aerometric
Geospatial Solutions
4020 Technology Parkway
Sheboygan, WI 53083
P: 920.457.3631
F: 920.457.0410
www.aerometric.com

Airborne GPS Survey Report For

United States Geological Survey

National Geospatial Technical Operations Center

1400 Independence Road

Rolla, Missouri 65401

573-308-3799

LiDAR Collection Juneau, Alaska

Contract ID G10PC00025

Task Order G12PD00481

Prepared by

AERO-METRIC, INC.

4020 Technology Parkway

Sheboygan, Wisconsin 53082-0449

920-457-3631

Aerometric Project No. 6120404

Table of Contents

United States Geological Survey

LiDAR Collection Juneau, Alaska

LiDAR Task Order G12PD00481

Contract ID G10PC00025

Aerometric Project No. 6120404

1 INTRODUCTION

This report contains a summary of the LiDAR data acquisition and processing in the vicinity of Juneau, Alaska. Data collection includes the city of Juneau and coastal areas near Juneau.

1.1 Contact Info

Questions regarding the technical aspects of this report should be addressed to:
Aero-Metric, Inc.
4020 Technology Parkway
Sheboygan, WI 53083

Attention: Chris Guy (LiDAR Manager)
FAX: 920-457-0410
Email:cguy@aerometric.com

1.2 Purpose

Aero-Metric, Inc. acquired high accuracy Light Detection and Ranging (LiDAR) data in the Juneau region of Alaska for the U.S. Geological Survey in accordance with requirements specified to produce such a dataset as outlined in contract ID G10PC00025 and as defined by United States Geological Survey National Geospatial Program Base LiDAR Specification, Version 13 (ILMF).

1.3 Project Locations

The project area includes Juneau, Alaska and coastal zones in the Juneau vicinity. Area for collection was defined and supplied by The United States Geological Survey and includes approximately 408 square kilometers or 155 square miles for data collection. The collection includes Juneau and coastal areas approximately forty kilometers to the north and ten kilometers to the south of Juneau and a significant portion of Douglas Island coast. Item 3.3.a shows a graphic of the approximate area of acquisition.

1.4 Time Period

LiDAR data acquisition was performed from April 25th, 2012 to July 19, 2012. Particular flight mission dates can be found in the individual flight logs in Section 7 of this document. Eleven (11) missions were logged to cover the project area. See Item 3.3 b for a graphic of the acquisition passes and Section 7 contains the individual flight logs. One re-flight was made on October 2nd, 2012 to acquire data in an area of insufficient data.

1.5 Project Scope

Data collection was accomplished with aircraft operated by Aerometric Inc. utilizing Optech Gemini airborne LiDAR system. Flights were performed at a nominal altitude of 1500 to 2000 meters above mean sea level with data collected at a nominal point spacing of 1.0 meters to provide an optimal data set of the project area terrain.

As documented in the Task Order, collected data was to achieve a vertical accuracy of 12.5 cm in open terrain areas. The accuracy as tested and published in this report in Section 9 has met the vertical accuracy requirement.

2 GEODETIC CONTROL

QC surveys and ground control point readings were completed by DOWL HKM from May 7, 2012 through May 11, 2012. Field notes covering ground point collection are included in Section 10 of this document. A delivery report detailing ground point survey collection by DOWL-HKM is also included in Section 10 of this document.

3 LiDAR ACQUISITION AND PROCEDURES

3.1 Acquisition Time Period

LiDAR data acquisition and Airborne GPS control surveys were completed between April 25th, 2012 and July 19, 2012. Eleven flight missions were required to cover the project area. One re-flight was made on October 2nd, 2012 to acquire data that was insufficient in initial flights.

3.2 LiDAR Planning

The LiDAR data for this project was collected with Aerometric's Optech Gemini airborne LiDAR systems. All flight planning and flights were completed using Optech ALTM-Nav, version 2.1.25b (flight planning and LiDAR control software). Plan version 5.97 in .pln files.

Flying Height (Above mean sea level)	1500 m
Laser Pulse Rate	70 kHz
Mirror Scan Rate Frequency	45 Hz
Scan Angle (degrees)	28 °
Side Lap	55%
Ground Speed	150 kts
Nominal Point Spacing/meter	1.0 m

Item 3.2 Acquisition details for the project acquisition flights.

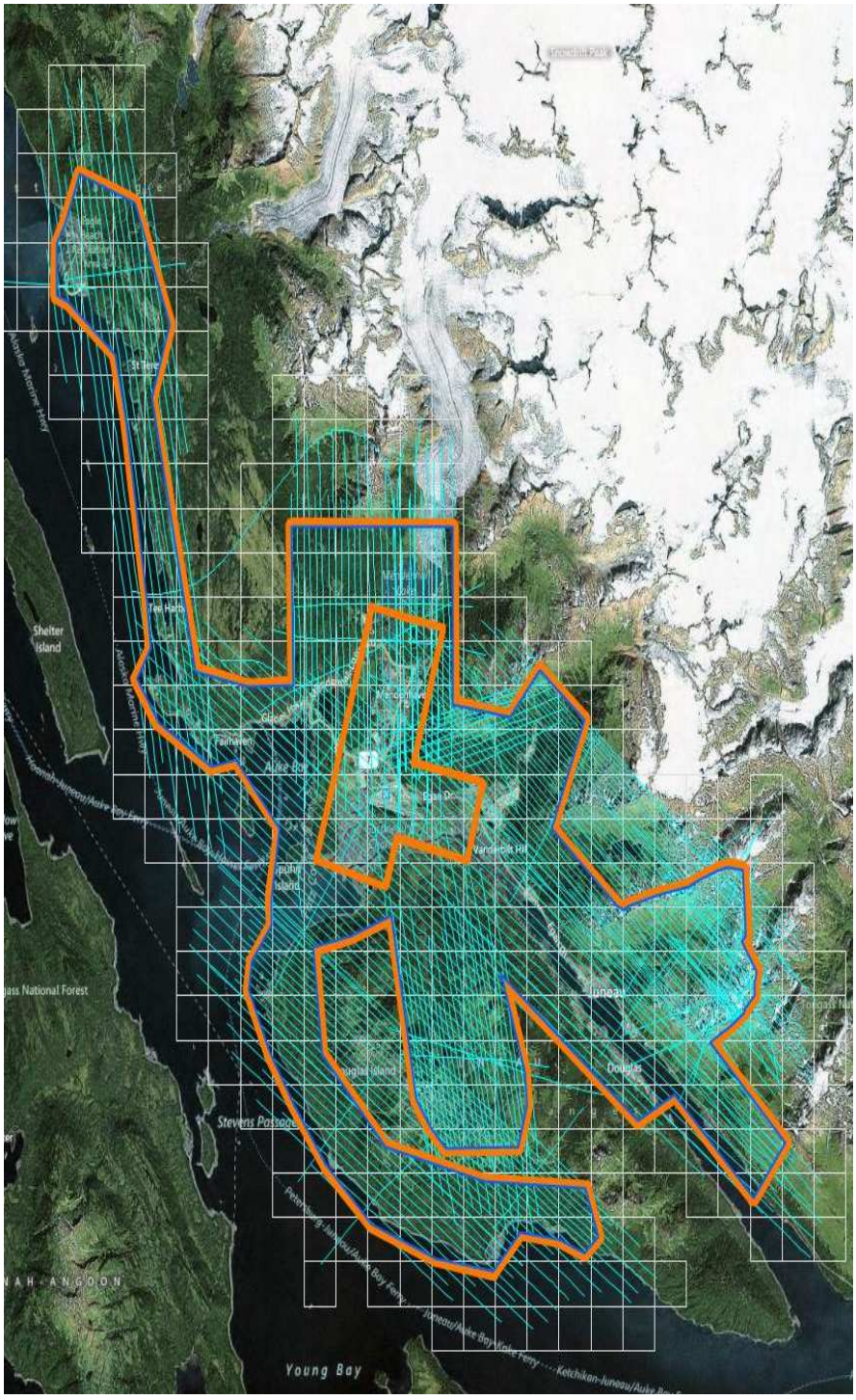
3.3 LiDAR Acquisition

A total of eleven flight missions were required to complete the project area. The missions were flown using the values in the chart above, Item 3.2. A graphic of the acquisition missions or flight lines follow as Item 3.3 b. Section 7 contains the flight logs.

Airborne GPS and IMU position and trajectory data of the LiDAR sensor were also acquired during the time of flight.

Missions were typically four to five hours long. Before take-off, the LiDAR system and the Airborne GPS and IMU system were initialized for a period of five minutes and in operation after landing for another five minutes. The missions acquired data according to the planned flight lines and included a minimum of one (usually two) cross flights. The cross flights were flown perpendicular to the planned flight lines and their data used in the in-situ calibration of the sensor. Item 3.3.b indicates these cross flights.

3.3 a Red boundary indicates the approximate acquisition area.



3.3 b Acquisition area indicating flight lines relative to ground.

3.4 LiDAR Trajectory Processing

The airborne positioning was based on the following Continuously Operating Reference Stations (CORS); AB50 and JNU1. See CORS Stations relative to project area in Item 3.4 a

3.4 a JNU1 and AB50 CORS station locations relative to project bounds

4 QC SURVEYS

A field survey was performed by DOWL HKM from May 7, 2012 through May 11, 2012. Some 500 check points were measured in various land coverage categories through the project area to be used to evaluate airborne LiDAR data.

See Section 10 for further details of control report and a description of procedures followed during ground survey control collection as submitted by DOWL-HKM.

4.0.a Relative positions of Ground Survey Check Points.

5 FINAL LiDAR PROCESSING

5.1 ABGPS and IMU Processing

Airborne GPS

Applanix - POSGPS
Utilizing carrier phase ambiguity resolution on the fly (i.e., without initialization), the solution to sub-decimeter kinematic positioning without the operational constraint of static initialization as used in semi-kinematic or stop-and-go positioning was utilized for the airborne GPS post-processing.

The processing technique used by Applanix, Inc. for achieving the desired accuracy is Kinematic Ambiguity Resolution (KAR). KAR searches for ambiguities and uses a special method to evaluate the relative quality of each intersection (RMS). The quality indicator is used to evaluate the accuracy of the solution for each processing computation. In addition to the quality indicator, the software will compute separation plots between any two solutions, which will ultimately determine the acceptance of the airborne GPS post processing.

Inertial Data
The post-processing of inertial and aiding sensor data (i.e. airborne GPS post processed data) is to compute an optimally blended navigation solution. The Kalman filter-based aided inertial navigation algorithm generates an accurate (in the sense of least-square error) navigation solution that will retain the best characteristics of the processed input data. An example of inertial/GPS sensor blending is the following: inertial data is smooth in the short term. However, a free- inertial navigation solution has errors that grow without bound with time. A GPS navigation solution exhibits short-term noise but has errors that are bounded. This optimally blended navigation solution will retain the best features of both, i.e. the blended navigation solution has errors that are smooth and bounded. The resultant processing generates the following data:

- ....Position:..... Latitude, Longitude, Altitude
- ....Velocity:..... North, East, and Down components
- ....3-axis attitude:..... roll, pitch, true heading
- ....Acceleration:..... x, y, z components
- ....Angular rates:..... x, y, z components

The Applanix software, version 4.4, was used to determine both the ABGPS trajectory and the blending of inertial data.

The airborne GPS and blending of inertial and GPS post-processing were completed in multiple steps.

1. The collected data was transferred from the field data collectors to the main computer. Data was saved under the project number and separated between LiDAR mission dates. Inside each mission date, a sub-directory was created with the aircraft's tail number and an A or B suffix was attached for the time of when the data was collected. Inside the tail number sub-directory, five sub-directories were also created EO, GPS, IMU, PROC, and RAW.

2. The aircraft raw data (IMU and GPS data combined) was run through a data extractor program. This separated the IMU and GPS data. In addition to the extracting of data, it provided the analyst the first statistics on the overall flight. The program was POSPac (POS post-processing PACkage).

3. Executing POSGPS program to derive accurate GPS positions for all flights: Applanix POSGPS

The software utilized for the data collected was PosGPS, a kinematic on- the-fly (OTF) processing software package. Post processing of the data is computed from each base station (Note: only base stations within the flying area were used) in both a forward and backward direction. This provides the analyst the ability to Quality Check (QC) the post processing, since different ambiguities are determined from different base stations and also with the same data from different directions.

The trajectory separation program is designed to display the time of week that the airborne or roving antenna traveled, and compute the differences found between processing runs. Processed data can be compared between a forward/reverse solution from one base station, a reverse solution from one base station and a forward solution from the second base station, etc. For the Applanix POSGPS processing, this is considered the final QC check for the given mission. If wrong ambiguities were found with one or both runs, the analyst would see disagreements from the trajectory plot, and re-processing would continue until an agreement was determined.

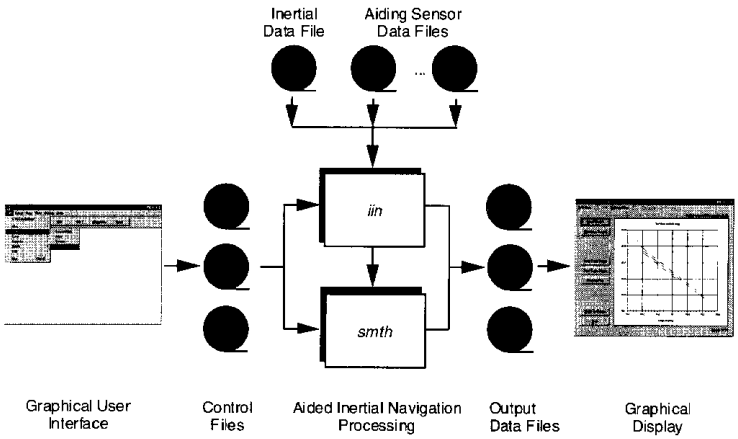
Once the analyst accepts a forward and reverse processing solution, the trajectory plot is analyzed and the combined solution is stored in a file format acceptable for the IMU post processor.

Please see Section 8 of the control report for the final accepted trajectory plots.

4. When the processed trajectory (either through POSGPS) data was accepted after quality control analysis, the combined solution is stored in a file format acceptable for the IMU post processor (i.e. POSProc).

5. Execute POS Proc. POS Proc comprises a set of individual processing interface tools that execute and provide the following functions:

The diagram below shows the organization of these tools, and is a function of the POSProc processing components.



Integrated Inertial Navigation (iin) Module.
The name *iin* is a contraction of Integrated Inertial Navigation. *iin* reads inertial data and aiding data from data files specified in a processing environment file and computes the aided inertial navigation solution. The inertial data comes from a strapdown IMU. *iin* outputs the navigation data between start and end times at a data rate as specified in the environment file. *iin* also outputs Kalman filter data for analysis of estimation error statistics and smoother data that the smoothing program *smth* uses to improve the navigation solution accuracy.

iin implements a full strapdown inertial navigator that solves Newton's equation of motion on the earth using inertial data from a strapdown IMU. The inertial navigator implements coning and sculling compensation to handle potential problems caused by vibration of the IMU.

Smoother Module (*smth*).
smth is a companion processing module to *iin*. *smth* is comprised of two individual functions that run in sequence. *smth* first runs the *smoother function* and then runs the *navigation correction function*.

The *smth* smoother function performs backwards-in-time processing of the forwards-in-time blended navigation solution and Kalman filter data generated by *iin* to compute smoothed error estimates. *smth* implements a modified Bryson-Frazier smoothing algorithm specifically designed for use with the *iin* Kalman filter. The resulting smoothed strapdown navigator error estimates at a given time point are the optimal estimates based on all input data before and after the given time point. In this sense, *smth* makes use of all available information in the input data. *smth* writes the smoothed error estimates and their RMS estimation errors to output data files.

The *smth* navigation correction function implements a feedforward error correction mechanism similar to that in the *iin* strapdown navigation solution using the smoothed strapdown navigation errors. s*mth* reads in the smoothed error estimates and with these, corrects the strapdown navigation data. The resulting navigation solution is called a Best Estimate of Trajectory (BET), and is the best obtainable estimate of vehicle trajectory with the available inertial and aiding sensor data.

The above mentioned modules provide the analyst the following statistics to ensure that the most optimal solution was achieved: a log of the *iin* processing, the Kalman filter Measurement Residuals, Smoothed RMS Estimation Errors, and Smoothed Sensor Errors and RMS.

5.2 LiDAR "Point Cloud" Processing

The ABGPS/IMU post processed data along with the LiDAR raw measurements were processed using Optech Incorporated's ASDA software. This software was used to match the raw LiDAR measurements with the computed ABGPS/IMU positions and attitudes of the LiDAR sensor. The result was a "point cloud" of LiDAR measured points referenced to the ground control system.

5.3 LiDAR CALIBRATION

Introduction

The purpose of the LiDAR system calibration is to refine the system parameters in order for the post-processing software to produce a "point cloud" that best fits the actual ground.

The following report outlines the calibration techniques employed for this project.

Calibration Procedures

All Companies involved in collection routinely performs two types of calibrations on its airborne LiDAR system. The first calibration, system calibration, is performed whenever the LiDAR system is installed in the aircraft. This calibration is performed to define the system parameters affected by the physical misalignment of the system versus aircraft. The second calibration, in-situ calibration, is performed for each mission using that missions data. This calibration is performed to refine the system parameters that are affected by the on site conditions as needed.

System Calibration

The system calibration is performed whenever the LiDAR system is installed in the aircraft. This calibration is performed to define the system parameters affected by the physical misalignment of the system versus aircraft. The main system parameters that are affected are the heading, pitch, roll, and mirror scale.

The system calibration is performed by collecting data over a known test site that incorporates a flat surface and a large, flat roofed building. A ground survey is completed to define the flat surface and the building corners. The processed LiDAR data and ground survey data is input into TerraSolid's TerraMatch software to determine the systematic errors. The system parameters are then corrected according to the determined errors and used in the processing of future LiDAR acquisition missions

In-situ Calibration

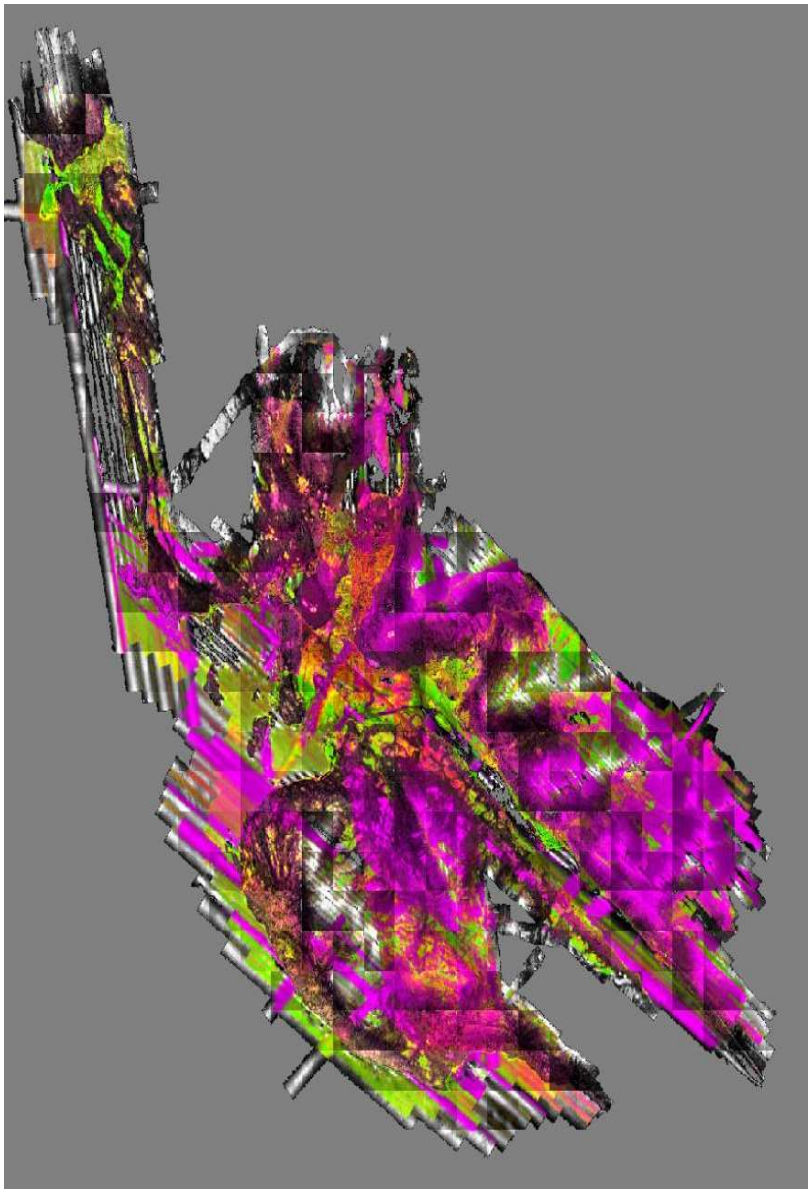
The in-situ calibration is performed as needed using the mission's data. This calibration is performed to refine the system parameters that are affected by the on site conditions.

For each mission, LiDAR data for at least one cross flight is acquired over the mission's acquisition site. The processed data of the cross flight is compared to the perpendicular flight lines using either the Optech proprietary software or TerraSolid's TerraMatch software to determine if any systematic errors are present. In this calibration, the data of individual flight lines are compared against each other and their systematic errors are corrected in the final processed data.

5.4 LiDAR Processing

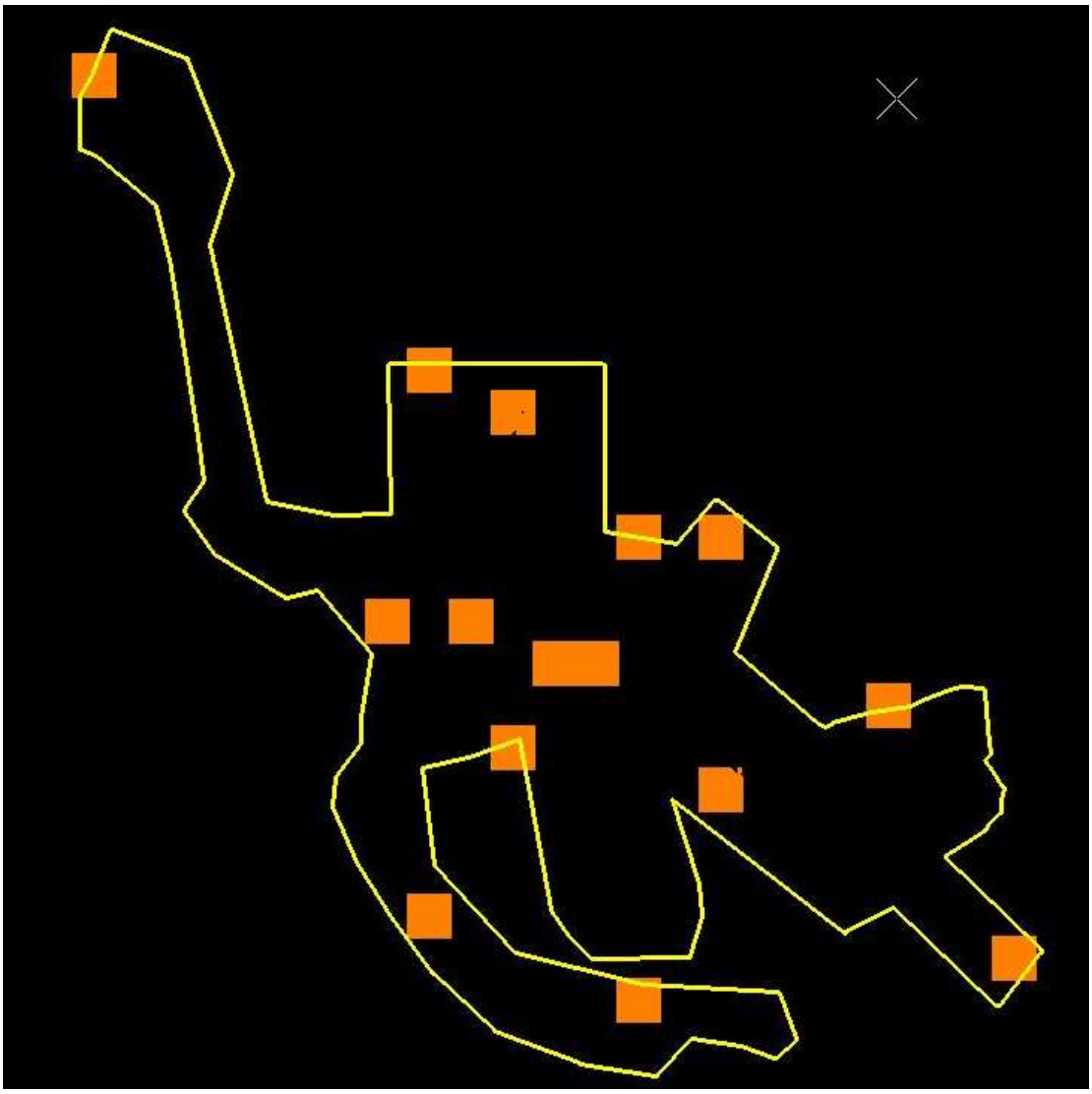
The LAS files were then imported, verified, and parsed into manageable, tiled grids using GeoCue version 2012.1.27.4. GeoCue allows for ease of data management and process tracking.

The first step after the data has been processed and calibrated is to perform a relative accuracy assessment on the flightline to flightline vertical alignment. Item 5.4.a illustrates relative vertical alignment of flightlines assessment. Green indicates a flightline comparison of less than 0.05 m; yellow 0.05– 0.1 m; orange 0.1-0.15 m; red 0.15-0.20 m; and magenta 0.20 m or greater. Areas containing dense vegetation coverage or inundation from water will show a greater elevation offset then is actually present in the ground data. This is due to these regions having a high number of returns from vegetation or non-ground objects and few returns from the ground causing the elevation offset to be exaggerated in the relative accuracy assessment procedure.



5.4.a Relative Accuracy assessment

In addition to the relative accuracy assessment, Aerometric also reviews a few tiles to ensure that the desired point density has been met. Item 5.4.b illustrates tiles analyzed for point density. Aerometric utilizes in-house proprietary software to complete this task. Initially a grid is placed according to the version 12 specification that is based on the nominal post spacing. Point density is analyzed and the result indicates the density of the sampled tiles. The latest USGS specification, version 13, modifies the requirement allowing up to 2 times the nominal post spacing. Our data evaluation acknowledges this change and processes results under both criteria.



5.4.b Sample tile locations in point density analysis

Sampled tile names: 8_5084875.LAS, 8_5194680.LAS, 8_5204575.LAS, 8_5204770.LAS, 8_5224680.LAS, 8_5234635.LAS, 8_5234755.LAS, 8_5254665.LAS, 8_5264665.LAS, 8_5284545.LAS, 8_5284710.LAS, 8_5314620.LAS, 8_5314710.LAS, 8_5344575.LAS, 8_5374650.LAS

Run 1 (Version 12 – 1.0 meter grid size/point spacing)
Total number of cells: 33,289,178
Total number of cells with one or more points: 30,540,300
Percentage of tiles with 1 point or more: 91.7%

Run 2 (Version 13 – 2.0 meter grid size/point spacing)
Total number of cells: 8,460,015
Total number of cells with one or more points: 8,276,794
Percentage of tiles with 1 point or more: 97.8%

Once both the accuracy between swaths and data density is accepted an automated classification algorithm is performed using TerraSolid's TerraScan, version 012.017. This will produce the majority of the bare-earth datasets.

The remainder of the data was classified using manual classification techniques. The majority of the manual editing involved changing points initially misclassified as ground (class 2) to unclassified (class 1). Erroneous low points, high points, including clouds are classified to class 7.

5.5 Check Point Validation

The data was then verified against ground control data. TerraScan computes the vertical differences between the surveyed elevation of ground control points and the LiDAR derived elevations at these points.

A control report listing comparative statistics was created and can be found in Section 9, of this report.

5.6 LiDAR Data Delivery

Raw point cloud data supplied is in the following format:

- LAS, version 1.2
- GPS times adjusted to GPS Absolute
- Full swaths and delivered as 1 file per swath which did not exceed 2 gigabytes.

Classified point cloud data is also being supplied using the following criteria.

- LAS, version 1.2 in 1500 meter grid
- GPS times adjusted to GPS Absolute
- Classification scheme:
  - 1 – Processed, but unclassified
  - 2 – Bare Earth, Ground
  - 7 – Noise
  - 9 – Water
  - 10 – Ignored Ground (Breakline proximity)

Bare earth hydro-flattened one meter Digital Elevation Models (DEM) were created using TerraModeler (TerraSolid Ltd.). The ASCII grids were then imported into ARC and translated to raster format and placed in a geo-database DEM feature dataset.

Break lines polygon are first collected in a Microstation environment using the project specifications. They are checked for QC/QA. Upon acceptance the breaklines, either polygons or lines, are translated into ARC and imported to the final geo-database as separate features.

5.7 Conditions Affecting Final Data

The project area includes coastal zones subject to changing sea levels from tidal forces over time. Breaklines on water edges may shift where neighboring flightlines meet as hydro-breaklines are placed according to the conditions present at the time of data collection.

Areas of high elevation included in the project may have snowpack present throughout the year.

6 CONCLUSION

Sound procedures and use of new technology ensure this project data will serve the United States Geological Survey and all users requiring the provided LiDAR derivative products for the project area of Juneau, Alaska and near vicinity well into the future. Although this project presented challenges to equipment and personnel, the results are accurate and reliable.

7 FLIGHT LOGS

M042512A Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : April 25, 2012
Julian Day : 116
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:35:52

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
00:12:04.146	00:12:38.046	148	1363	70	46.00	14.00	OFF	NAR	ON	0.00	125
00:12:51.445	00:13:08.345	148	1455	70	46.00	14.00	OFF	NAR	ON	0.00	125
00:12:51.445	00:13:08.345	148	1464	70	46.00	14.00	OFF	NAR	ON	0.00	125
00:22:48.736	00:26:31.632	140	1495	70	46.00	14.00	OFF	NAR	ON	0.00	125
00:30:35.428	00:33:46.725	135	1481	70	46.00	14.00	OFF	NAR	ON	0.00	305
00:37:40.421	00:40:37.419	134	1478	70	46.00	14.00	OFF	NAR	ON	0.00	125
00:45:07.614	00:47:40.612	133	1486	70	46.00	14.00	OFF	NAR	ON	0.00	305
00:51:26.209	00:53:44.806	132	1488	70	46.00	14.00	OFF	NAR	ON	0.00	125
00:58:02.403	00:59:44.701	131	1486	70	46.00	14.00	OFF	NAR	ON	0.00	305
01:02:12.599	01:03:41.197	131	1491	70	46.00	14.00	OFF	NAR	ON	0.00	305
01:08:01.093	01:12:33.289	101	1481	70	46.00	14.00	OFF	NAR	ON	0.00	349
01:16:37.685	01:18:13.584	102	1495	70	46.00	14.00	OFF	NAR	ON	0.00	169
01:22:43.18	01:24:16.878	103	1477	70	46.00	14.00	OFF	NAR	ON	0.00	349
01:28:34.974	01:29:51.773	104	1492	70	46.00	14.00	OFF	NAR	ON	0.00	169
01:33:24.47	01:34:26.469	105	1483	70	46.00	14.00	OFF	NAR	ON	0.00	349
01:37:01.367	01:38:09.666	105	1503	70	46.00	14.00	OFF	NAR	ON	0.00	349
01:41:10.163	01:48:11.957	13	1498	70	46.00	14.00	OFF	NAR	ON	0.00	126

M050312A Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : May 03, 2012
Julian Day : 124
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:26:57

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
04:48:29.185	04:48:53.985	8	1055	70	46.00	14.00	OFF	NAR	ON	0.00	126
04:50:06.684	04:50:21.384	8	1470	70	46.00	14.00	OFF	NAR	ON	0.00	126
04:50:28.583	04:50:36.883	8	1464	70	46.00	14.00	OFF	NAR	ON	0.00	126
04:50:54.183	04:57:44.376	8	1461	70	46.00	14.00	OFF	NAR	ON	0.00	126
05:02:01.472	05:08:39.466	9	1466	70	46.00	14.00	OFF	NAR	ON	0.00	306
05:12:47.062	05:19:16.656	7	1468	70	46.00	14.00	OFF	NAR	ON	0.00	126
05:23:25.553	05:29:12.648	6	1477	70	46.00	14.00	OFF	NAR	ON	0.00	306
05:33:34.844	05:34:31.543	6	1481	70	46.00	14.00	OFF	NAR	ON	0.00	306

M052112A Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : May 21, 2012
Julian Day : 142
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:46:02

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
22:43:21.627	22:43:43.026	100	1523	70	46.00	14.00	OFF	NAR	ON	0.00	349
22:46:37.523	22:51:13.619	100	1518	70	46.00	14.00	OFF	NAR	ON	0.00	349
22:55:02.115	22:59:44.91	99	1513	70	46.00	14.00	OFF	NAR	ON	0.00	169
23:03:34.007	23:08:03.902	98	1516	70	46.00	14.00	OFF	NAR	ON	0.00	349
23:11:16.799	23:16:06.994	97	1517	70	46.00	14.00	OFF	NAR	ON	0.00	169
23:19:36.091	23:24:06.787	96	1497	70	46.00	14.00	OFF	NAR	ON	0.00	349
23:19:36.091	23:24:06.787	96	1501	70	46.00	14.00	OFF	NAR	ON	0.00	349
23:27:36.083	23:32:22.379	95	1513	70	46.00	14.00	OFF	NAR	ON	0.00	169
23:35:54.175	23:40:25.371	94	1509	70	46.00	14.00	OFF	NAR	ON	0.00	349
23:43:58.767	23:48:36.963	93	1508	70	46.00	14.00	OFF	NAR	ON	0.00	169
23:43:58.767	23:48:36.963	93	1509	70	46.00	14.00	OFF	NAR	ON	0.00	169
23:51:48.96	23:56:17.055	92	1515	70	46.00	14.00	OFF	NAR	ON	0.00	349
23:59:31.452	00:04:13.847	91	1524	70	46.00	14.00	OFF	NAR	ON	0.00	169
23:59:31.452	00:04:13.847	91	1524	70	46.00	14.00	OFF	NAR	ON	0.00	169
00:07:57.344	00:09:47.942	90	1505	70	46.00	14.00	OFF	NAR	ON	0.00	349
00:07:57.344	00:09:47.942	90	1506	70	46.00	14.00	OFF	NAR	ON	0.00	349
00:13:10.639	00:15:01.337	89	1539	70	46.00	14.00	OFF	NAR	ON	0.00	169
00:19:20.033	00:20:33.531	100	1517	70	46.00	14.00	OFF	NAR	ON	0.00	169
00:19:20.033	00:20:33.531	100	1517	70	46.00	14.00	OFF	NAR	ON	0.00	169

M052412B Flight Log

Project Number	0
S/N	0
Operator	???
Pilot(s)	???
Aircraft	???
Airport	???
Mission	M052412B
Wheels Up	???
Flight Length	
HOBBS Start	
HOBBS End	

Weather

Date	May 24, 2012
Julian Day	145
Temperature	???
Visibility	???
Clouds	???
Precipitation	???
Wind Dir	???
Wind Speed	???
Pressure	???

Statistics

Laser Time	01:58:20

M052412B Flight Log -(continue)

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
01:32:58.773	01:33:18.373	10	1524	70	46.00	14.00	OFF	NAR	ON	0.00	126
01:36:44.069	01:43:47.86	10	1512	70	46.00	14.00	OFF	NAR	ON	0.00	126
01:48:18.655	01:54:56.248	11	1503	70	46.00	14.00	OFF	NAR	ON	0.00	306
01:59:08.844	02:06:21.836	12	1517	70	46.00	14.00	OFF	NAR	ON	0.00	126
02:10:20.732	02:17:20.125	13	1501	70	46.00	14.00	OFF	NAR	ON	0.00	306
02:21:24.221	02:27:07.415	14	1505	70	46.00	14.00	OFF	NAR	ON	0.00	126
02:30:50.211	02:36:46.705	15	1501	70	46.00	14.00	OFF	NAR	ON	0.00	306
02:40:38.701	02:46:46.395	16	1505	70	46.00	14.00	OFF	NAR	ON	0.00	126
02:51:51.39	02:55:42.786	17	1517	70	46.00	14.00	OFF	NAR	ON	0.00	306
02:59:33.882	03:03:35.478	18	1512	70	46.00	14.00	OFF	NAR	ON	0.00	126
03:06:56.775	03:10:36.771	19	1526	70	46.00	14.00	OFF	NAR	ON	0.00	306
03:14:19.767	03:18:17.163	20	1515	70	46.00	14.00	OFF	NAR	ON	0.00	126
03:21:39.76	03:25:22.056	21	1499	70	46.00	14.00	OFF	NAR	ON	0.00	306
03:29:00.653	03:33:02.549	22	1510	70	46.00	14.00	OFF	NAR	ON	0.00	126
03:36:23.445	03:40:03.242	23	1522	70	46.00	14.00	OFF	NAR	ON	0.00	306
03:44:57.037	03:47:59.134	24	1518	70	46.00	14.00	OFF	NAR	ON	0.00	126
03:51:31.93	03:54:18.227	25	1530	70	46.00	14.00	OFF	NAR	ON	0.00	306
03:57:53.124	04:00:40.721	26	1507	70	46.00	14.00	OFF	NAR	ON	0.00	126
04:06:40.915	04:08:12.313	27	1518	70	46.00	14.00	OFF	NAR	ON	0.00	306
04:11:50.91	04:13:24.508	28	1522	70	46.00	14.00	OFF	NAR	ON	0.00	126
04:16:44.905	04:18:07.304	29	1516	70	46.00	14.00	OFF	NAR	ON	0.00	306
04:21:52.9	04:23:20.998	30	1515	70	46.00	14.00	OFF	NAR	ON	0.00	126
04:26:22.095	04:28:13.294	30	1513	70	46.00	14.00	OFF	NAR	ON	0.00	126
04:33:17.788	04:36:44.385	136	1507	70	46.00	14.00	OFF	NAR	ON	0.00	125
04:33:17.788	04:36:44.385	136	1508	70	46.00	14.00	OFF	NAR	ON	0.00	305
04:40:15.882	04:43:43.478	137	1503	70	46.00	14.00	OFF	NAR	ON	0.00	305
04:47:05.875	04:50:52.971	138	1508	70	46.00	14.00	OFF	NAR	ON	0.00	125
04:54:29.467	04:58:04.964	139	1515	70	46.00	14.00	OFF	NAR	ON	0.00	305
05:01:27.46	05:05:26.356	140	1512	70	46.00	14.00	OFF	NAR	ON	0.00	125
05:08:36.853	05:12:22.049	141	1504	70	46.00	14.00	OFF	NAR	ON	0.00	305
05:15:53.346	05:19:51.542	142	1505	70	46.00	14.00	OFF	NAR	ON	0.00	125
05:15:53.346	05:19:51.542	142	1504	70	46.00	14.00	OFF	NAR	ON	0.00	125
05:23:04.438	05:26:55.634	143	1494	70	46.00	14.00	OFF	NAR	ON	0.00	305
05:30:35.231	05:31:42.63	135	1500	70	46.00	14.00	OFF	NAR	ON	0.00	305

M060112A Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : M060112A
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : June 01, 2012
Julian Day : 153
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:52:23

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
20:17:06.443	20:17:22.043	144	1491	70	46.00	14.00	OFF	NAR	ON	0.00	125
20:17:06.443	20:17:22.043	144	1494	70	46.00	14.00	OFF	NAR	ON	0.00	125
20:21:42.439	20:26:26.434	144	1498	70	46.00	14.00	OFF	NAR	ON	0.00	125
20:32:00.829	20:36:23.324	145	1488	70	46.00	14.00	OFF	NAR	ON	0.00	305
20:40:55.02	20:45:34.216	146	1480	70	46.00	14.00	OFF	NAR	ON	0.00	125
20:50:00.911	20:54:24.207	147	1486	70	46.00	14.00	OFF	NAR	ON	0.00	125
20:58:00.804	21:02:38.3	148	1494	70	46.00	14.00	OFF	NAR	ON	0.00	125
21:06:13.696	21:10:42.492	149	1496	70	46.00	14.00	OFF	NAR	ON	0.00	305
21:14:19.589	21:18:53.084	150	1485	70	46.00	14.00	OFF	NAR	ON	0.00	125
21:22:20.581	21:26:56.377	151	1493	70	46.00	14.00	OFF	NAR	ON	0.00	305
21:30:32.674	21:35:10.069	152	1485	70	46.00	14.00	OFF	NAR	ON	0.00	125
21:38:32.166	21:43:03.262	153	1485	70	46.00	14.00	OFF	NAR	ON	0.00	305
21:46:47.558	21:51:07.854	154	1485	70	46.00	14.00	OFF	NAR	ON	0.00	125
21:54:42.851	21:55:44.65	155	1473	70	46.00	14.00	OFF	NAR	ON	0.00	305
21:59:17.447	22:00:16.746	156	1489	70	46.00	14.00	OFF	NAR	ON	0.00	125
22:03:27.643	22:04:38.742	154	1487	70	46.00	14.00	OFF	NAR	ON	0.00	125

M060412A_a Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : June 04, 2012
Julian Day : 156
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 01:12:58

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
15:46:11.248	15:46:41.048	5	1491	70	46.00	14.00	OFF	NAR	ON	0.00	126
15:48:21.946	15:52:50.842	5	1529	70	46.00	14.00	OFF	NAR	ON	0.00	126
15:58:13.837	16:01:50.433	4	1506	70	46.00	14.00	OFF	NAR	ON	0.00	306
15:58:13.837	16:01:50.433	4	1507	70	46.00	14.00	OFF	NAR	ON	0.00	126
16:06:14.329	16:09:13.526	3	1519	70	46.00	14.00	OFF	NAR	ON	0.00	126
16:14:04.622	16:16:28.519	2	1475	70	46.00	14.00	OFF	NAR	ON	0.00	306
16:21:42.414	16:24:04.112	1	1497	70	46.00	14.00	OFF	NAR	ON	0.00	126
16:29:56.407	16:34:55.202	32	1481	70	46.00	14.00	OFF	NAR	ON	0.00	311
16:39:01.298	16:44:26.393	33	1454	70	46.00	14.00	OFF	NAR	ON	0.00	131
16:48:59.289	16:54:10.284	34	1499	70	46.00	14.00	OFF	NAR	ON	0.00	311
16:58:44.18	17:04:07.874	35	1467	70	46.00	14.00	OFF	NAR	ON	0.00	131
17:07:50.471	17:12:55.866	36	1476	70	46.00	14.00	OFF	NAR	ON	0.00	311
17:17:04.162	17:22:19.957	37	1500	70	46.00	14.00	OFF	NAR	ON	0.00	131
17:27:41.152	17:31:38.748	38	1481	70	46.00	14.00	OFF	NAR	ON	0.00	311
17:35:01.645	17:39:37.44	39	1517	70	46.00	14.00	OFF	NAR	ON	0.00	131
17:42:53.337	17:47:11.933	40	1477	70	46.00	14.00	OFF	NAR	ON	0.00	311
17:50:43.73	17:55:14.125	41	1475	70	46.00	14.00	OFF	NAR	ON	0.00	131
17:59:05.422	18:03:24.217	42	1474	70	46.00	14.00	OFF	NAR	ON	0.00	311
18:08:04.513	18:12:37.608	43	1482	70	46.00	14.00	OFF	NAR	ON	0.00	131

M060412A_b **Flight Log**

Project Number	0
S/N	0
Operator	???
Pilot(s)	???
Aircraft	???
Airport	???
Mission	???
Wheels Up	???
Flight Length	
HOBBS Start	
HOBBS End	

Weather

Date	June 04, 2012
Julian Day	156
Temperature	???
Visibility	???
Clouds	???
Precipitation	???
Wind Dir	???
Wind Speed	???
Pressure	???

Statistics

Laser Time	05:53:38

M060412A_b Flight Log (continued)

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
13:21:31.959	18:19:21.102	0	1467	70	46.00	14.00	OFF	NAR	ON	0.00	90
18:28:09.593	18:31:59.19	31	1464	70	46.00	14.00	OFF	NAR	ON	0.00	131
18:36:30.885	18:37:42.484	31	1523	70	46.00	14.00	OFF	NAR	ON	0.00	131
18:40:52.281	18:42:16.98	1	1462	70	46.00	14.00	OFF	NAR	ON	0.00	306
18:48:10.674	18:50:39.272	106	1719	70	46.00	14.00	OFF	NAR	ON	0.00	348
18:54:38.468	18:56:35.666	107	1677	70	46.00	14.00	OFF	NAR	ON	0.00	168
19:00:16.663	19:01:57.261	108	1678	70	46.00	14.00	OFF	NAR	ON	0.00	348
19:05:20.558	19:07:19.556	109	1684	70	46.00	14.00	OFF	NAR	ON	0.00	168
19:11:00.453	19:12:52.351	110	1693	70	46.00	14.00	OFF	NAR	ON	0.00	348
19:16:17.248	19:18:14.346	111	1671	70	46.00	14.00	OFF	NAR	ON	0.00	168
19:22:00.442	19:23:29.741	112	1696	70	46.00	14.00	OFF	NAR	ON	0.00	348
19:27:09.138	19:28:53.336	113	1682	70	46.00	14.00	OFF	NAR	ON	0.00	168
19:32:24.233	19:33:54.331	114	1670	70	46.00	14.00	OFF	NAR	ON	0.00	348
19:37:55.328	19:39:40.826	115	1677	70	46.00	14.00	OFF	NAR	ON	0.00	168
19:43:12.623	19:44:46.821	116	1665	70	46.00	14.00	OFF	NAR	ON	0.00	348
19:48:13.318	19:49:58.816	117	1668	70	46.00	14.00	OFF	NAR	ON	0.00	168
19:53:36.313	19:55:56.811	118	1677	70	46.00	14.00	OFF	NAR	ON	0.00	348
19:59:26.407	20:02:01.805	119	1694	70	46.00	14.00	OFF	NAR	ON	0.00	168
20:04:59.502	20:07:24.4	120	1669	70	46.00	14.00	OFF	NAR	ON	0.00	348
20:11:02.497	20:13:32.294	121	1673	70	46.00	14.00	OFF	NAR	ON	0.00	168
20:16:58.691	20:19:21.789	122	1689	70	46.00	14.00	OFF	NAR	ON	0.00	348
20:21:59.086	20:24:21.084	123	1635	70	46.00	14.00	OFF	NAR	ON	0.00	168
20:27:43.681	20:29:46.979	130	1715	70	46.00	14.00	OFF	NAR	ON	0.00	168
20:39:26.17	20:41:40.168	124	1741	70	46.00	14.00	OFF	NAR	ON	0.00	348
20:45:27.364	20:47:51.262	125	1732	70	46.00	14.00	OFF	NAR	ON	0.00	168
20:51:10.459	20:53:25.957	126	1730	70	46.00	14.00	OFF	NAR	ON	0.00	348
20:57:08.253	20:59:15.151	127	1730	70	46.00	14.00	OFF	NAR	ON	0.00	168
21:03:21.548	21:05:16.446	128	1710	70	46.00	14.00	OFF	NAR	ON	0.00	348
21:08:45.243	21:10:38.741	129	1756	70	46.00	14.00	OFF	NAR	ON	0.00	168

M060412B_a Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : June 04, 2012
Julian Day : 156
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 01:02:30

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
23:09:55.946	23:10:08.646	130	1692	70	46.00	14.00	OFF	NAR	ON	0.00	348
23:11:41.944	23:12:42.243	130	1683	70	46.00	14.00	OFF	NAR	ON	0.00	348
23:16:40.939	23:18:21.637	130	1662	70	46.00	14.00	OFF	NAR	ON	0.00	348
23:23:57.631	23:28:34.826	44	1459	70	46.00	14.00	OFF	NAR	ON	0.00	311
23:33:01.622	23:37:52.417	45	1488	70	46.00	14.00	OFF	NAR	ON	0.00	131
23:42:34.612	23:47:04.708	46	1500	70	46.00	14.00	OFF	NAR	ON	0.00	311
23:51:27.003	23:56:22.398	47	1503	70	46.00	14.00	OFF	NAR	ON	0.00	131
00:01:21.193	00:05:51.489	48	1497	70	46.00	14.00	OFF	NAR	ON	0.00	311
00:10:29.084	00:14:21.881	49	1539	70	46.00	14.00	OFF	NAR	ON	0.00	131
00:19:01.876	00:22:47.972	50	1504	70	46.00	14.00	OFF	NAR	ON	0.00	311
00:26:13.769	00:30:15.965	51	1527	70	46.00	14.00	OFF	NAR	ON	0.00	131
00:34:00.561	00:37:42.458	52	1483	70	46.00	14.00	OFF	NAR	ON	0.00	311
00:41:30.754	00:45:30.05	53	1515	70	46.00	14.00	OFF	NAR	ON	0.00	131
00:49:46.146	00:53:26.742	54	1535	70	46.00	14.00	OFF	NAR	ON	0.00	311
00:57:01.139	01:00:41.535	55	1536	70	46.00	14.00	OFF	NAR	ON	0.00	131
01:04:47.031	01:08:05.328	56	1547	70	46.00	14.00	OFF	NAR	ON	0.00	311
01:12:19.824	01:16:02.52	57	1522	70	46.00	14.00	OFF	NAR	ON	0.00	311
01:20:41.516	01:24:09.112	58	1552	70	46.00	14.00	OFF	NAR	ON	0.00	311

M060412B_b **Flight Log**

Project Number	0
S/N	0
Operator	???
Pilot(s)	???
Aircraft	???
Airport	???
Mission	???
Wheels Up	???
Flight Length	
HOBBS Start	
HOBBS End	

Weather

Date	June 04, 2012
Julian Day	156
Temperature	???
Visibility	???
Clouds	???
Precipitation	???
Wind Dir	???
Wind Speed	???
Pressure	???

Statistics

Laser Time	00:09:11

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
20:44:23.251	01:32:57.204	0	1535	70	46.00	14.00	OFF	NAR	ON	0.00	306
01:38:30.098	01:41:53.895	60	1513	70	46.00	14.00	OFF	NAR	ON	0.00	311
01:46:16.891	01:49:38.688	61	1566	70	46.00	14.00	OFF	NAR	ON	0.00	131
01:53:57.083	01:55:09.882	62	1570	70	46.00	14.00	OFF	NAR	ON	0.00	311
01:58:21.579	01:59:48.378	62	1579	70	46.00	14.00	OFF	NAR	ON	0.00	311

M062112A_a Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : June 21, 2012
Julian Day : 173
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:37:26

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
16:43:47.361	16:44:32.46	63	1411	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:43:47.361	16:44:32.46	63	1419	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:49:56.954	16:50:24.054	63	1529	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:49:56.954	16:50:24.054	63	1529	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:50:52.353	16:53:06.451	63	1525	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:56:56.747	16:59:17.445	64	1480	50	35.00	20.00	OFF	NAR	OFF	0.00	179
16:56:56.747	16:59:17.445	64	1481	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:03:32.14	17:05:57.438	65	1546	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:03:32.14	17:05:57.438	65	1547	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:09:53.834	17:11:58.332	66	1515	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:09:53.834	17:11:58.332	66	1515	50	35.00	20.00	OFF	NAR	OFF	0.00	179

17:17:36.926	17:19:55.224	67	1537	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:17:36.926	17:19:55.224	67	1537	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:23:29.12	17:25:34.618	68	1511	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:23:29.12	17:25:34.618	68	1512	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:23:29.12	17:25:34.618	68	1513	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:29:36.414	17:31:56.212	69	1526	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:29:36.414	17:31:56.212	69	1525	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:35:19.008	17:37:37.906	70	1522	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:35:19.008	17:37:37.906	70	1522	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:35:19.008	17:37:37.906	70	1521	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:41:58.201	17:44:22.299	71	1543	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:41:58.201	17:44:22.299	71	1543	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:47:54.595	17:50:14.593	72	1505	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:47:54.595	17:50:14.593	72	1505	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:55:09.988	17:57:37.786	73	1502	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:55:09.988	17:57:37.786	73	1501	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:55:09.988	17:57:37.786	73	1500	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:01:02.482	18:03:20.08	74	1509	50	35.00	20.00	OFF	NAR	OFF	0.00	179
18:01:02.482	18:03:20.08	74	1508	50	35.00	20.00	OFF	NAR	OFF	0.00	179
18:07:19.276	18:09:52.473	75	1529	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:07:19.276	18:09:52.473	75	1529	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:07:19.276	18:09:52.473	75	1529	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:13:02.77	18:15:28.867	76	1509	50	35.00	20.00	OFF	NAR	OFF	0.00	179
18:13:02.77	18:15:28.867	76	1509	50	35.00	20.00	OFF	NAR	OFF	0.00	179
18:19:01.064	18:21:32.661	77	1524	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:19:01.064	18:21:32.661	77	1525	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:19:01.064	18:21:32.661	77	1525	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:19:01.064	18:21:32.661	77	1525	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:19:01.064	18:21:32.661	77	1525	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:19:01.064	18:21:32.661	77	1525	50	35.00	20.00	OFF	NAR	OFF	0.00	359
18:24:34.058	18:26:48.256	78	1490	50	35.00	20.00	OFF	NAR	OFF	0.00	179
18:24:34.058	18:26:48.256	78	1490	50	35.00	20.00	OFF	NAR	OFF	0.00	179

M062112A_b Flight Log

Project Number	0
S/N	0
Operator	???
Pilot(s)	???
Aircraft	???
Airport	???
Mission	???
Wheels Up	???
Flight Length	
HOBBS Start	
HOBBS End	

Weather

Date	June 21, 2012
Julian Day	173
Temperature	???
Visibility	???
Clouds	???
Precipitation	???
Wind Dir	???
Wind Speed	???
Pressure	???

Statistics

Laser Time	04:49:23

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
13:47:13.856	18:36:40.646	0	1551	50	35.00	20.00	OFF	NAR	OFF	0.00	306

M062112A_c Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : June 21, 2012
Julian Day : 173
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:06:59

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
18:58:38.623	18:59:11.723	79	1511	70	46.00	14.00	OFF	NAR	ON	0.00	359
19:01:15.121	19:03:27.819	79	1585	70	46.00	14.00	OFF	NAR	ON	0.00	359
19:01:15.121	19:03:27.819	79	1586	70	46.00	14.00	OFF	NAR	ON	0.00	359
19:13:21.609	19:15:12.907	80	1524	70	46.00	14.00	OFF	NAR	ON	0.00	179
19:13:21.609	19:15:12.907	80	1524	70	46.00	14.00	OFF	NAR	ON	0.00	179

M062212A_a Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : June 22, 2012
Julian Day : 174
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:42:45

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
16:27:42.302	16:28:22.201	79	1517	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:29:32.8	16:31:55.597	79	1531	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:29:32.8	16:31:55.597	79	1531	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:35:48.193	16:37:54.591	80	1482	50	35.00	20.00	OFF	NAR	OFF	0.00	179
16:35:48.193	16:37:54.591	80	1480	50	35.00	20.00	OFF	NAR	OFF	0.00	179
16:42:40.286	16:45:16.283	81	1528	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:42:40.286	16:45:16.283	81	1531	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:49:02.079	16:51:39.776	82	1474	50	35.00	20.00	OFF	NAR	OFF	0.00	179
16:56:16.071	16:58:46.568	83	1513	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:56:16.071	16:58:46.568	83	1513	50	35.00	20.00	OFF	NAR	OFF	0.00	359
16:56:16.071	16:58:46.568	83	1515	50	35.00	20.00	OFF	NAR	OFF	0.00	359
17:03:35.363	17:05:52.161	85	1519	50	35.00	20.00	OFF	NAR	OFF	0.00	179

17:03:35.363	17:05:52.161	85	1521	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:10:27.556	17:12:28.454	85	1560	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:10:27.556	17:12:28.454	85	1562	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:10:27.556	17:12:28.454	85	1562	50	35.00	20.00	OFF	NAR	OFF	0.00	179
17:19:57.346	17:21:31.844	157	2162	70	46.00	14.00	OFF	NAR	ON	0.00	128
17:19:57.346	17:21:31.844	157	2162	70	46.00	14.00	OFF	NAR	ON	0.00	128
17:27:29.338	17:28:46.237	158	2048	70	46.00	14.00	OFF	NAR	ON	0.00	308
17:33:56.031	17:35:34.83	159	2201	70	46.00	14.00	OFF	NAR	ON	0.00	128
17:33:56.031	17:35:34.83	159	2202	70	46.00	14.00	OFF	NAR	ON	0.00	128
17:40:09.225	17:41:16.024	160	2141	70	46.00	14.00	OFF	NAR	ON	0.00	308
17:40:09.225	17:41:16.024	160	2138	70	46.00	14.00	OFF	NAR	ON	0.00	308
17:46:17.519	17:47:37.217	161	2168	70	46.00	14.00	OFF	NAR	ON	0.00	128
17:46:17.519	17:47:37.217	161	2168	70	46.00	14.00	OFF	NAR	ON	0.00	128
17:53:35.611	17:54:39.11	162	2150	70	46.00	14.00	OFF	NAR	ON	0.00	308
17:53:35.611	17:54:39.11	162	2147	70	46.00	14.00	OFF	NAR	ON	0.00	308
17:53:35.611	17:54:39.11	162	2144	70	46.00	14.00	OFF	NAR	ON	0.00	308
17:59:10.105	17:59:49.105	162	2252	70	46.00	14.00	OFF	NAR	ON	0.00	308
18:04:56.2	18:06:12.198	162	2293	70	46.00	14.00	OFF	NAR	ON	0.00	308
18:04:56.2	18:06:12.198	162	2293	70	46.00	14.00	OFF	NAR	ON	0.00	308
18:04:56.2	18:06:12.198	162	2293	70	46.00	14.00	OFF	NAR	ON	0.00	308
18:13:31.491	18:14:27.19	163	1494	70	46.00	14.00	OFF	NAR	ON	0.00	250.66
18:19:36.385	18:20:44.284	164	1633	70	46.00	14.00	OFF	NAR	ON	0.00	135.8
18:19:36.385	18:20:44.284	164	1641	70	46.00	14.00	OFF	NAR	ON	0.00	135.8
18:24:46.179	18:25:49.678	165	1495	70	46.00	14.00	OFF	NAR	ON	0.00	313.18
18:24:46.179	18:25:49.678	165	1494	70	46.00	14.00	OFF	NAR	ON	0.00	313.18
18:24:46.179	18:25:49.678	165	1494	70	46.00	14.00	OFF	NAR	ON	0.00	313.18
18:32:52.071	18:34:07.269	166	1456	70	46.00	14.00	OFF	NAR	ON	0.00	133.29
18:32:52.071	18:34:07.269	166	1456	70	46.00	14.00	OFF	NAR	ON	0.00	133.29
18:32:52.071	18:34:07.269	166	1456	70	46.00	14.00	OFF	NAR	ON	0.00	133.29
18:37:16.066	18:38:12.965	166	1504	70	46.00	14.00	OFF	NAR	ON	0.00	313.29
18:37:16.066	18:38:12.965	166	1504	70	46.00	14.00	OFF	NAR	ON	0.00	313.29
18:45:19.458	18:46:37.856	167	1542	70	46.00	14.00	OFF	NAR	ON	0.00	128.12
18:45:19.458	18:46:37.856	167	1540	70	46.00	14.00	OFF	NAR	ON	0.00	128.12
18:50:09.452	18:51:14.451	169	1528	70	46.00	14.00	OFF	NAR	ON	0.00	310.91
18:50:09.452	18:51:14.451	169	1524	70	46.00	14.00	OFF	NAR	ON	0.00	310.91
18:50:09.452	18:51:14.451	169	1522	70	46.00	14.00	OFF	NAR	ON	0.00	310.91
18:58:35.843	18:59:54.942	170	1631	70	46.00	14.00	OFF	NAR	ON	0.00	132.84
18:58:35.843	18:59:54.942	170	1625	70	46.00	14.00	OFF	NAR	ON	0.00	132.84
19:04:12.037	19:06:07.635	171	1516	70	46.00	14.00	OFF	NAR	ON	0.00	313.25
19:04:12.037	19:06:07.635	171	1515	70	46.00	14.00	OFF	NAR	ON	0.00	313.25
19:04:12.037	19:06:07.635	171	1511	70	46.00	14.00	OFF	NAR	ON	0.00	313.25
19:04:12.037	19:06:07.635	171	1506	70	46.00	14.00	OFF	NAR	ON	0.00	313.25

19:10:42.43	19:11:55.129	172	1689	70	46.00	14.00	OFF	NAR	ON	0.00	131.17
19:10:42.43	19:11:55.129	172	1686	70	46.00	14.00	OFF	NAR	ON	0.00	131.17
19:16:14.524	19:17:01.124	173	1681	70	46.00	14.00	OFF	NAR	ON	0.00	307.73
19:16:14.524	19:17:01.124	173	1679	70	46.00	14.00	OFF	NAR	ON	0.00	307.73
19:22:08.018	19:23:25.017	174	1727	70	46.00	14.00	OFF	NAR	ON	0.00	128.64
19:22:08.018	19:23:25.017	174	1725	70	46.00	14.00	OFF	NAR	ON	0.00	128.64
19:27:03.413	19:28:05.312	174	1734	70	46.00	14.00	OFF	NAR	ON	0.00	128.64
19:33:11.106	19:34:57.705	163	1716	70	46.00	14.00	OFF	NAR	ON	0.00	70.66
19:44:11.495	19:44:34.694	83	1472	70	46.00	14.00	OFF	NAR	ON	0.00	179
19:44:11.495	19:44:34.694	83	1470	70	46.00	14.00	OFF	NAR	ON	0.00	179

M062312A_a Flight

Project Number	0
S/N	0
Operator	???
Pilot(s)	???
Aircraft	???
Airport	???
Mission	???
Wheels Up	???
Flight Length	
HOBBS Start	
HOBBS End	

Weather

Date	June 23, 2012
Julian Day	175
Temperature	???
Visibility	???
Clouds	???
Precipitation	???
Wind Dir	???
Wind Speed	???
Pressure	???

Statistics

Laser Time	01:00:17

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
16:45:11.36	16:45:35.259	79	1557	70	46.00	14.00	OFF	NAR	OFF	0.00	359
16:46:26.758	16:48:50.456	79	1550	70	46.00	14.00	OFF	NAR	OFF	0.00	359
16:46:26.758	16:48:50.456	79	1552	70	46.00	14.00	OFF	NAR	OFF	0.00	359
16:53:19.051	16:55:50.948	80	1466	70	46.00	14.00	OFF	NAR	OFF	0.00	179
16:59:59.143	17:02:27.74	81	1499	70	46.00	14.00	OFF	NAR	OFF	0.00	359
17:06:57.435	17:09:27.133	82	1498	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:06:57.435	17:09:27.133	82	1501	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:13:22.928	17:15:51.025	83	1499	70	46.00	14.00	OFF	NAR	OFF	0.00	359
17:20:33.42	17:23:11.817	84	1521	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:20:33.42	17:23:11.817	84	1520	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:20:33.42	17:23:11.817	84	1520	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:28:11.111	17:30:38.409	85	1487	70	46.00	14.00	OFF	NAR	OFF	0.00	359

M062312A_a Flight (continued)

17:28:11.111	17:30:38.409	85	1483	70	46.00	14.00	OFF	NAR	OFF	0.00	359
17:34:00.505	17:36:08.103	86	1537	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:34:00.505	17:36:08.103	86	1537	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:34:00.505	17:36:08.103	86	1537	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:41:58.496	17:44:01.894	87	1477	70	46.00	14.00	OFF	NAR	OFF	0.00	359
17:41:58.496	17:44:01.894	87	1477	70	46.00	14.00	OFF	NAR	OFF	0.00	359
17:47:12.19	17:48:59.888	88	1518	70	46.00	14.00	OFF	NAR	OFF	0.00	179
17:55:08.081	17:57:56.578	88	1581	70	46.00	14.00	OFF	NAR	OFF	0.00	359
17:55:08.081	17:57:56.578	88	1584	70	46.00	14.00	OFF	NAR	OFF	0.00	359
18:14:04.16	18:15:15.359	10	1685	70	46.00	14.00	OFF	NAR	ON	0.00	335.7
18:19:48.254	18:21:12.952	11	1777	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:25:09.248	18:26:20.547	12	1774	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
18:25:09.248	18:26:20.547	12	1775	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
18:29:47.343	18:31:20.641	13	1808	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:29:47.343	18:31:20.641	13	1809	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:35:14.137	18:36:32.036	14	1751	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
18:35:14.137	18:36:32.036	14	1752	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
18:41:46.13	18:43:16.328	15	1808	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:41:46.13	18:43:16.328	15	1808	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:47:19.724	18:48:36.023	16	1764	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
18:47:19.724	18:48:36.023	16	1764	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
18:53:05.218	18:54:40.516	17	1819	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:53:05.218	18:54:40.516	17	1820	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:53:05.218	18:54:40.516	17	1822	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:53:05.218	18:54:40.516	17	1825	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
18:58:30.712	18:59:58.01	18	1774	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
18:58:30.712	18:59:58.01	18	1775	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
19:04:04.206	19:05:27.705	19	1834	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
19:04:04.206	19:05:27.705	19	1837	70	46.00	14.00	OFF	NAR	ON	0.00	75.02
19:09:18.4	19:10:20.099	20	1779	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
19:09:18.4	19:10:20.099	20	1772	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
19:09:18.4	19:10:20.099	20	1767	70	46.00	14.00	OFF	NAR	ON	0.00	255.02
19:17:54.091	19:20:20.488	1	2408	70	46.00	14.00	OFF	NAR	ON	0.00	130.66
19:17:54.091	19:20:20.488	1	2409	70	46.00	14.00	OFF	NAR	ON	0.00	310.66
19:24:47.384	19:26:42.982	2	2415	70	46.00	14.00	OFF	NAR	ON	0.00	310.66
19:24:47.384	19:26:42.982	2	2416	70	46.00	14.00	OFF	NAR	ON	0.00	310.66
19:32:02.776	19:34:31.073	3	2405	70	46.00	14.00	OFF	NAR	ON	0.00	131.13
19:32:02.776	19:34:31.073	3	2407	70	46.00	14.00	OFF	NAR	ON	0.00	310.78
19:32:02.776	19:34:31.073	3	2412	70	46.00	14.00	OFF	NAR	ON	0.00	130.78
19:38:44.069	19:40:51.567	4	2432	70	46.00	14.00	OFF	NAR	ON	0.00	310.78
19:38:44.069	19:40:51.567	4	2435	70	46.00	14.00	OFF	NAR	ON	0.00	310.78
19:46:11.061	19:48:32.759	5	2419	70	46.00	14.00	OFF	NAR	ON	0.00	135.43
19:46:11.061	19:48:32.759	5	2419	70	46.00	14.00	OFF	NAR	ON	0.00	135.43

19:52:09.455	19:53:35.953	5	2391	70	46.00	14.00	OFF	NAR	ON	0.00	135.43
19:52:09.455	19:53:35.953	5	2390	70	46.00	14.00	OFF	NAR	ON	0.00	135.43
19:57:10.25	19:58:08.549	6	2547	70	46.00	14.00	OFF	NAR	ON	0.00	135.38
19:57:10.25	19:58:08.549	6	2548	70	46.00	14.00	OFF	NAR	ON	0.00	135.38
20:02:41.244	20:03:54.443	7	2563	70	46.00	14.00	OFF	NAR	ON	0.00	311.3
20:02:41.244	20:03:54.443	7	2563	70	46.00	14.00	OFF	NAR	ON	0.00	312.96
20:08:11.438	20:09:34.637	8	2582	70	46.00	14.00	OFF	NAR	ON	0.00	132.96
20:08:11.438	20:09:34.637	8	2581	70	46.00	14.00	OFF	NAR	ON	0.00	132.96
20:14:04.732	20:15:18.331	9	2434	70	46.00	14.00	OFF	NAR	ON	0.00	311.41
20:14:04.732	20:15:18.331	9	2433	70	46.00	14.00	OFF	NAR	ON	0.00	311.41
20:14:04.732	20:15:18.331	9	2432	70	46.00	14.00	OFF	NAR	ON	0.00	311.41
20:20:11.126	20:21:42.724	8	2607	70	46.00	14.00	OFF	NAR	ON	0.00	132.96
20:26:14.12	20:28:08.818	8	2600	70	46.00	14.00	OFF	NAR	ON	0.00	132.96
20:26:14.12	20:28:08.818	8	2599	70	46.00	14.00	OFF	NAR	ON	0.00	132.96

M071912A Flight Log

Project Number: 0
S/N : 0
Operator : ???
Pilot(s) : ???
Aircraft : ???
Airport : ???
Mission : ???
Wheels Up : ???
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : July 19, 2012
Julian Day : 201
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:12:05

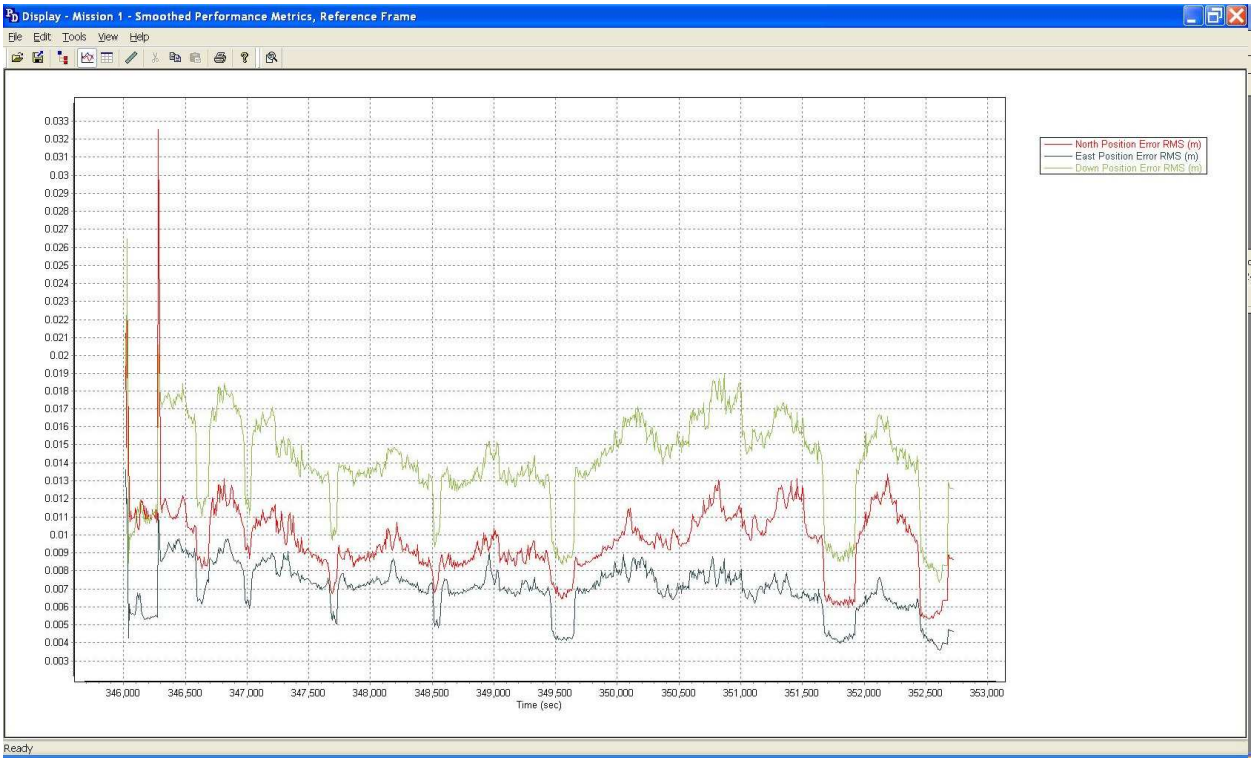
START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	MPM	HDG	Plan File
20:41:33.388	20:41:47.788	1	2016	70	46.00	14.00	OFF	NAR	ON	OFF	314.00	6120404_Juneau_Lidar_Gaps_V2.pln
20:41:58.288	20:42:06.988	1	2123	70	46.00	14.00	OFF	NAR	ON	OFF	314.00	6120404_Juneau_Lidar_Gaps_V2.pln
20:46:11.583	20:47:04.383	1	2497	70	46.00	14.00	OFF	NAR	ON	OFF	314.00	6120404_Juneau_Lidar_Gaps_V2.pln
20:50:00.68	20:51:21.678	2	2482	70	46.00	14.00	OFF	NAR	ON	OFF	125.00	6120404_Juneau_Lidar_Gaps_V2.pln
20:54:11.675	20:55:23.674	3	2591	70	46.00	14.00	OFF	NAR	ON	OFF	305.00	6120404_Juneau_Lidar_Gaps_V2.pln
20:58:59.571	21:00:24.769	4	2293	70	46.00	14.00	OFF	NAR	ON	OFF	134.00	6120404_Juneau_Lidar_Gaps_V2.pln
21:03:22.366	21:04:39.965	5	2279	70	46.00	14.00	OFF	NAR	ON	OFF	125.00	6120404_Juneau_Lidar_Gaps_V2.pln
21:06:56.663	21:08:35.561	6	2401	70	46.00	14.00	OFF	NAR	ON	OFF	125.00	6120404_Juneau_Lidar_Gaps_V2.pln
21:11:36.858	21:12:50.957	7	2396	70	46.00	14.00	OFF	NAR	ON	OFF	305.00	6120404_Juneau_Lidar_Gaps_V2.pln
21:15:45.954	21:17:06.153	8	2405	70	46.00	14.00	OFF	NAR	ON	OFF	125.00	6120404_Juneau_Lidar_Gaps_V2.pln
21:19:24.951	21:20:17.05	8	2390	70	46.00	14.00	OFF	NAR	ON	OFF	125.00	6120404_Juneau_Lidar_Gaps_V2.pln
21:22:04.648	21:23:15.247	4	2405	70	46.00	14.00	OFF	NAR	ON	OFF	314.00	6120404_Juneau_Lidar_Gaps_V2.pln

121002_164251 Flight Log

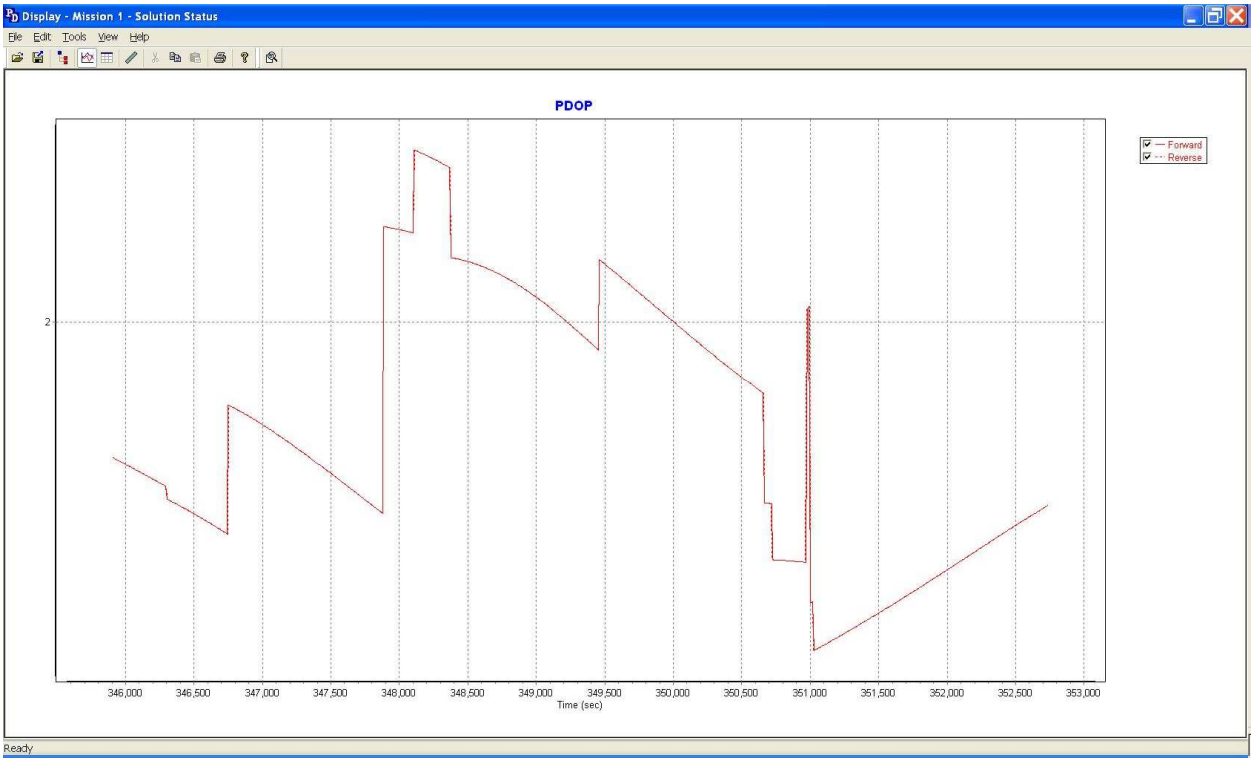
LINE ID	LINE NUMBER	SET FOV	SET SCAN RATE	PULSE RATE	WEEK NUM	SECONDS OF WEEK	LAT	LON	ALT	HEADING	SPEED (knots)	Scan Pattern
121002_173137	A03	28	61.1	75000	1708	235915.6	58.26295	-134.565	1710.89	21.386	164.629	Triangle
121002_173529	A02	28	61.1	75000	1708	236148.1	58.26858	-134.569	1720.961	118.379	173.583	Triangle
121002_173908	A01	28	61.1	75000	1708	236366.4	58.26491	-134.555	1720.119	300.765	158.686	Triangle
121002_174314	A06	28	42.6	75000	1708	236613.1	58.42929	-134.53	1717.725	356.058	161.258	Triangle
121002_174659	A06	28	42.6	75000	1708	236838.1	58.44321	-134.532	1717.004	176.853	161.963	Triangle
121002_175042	A05	28	47.3	75000	1708	237061	58.43738	-134.522	1722.663	270.468	159.997	Triangle
121002_175418	A04	28	45.5	75000	1708	237276.4	58.43537	-134.541	1719.6	89.642	162.654	Triangle

8 LiDAR GPS PROCESSING PLOTS

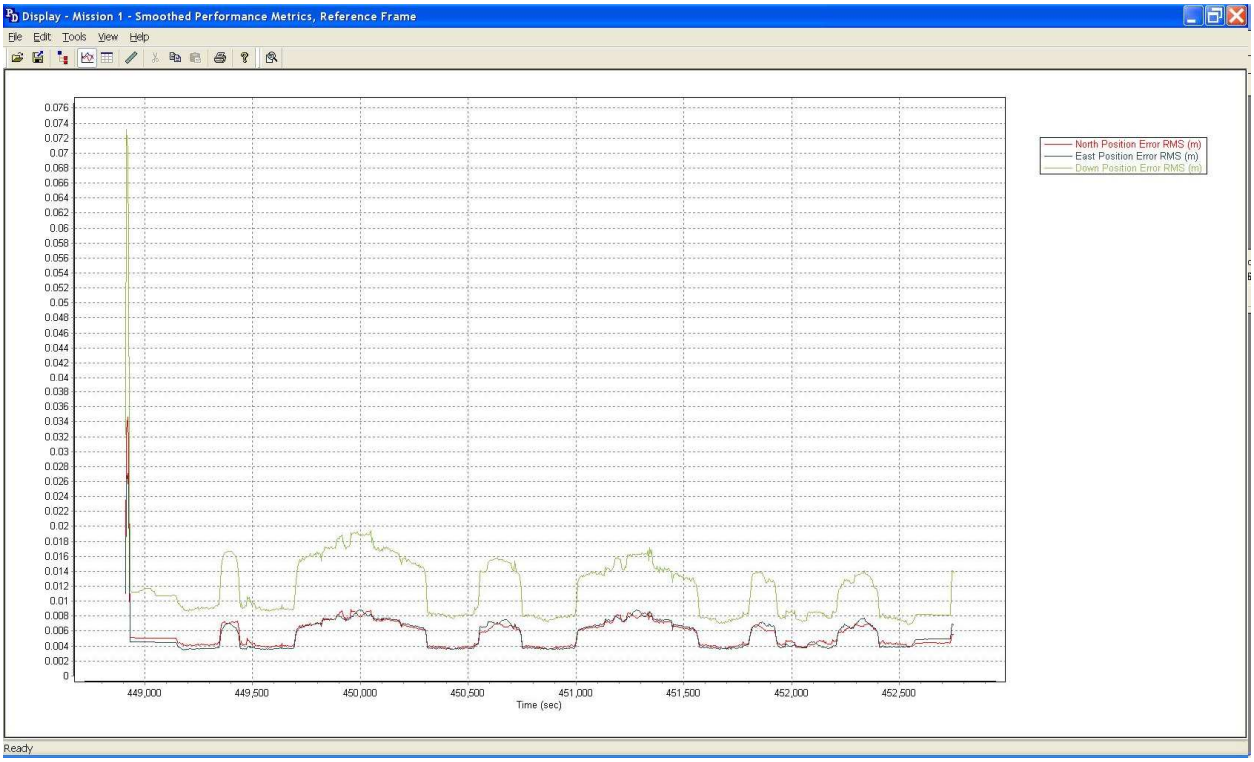
Combined Separation Plots M042512A



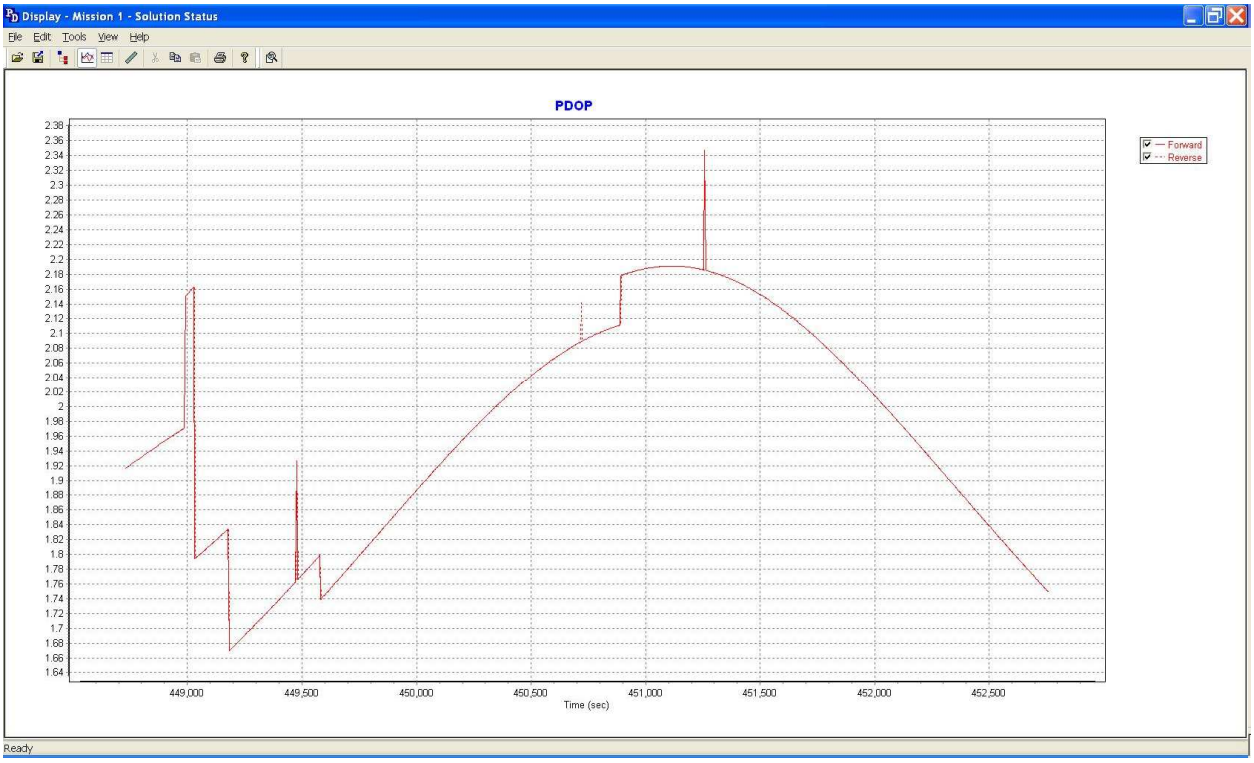
PDOP M042512A



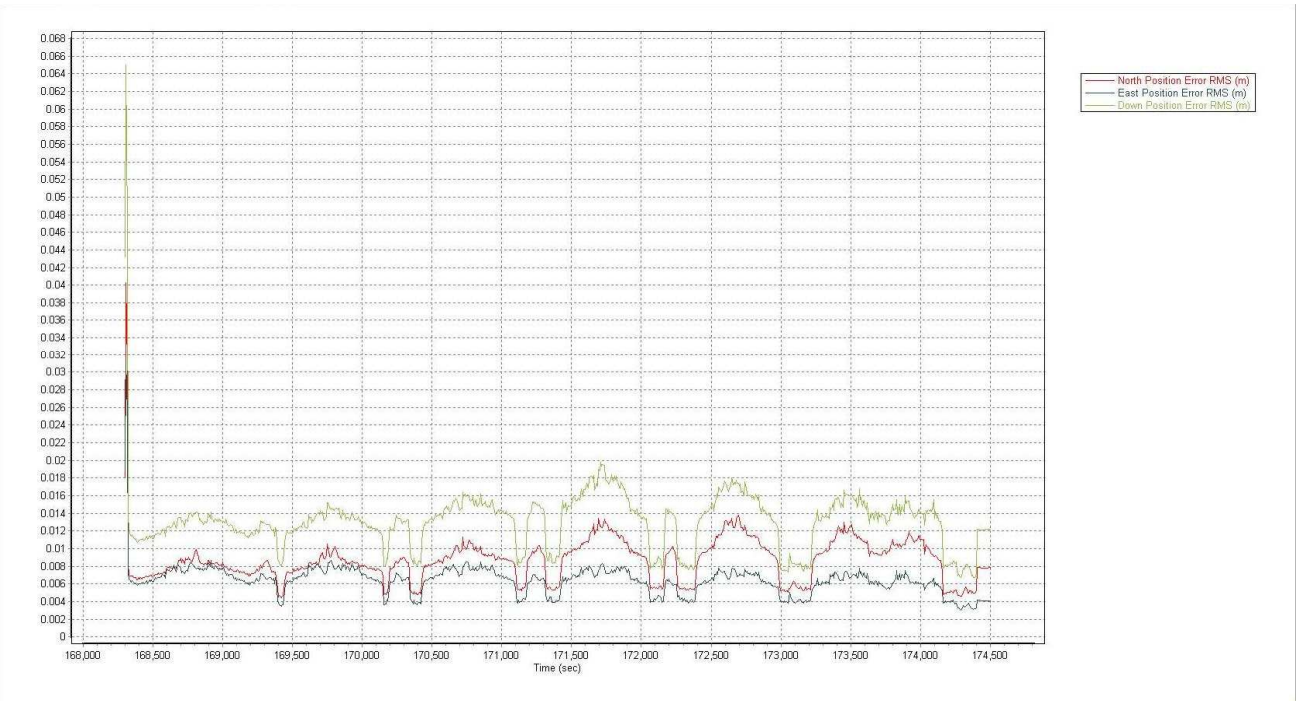
Combined Separation Plots M050312A



PDOP M050312A

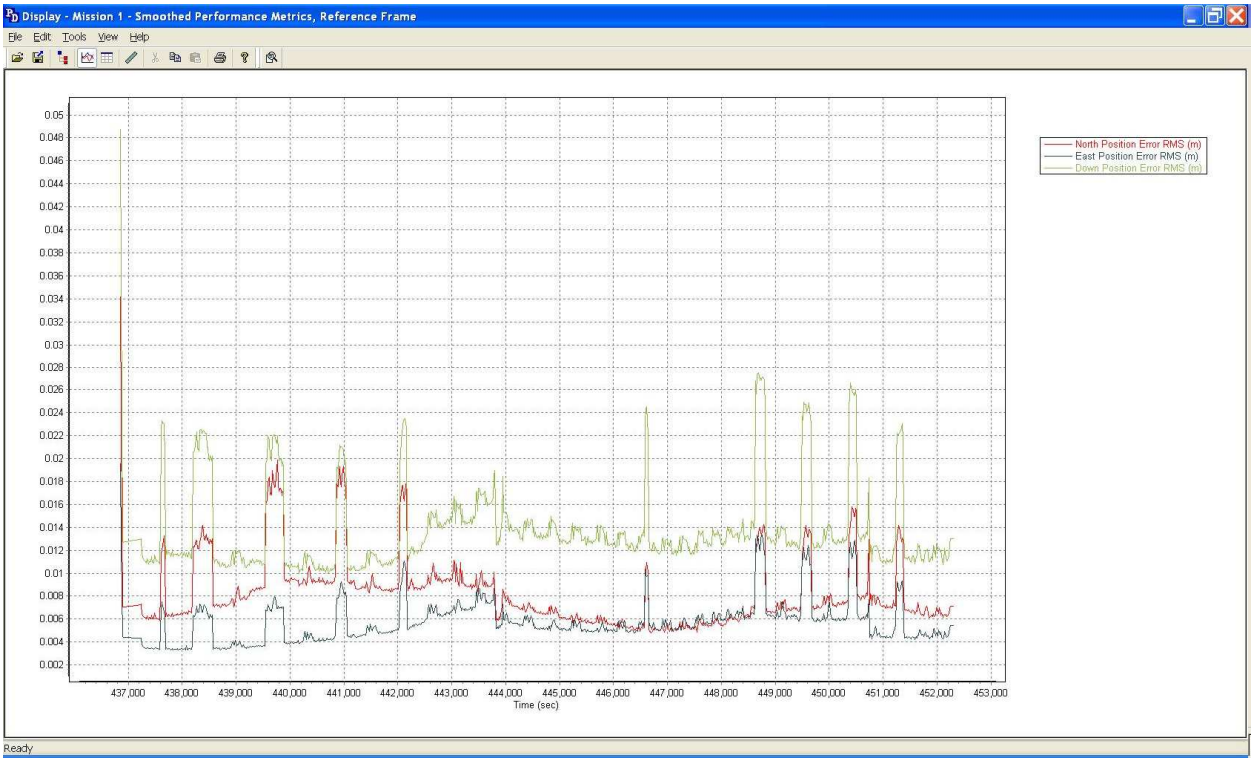


Combined Separation Plots M052112A

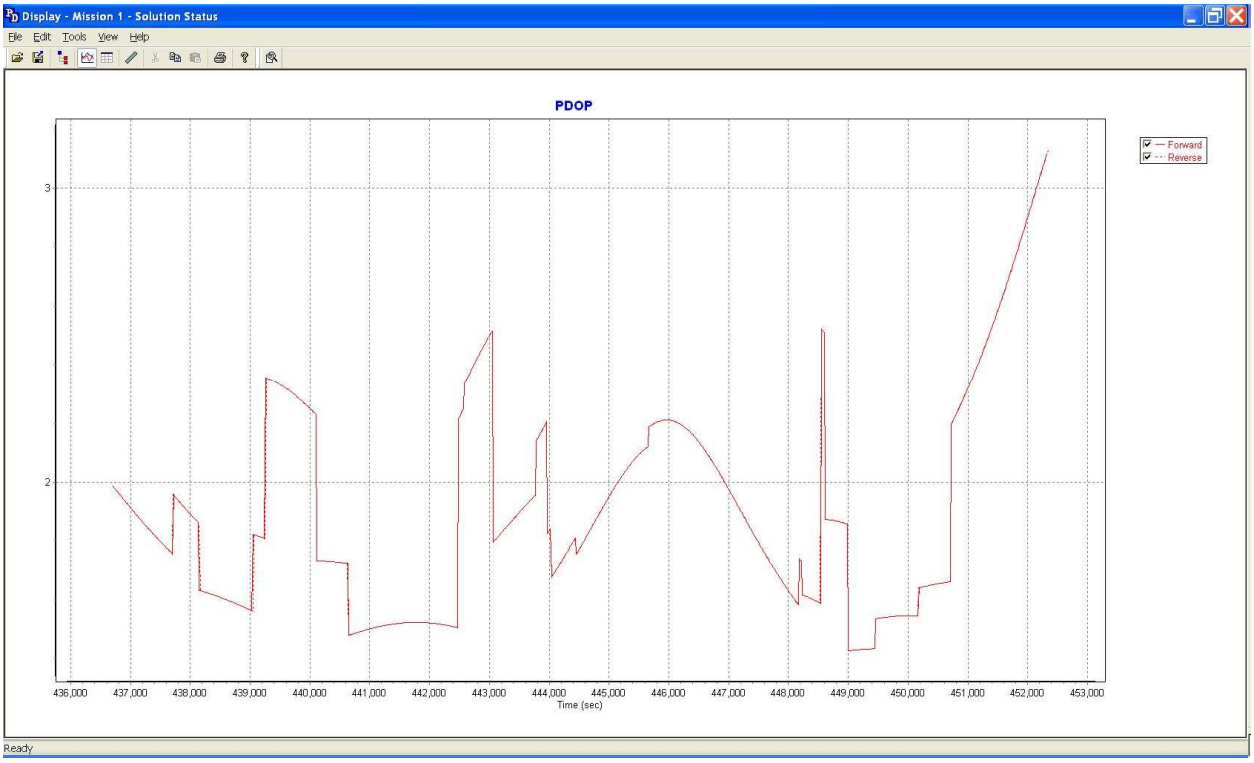


PDOP M052112A

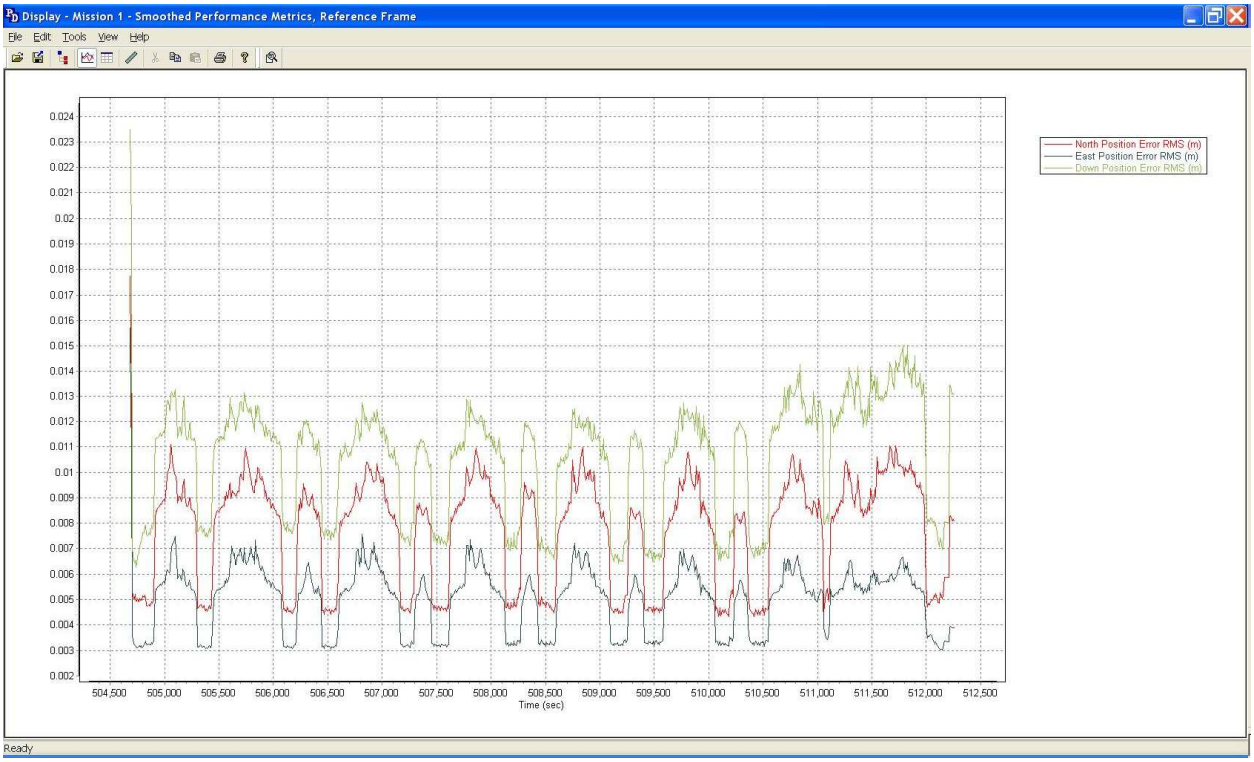
Combined Separation Plots M052412B



PDOP M052412B

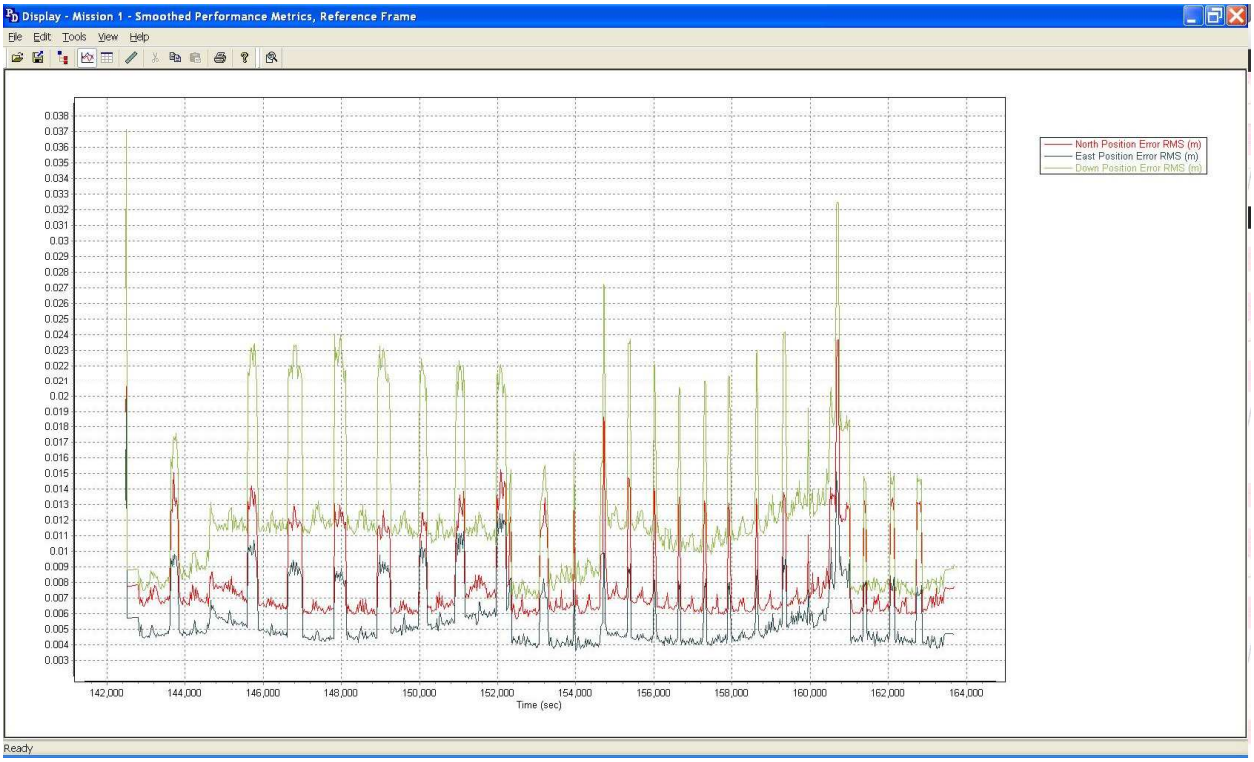


Combined Separation Plots M060112A

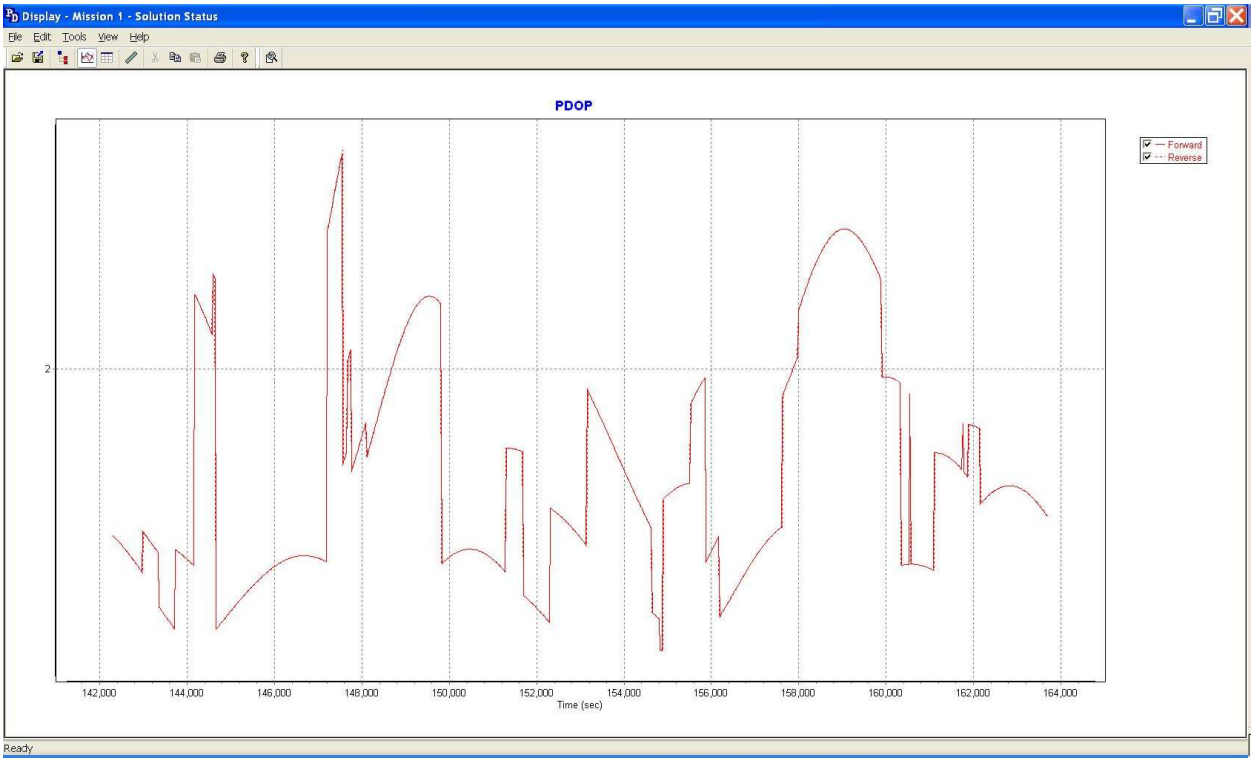


PDOP M060112A

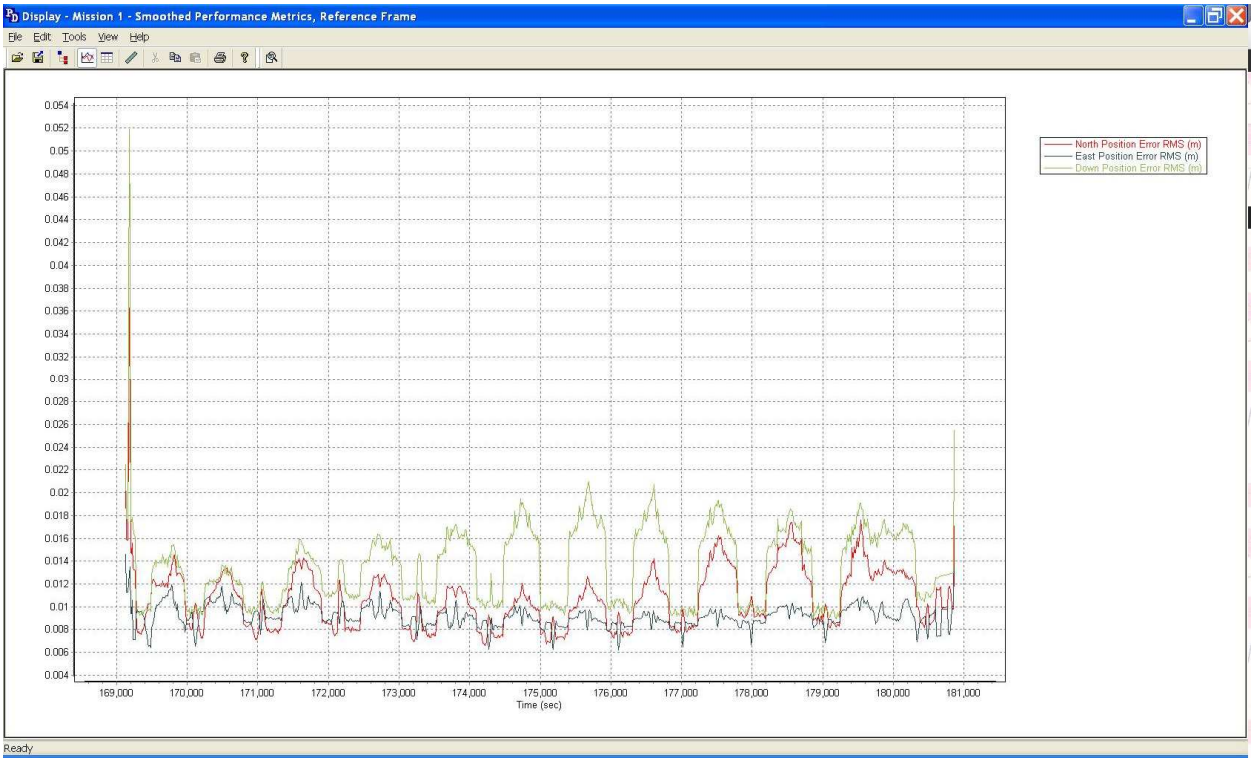
Combined Separation Plots M060412A



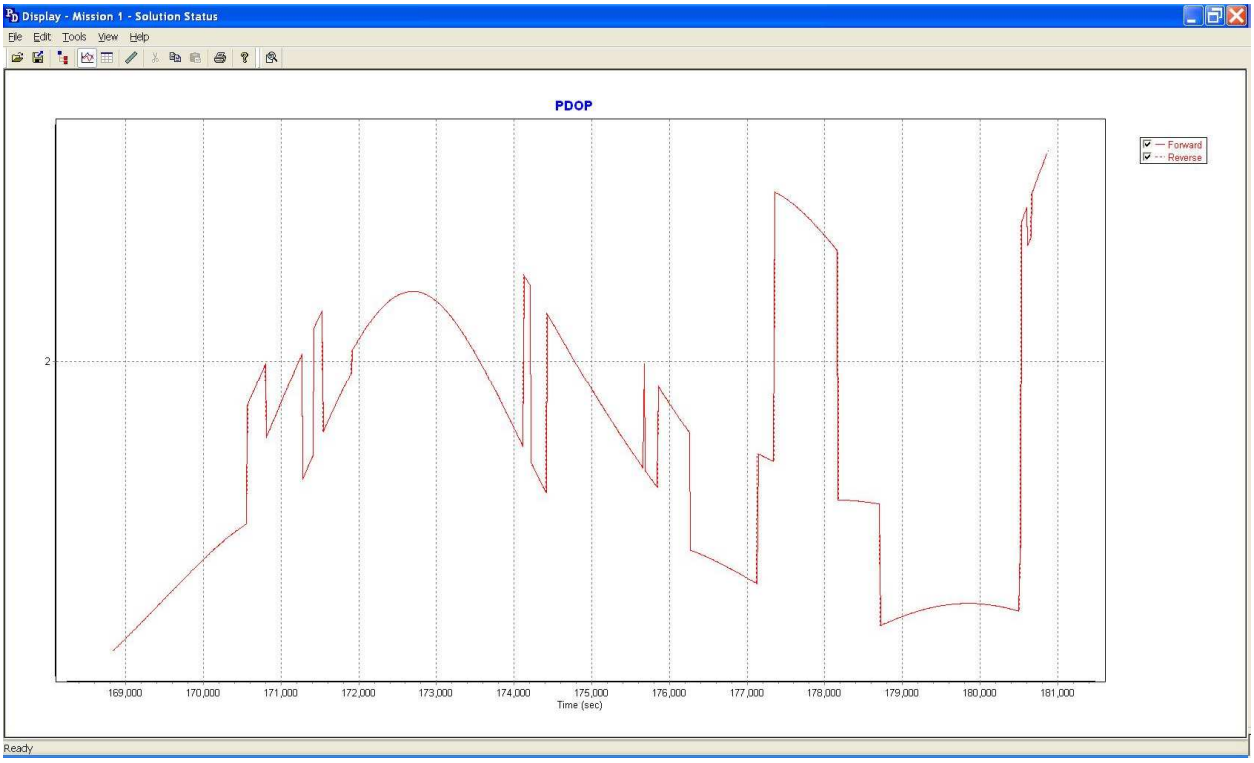
PDOP M060412A



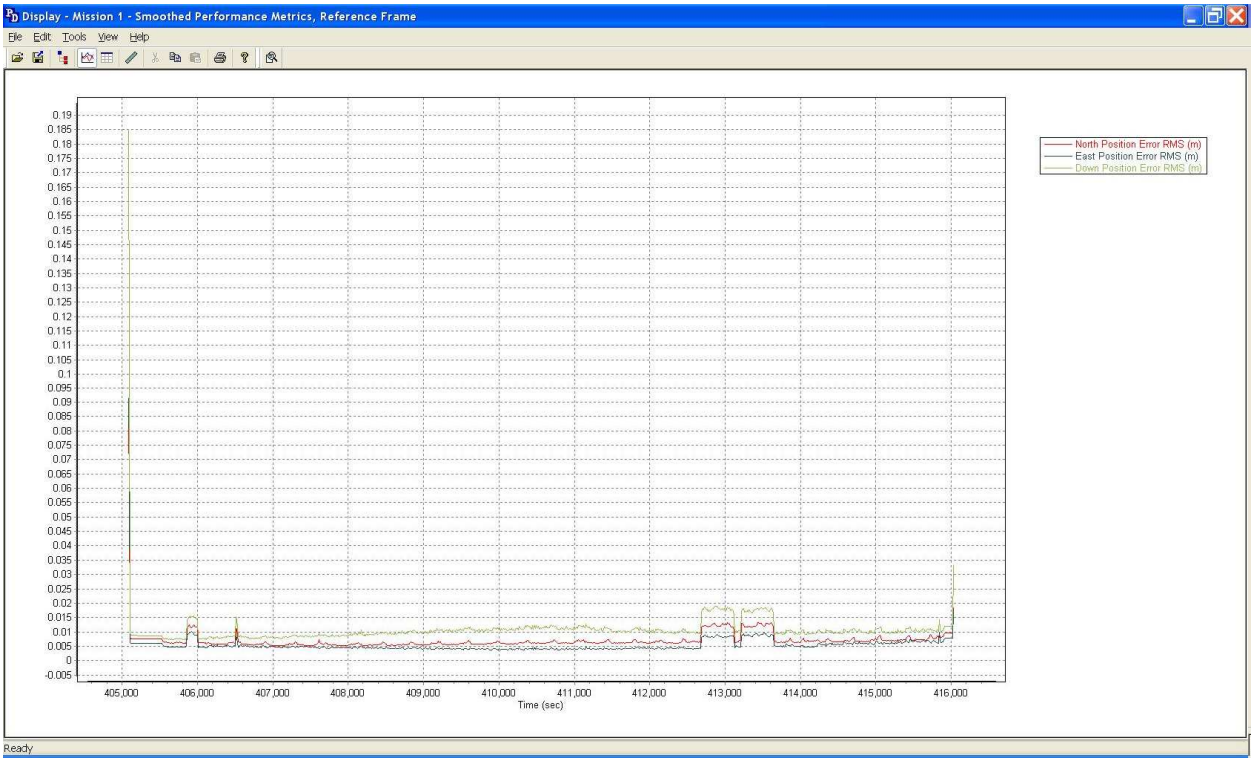
Combined Separation Plots M060412B



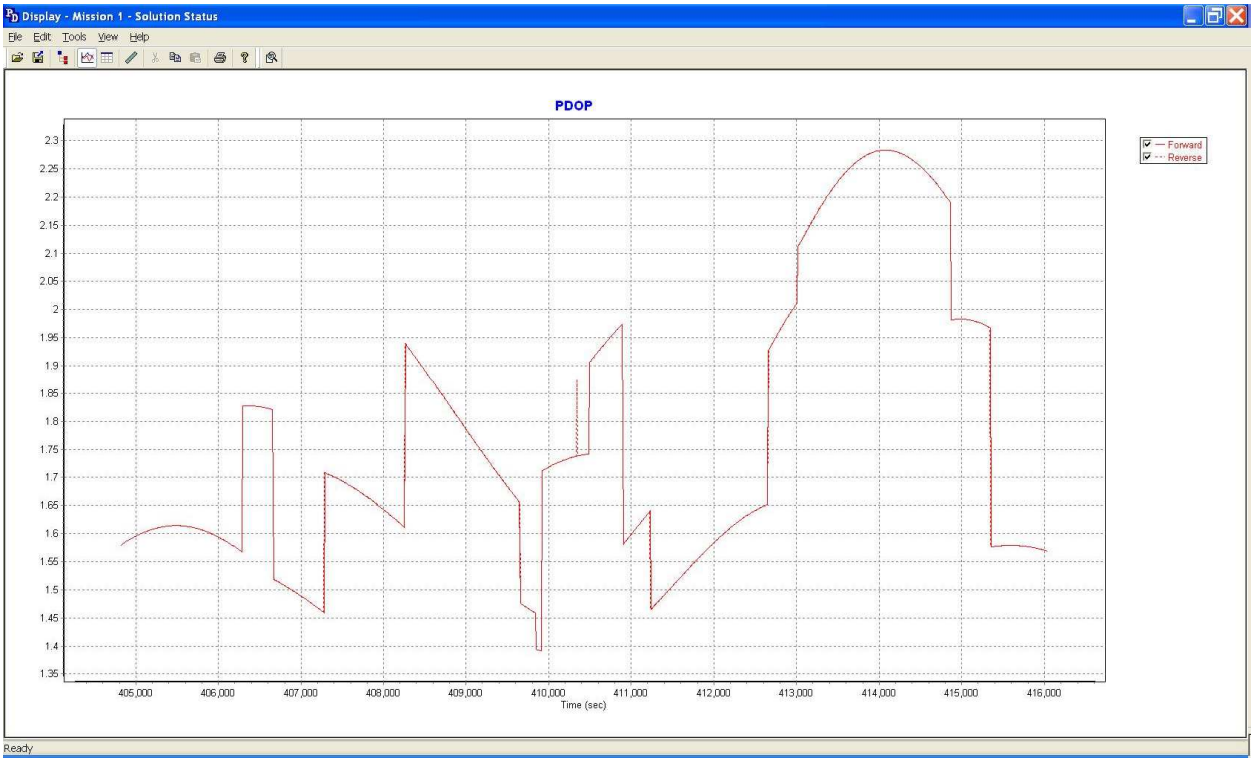
PDOP M060412B



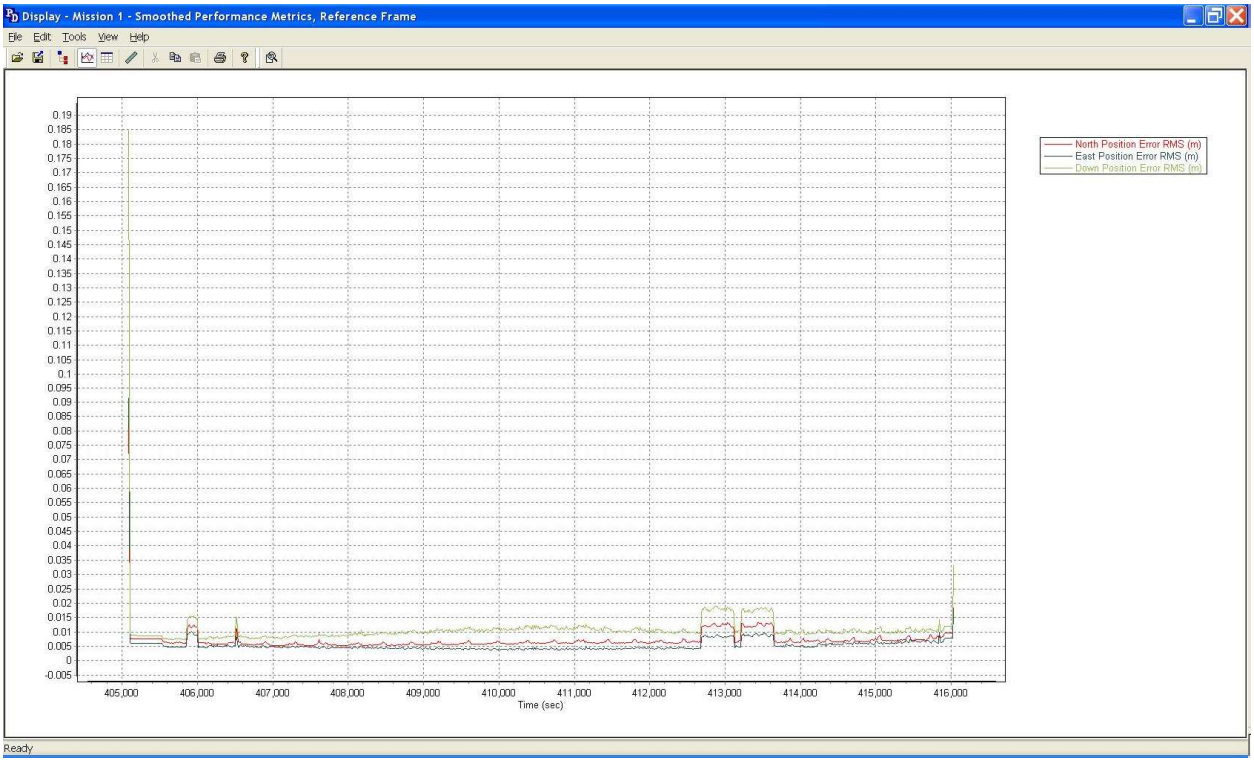
Combined Separation Plots M062112A



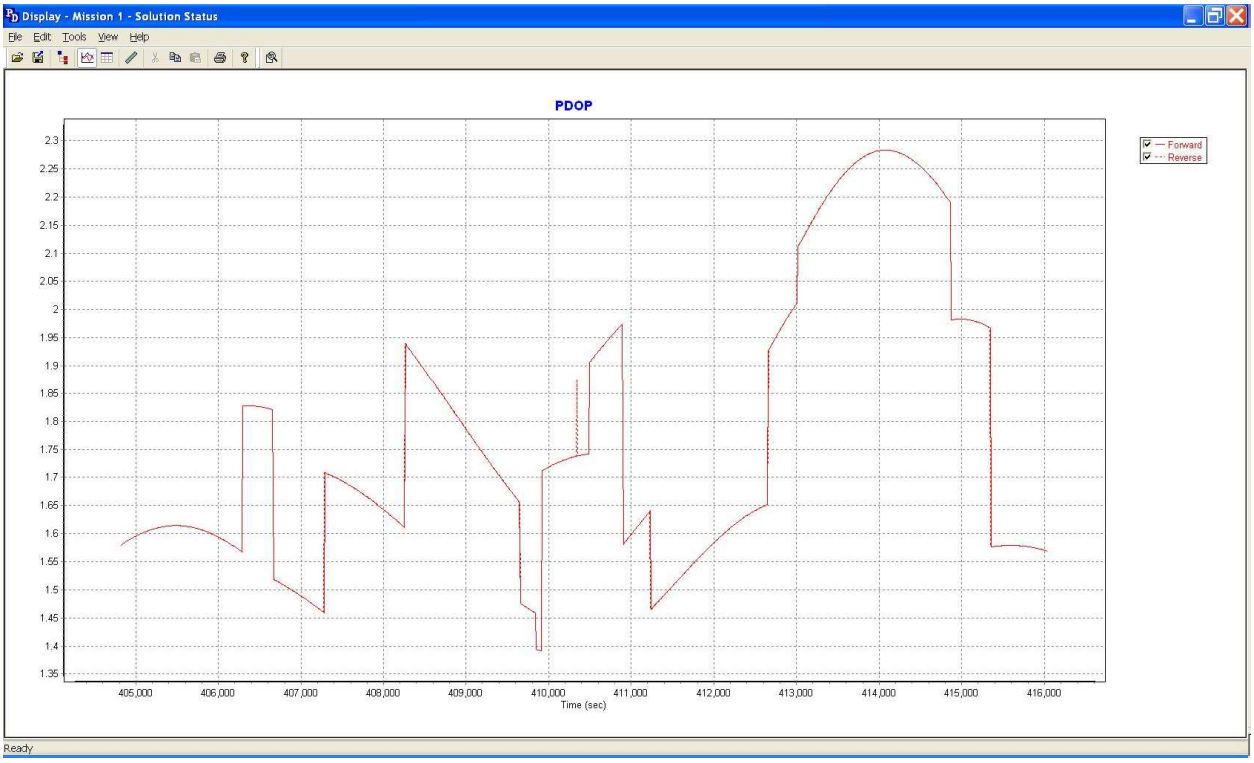
PDOP M062112A



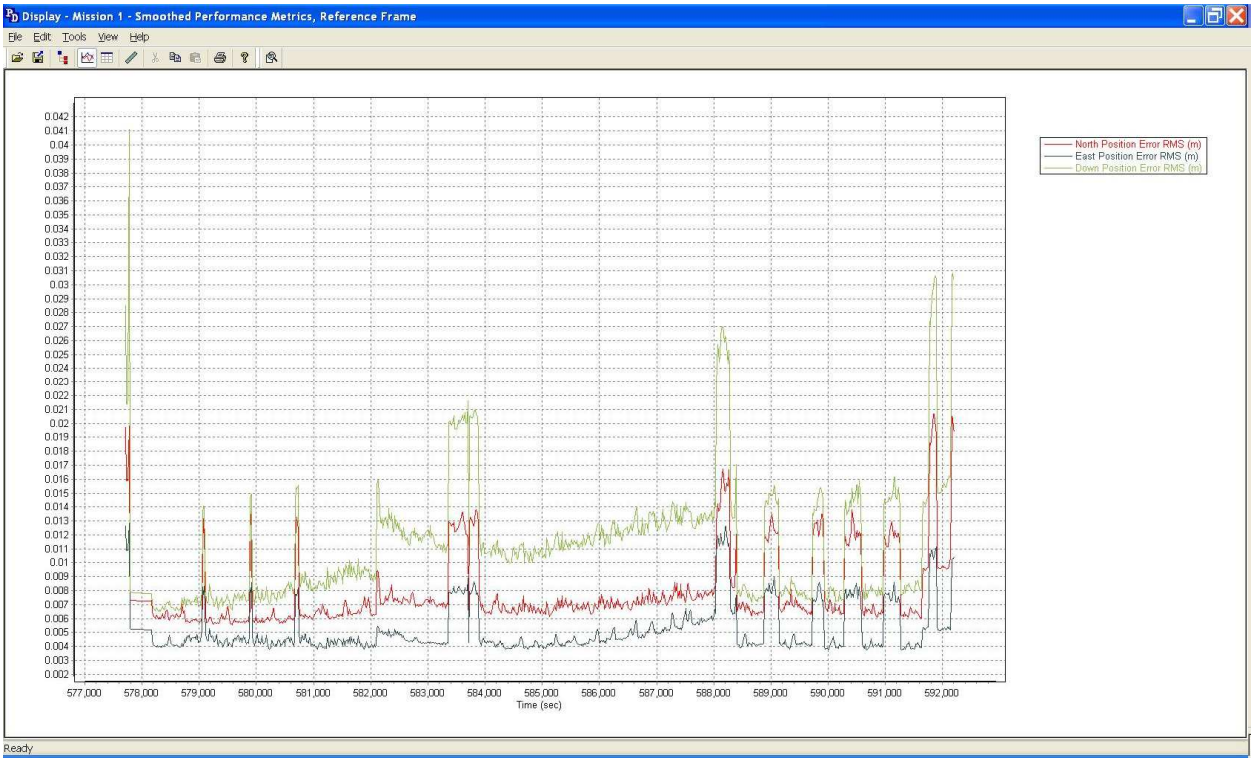
Combined Separation Plots M062212A



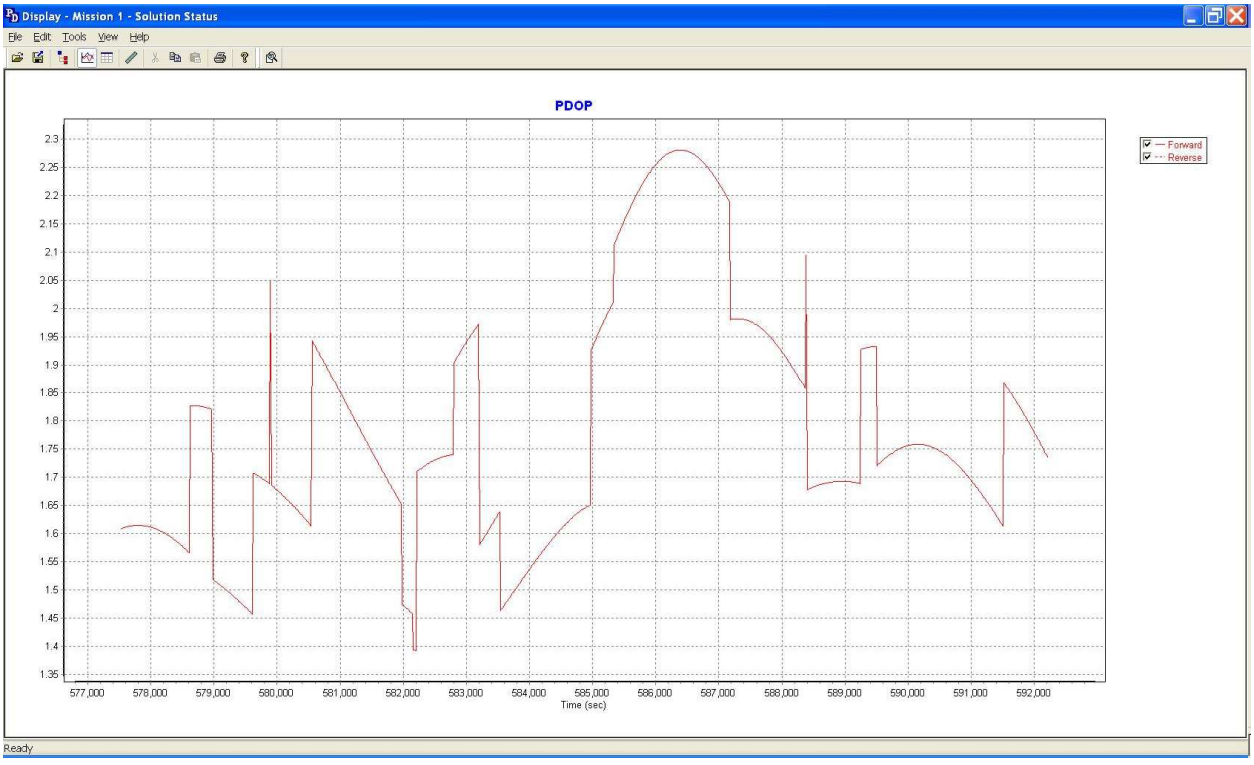
PDOP M062212A



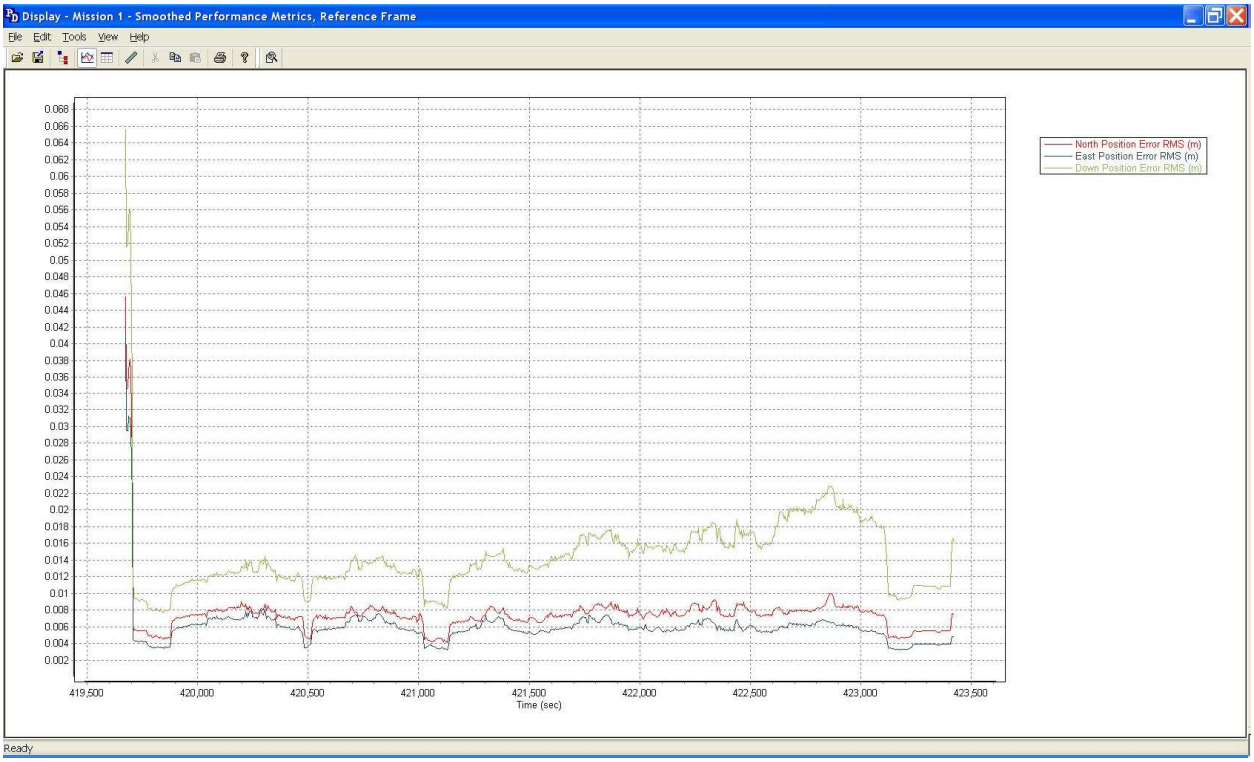
Combined Separation Plots M062312A



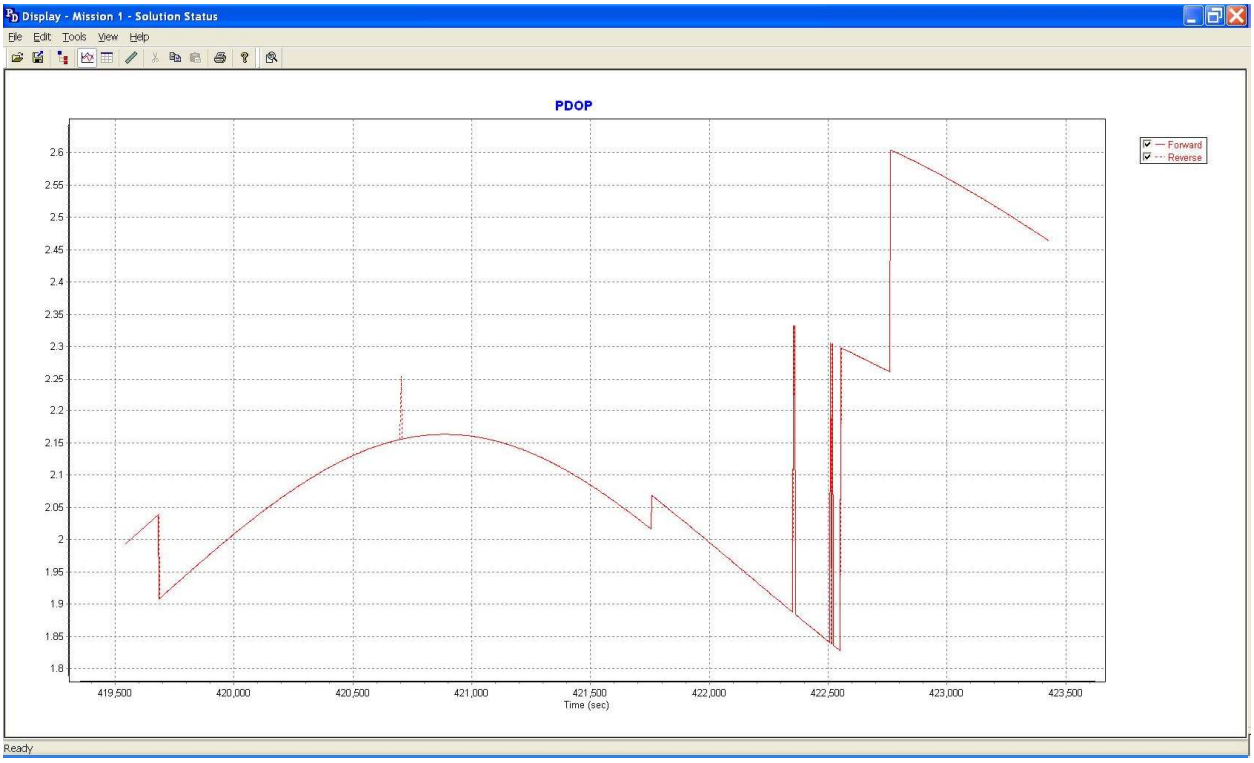
PDOP M062312A



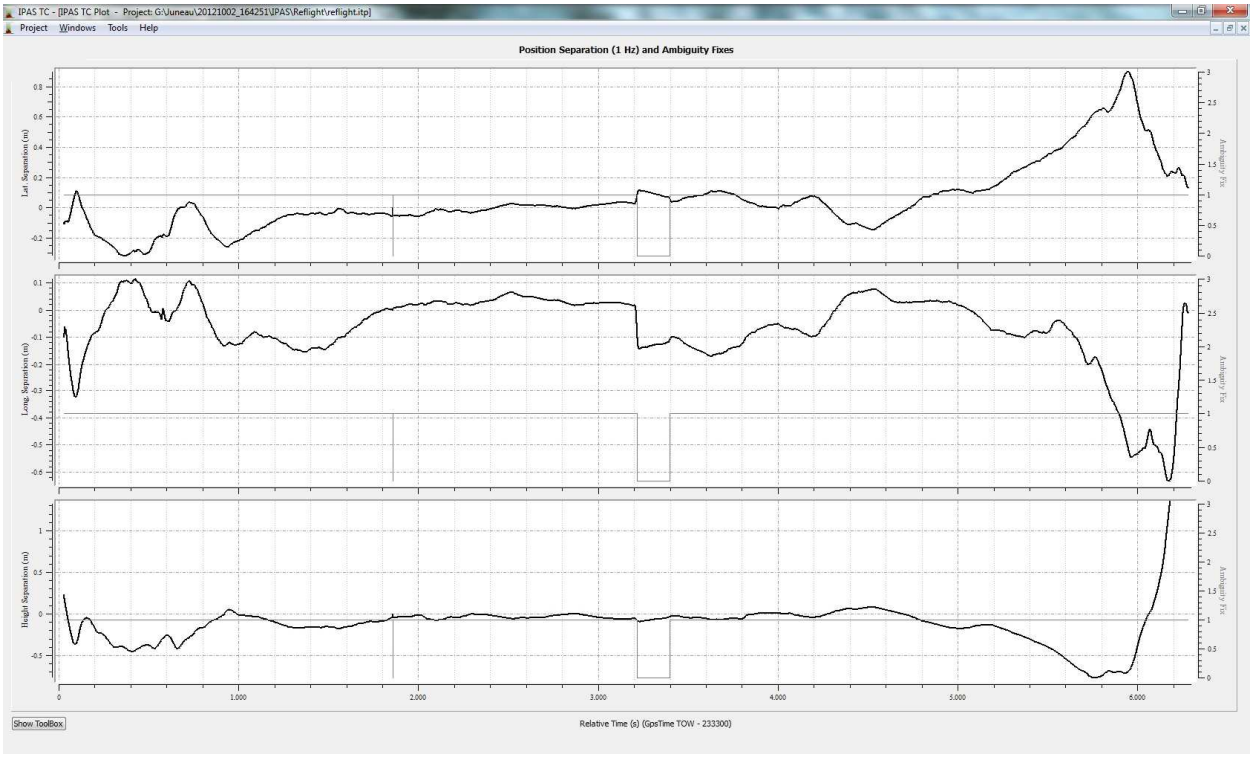
Combined Separation Plots M071912A



PDOP M071912A



Combined Separation Plot 20121002_164251



9 CONTROL REPORT QA QC

N:\6120404\Lidar\QAQC\Juneau_Ground.txt

Number	Easting	Northing	Known Z	Laser Z	Dz
5287	522944.559	6473351.027	15.097	removed	*
5309	521220.866	6468668.510	52.221	52.220	-0.001
5310	521210.400	6468680.968	52.386	52.360	-0.026
5311	521195.139	6468683.757	52.407	52.400	-0.007
5337	520802.742	6467619.205	14.245	14.260	+0.015
5338	520797.724	6467616.926	14.041	14.040	-0.001
5367	520274.205	6471810.902	17.778	17.750	-0.028
5368	520281.367	6471805.945	17.199	17.200	+0.001
5378	520206.729	6471797.544	21.453	21.470	+0.017
5379	520218.919	6471806.902	20.957	20.970	+0.013
5380	520231.029	6471815.133	20.282	20.320	+0.038
5388	521884.893	6470806.894	39.768	39.860	+0.092
5389	521887.286	6470800.962	39.514	39.760	+0.246
5393	522442.945	6470184.335	9.505	9.530	+0.025
5394	522450.912	6470198.085	9.607	9.630	+0.023
5395	522458.457	6470210.968	9.762	9.760	-0.002
5406	522513.802	6470183.430	8.193	8.460	+0.267
5407	522521.574	6470170.556	8.091	8.380	+0.289
5417	523096.935	6469149.863	6.957	7.160	+0.203
5418	523106.709	6469160.726	7.050	7.280	+0.230
5444	521810.350	6467778.136	30.932	30.970	+0.038
5445	521816.524	6467771.924	31.005	31.050	+0.045
5446	521814.864	6467781.334	30.320	30.350	+0.030
5473	512569.721	6481074.760	15.978	15.990	+0.012
5474	512566.042	6481058.700	15.940	15.920	-0.020
5484	514190.088	6475551.554	24.762	24.740	-0.022
5485	514188.708	6475556.596	24.688	24.710	+0.022
5486	514181.681	6475585.951	24.339	24.330	-0.009
5502	513565.070	6472294.276	32.577	32.550	-0.027
5503	513563.714	6472282.579	33.460	33.430	-0.030

Average dz	+0.049
Minimum dz	-0.030
Maximum dz	+0.289
Average magnitude	0.061
Root mean square	0.107
Std deviation	0.096

10 GROUND CONTROL SURVEY REPORTS

JUNEAU ALASKA LIDAR

JUNEAU, ALASKA
GROUND CONTROL SURVEYING REPORT

Prepared for:

Aero-Metric, Inc.
2014 Merrill Field Drive
Anchorage, Alaska 99501-4116

Prepared by:

DOWL HKM
4041 B Street
Anchorage, Alaska 99503
(907) 562-2000

DOWL HKM Project Number 1127.61159.01
USGS Task No: G12PD004841

May 2012

TABLE OF CONTENTS

LIST OF ACRONYMS

GPS....Global Positioning System

MLLW....Mean Lower Low Water

NGS....National Geodetic Survey

QC....Quality Control

USGS....United States Geological Survey

HORIZONTAL & VERTICAL CONTROL SUMMARY

1.0 INTRODUCTION

This project is a Lidar mapping effort of a large portion of Juneau Alaska. DOWL HKM is working as a sub consultant to Aero-metric, Inc. to provide the ground control survey and the independent Lidar Quality Control (QC) survey. Aero-Metric, Inc. is under contract with the United States Geological Survey (USGS) organization to provide the mapping.

2.0 HORIZONTAL CONTROL SUMMARY

A field survey was performed by DOWL HKM from May 7, 2012 through May 11, 2012 by A. Willie Stoll, PLS (Alaska #12041). Eight temporary GPS stations were established, one near the end of each of the proposed road profiles, and two mid project, for use as Post Processed Kinematic Profile Base Stations. We performed a project-wide Static GPS network to tie the temporary GPS stations to National Geodetic Survey (NGS) Station “JNU TIDAL GPS” (PID=AI4908) and the NGS CORS station “JNU1 ARP” (PID=DF4367).

GPS vectors to these control points originated from NGS Station “JNU TIDAL GPS”. The published NAD83 (NSRS2007) values for this station were held for this survey.

3.0 HORIZONTAL CONTROL STATEMENT

Coordinates are NAD83 (NSRS2007) UTM Zone 8 expressed in Meters. The Basis of Coordinates NGS Station "JNU TIDAL GPS" (PID=AI4908), a Brass Cap having a value of N 6,462,156.985 and E 534,033.122. Bearings are grid bearings as determined by GPS observations collected with Leica dual frequency GPS receivers.

4.0 VERTICAL CONTROL SUMMARY

Alaska Department of Transportation South-East Region provided the datum selection for this project. MLLW 1983-2001 tidal epoch was chosen. Although there is a more current Tidal Epoch, this is the one that was chosen. Elevations for all control points were determined using GPS observations collected with Leica dual frequency GPS receivers and a geoid model. Geoid-09 orthometric heights were computed, and a bias was calculated to convert to the MLLW datum. This Bias was applied directly to the Geoid-09 orthometric heights.

5.0 VERTICAL CONTROL STATEMENT

Elevations are Mean Lower Low Water (MLLW) based on the superseded 1983-2001 tidal epoch in Meters. The basis of elevations is NOAA/NOS Tertiary Tide Station "9452210 JUNEAU, AK". Bench mark "945-2210 A" is a Brass Cap, and has a value of 7.931 Meters above MLLW, published 10/2011, as provided by the Alaska Department of Transportation South-East Region. Elevations for all other control points were determined using GPS observations collected with Leica dual frequency GPS receivers.

6.0 LIDAR QUALITY CONTROL SURVEY

Lidar QC data was collected throughout the project. We collected approximately 500 checkpoints distributed among the five common land coverage categories, and dispersed throughout the project area. All the Lidar QC data was collected using RTK GPS surveying techniques.

7.0 LIDAR NORMALIZATION DATA

Lidar Normalization data was collected on the major roads throughout the project. Initial intentions were to collect data on:

- The major road (Glacier Highway) between Thane, Alaska and Eagle Beach north of Juneau (approximately 32 miles).
- The North Douglas Highway (approximately 12 miles),
- Fish Creek Road (approximately 6 miles),
- Fritz Cove Road (approximately 6 miles),
- Mendenhall Loop Road from Glacier Highway to Mendenhall Glacier Visitor Center (approximately 4 miles).

Due to the obstructions, PPK GPS was not preforming very well in certain areas. Fritz Cove Road and the Glacier Highway north of Auke Bay were both low quality GPS resolutions. Two separate PPK profiles were collected through these areas, and the data was stringently processed. Sections of the road profiles were omitted from the submission to ensure that the data provided meets specifications.

During the data editing, sections of data that are on bridges was removed, and also data that was in areas of road construction was also removed. A majority of Thane Road is under construction and was removed.

8.0 QUALITY ASSURANCE

Quality Assurance (QA) methods and procedures outlined in the statement of services were reviewed with our staff and adhered to. Some examples of QA methods include the following:

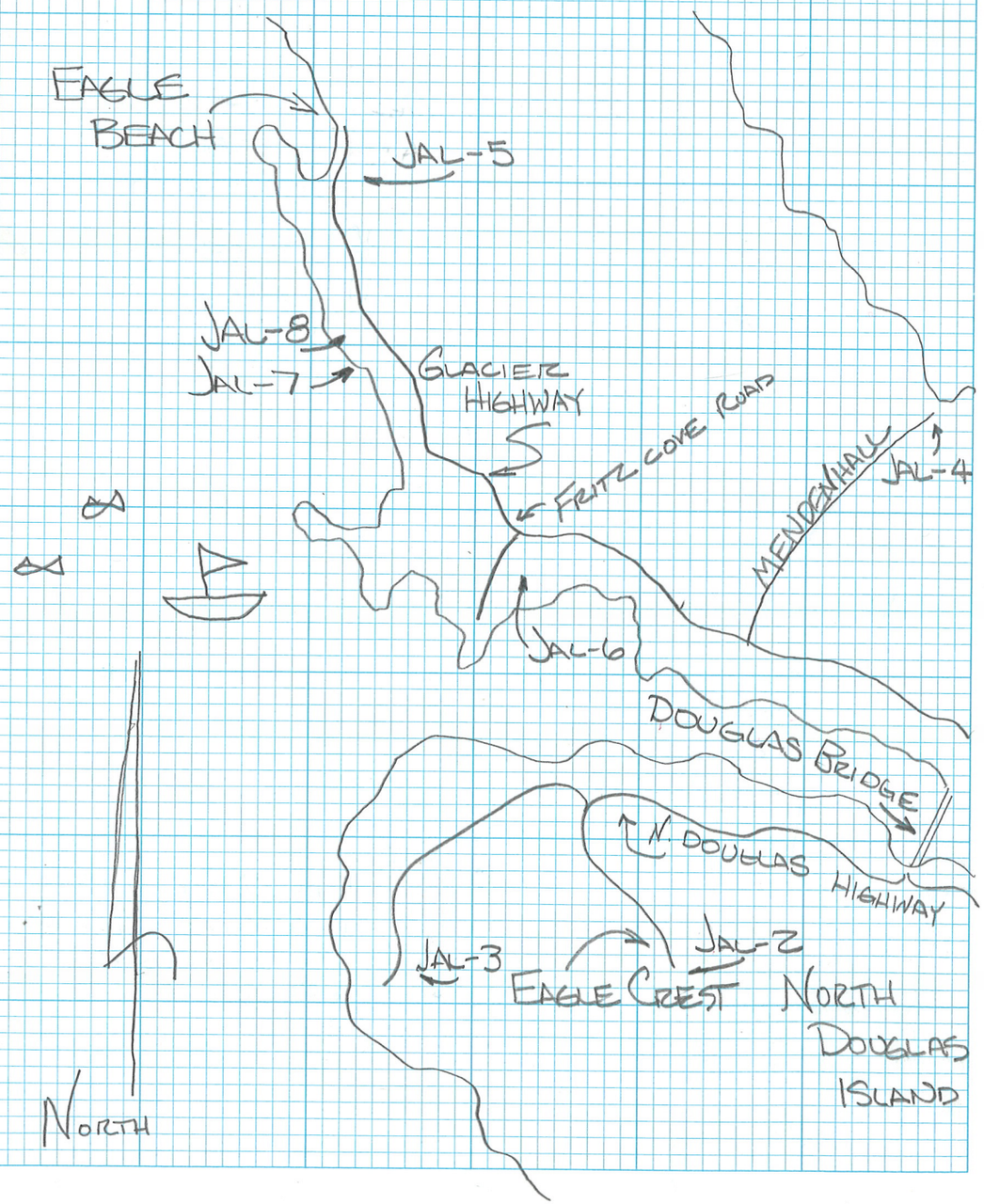
- All equipment utilized during this project was checked for accuracy, and adjusted when necessary, prior to commencing any work.
- Redundant distance measurements were made in feet and meters.
- Tripods with optical plummet tribrachs or laser plummet tribrachs were used to set up over the points while measuring all control.
- Redundant overlapping data was collected using PPK and RTK surveying procedures. Comparison of this data validates both mechanisms for not having systematic errors.

9.0 SURVEYOR'S CERTIFICATION

I, A. William Stoll, Alaska Land Surveyor #12041, do hereby certify that the information contained herein is the result of work performed by me or by others working under our direct supervision.

1127.61159.01 JUNEAU ALASKA LIDAR USGS

-CONTROL SKETCH-



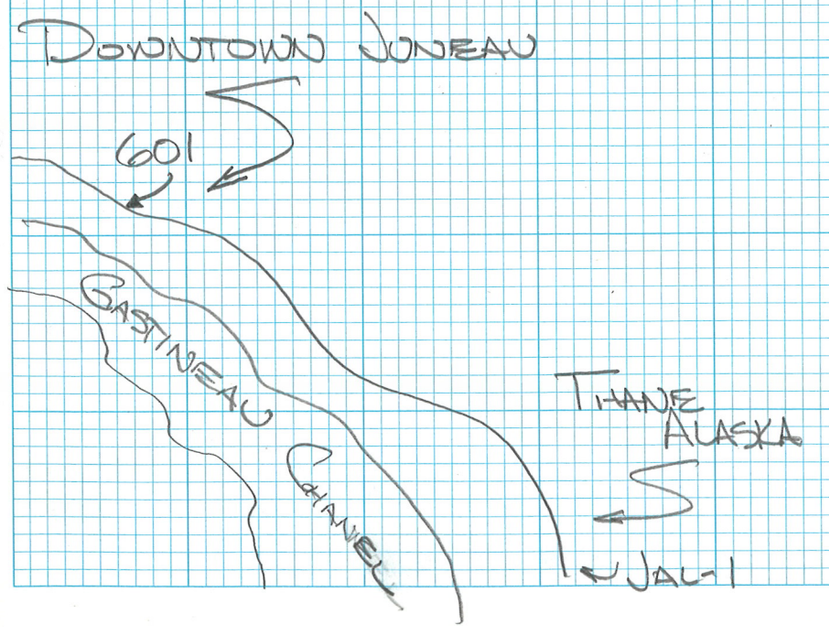
07 MAY 2012

⇕

11 MAY 2012

2397 22
STOLL

*PPK PROFILES WERE COLLECTED ALONG THE GLACIER HIGHWAY FROM THANE TO EAGLE BEACH, FRITZ COVE RD., N. DOUGLAS HIGHWAY, MENDENHALL LOOP, & THE ROAD TO EAGLE CREST SKI AREA.



1127.61159.01 USGS JUNEAU ALASKA LIDAR

-STATIC GPS CONTROL-

POINT	MISS/UNIT	HT READG	ANT'N	LOCAL TIME	GDOP/SATS
1	SITESA-15	0.981 M 3.218 FT	ATX1230GG TRIPOD	0953	✓
		0.981 M 3.218 FT	(0.360M)		

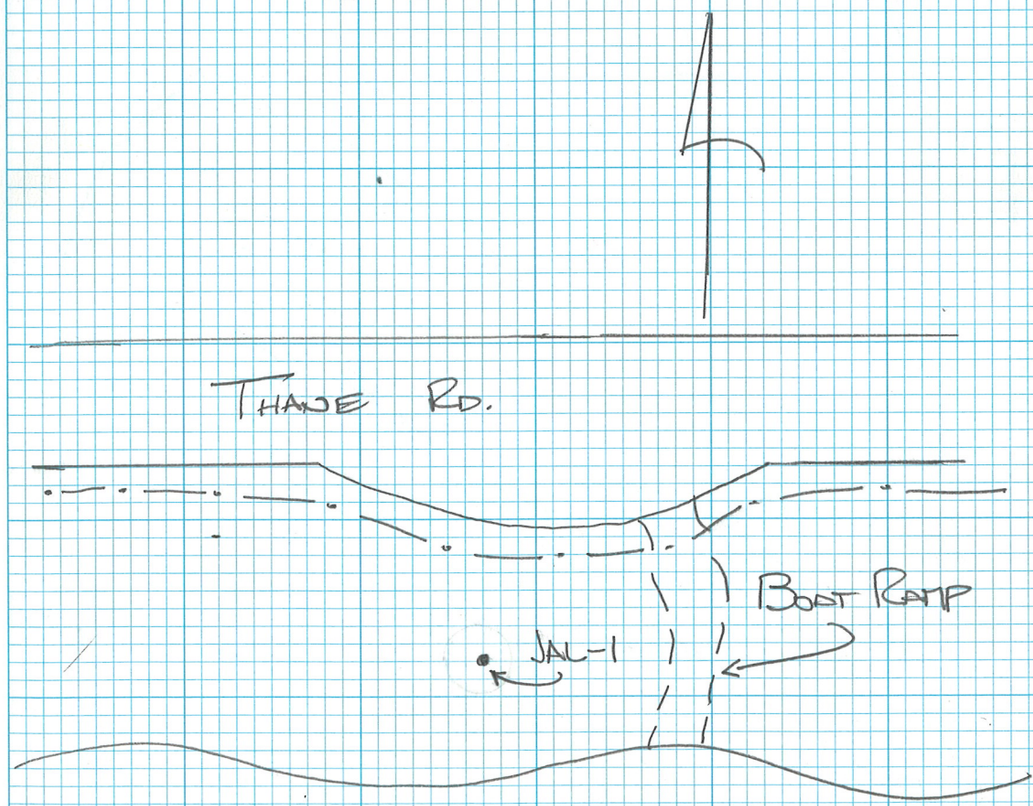
08 MAY 2012
35°F - RAIN

2397 23

STOLL

DESC.

SET SPIKE FLUSH W/GRADE
APPROX 25' SOUTH OF THE S.
GUARDRAIL



1/27.6/159.01 – JUNEAU ALASKA LIDAR USGS

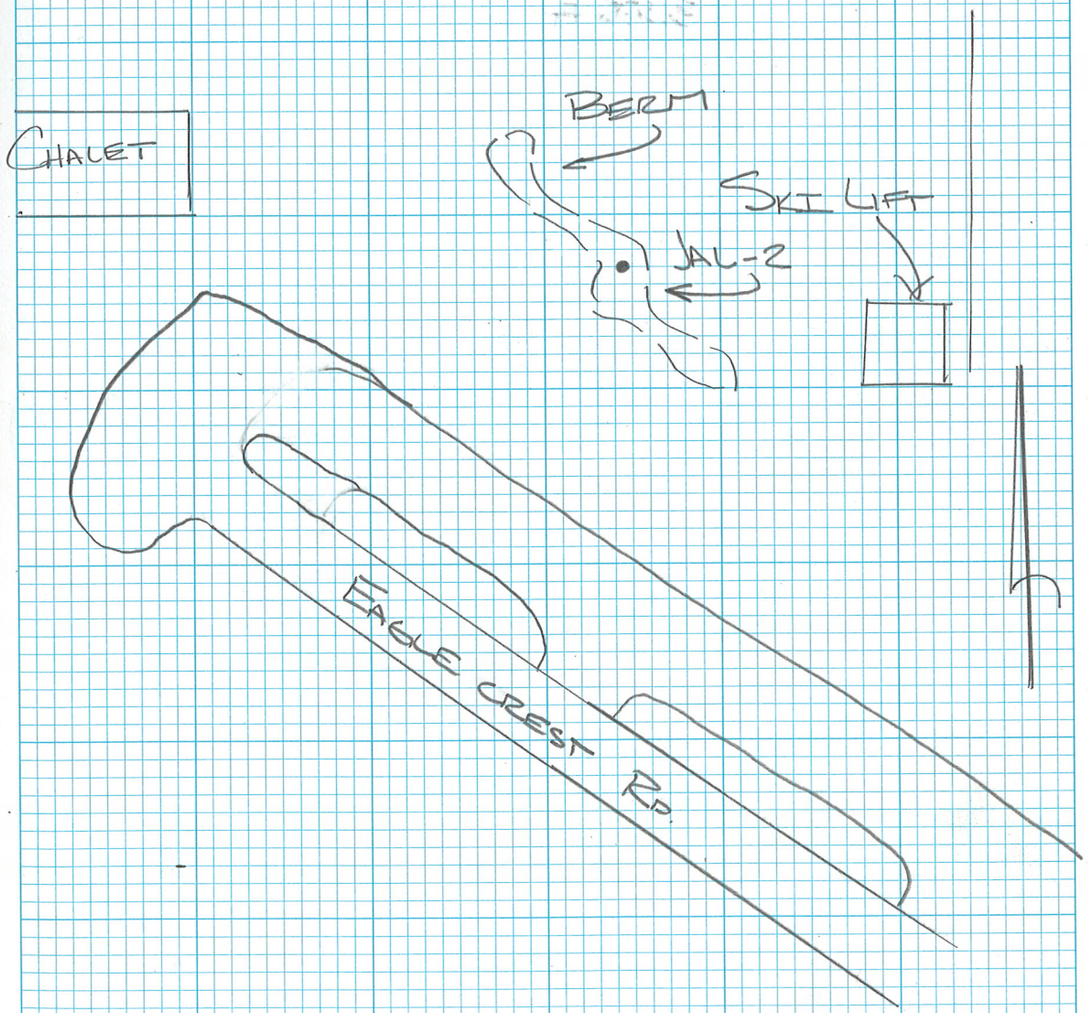
– STATIC GPS CONTROL –

POINT	MISS/UNIT	HT READG	ANT O/S	LOCAL TIME	GDOP/SATS
2	SFSSSA-9	1.088 M 3.570 FT	AT 502 TRIPOD	✓	✓
		1.088 M 3.570 FT	(0.360)		

08 MAY 2012
39°F RAIN

2397 24
STOLL

DESC.
SET SPIKE FLUSH W/ GRADE



1127.61159.01 USGS JUNEAU ALASKA LIDAR

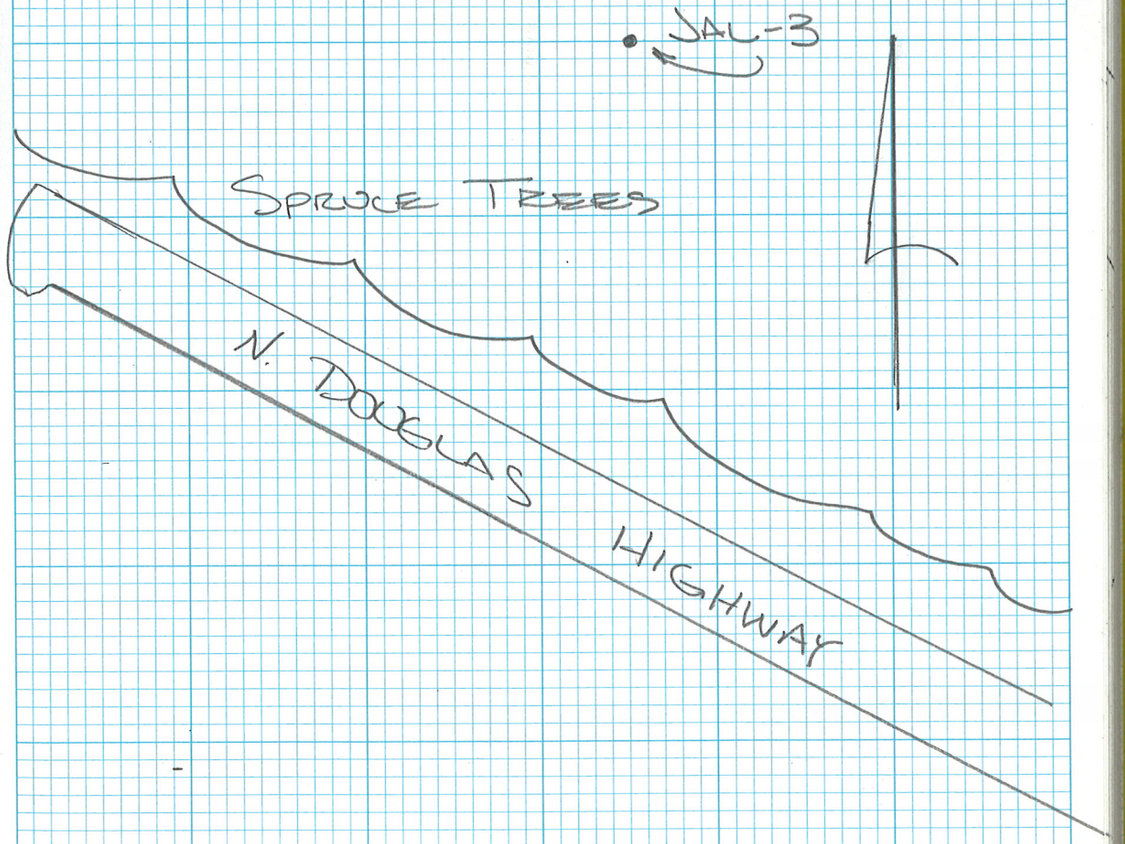
—STATIC GPS CONTROL—

POINT	MISS/UNIT	H READ	ANT 0/S	LOCAL TIME	GOOD/SATS
3	STESSA-21	1.108 M 3.635 FT	AT502 TRIPOD		
		1.108 M 3.635 FT	(0.360)		

08 MAY 2012
39°F - RAIN

2397 25
STOLL

DESC:
SET SPIKE FLUSH W/ GRADE
200' NW OF THE N. DOUGLAS HWY



1.127.61.53.01 USGS JUNEAU ALASKA LIDAR

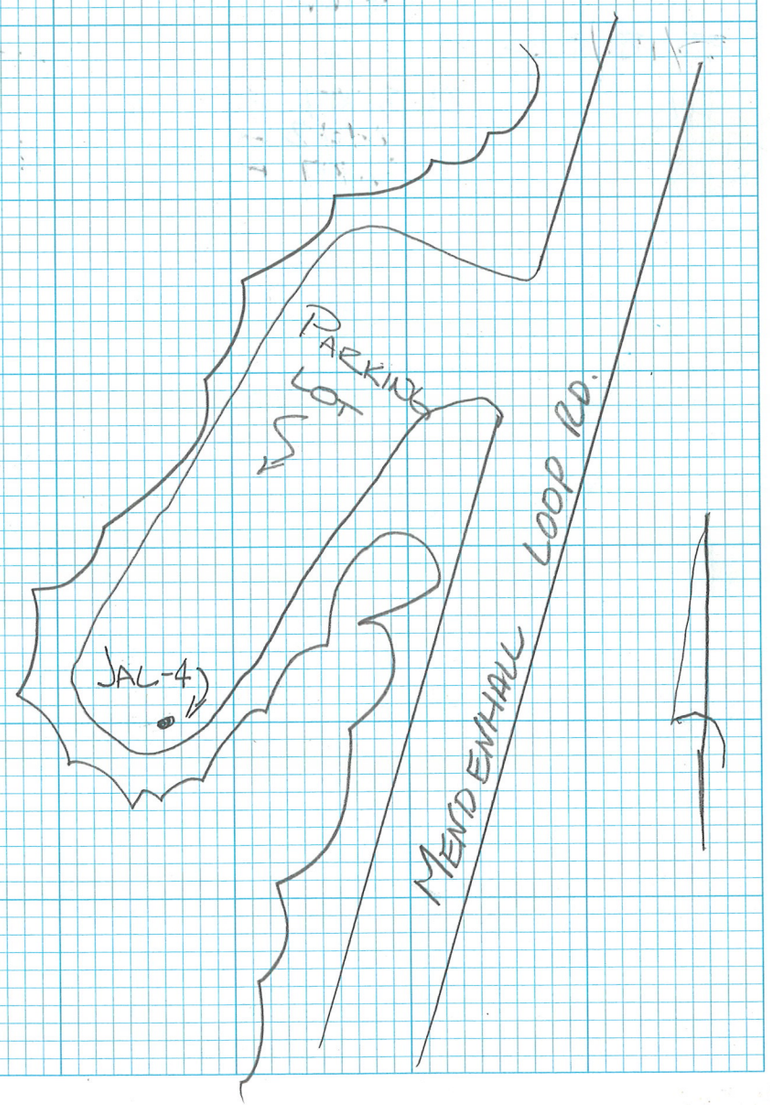
-STATIC GPS CONTROL-

POINT	MISS/UNIT	HT READS	ANT O/S	LOCAL TIME	GOOD/SATS
		1.255 M	AT 502.		
4	SISSA-88	4.117 FT	TRIPOD		
		1.255 M	(0.360)		
		4.117 FT			
5/10/2012		1.258 M		0847	
		4.127 FT			
"	"	1.258 M	"		
		4.127 FT		12:23	

08 MAY 2012
40F RAIN

2397 26
STOLL

DESC.
SET SPIKE FLUSH W/ GRADE
IN A GRAVEL PARKING AREA.



1127.61159.01 USGS JUNEAU ALASKA LIDAR

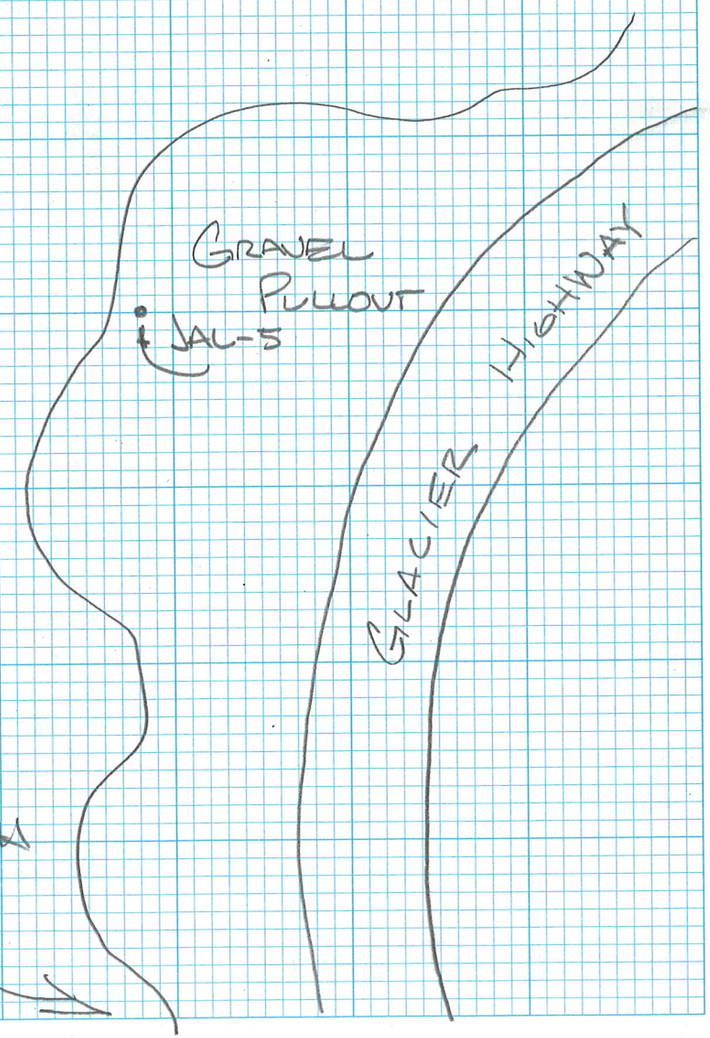
-STATIC GPS CONTROL-

POINT	MES/UNIT	HT READG	ANT O/S	LOCAL TIME	GDOP/SATS
		1.270 M	AT502	06:56	
		4.166 FT	TRIPOD		
5	STSSSA-16	1.270 M	(0.3600)		
		4.166 FT			
5/10/12		1.142 M		07:58	
11	"	-21 3.747 FT	"		"
		1.142 M		11:47	
		3.747 FT			

08 MAY 2012
40°F - RAIN

2397 27
STOLL

DESC.
SET SPIKE FLUSH W/ GRADE
IN A GRAVEL PULLOUT.



11.27.61159.01 USGS JUNEAU ALASKA LIDAR

—PPK PROFILE—

POINT	MISS/UNIT HT	READG	ANT O/S	LOCAL TIME	GOOD/SATS
601	PPK10	5.66 FT	MOVING	09:12	✓
		3.51 FT	STATIC	10:20	MOVING
				10:31:24	STOPLIGHT
				10:32:24	"
				10:34:16	"
				10:36.15 → 11:12.00	CONST
				11:13.20 11:13.30	BRIDGE
				11:19.10 11:19.20	"
				11:22.00 11:54	CONST.
				11:57 26	STOPLIGHT
				11 58.12 – 11 58 22	BRIDGE
				11 58 50 11 59 00	"
				1200 → 1230	INITIALIZE
				12:37.02 12 38 01	BRIDGE
				1237 54 1237 59	"
				/ 1240 57	STOP
				1310 29 1310 34	BRIDGE
				1327 35 1327 40	"
				1341 30 1342 12	"
				1350 41 1350 46	"
				1351 46 1351 50	"
				1355 48	STOP
				1408 41 1408 57	STOP
				1410 31 1411 05	STOP
				1412 32 1412 42	BRIDGE
				1442 36 1442 41	
				1443 34 1443 46	
				1446 29 1446 34	
				1447 23 1447 30	
				1452 46 1452 50	

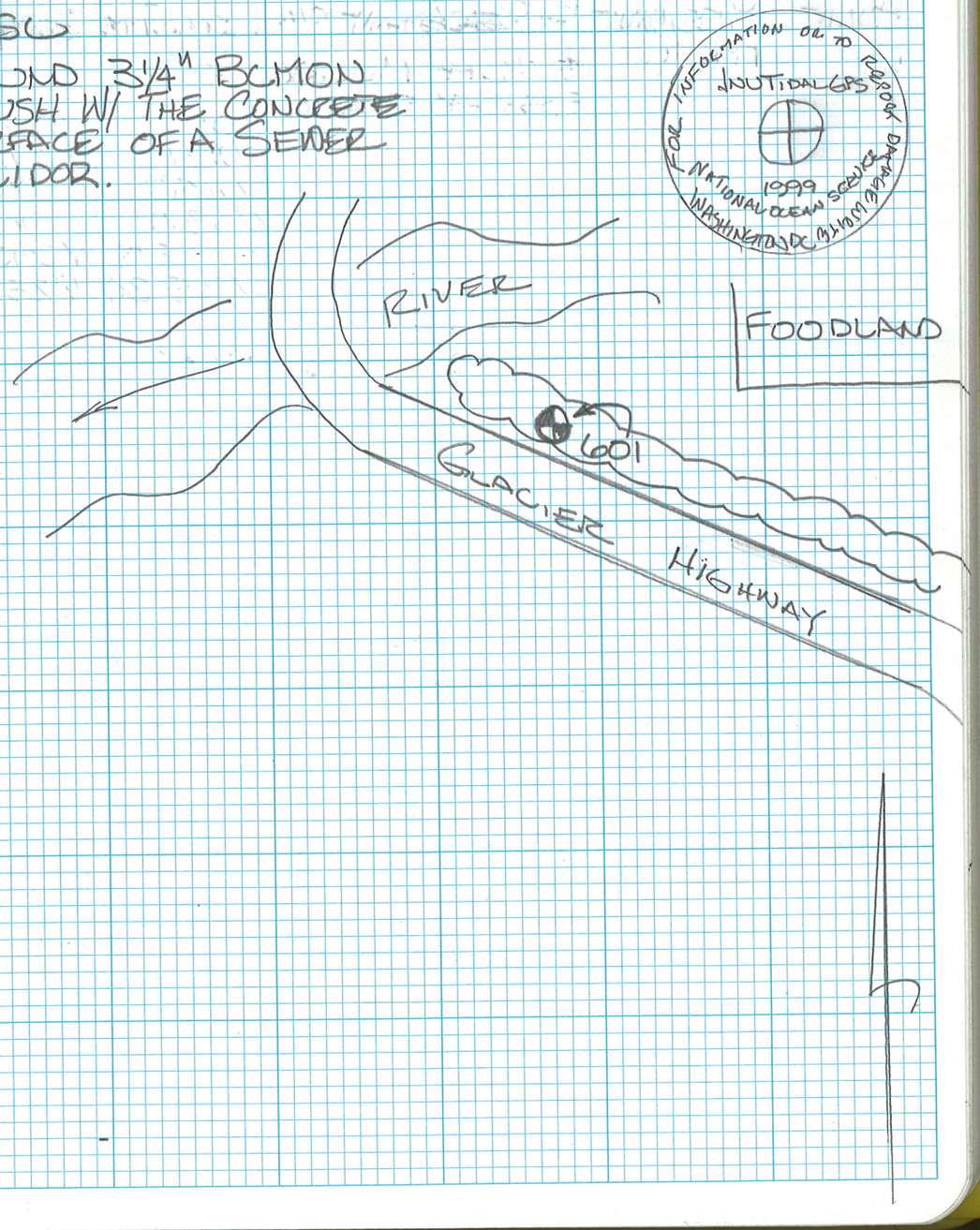
Pt 6 INITIALIZE

09 MAY 2012
40°F RAIN

2397 28
STOLL

DESC

FOUND 3¼" BCMON FLUSH W/ THE CONCRETE SURFACE OF A SEWER UTILIDOR.



1127.61159.01 USGS JUNEAU ALASKA LIDAR

-PPK PROFILE-

POINT	MISS/UNIT	HT READG	ANT O/S	LOCAL TIME	GDOP/SATS
PT 7	PPK 1'0	4.973	AX1202	POLE 0823	
		5.66FT		11 05 15	11 05 20
				11 10 05	11 11 11
				11 11 57	11 12 05
				11 19 00	11 19 05
				11 19 55	11 20 00
				11 25 24	11 25 30
		5.66FT			
PT 7	"	4.973		1203	

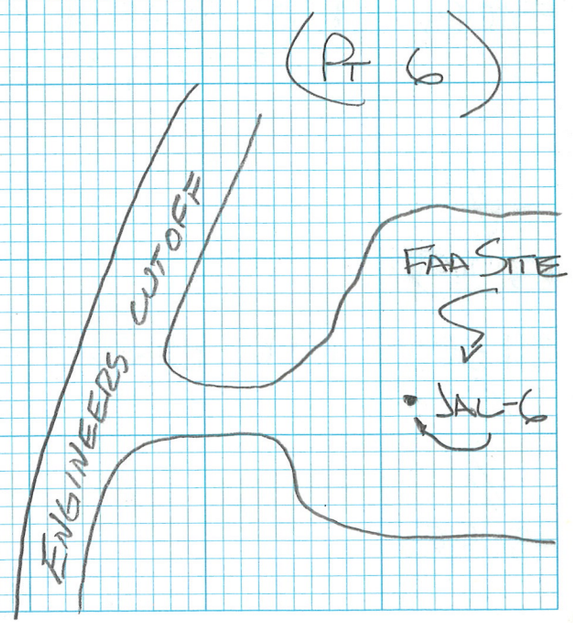
09 MAY 2012
40'F RAIN.

2397 29
STOLL

DESC.
SET SPIKE

BRIDGE

SET SPIKE
FLUSH W/ GRADE
IN THE FAA
COMPOUND ALONG
ENGINEERS CUTOFF



1127.61153.01 USGS JUNEAU ALASKA LIDAR

— RTK QC DATA —

POINT	MISC/UNIT HT READ	ANT O/S	LOCAL TIME	CQ/SATS
5001	RTK ROVER 6.562ft	AX120 POLE		0944
5014				
5016				
5022	RTK BASE @ PT 1		11:44	
5023	" " "		13:54	
	— RTK BASE @ 601 —			
5107			17:38	
5108	RTK BASE @ 3 5/9/12		16:18	
5129			16:32	
5130	RTK BASE @ 2		17:12	
5180			17:28	

* RTK BASE @ 0809 MAY 2012 40°F - RAIN 2397 30 STOLL

DESC.

GS/11000
GS/01110
GS/01111

GS/

* DATA IS COLLECTED ON A CODING SYSTEM AS FOLLOWS:

	NONE	LIGHT	MODERATE	HEAVY
URBAN	0	1	2	3
GROUND				
GRASS				
BRUSH				
TREES				

FOR EXAMPLE A NONURBAN, EVEN GROUND, LIGHT GRASS WITHOUT BRUSH OR TREES IS A GS/01100

1127.6115.01 USGS JUNEAU ALASKA LIDAR
– RTK QC DATA

09-10 MAY 2012
40° F RAIN

2397 31
STOLL

POINT	MISS/UNIT HT READ	ANT O/S	LOCAL TIME	GOOD/SATS
5181	RTKROVIO 6.562		19:18	
↓	RTK BASE @ 5			
5242	5/9/12		19:57	
	5/10/12			
5243	" "		08:51	
	RTK BASE @ 4			
↓				
5304			09:49	
5305			17:12	
↓	RTK BASE @ 6			
5446			19:31	

DESC.
GSF
↓

11 MAY 2012

2397 32
STOLL

1127.641159.01 USGS JUNEAU ALASKA LIDAR

-RTK QC DATA-

POINT MISS/UNIT HI READY ANT O/S LOCAL TIME CQ/SATS DESC.

5447 RTK ROV 10 6.562 FT 06:31

RTK BASE @ 7

5507

07:41

1127.61159.01 USGS JUNEAU AUASLAUDAR

— STATIC GPS CONTROL

POINT	MISS/UNIT	HT READ	ANT ⌀'S	LOCAL TIME	GOOP/SATS
5/10/2012	1.215 M	AT	502	0723	
6	STSSA-8	3.986 FT			
		1.215 M	TRIPOD	1243	
		3.986 FT			

5/10/2012

45°F RAIN

2397 33

STOW

DESC

SET SPIKE SEE PG 29

1127.61159.01 USGS JUNEAU ALASKA LIDAR

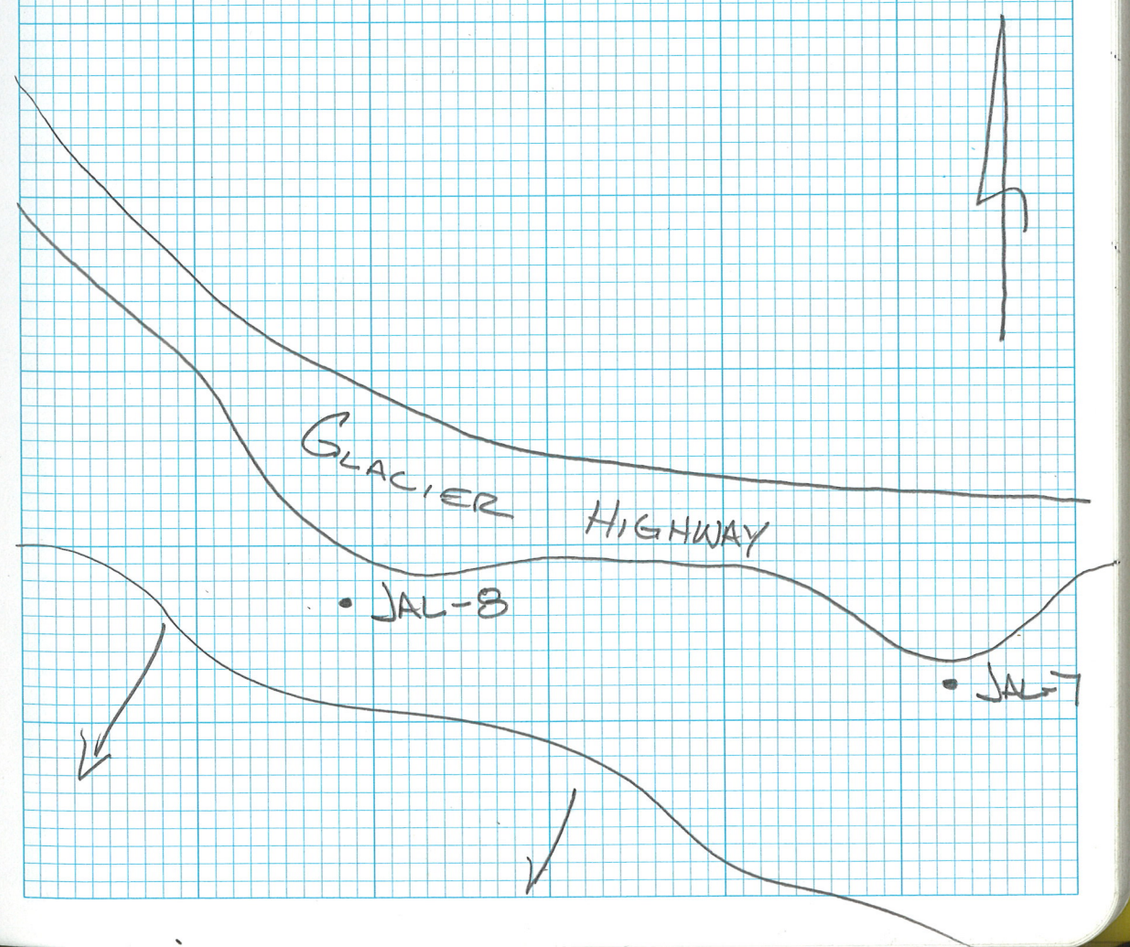
STATIC GPS CONTROL

POINT	MISS/UNIT	HT READ	ANT	LOCAL TIME	GPS
		1.188m	AT502	08:15	
D	STSSSA-9	3.896ft	TRIPOD		4
		1.188m			
		3.897ft	0.360	11:59	

10 MAY 2012
40°F - RAIN

2397 34
STOLZ

DESC
SET SPIKE RWG
ALONG A PULLOUT



11 27.61 59.01 USGS JUNEAU ALASKA LIDAR

— STATIC GPS CONTROL

POINT	MISS/UNIT	HT READ & UNITS	ANT TYPE	LOCAL TIE	GOOP/SATS
7	SISSA-10	1.516 M 4.974 FT	AX1202	0823	
		1.516 M 4.974 FT (O)	POLE	10:19	

10 MAY 2012

2397 35
STOLL

REDU
SET SPIKE FUG IN A
PULLOUT SEE PREV PG

1127.61159.01 USGS JUNEAU ALASKA LIDAR

2397 36
STOLL

—NARRATIVE OF WORK—

—THIS PROJECT IS A LIDAR SUPPORT PROJECT FOR AEROMETRIC, INC. WHOM IS UNDER CONTRACT WITH THE USGS. OUR WORK PRODUCTS ARE;

—PROVIDE PPK PROFILES OF THE GLACIER HIGHWAY FROM THANE TO EAGLE BEACH, MENDENHALL LOOP ROAD FROM THE GLACIER HIGHWAY TO THE MENDENHALL GLACIER VISITOR CENTER, FRITZ COVE ROAD, N. DOUGLAS HIGHWAY, & THE ROAD TO EAGLECREST SKI AREA.

—WE WERE ALSO TASKED WITH COLLECTING RTK QC DATA OF THE MAPPING AREA.

—THESE EFFORTS WERE A STRUGGLE DUE TO POOR GPS RECEPTION. DURING THE INITIAL PPK PROFILE, THE RESOLUTION OF THE GLACIER HIGHWAY N. OF AUKE BAY WAS NEAR NON-EXISTENT & FRITZ COVE ROAD WAS ALSO NON-EXISTENT. BOTH ROADS WERE RE-GPS'D TO NO AVAIL. EVEN RTK GPS WAS LIMITED. ATTEMPTS WERE MADE TO COLLECT MORE RTK GPS QC DATA, HOWEVER, WHAT WAS COLLECTED IS REPRESENTATIVE OF CONDITIONS.

ALTHOUGH THE DATA COLLECTED IS SUFFICIENT IT IS BY NO MEANS EXCEPTIONAL, ALL ATTEMPTS WERE MADE UTILIZING THE TOOLS AT HAND.