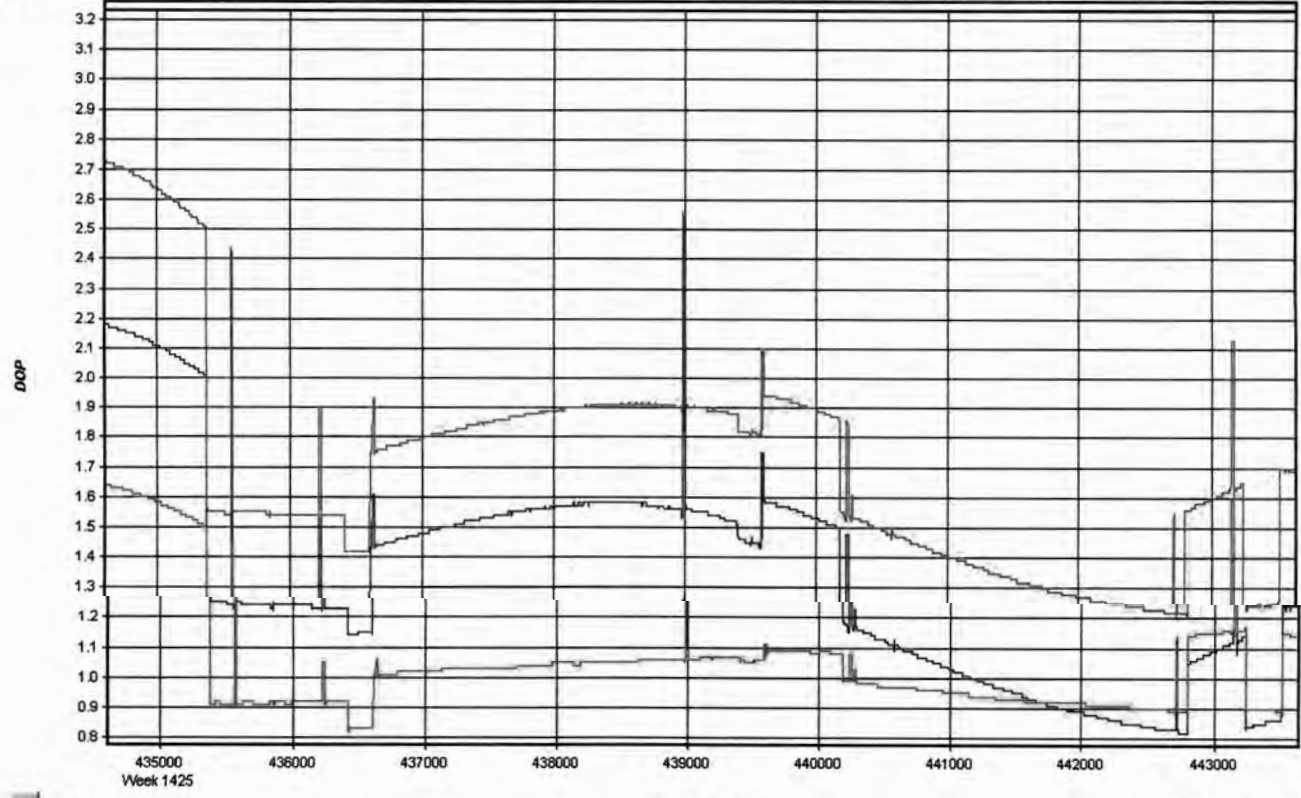
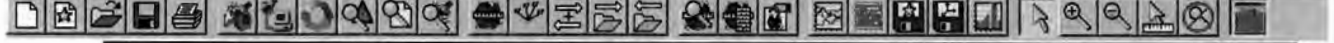
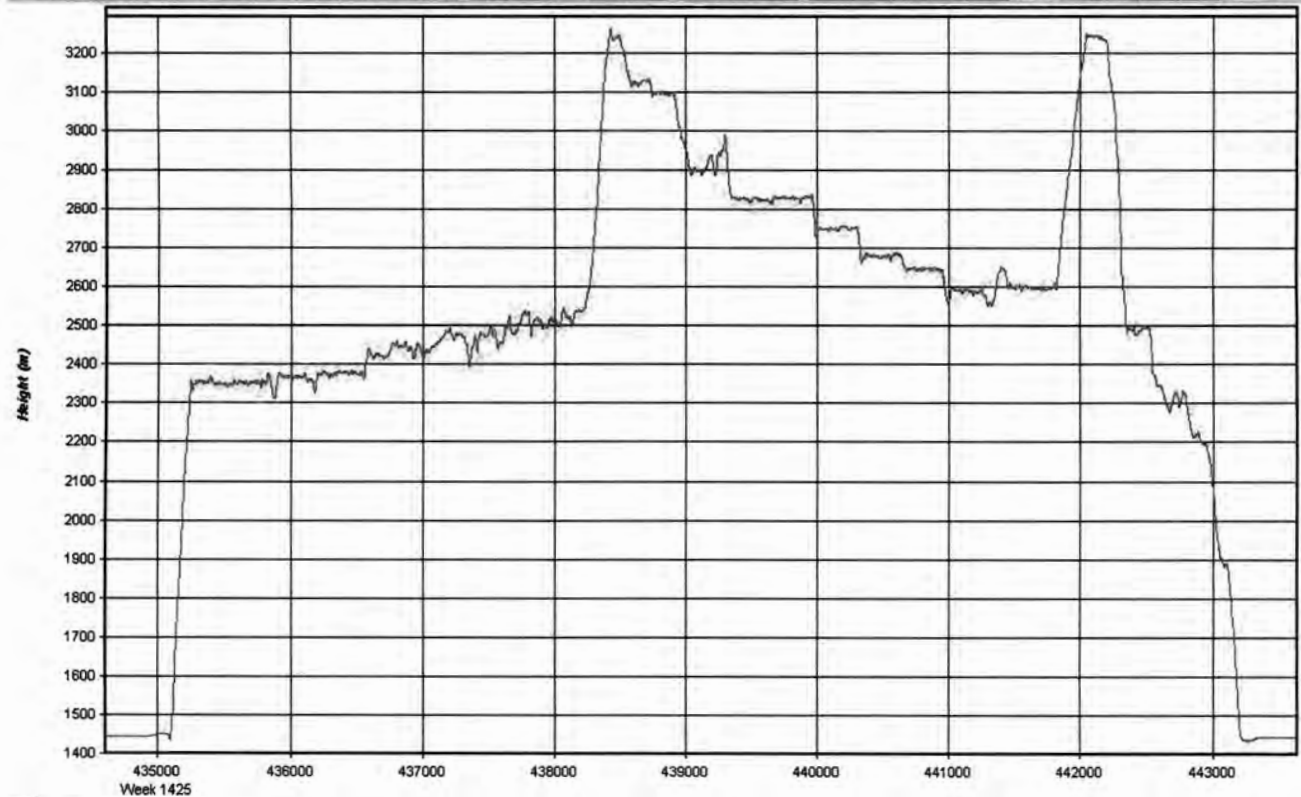
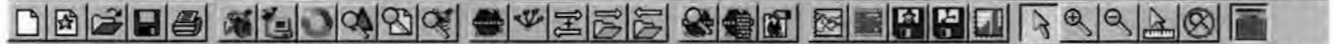


Diagram – Aircraft Trajectory Plot

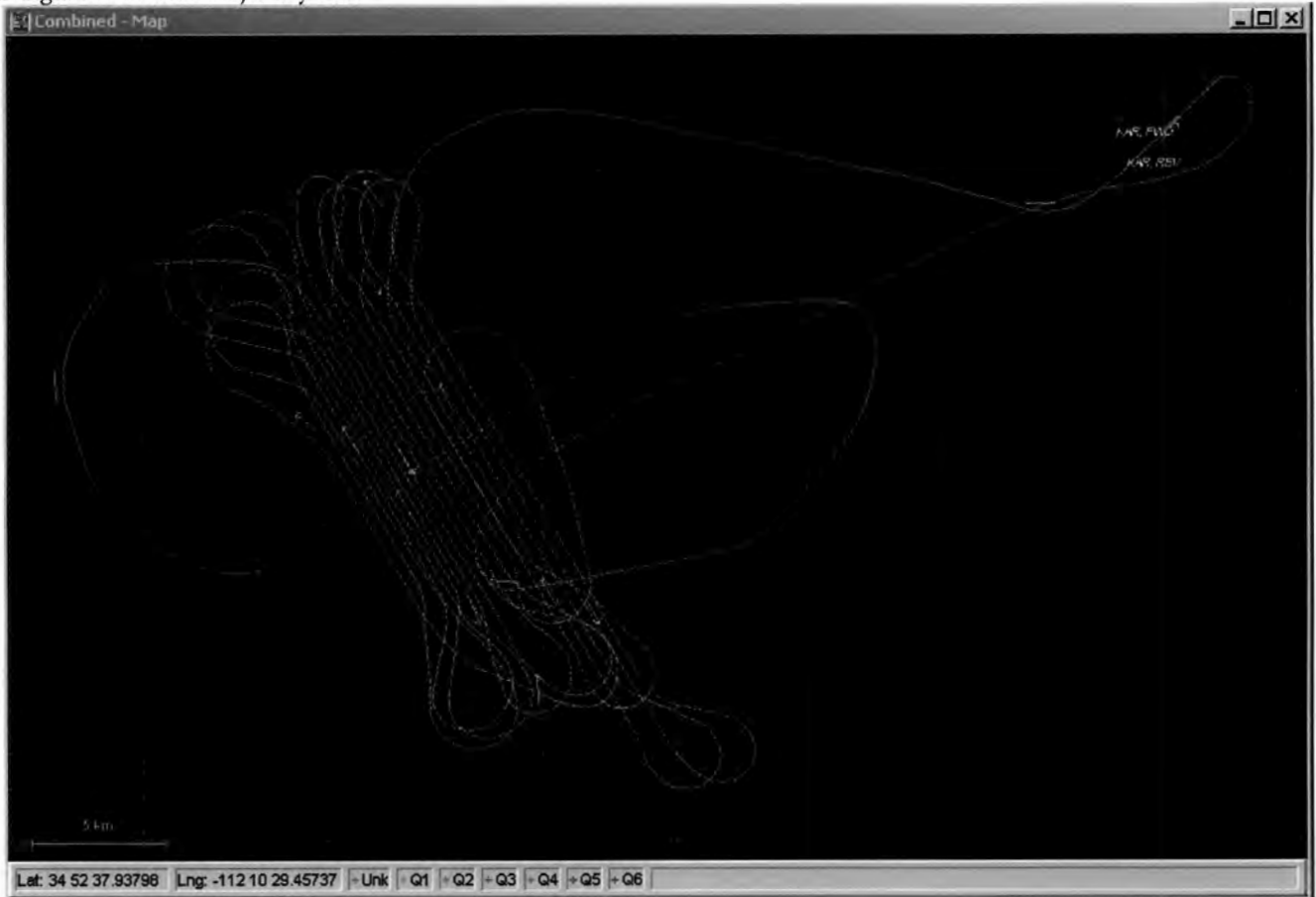


Diagram – LiDAR Coverage Check for Project Lines

