Federal Emergency Management Agency

Suffolk County, Massachusetts

Charles River HUC 8 LiDAR FY2010

Technical Support Data Notebook

Terrain Project Narrative

Elevation Data Acquisition

CID 25025C

CASE NO. 11-01-0717S
CONTRACT NO. HSFEHQ-09-D-0370
TASK ORDER NO. HSFEHQ-10-J-0005

Date June 10, 2011

Prepared By:

Table of Contents

List of Tables

List of Figures

1. Introduction

Beginning in Fiscal Year 2010, FEMA initiated a five-year program for Risk Mapping, Assessment, and Planning (Risk MAP). The vision for Risk MAP is to deliver quality data that increases public awareness and leads to action that reduces risk to life and property. In order to realize the Risk MAP vision FEMA is acquiring high resolution terrain elevation and land cover elevation data to increase production efficiencies for NFIP regulatory products and support risk assessment data development. FEMA has made a commitment through Risk MAP to work closely with NDEP (National Digital Elevation Program) partners to obtain and support the collection of terrain data throughout the United States.

Terrain data, collected under the Risk MAP program, will be required to meet minimum specifications outlined in the *Draft Procedure Memorandum No. 61—Standards for LiDAR and Other High Quality Digital Topography dated August 1st, 2010*[1]. FEMA also requires all deliverables for topographic data collection be submitted in accordance with *Appendix M: Data Capture Standards March 2009*[2]. All relevant project materials have been reviewed to insure that these requirements are met.

The objectives for elevation data acquisition for the Charles River watershed are as follows:

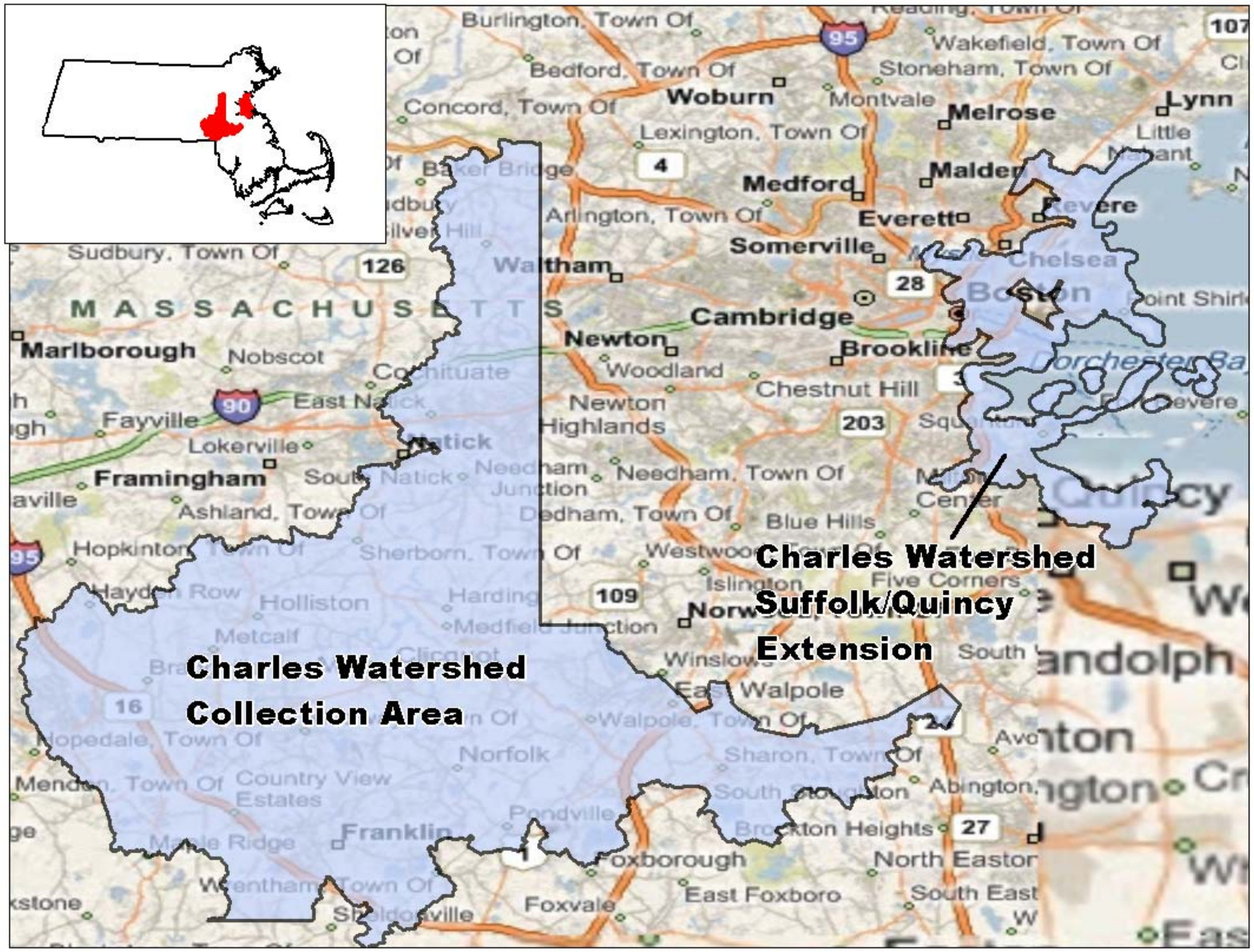
1. LAS point cloud files collected for 283 square miles
2. LAS point cloud files captured using the “Highest” vertical accuracy requirements
3. LAS point cloud files collected at equivalent of a 2-foot contour accuracy
4. LAS point cloud files collected using a nominal pulse spacing of 1-meter
5. LAS classified as Bare Earth processed for 283 square miles
6. LAS data collected to complement the Metro Boston LiDAR data

Table 1. Vertical Accuracy Requirements

Contour Accuracy	Specification Level	$RMSE_z$	FVA	CVA
2ft	Highest	18.5 cm	24.5 cm	36.3 cm

The Charles River watershed consists of two functional areas. One is in the southwest portion of the watershed covering 243 square miles, which borders the Metro Boston LiDAR collection area. The other area consists of 40 square miles and covers portions of Suffolk County and the City of Quincy. This area of interest is known as the Charles Suffolk/Quincy extension.

Figure 1. Project Location



2. Scope of Work

Statement of Priorities
PTS Elevation Data Acquisition
STARR – Contract # HSFEHQ-09-D-0370

The contractor shall acquire elevation data to support flood hazard data updates based on the minimum requirements shown of the attached ordering sheet. Elevation data shall comply with the draft FEMA Procedure Memorandum: Standards for LiDAR and Other High Quality Elevation Data.

The contractor shall respond with pricing for the minimum elevation collections and bare earth processing specified the attached ordering sheet. The contractor's proposal shall identify any breakline creation or other post-processing that is required to use the elevation data for the flood hazard data updates based on the risk, terrain type, anticipated engineering methods and other relevant factors. The proposal must explain the reasons this additional processing is needed.

The contractor will also be responsible for performing QA of the elevation data as specified in the Standards for LiDAR and Other High Quality Elevation Data procedure memo.

The contractor shall also propose collection and processing alternatives that group the collections into larger, more cost effective collection blocks or other collection and processing alternatives that may be more advantageous for the government as an alternative option.

Scope Details:

LiDAR acquisition of Charles River watershed, consisting of 283 square miles, divided between the southwest Charles River Watershed (243 square miles.) and the Suffolk/Quincy extension (40 square miles). All data captured to the "Highest" vertical accuracy requirement. This collection specification is the equivalent of a 2-foot contour accuracy and will be collected with a nominal pulse spacing of 1-meter. Post processing is required for all 283 square miles covering both collection areas.

3. Issues

A. Special Problem Reports

None

B. Project Modifications

None

4. Information for the Next Mapping Partner

The Charles River LiDAR collection AOI consists of two functional areas. This project included both LiDAR point cloud development and Bare Earth post processing. Point Cloud LiDAR data for this project is partially classified LAS 1.2 binary file format. The Bare Earth LiDAR for this project has been classified using ASPRS LiDAR classifications. Bare Earth classified as class 2 is considered to be Bare Earth and points classified as class 8 are Model Key. All data for this project has been collected using the following spatial reference information:

Projection: Universal Transverse Mercator
UTM Zone: 19
Linear units: Meter
Horizontal Datum: North American Datum 1983
Vertical Datum: North American Vertical Datum of 1988
Vertical units: Meters

LAS point files are named according to the UTM Coordinates at the southwest corner of the tile, following the zz_0xxxyyy convention, where z is the UTM zone number, x and y are the UTM coordinates.

Table 2. LAS file information

Product	# Tiles	Total File Size	Point Count	Avg. Point Spacing
Point Cloud Charles	342	50.5GB	1943032559	0.6
Bare Earth Charles	342	50.5GB	1937735108	0.6
Point Cloud Suffolk/Quincy	138	9GB	300506938	1.1
Bare Earth Suffolk/Quincy	138	9GB	300506938	1.1

Details about the storage of this dataset can be found within Appendix G of this document.

Ground control and quality control checkpoints were collected by CompassData, Inc. Photo Science, Inc. performed LiDAR acquisition flights, automated processing and Bare Earth manual edits.. Independent QC of the point cloud and bare earth surface was performed by CompassData, Inc. Quality Assurance testing was conducted by Greenhorne & O'Mara, Inc. All firms were under contract to STARR, A Joint Venture which held the FEMA Professional Technical Services contract and task order for this work. All contact information for the project team can be found in Appendix A of this document.

A. Ground Control Survey

Ground Control is collected throughout the AOI for use in the processing of LiDAR data to ensure data accurately represents the ground surface. QA/QC checkpoints, also collected throughout the AOI, are used for independent quality checks of the processed LiDAR data.

GPS based surveys were utilized to support both processing and testing of LiDAR data within FEMA designated Areas of Interest (AOIs). Geographically distinct ground points were surveyed using GPS technology throughout the AOIs to provide support for three distinct tasks:

Task1 was to provide Vertical Ground Control to support the aerial acquisition and subsequent bare earth model processing. To accomplish this, survey-grade Trimble R-8 GPS receivers were used to collect a series of control points located on open areas, free of excessive or significant slope, and at least 5 meters away from any significant terrain break. Most if not all control points were collected at street/road intersections on bare level pavement.

Task 2 was to collect Fundamental Vertical Accuracy (FVA) checkpoints to evaluate the initial quality of the collected point cloud and to ensure that the collected data was satisfactory for further processing to meet FEMA specifications. The FVA points were collected in identical fashion to the Vertical Ground Control Points, but segregated from the point pool to ensure independent quality testing without prior knowledge of FVA locations by the aerial vendors.

Task 3 was to collect Consolidated Vertical Accuracy CVA) checkpoints to allow vertical testing of the bare-earth processed LiDAR data in different classes of land cover, including: open (pavement, open dirt, short grass), High Grass and Crops, Brush and Low Trees, Forest, and Urban. CVA points were collected in similar fashion as Control and FVA points with emphasis on establishing point locations within the predominant land cover classes within each AOI or Functional AOI Group.

In order to successfully collect the Forest land cover class, it was necessary to establish a Backsight and Initial Point with the R8 receiver, and then employ a Nikon Total Station to observe a retroreflective prism stationed under tree canopy. This was necessary due to the reduced GPS performance and degradation of signal under tree canopy. The R-8 receivers were equipped with cellular modems to receive real-time correction signals from the Keystone Precision Virtual Reference Station (VRS) network encompassing the Region 1 AOIs.

Use of the VRS network allowed rapid collection times (~3 minutes/point) at 2.54 cm (1 inch) initial accuracy. All points collected were below the 8cm specification for testing 24cm, highest category LiDAR data. To ensure valid in-field collections, an NGS monument with suitable vertical reporting was measured using the same equipment and procedures used for Control, FVA and CVA points on a daily basis. The measurement was compared to the NGS published values to ensure that the GPS collection schema was producing valid data and as a physical proof point of quality of collection. Those monument measurements are summarized in the Accuracy report included in the data delivered to FEMA.

In order to meet FEMA budgetary requirements, AOIs were consolidated into Functional Groups: if AOIs were contiguous, they were treated as one large AOI to allow collection of 20 FVA points and 15 additional CVA points across the group of AOIs. 20 FVA points are necessary to allow testing to CE95 – 1 point out of 20 may fail vertical testing and still allow the entire dataset to meet 95% accuracy requirements. In similar fashion, 20 CVA points are necessary to test to CE95 as discussed above.

15 CVA points were collected per AOI or per Functional Group with the intention at the outset that 5 of the collected FVAs would perform double – duty as Open-class CVA points, to total 20 CVAs per AOI or Functional Group. The Functional Groups are as follows:

- Narragansett/Charles/Blackstone (northeast)
- Quincy/Suffolk (while included as part of the FEMA Charles AOI, was physically separated from the Charles AOI polygon and treated as an independent functional area)

The following software packages and utilities were used to control the GPS receiver in the field during data collection, and then ingest and export the collected GPS data for all points:

- Trimble Survey Controller
- Trimble Pathfinder Office

The following software utilities were used to translate the collected Latitude/Longitude Decimal Degree HAE GPS data for all points into Latitude/Longitude Degrees/Minutes/Seconds for checking the collected monument data against the published NGS Datasheet Lat/Long DMS values and into UTM NAD83 Northings/Eastings:

- U.S. Army Corps of Engineers CorpsCon
- National Geodetic Survey Geoid09NAVD88

MSL values were determined using the most recent NGS-approved geoid model to generate geoid separation values for each Lat/Long coordinate pair. In this fashion, Orthometric heights were determined for each Control, FVA and CVA point by subtracting the generated Geoid Separation value from the Ellipsoidal Height (HAE) for publication and use as MSL NAVD88(09).

Figure 2. Charles AOI Ground Control Survey Coverage

Figure 3. Charles Suffolk/Quincy Extension AOI Ground Control Survey Coverage

Figure 4. Charles AOI FVA CVA Results

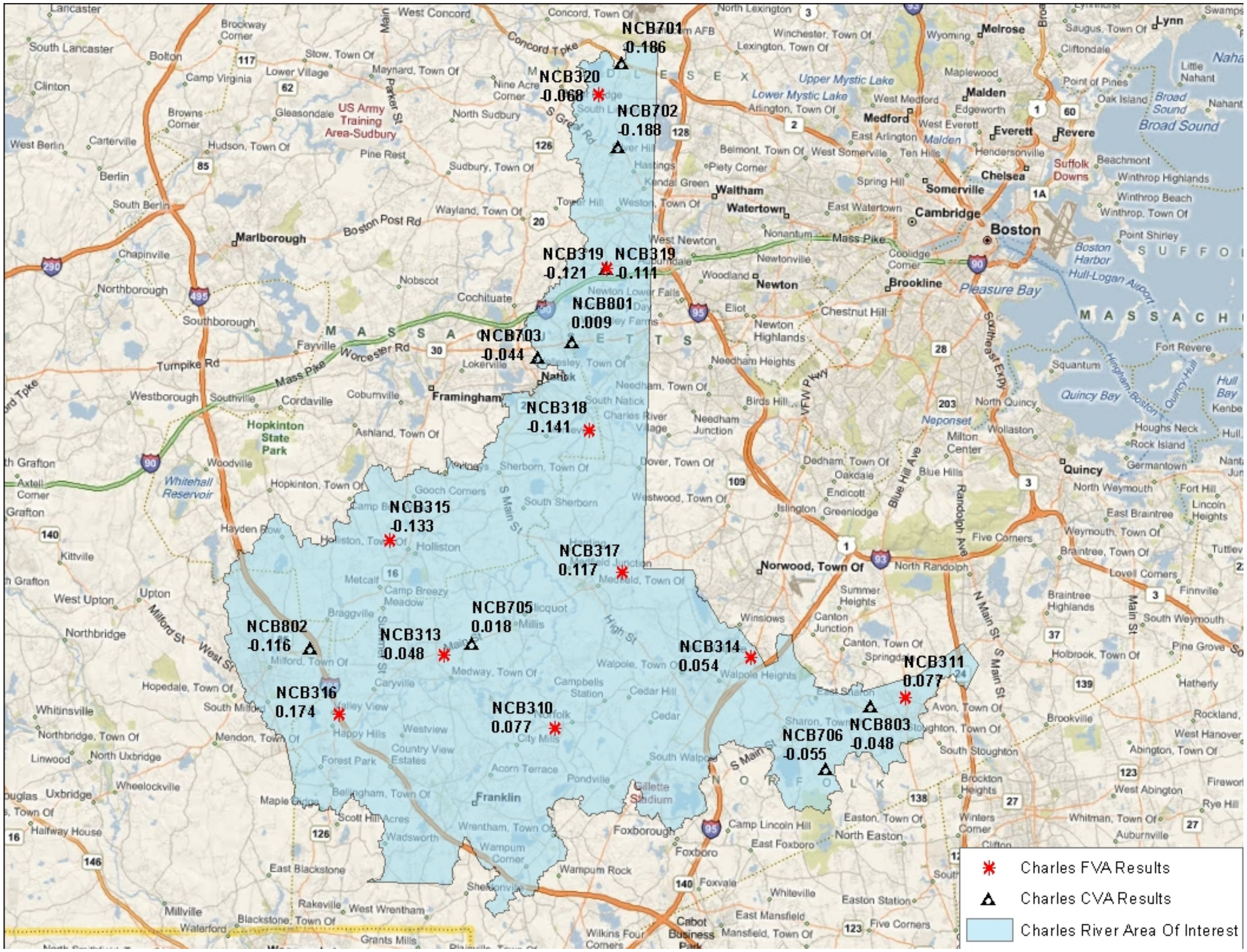


Figure 5. Charles Suffolk/Quincy Extension FVA CVA Results

B. Data Acquisition

LiDAR acquisition products include Pre- and Post- flight reports which contain information on the flight lines, equipment parameters, and other pertinent acquisition details. The LiDAR product is considered to be point cloud data and consists of 1500mx1500m tiles of LAS points which are partially classified such that the bare earth points can be calibrated to the ground surface and tested via the independent QC to ensure the ground surface is accurately represented.

Applanix software was used in the post processing of the airborne GPS and inertial data that is critical to the positioning and orientation of the sensor during all flights. POSPac MMS provides the smoothed best estimate of trajectory (SBET) that is necessary for Optech's post processor to develop the point cloud from the LiDAR missions. The point cloud is the mathematical three dimensional collections of all returns from all laser pulses as determined from the aerial mission.

Optech’s DASHMap software and Leica’s ALS Post Processor software were used to create the Raw LIDAR Flight Line strips. At this point this data is ready for analysis, classification, and filtering to generate a bare earth surface model in which the above ground features are removed from the data set. The GeoCue and TerraScan software packages are then used for the automated data classification. Project specific macros are created to classify the ground and to remove the side overlap between parallel flight lines.

LAS Class 2 (Ground) is used to check the surveyed control points against the Triangulated LIDAR surface. Any bias is then removed using macro functionality within TerraScan.Unclassified Point Cloud tiles are then created using TerraScan macro functionality. These tiles are populated within GeoCue to ensure correct LAS versioning and LAS Header information. LAS Class 2 is used to check the independent QC points against the Triangulated LiDAR surface. If RMSE is not within guidelines TerraScan software is utilitzed to remove any bias, and the check is performed again.

C. Post Processing

Point Cloud data is manually reviewed and any remaining artifacts are removed using functionality provided within the TerraScan and TerraModeler software packages. Additional project specific macros are created and run within GeoCue/TerraScan to ensure correct LAS classification prior to project delivery.

All points were placed in one of the following categories: 1 Unclassified, 2 Ground, 7 Noise, and 12 Overlap Points. Model Key points were then generated from the Ground points and placed in Category 8.

Final Classified LAS tiles are created within GeoCue to confirm correct LAS versioning and header information. In-house software is then used to check LAS header information and final LAS classification prior to delivery. LAS Class 2 is used to check the independent QC points against the Triangulated LiDAR surface.

Figure 6. Charles AOI Point Cloud and Post Processing Area

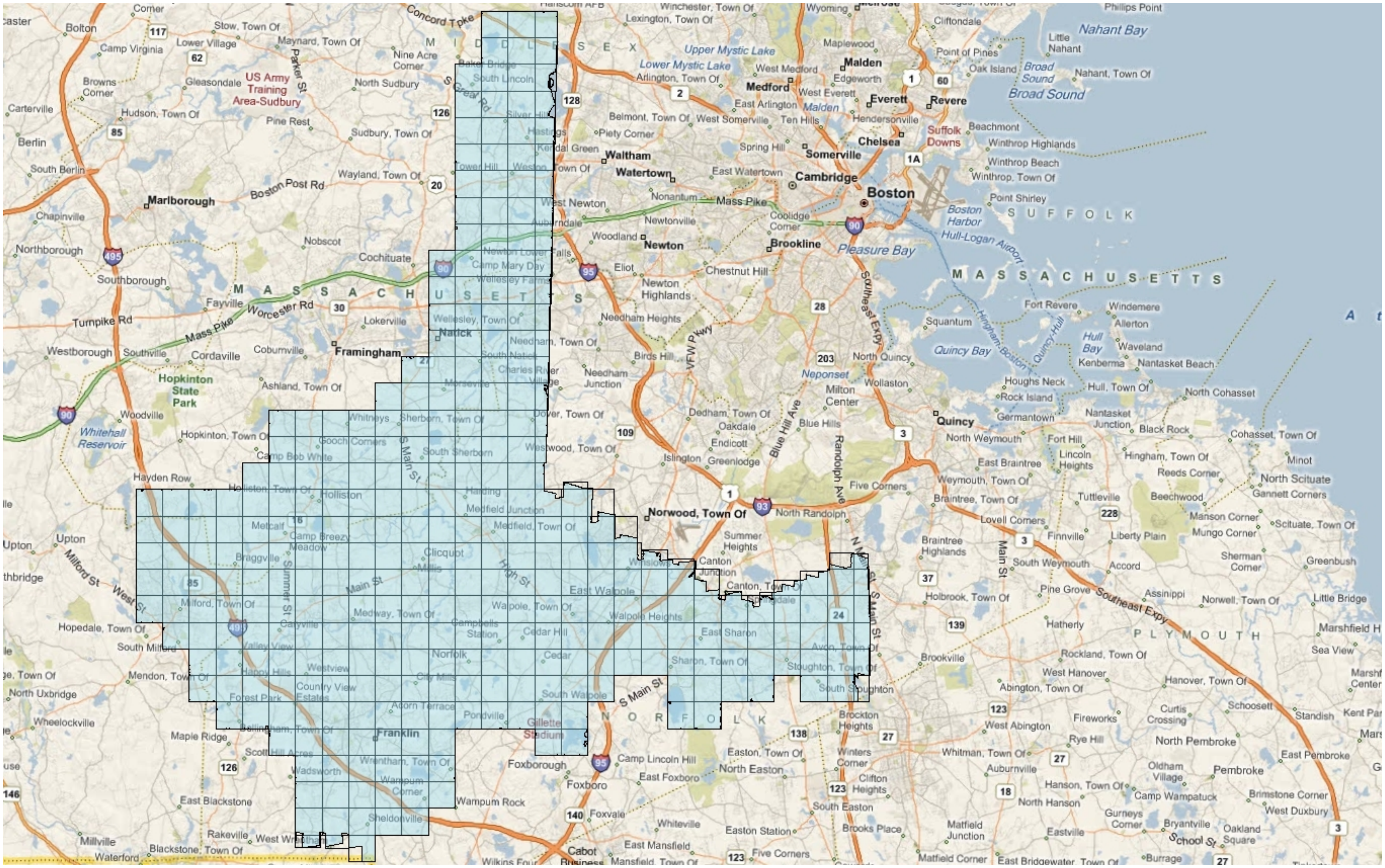
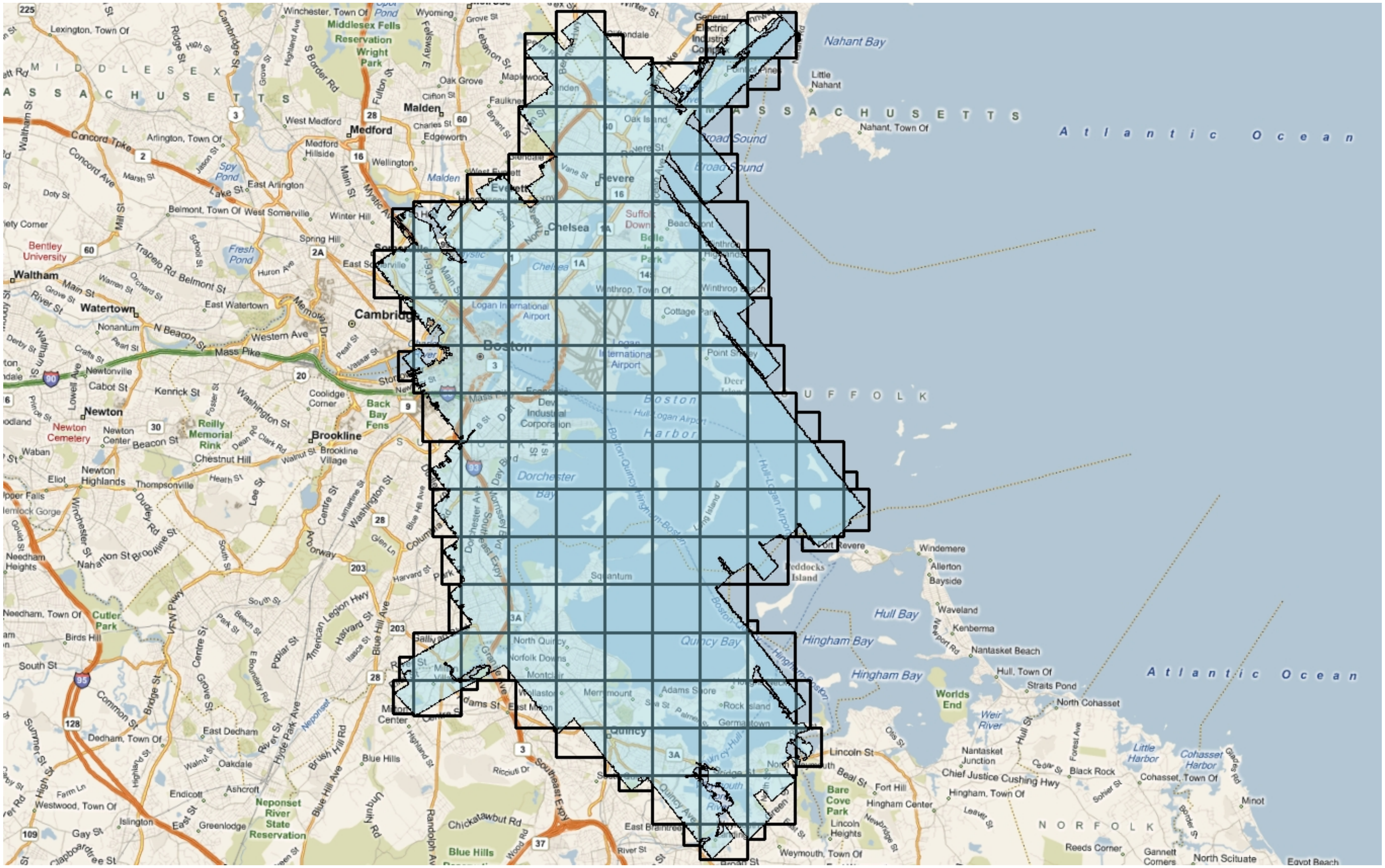


Figure 7. Charles Suffolk/Quincy Extension Point Cloud and Post Processing Collection Area



D. Quality Control

Fundamental Vertical Accuracy (FVA) checkpoints are located only in open terrain, where there is a high probability that the sensor will have detected the ground surface without influence from surrounding vegetation and/or buildings. Checkpoints are located on flat or uniformly sloping terrain and at least five (5) meters away from an break line where there is a change in slope. Checkpoints are located randomly across the acquisition area. At least 20 FVA points were collected for each test.

Consolidated Vertical Accuracy (CVA) checkpoints are collected randomly across different land use types using the ASPRS NSSDA land cover types. The points are located in flat areas with no substantial elevation breaks within a five meter radius. The CVA assessment incorporates a representative sample of the FVA assessment points into the dataset to save on the total number of points collected. CVA points were not collected for any land class comprising less that 10% of the total project area; this may have resulted in less than 4 land classes being collected in a particular area. At least 15 CVA points were collected and 5 FVA points used, for a total of at least 20 points for the CVA testing.

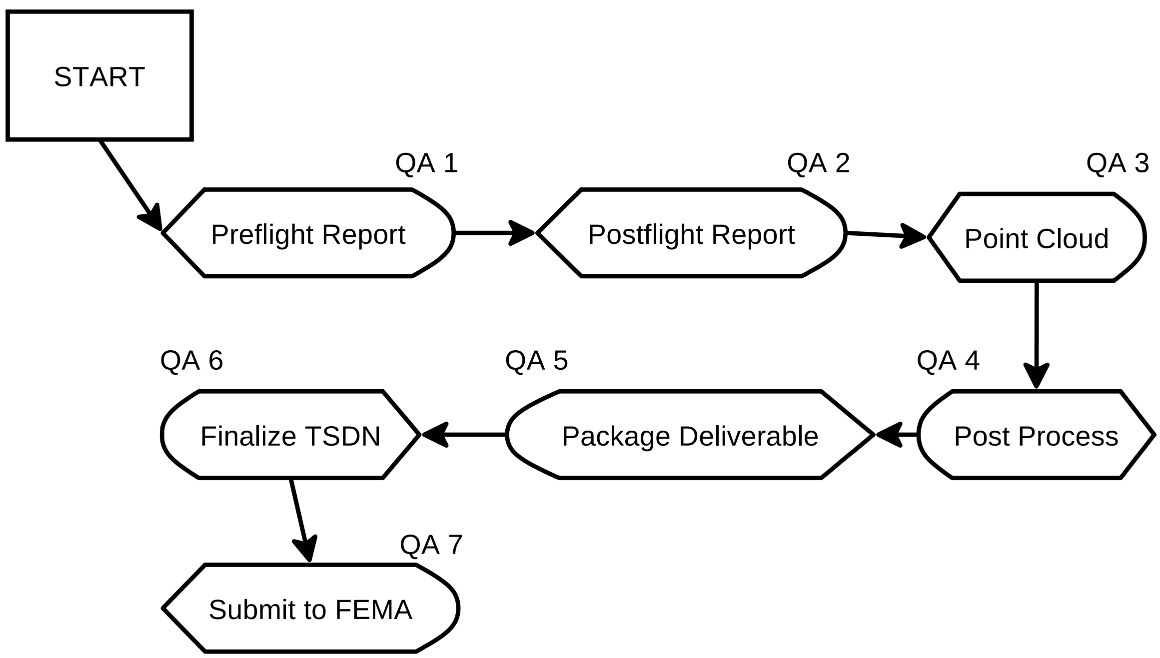
All checkpoints were collected by CompassData to ensure the 'independence' of the quality control check. All points were collected at three times the accuracy of the surface being checked. Thus to check a 24.5cm surface the points were collected accurate to 8cm.

Tests were conducted when processing by the LiDAR vendor was complete and points were called for. CompassData provided the point coordinates in an excel spreadsheet to the LiDAR vendor. The LiDAR vendor found the corresponding elevation from a surface created from the LiDAR points, filled in the spreadsheet and returned it to CompassData. CompassData compared the elevation of the LiDAR data with that of the accuracy check point, calculated the difference and reported their findings both in terms of $RMSE_z$ and at the 95% confidence level (computed as $RMSE_z$ x 1.9600). LiDAR datasets passing the quality control checks were delivered to STARR for quality assurance approval.

E. Quality Assurance

Quality assurance for all elevation data collected for this project has been completed using *FEMA Draft PM61*[1], *FEMA Appendix M*[2], *USGS LiDAR Guidelines and Base Specifications v13*[3], and *FEMA Appendix A*[4] as guidance. Products generated during this project are checked for conformance to the aforementioned guidance and specifications before submittal to FEMA.

Figure 8. Quality Assurance Workflow



QA1: Preflight Planning and Reporting

Project preflight operations planning were delivered as a report. This report was reviewed for completeness based on: *Table 4.1 and checklists provided in section 4.2.1in PM61*[1]. The report was reviewed and is compliant with FEMA guidance and specifications. This report is included within Appendix C of this document. Appendix G contains information about the location of report data on the MIP.

QA2: Post flight Report

Post flight reporting for this project has been reviewed for both content and completeness based upon: *Table 4.2 and checklists* *provided in section 4.2.1in PM61*[1]. The report is included with Appendix E of this document. The report is complete and all content meets the guidance and specifications.

QA3: Raw Point Cloud Review

Fully calibrated raw point cloud data has been reviewed at both a macro and micro level using *Table 4.3 and checklists provided in section 4.2.1in PM61*[1], and USGS *LiDAR Guidelines and Base Specifications v13*[3]. 5% of the total number of project tiles was reviewed for compliance with USGS and FEMA specifications. All tiles reviewed for this project passed both the macro and micro reviews. Quality assurance results for the point cloud are contained within Appendix F of this document.

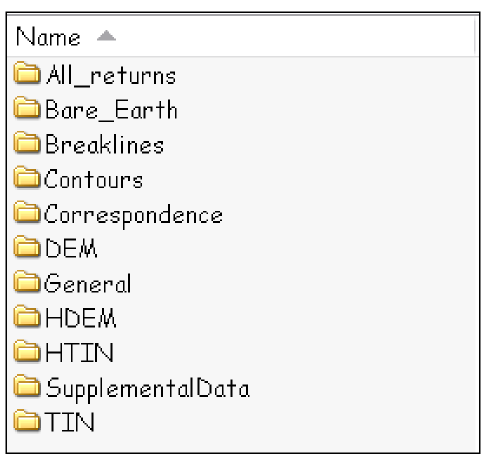
QA4: Bare Earth Review

Post-processed data has been reviewed at both a macro and micro level using *Table 4.4 and checklists provided in section 4.2.1in PM61*[1], and USGS *LiDAR Guidelines and Base Specifications v13*[3]. 10% of the total number of project tiles was reviewed for compliance with USGS and FEMA specifications. All tiles reviewed for this project passed both the macro and micro reviews. Quality assurance results for the bare earth are contained within Appendix F of this document.

QA5: Create Delivery Package

All deliverables have been organized in accordance with *Appendix M: Data Capture Standards March 2009 Section M.4.2.8*[2].

Figure 9. Terrain Deliverable Directory Structure



QA6: Finalization of Deliverables and TSDN

All data to be submitted for delivery has been reviewed for completeness based on the map activity statement, scope of work, and FEMA deliverable requirements. Quality assurance checklists are included in Appendix F of this document.

QA7: FEMA submission

All data for the elevation data acquisition task was delivered to FEMA on April 15, 2011. A transmittal of this submission is included in Appendix G of this document.

5. References

1. Draft Procedure Memorandum 61 included in Appendix H
2. FEMA Appendix M section M.4 included in Appendix H
3. USGS LiDAR Guidelines and Base Specifications v13 included in Appendix H
4. Appendix A: Guidance for Aerial Mapping and Surveying [includes guidance on Light Detection and Ranging Systems (LIDAR)] http://www.fema.gov/library/viewRecord.do?id=2206

Appendix A: Contact Information

STARR Contacts:

Project Management and Quality Assurance

Company	Greenhorne & O'Mara, Inc.
Name	Diane Rogers
Email	drogers@g-and-o.com
Phone	301-982-2800
Mailing Address	5565 Centerview Drive, Suite 107 Raleigh, NC 27606

LiDAR Ground Control and QC survey

Company	Compass Data, Inc.
Name	Hayden Howard
Email	haydenh@compassdatainc.com
Phone	303-627-4058
Mailing Address	12353 East Easter Avenue, Suite 200 Centennial, CO 80112

LiDAR data acquisition and Post Processing

Company	Photo Science, Inc
Name	Paul Bishop
Email	bishop@photoscience.com
Phone	859-277-8700
Mailing Address	2670 Wilhite Drive Lexington, KY 40503

Appendix B: FEMA Compliance Forms and Metadata

Project Name:	**Region 1: Charles, Massachusetts – Elevation Data Acquisition**
Statement of Work No.:	FEMA TASK ORDER NUMBER: HSFEHQ-10-J-0005 WORK ORDER NUMBER: CP HQ 10 001
Interagency Agreement No.:	STARR PROJECT NUMBER: 400000058 STARR PARTNER TRACKING NUMBER: CP HQ 10 001
CTP Agreement No.:	N/A
Statement/Agreement Date:	10/10/10
Certification Date:	6/1/11

	Tasks/Activities Covered by This Certification (Check All That Apply)
☐	Base Map
☐	Topographic Data Development
X	Survey: Including Ground Control Points (GCPs), Fundamental Vertical Accuracy Testing (FVA), and Consolidated Vertical Accuracy Testing (CVA). The testing included parts of Blackstone and Narragansett.
☐	Hydrologic Analysis
☐	Hydraulic Analysis
☐	Alluvial Fan Analysis
☐	Coastal Analysis
☐	Floodplain Mapping
	This is to certify that the work summarized above was completed in accordance with the statement/agreement cited above and all amendments thereto, together with all such modifications, either written or oral, as the Regional Project Officer and/or Assistance Officer or their representative have directed, as such modifications affect the statement/agreement, and that all such work has been accomplished in accordance with the provisions contained in *Guidelines and Specifications for Flood Hazard Mapping Partners* cited in the contract document, and in accordance with sound and accepted engineering practices within the contract provisions for respective phases of the work. This is also to certify that data files submitted for the work summarized above are complete and final. Any revisions made to the already submitted data are included in the final submittal.

Name:	Philipp H. Hummel, PLS	COLORADO LICENSED PHILIPP H. HUMMEL 38155 June 1, 2011 PROFESSIONAL LAND SURVEYOR
Title:	Professional Land Surveyor, Geodesist	
Firm Represented:	Compass Data, Inc.	
Registration No.:	38155	
Signature:	Philipp Hummel	For and on behalf of Compass Data, Inc. Job. No.: 1508

This form must be signed by a representative of the firm or agency contracted to perform the work, who must be a registered or certified professional in the area of work performed, in compliance with Federal and State regulations.

Project Name:	Charles (Suffolk & Quincy), LiDAR Acquisition
Statement of Work No.:	HSFEHQ-10-J-0005
Interagency Agreement No.:	N/A
CTP Agreement No.:	N/A
Statement/Agreement Date:	N/A
Certification Date:	May 13, 2011

	Tasks/Activities Covered by This Certification (Check All That Apply)
☐	Base Map
X	Topographic Data Development
☐	Survey
☐	Hydrologic Analysis
☐	Hydraulic Analysis
☐	Alluvial Fan Analysis
☐	Coastal Analysis
☐	Floodplain Mapping
	This is to certify that the work summarized above was completed in accordance with the statement/agreement cited above and all amendments thereto, together with all such modifications, either written or oral, as the Regional Project Officer and/or Assistance Officer or their representative have directed, as such modifications affect the statement/agreement, and that all such work has been accomplished in accordance with the provisions contained in *Guidelines and Specifications for Flood Hazard Mapping Partners* cited in the contract document, and in accordance with sound and accepted engineering practices within the contract provisions for respective phases of the work. This is also to certify that data files submitted for the work summarized above are complete and final. Any revisions made to the already submitted data are included in the final submittal.

Name:	Mark E. Meade, PE, PLS, CP
Title:	Senior Vice President
Firm/Agency Represented:	Photo Science
Registration No.:	R1050
Signature:	
	This form must be signed by a representative of the firm or agency contracted to perform the work, who must be a registered or certified professional in the area of work performed, in compliance with Federal and State regulations.

American Society for Photogrammetry and Remote Sensing
MARK E. MEADE
CERTIFIED
PHOTOGRAMMETRIST
(ASPRS) No. 1050
Exp. 03/21/12

Ground Control Metadata

Identification_Information:
Citation:
Citation_Information:
Originator: Federal Emergency Management Agency
Publication_Date: 20110128
Title: TERRAIN, Charles, Massachusetts
Geospatial_Data_Presentation_Form: FEMA-DCS-Terrain
Publication_Information:
Publication_Place: Washington, DC
Publisher: Federal Emergency Management Agency
Online_Linkage: http://hazards.fema.gov
Larger_Work_Citation:
Citation_Information:
Originator: Federal Emergency Management Agency
Publication_Date: 20110128
Title: FEMA CASE 11-01-0717S
Description:
Abstract: The Charles AOI consists of two functional areas, Charles and Quincy. See the Ground Control process step for further information on functional areas. Ground Control is collected throughout the AOI for use in the processing of LiDAR data to ensure data accurately represents the ground surface. QA/QC checkpoints, (FVA and CVA - see Ground Control process step for further information) also collected throughout the AOI, are used for independent quality checks of the processed LiDAR data.
Purpose: Provide high resolution terrain elevation and land cover elevation data. Terrain data is used to represent the topography of a watershed and/or floodplain environment and to extract useful information for hydraulic and hydrologic models.

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110128
Currentness_Reference: ground condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -71.611463
East_Bounding_Coordinate: -70.917567
North_Bounding_Coordinate: 42.466953
South_Bounding_Coordinate: 41.905124
Keywords:
Theme:
Theme_Keyword_Thesaurus: ISO 19115 Topic Category
Theme_Keyword: elevation
Theme:

Theme_Keyword_Thesaurus: FEMA NFIP Topic Category
Theme_Keyword: Land Surface
Theme_Keyword: Topography
Theme_Keyword: Digital Terrain Model
Theme_Keyword: Elevation Data
Theme_Keyword: LIDAR
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Ground Control
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK
Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY BOSTON, CITY OF
Place_Keyword: FEMA-CID 250286
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK
Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY CHELSEA, CITY OF
Place_Keyword: FEMA-CID 250287
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK
Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY REVERE, CITY OF
Place_Keyword: FEMA-CID 250288
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK
Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY WINTHROP, TOWN OF
Place_Keyword: FEMA-CID 250289

Access_Constraints: None
Use_Constraints: Acknowledgement of FEMA would be appreciated in products derived from these data. This digital data is produced for the purposes of updating/creating a DFIRM database.
Data_Set_Credit: Ground control and quality control checkpoints were collected by CompassData, Inc. Quality Assurance testing was conducted by Greenhorne & O'Mara, Inc. All firms were under contract to STARR, A Joint Venture which held the FEMA contract and task order for this work.

Data_Quality_Information:
Logical_Consistency_Report: Survey data have been confirmed to be in proper units, coordinate systems and format.
Completeness_Report: Survey data have been checked for completeness, points have been collected in correct vegetation units, and distributed throughout the AOI.

Positional_Accuracy:
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: Deliverables were tested by for both vertical and horizontal accuracy. The vertical unit of the data file is in meters with 2-decimal point precision.
Quantitative_Vertical_Positional_Accuracy_Assessment:
Vertical_Positional_Accuracy_Value:
Vertical_Positional_Accuracy_Explanation: RMSE in meters.

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Ground_Control Charles
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110128
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other1
Source_Contribution: Control points for tying LiDAR data to the ground surface.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: FVA_CVA Charles
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110128
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other2
Source_Contribution: Quality Assurance points to confirm LiDAR data meets vertical accuracy requirements.

Process_Step:

Process_Description: GPS based surveys were utilized to support both processing and testing of LiDAR data within FEMA designated Areas of Interest (AOIs). Geographically distinct ground points were surveyed using GPS technology throughout the AOIs to provide support for three distinct tasks.
Task 1 was to provide Vertical Ground Control to support the aerial acquisition and subsequent bare earth model processing. To accomplish this, survey-grade Trimble R-8 GPS receivers were used to collect a series of control points located on open areas, free of excessive or significant slope, and at least 5 meters away from any significant terrain break. Most if not all control points were collected at street/road intersections on bare level pavement.
Task 2 was to collect Fundamental Vertical Accuracy (FVA) checkpoints to evaluate the initial quality of the collected point cloud and to ensure that the collected data was satisfactory for further processing to meet FEMA specifications. The FVA points were collected in identical fashion to the Vertical Ground Control Points, but segregated from the point pool to ensure independent quality testing without prior knowledge of FVA locations by the aerial vendor.
Task 3 was to collect Consolidated Vertical Accuracy CVA) checkpoints to allow vertical testing of the bare-earth processed LiDAR data in different classes of land cover, including: Open (pavement, open dirt, short grass), High Grass and Crops, Brush and Low Trees, Forest, Urban. CVA points were collected in similar fashion as Control and FVA points with emphasis on establishing point locations within the predominant land cover classes within each AOI or Functional AOI Group. In order to successfully collect the Forest land cover class, it was necessary to establish a Backsight and Initial Point with the R8 receiver, and then employ a Nikon Total Station to observe a retroreflective prism stationed under tree canopy. This was necessary due to the reduced GPS performance and degradation of signal under tree canopy.
The R-8 receivers were equipped with cellular modems to receive real-time correction signals from the Keystone Precision Virtual Reference Station (VRS) network encompassing the Region 1 AOIs. Use of the VRS network allowed rapid collection times (~3 minutes/point) at 2.54 cm (1 inch) initial accuracy.
All points collected were below the 8cm specification for testing 24cm, Highest category LiDAR data. To ensure valid in-field collections, an NGS monument with suitable vertical reporting was measured using the same equipment and procedures used for Control, FVA and CVA points on a daily basis. The measurement was compared to the NGS published values to ensure that the GPS collection schema was producing valid data and as a physical proof point of quality of collection. Those monument measurements are summarized in the Accuracy report included in the data delivered to FEMA.
In order to meet FEMA budgetary requirements, AOIs were consolidated into Functional Groups: if AOIs were contiguous, they were treated as one large AOI to allow collection of 20 FVA points and 15 additional CVA points across the group of AOIs. 20 FVA points are necessary to allow testing to CE95 – 1 point out of 20 may fail vertical testing and still allow the entire dataset to meet 95% accuracy requirements.
In similar fashion, 20 CVA points are necessary to test to CE95 as discussed above. 15 CVA points were collected per AOI or per Functional Group with the intention at the outset that 5 of the collected FVAs would perform double –duty as Open-class CVA points, to total 20 CVAs per AOI or Functional Group.
The Functional Groups are as follows: Narragansett/Charles/Blackstone(northeast), Nashua, Blackstone(north and west), Quinnipiac, Quincy/Suffolk (while included as part of the FEMA Charles AOI, was physically separated from the Charles AOI polygon and treated as an independent functional area).
The following software packages and utilities were used to control the GPS receiver in the field during data collection, and then ingest and export the collected GPS data for all points: Trimble Survey Controller, Trimble Pathfinder Office.
The following software utilities were used to translate the collected Latitude/Longitude Decimal Degree HAE GPS data for all points into Latitude/Longitude Degrees/Minutes/Seconds for checking the collected

monument data against the published NGS Datasheet Lat/Long DMS values and into UTM NAD83 Northings/Eastings: U.S. Army Corps of Engineers CorpsCon, National Geodetic Survey Geoid09NAVD88. MSL values were determined using the most recent NGS-approved geoid model to generate geoid separation values for each Lat/Long coordinate pair. In this fashion, Orthometric heights were determined for each Control, FVA and CVA point by subtracting the generated Geoid Separation value from the Ellipsoidal Height (HAE) for publication and use as MSL NAVD88(09).
Process_Date: 2011

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 19
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -69.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000010
Ordinate_Resolution: 0.000010
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.00
Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Datum_Name: North American Vertical Datum of 1988
Altitude_Resolution: 0.01
Altitude_Distance_Units: meters
Altitude_Encoding_Method: Attribute Values

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142860\SupplementalData\GroundControl Charles
Entity_Type_Definition: Ground Control Survey for LiDAR collection
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:

Entity_Type:
Entity_Type_Label: Terrain\2142860\SupplementalData\FVA_CVA Charles
Entity_Type_Definition: Survey for Horizontal and Vertical LiDAR QC
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Overview_Description:
Entity_and_Attribute_Overview: The Terrain data package is made up of several data themes containing primarily spatial information. These data supplement the Elevation datasets by providing additional information to aid flood risk evaluation and flood hazard area delineations.
Entity_and_Attribute_Detail_Citation: Appendix M of FEMA Guidelines and Specifications for FEMA Flood Hazard Mapping Partners contains a detailed description of the data themes and references to other relevant information.

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Federal Emergency Management Agency Engineering Library
Contact_Address:
Address_Type: mailing address
Address: Marie Sparrow, Zimmerman Associates, Inc.
Address: 847 South Pickett Street
City: Alexandria
State_or_Province: Virginia
Postal_Code: 22304
Country: USA
Contact_Voice_Telephone: 1-877-336-2627
Contact_Electronic_Mail_Address: miphelp@mapmodteam.com

Distribution_Liability: No warranty expressed or implied is made by FEMA regarding the utility of the data on any other system nor shall the act of distribution constitute any such warranty.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: FEMA-DCS-Terrain
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: http://hazards.fema.gov
Fees: Contact Distributor

Metadata_Reference_Information:
Metadata_Date: 20110128
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:

Contact_Person: FEMA Representative
Contact_Organization: Federal Emergency Management Agency
Contact_Address:
Address_Type: mailing address
Address: 500 C Street, S.W.
City: Washington
State_or_Province: District of Columbia
Postal_Code: 20472
Country: USA
Contact_Voice_Telephone: 1-877-336-2627
Contact_Electronic_Mail_Address: miphelp@mapmodteam.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Extensions:
Online_Linkage: http://hazards.fema.gov
Online_Linkage: http://www.epsg.org
Profile_Name: FEMA NFIP Metadata Content and Format Standard

Acquisition Metadata

Identification_Information:
Citation:
Citation_Information:
Originator: Federal Emergency Management Agency
Publication_Date: 20110405
Title: TERRAIN, Charles, Massachusetts
Geospatial_Data_Presentation_Form: FEMA-DCS-Terrain
Publication_Information:
Publication_Place: Washington, DC
Publisher: Federal Emergency Management Agency
Online_Linkage: http://hazards.fema.gov
Larger_Work_Citation:
Citation_Information:
Originator: Federal Emergency Management Agency
Publication_Date: 20110405
Title: FEMA CASE 11-01-0717S
Description:
Abstract: The Charles AOI consists of two functional areas, Charles and Quincy. See the Ground Control process step for further information on functional areas. Ground Control is collected throughout the AOI for use in the processing of LiDAR data to ensure data accurately represents the ground surface. QA/QC checkpoints, (FVA and CVA - see Ground Control process step for further information) also collected throughout the AOI, are used for independent quality checks of the processed LiDAR data.
LiDAR acquisition products include Pre- and Post- flight reports which contain information on the flightlines, equipment parameters, and other pertinant acquisition details. The LiDAR product is considered to be point cloud data and consists of 1500mx1500m tiles of LAS points which are partially classified such that the bare earth points can be calibrated to the ground surface and tested via the independent QC to ensure the ground surface is accurately represented.
Purpose: Provide high resolution terrain elevation and land cover elevation data. Terrain data is used to represent the topography of a watershed and/or floodplain environment and to extract useful information for hydraulic and hydrologic models.

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Currentness_Reference: ground condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Unknown
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -71.611463
East_Bounding_Coordinate: -70.917567
North_Bounding_Coordinate: 42.466953
South_Bounding_Coordinate: 41.905124

Keywords:
 Theme:
  Theme_Keyword_Thesaurus: ISO 19115 Topic Category
  Theme_Keyword: elevation
 Theme:
  Theme_Keyword_Thesaurus: FEMA NFIP Topic Category
  Theme_Keyword: Land Surface
  Theme_Keyword: Topography
  Theme_Keyword: Digital Terrain Model
  Theme_Keyword: Elevation Data
  Theme_Keyword: LIDAR
 Theme:
  Theme_Keyword_Thesaurus: None
  Theme_Keyword: Ground Control
  Theme_Keyword: Point Cloud
  Theme_Keyword: LAS Point Files
 Place:
  Place_Keyword_Thesaurus: None
  Place_Keyword: REGION I
  Place_Keyword: STATE MA
  Place_Keyword: COUNTY SUFFOLK
  Place_Keyword: COUNTY-FIPS 025
  Place_Keyword: COMMUNITY BOSTON, CITY OF
  Place_Keyword: FEMA-CID 250286
 Place:
  Place_Keyword_Thesaurus: None
  Place_Keyword: REGION I
  Place_Keyword: STATE MA
  Place_Keyword: COUNTY SUFFOLK
  Place_Keyword: COUNTY-FIPS 025
  Place_Keyword: COMMUNITY CHELSEA, CITY OF
  Place_Keyword: FEMA-CID 250287
 Place:
  Place_Keyword_Thesaurus: None
  Place_Keyword: REGION I
  Place_Keyword: STATE MA
  Place_Keyword: COUNTY SUFFOLK
  Place_Keyword: COUNTY-FIPS 025
  Place_Keyword: COMMUNITY REVERE, CITY OF
  Place_Keyword: FEMA-CID 250288
 Place:
  Place_Keyword_Thesaurus: None
  Place_Keyword: REGION I
  Place_Keyword: STATE MA
  Place_Keyword: COUNTY SUFFOLK
  Place_Keyword: COUNTY-FIPS 025
  Place_Keyword: COMMUNITY WINTHROP, TOWN OF
  Place_Keyword: FEMA-CID 250289

Access_Constraints: None
Use_Constraints: Acknowledgement of FEMA would be appreciated in products derived from these data. This digital data is produced for the purposes of updating/creating a DFIRM database.
Data_Set_Credit: Ground control and quality control checkpoints were collected by CompassData, Inc. LiDAR was acquired and processed by Photo Science, Inc. Quality Control testing was performed by CompassData, Inc. Quality Assurance testing was conducted by Greenhorne & O'Mara, Inc. All firms were under contract to STARR, A Joint Venture which held the FEMA contract and task order for this work.

Data_Quality_Information:
Logical_Consistency_Report: Survey data have been confirmed to be in proper units, coordinate systems and format. The terrain data have been confirmed as complete LAS format data files. Header files are in proper LAS format with content as specified by FEMA Procedural Memo No. 61.
Completeness_Report: Survey data have been checked for completeness, points have been collected in correct vegetation units, and distributed throughout the AOI. The terrain data have been checked for completeness against AOI polygons. No gaps as defined by FEMA Procedural Memo No. 61 are known to exist within the dataset. Positional accuracy was calculated for each of the two functional areas. The Charles area is reported in the Postional Accuracy section of this metadata. The Quincy area accuracy value is 0.136 meters.

Positional_Accuracy:
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: Deliverables were tested by for both vertical and horizontal accuracy. The vertical unit of the data file is in meters with 2-decimal point precision.
Quantitative_Vertical_Positional_Accuracy_Assessment:
Vertical_Positional_Accuracy_Value: 0.166
Vertical_Positional_Accuracy_Explanation: Fundamental Vertical Accuracy (FVA) equal to the 95th percentile confidence level (RMSE[z] x 1.9600) calculated in open terrain. Reported in meters.

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Ground_Control Charles
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110128
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other1
Source_Contribution: Control points for tying LiDAR data to the ground surface.
Source_Information:
Source_Citation:
Citation_Information:

Originator: STARR
Publication_Date: 2011
Title: FVA_CVA Charles
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110128
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other2
Source_Contribution: Quality Assurance points to confirm LiDAR data meets vertical accuracy requirements.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Charles_Collection_Area
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: Other3
Source_Contribution: Shapefile of Charles LiDAR acquisition area.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: All_Returns
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other4
Source_Contribution: Point Cloud (All Returns) LAS point files named according to Charles LiDAR Tile Index.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Charles_PreFlightReport
Type_of_Source_Media: DIGITAL

Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other5
Source_Contribution: Document contains the operations plans for the LiDAR acquisition.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Charles_PostFlightReport
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other6
Source_Contribution: Document contains the acquisition and calibration report for the LiDAR acquisition
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Char_Tile_Index
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other7
Source_Contribution: Shapefile of tile index used to populate and reference the LAS tiled data.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Region 1 Charles Narragansett partial Blackstone Testing Results FVA CVA
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition

Source_Citation_Abbreviation: Other8
Source_Contribution: Document contains QC test results for both FVA and CVA blind check point tests against open area and bare earth surfaces generated from All Returns and Bare Earth (respectively) LAS points.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Region 1 Quincy Testing Results FVA CVA
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other9
Source_Contribution: Document contains QC test results for both FVA and CVA blind check point tests against open area and bare earth surfaces generated from All Returns and Bare Earth (respectively) LAS points.
Process_Step:
Process_Description: GPS based surveys were utilized to support both processing and testing of LiDAR data within FEMA designated Areas of Interest (AOIs). Geographically distinct ground points were surveyed using GPS technology throughout the AOIs to provide support for three distinct tasks.
Task 1 was to provide Vertical Ground Control to support the aerial acquisition and subsequent bare earth model processing. To accomplish this, survey-grade Trimble R-8 GPS receivers were used to collect a series of control points located on open areas, free of excessive or significant slope, and at least 5 meters away from any significant terrain break. Most if not all control points were collected at street/road intersections on bare level pavement.
Task 2 was to collect Fundamental Vertical Accuracy (FVA) checkpoints to evaluate the initial quality of the collected point cloud and to ensure that the collected data was satisfactory for further processing to meet FEMA specifications. The FVA points were collected in identical fashion to the Vertical Ground Control Points, but segregated from the point pool to ensure independent quality testing without prior knowledge of FVA locations by the aerial vendor.
Task 3 was to collect Consolidated Vertical Accuracy CVA) checkpoints to allow vertical testing of the bare-earth processed LiDAR data in different classes of land cover, including: Open (pavement, open dirt, short grass), High Grass and Crops, Brush and Low Trees, Forest, Urban. CVA points were collected in similar fashion as Control and FVA points with emphasis on establishing point locations within the predominant land cover classes within each AOI or Functional AOI Group. In order to successfully collect the Forest land cover class, it was necessary to establish a Backsight and Initial Point with the R8 receiver, and then employ a Nikon Total Station to observe a retroreflective prism stationed under tree canopy. This was necessary due to the reduced GPS performance and degradation of signal under tree canopy.
The R-8 receivers were equipped with cellular modems to receive real-time correction signals from the Keystone Precision Virtual Reference Station (VRS) network encompassing the Region 1 AOIs. Use of the VRS network allowed rapid collection times (~3 minutes/point) at 2.54 cm (1 inch) initial accuracy.
All points collected were below the 8cm specification for testing 24cm, Highest category LiDAR data. To ensure valid in-field collections, an NGS monument with suitable vertical reporting was measured using

the same equipment and procedures used for Control, FVA and CVA points on a daily basis. The measurement was compared to the NGS published values to ensure that the GPS collection schema was producing valid data and as a physical proof point of quality of collection. Those monument measurements are summarized in the Accuracy report included in the data delivered to FEMA.
In order to meet FEMA budgetary requirements, AOIs were consolidated into Functional Groups: if AOIs were contiguous, they were treated as one large AOI to allow collection of 20 FVA points and 15 additional CVA points across the group of AOIs. 20 FVA points are necessary to allow testing to CE95 – 1 point out of 20 may fail vertical testing and still allow the entire dataset to meet 95% accuracy requirements.
In similar fashion, 20 CVA points are necessary to test to CE95 as discussed above. 15 CVA points were collected per AOI or per Functional Group with the intention at the outset that 5 of the collected FVAs would perform double –duty as Open-class CVA points, to total 20 CVAs per AOI or Functional Group.
The Functional Groups are as follows: Narragansett/Charles/Blackstone(northeast), Nashua, Blackstone(north and west), Quinnipiac, Quincy/Suffolk (while included as part of the FEMA Charles AOI, was physically separated from the Charles AOI polygon and treated as an independent functional area).
The following software packages and utilities were used to control the GPS receiver in the field during data collection, and then ingest and export the collected GPS data for all points: Trimble Survey Controller, Trimble Pathfinder Office.
The following software utilities were used to translate the collected Latitude/Longitude Decimal Degree HAE GPS data for all points into Latitude/Longitude Degrees/Minutes/Seconds for checking the collected monument data against the published NGS Datasheet Lat/Long DMS values and into UTM NAD83 Northings/Eastings: U.S. Army Corps of Engineers CorpsCon, National Geodetic Survey Geoid09NAVD88.
MSL values were determined using the most recent NGS-approved geoid model to generate geoid separation values for each Lat/Long coordinate pair. In this fashion, Orthometric heights were determined for each Control, FVA and CVA point by subtracting the generated Geoid Separation value from the Ellipsoidal Height (HAE) for publication and use as MSL NAVD88(09).
  Process_Date: 2011
Process_Step:
  Process_Description: Using an Optech Gemini LiDAR system, a total 222 flightlines of highest density (Nominal pulse Spacing of 1.0m) were collected over the functional area of Narragansett/charles/Blackstone (northest) and over the Quincy/Suffolk areas. A total of 286 square mils was collected for the Charles area. A total of 24 missions were flown between December 2 and December 17, 2010. Four airborne global positioning system (GPS) base stations were used to support the LiDAR data acquisition: BED A-AI5558, Central-LW0418, ORH A-AI5600, and Mansfield-LW5147. Coordinates are available in the Post-Flight Aerial Acquisition Report.
  Process_Date: 2011
Process_Step:
  Process_Description: Applanix software was used in the post processing of the airborne GPS and inertial data that is critical to the positioning and orientation of the sensor during all flights. POSPac MMS provides the smoothed best estimate of trajectory (SBET) that is necessary for Optech's post processor to develop the point cloud from the LiDAR missions. The point cloud is the mathematical three dimensional collection of all returns from all laser pulses as determined from the aerial mission. Optech’s DASHMap software and Leica’s ALS Post Processor software were used to create the Raw LIDAR Flight Line strips. At this point this data is ready for analysis, classification, and filtering to generate a bare earth surface model in which the above ground features are removed from the data set. The GeoCue and TerraScan software packages are then used for the automated data classification. Project specific macros are created to classify the ground and to remove the side overlap between parallel flight lines.

LAS Class 2 (Ground) is used to check the surveyed control points against the Triangulated LIDAR surface. Any bias is then removed using macro functionality within TerraScan.
Unclassified Point Cloud tiles are then created using TerraScan macro functionality. These tiles are populated within GeoCue to ensure correct LAS versioning and LAS Header information.
LAS Class 2 is used to check the independent QC points against the Triangulated LiDAR surface. If RMSE is not within guidelines TerraScan software is utilitzed to remove any bias, and the check is performed again.
Process_Date: 2011

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 19
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -69.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000010
Ordinate_Resolution: 0.000010
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.00
Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Datum_Name: North American Vertical Datum of 1988
Altitude_Resolution: 0.01
Altitude_Distance_Units: meters
Altitude_Encoding_Method: Attribute Values

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142860\SupplementalData\GroundControl Charles
Entity_Type_Definition: Ground Control Survey for LiDAR collection
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)

Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142860\SupplementalData\FVA_CVA Charles
Entity_Type_Definition: Survey for Horizontal and Vertical LiDAR QC
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Charles_Collection_Area
Entity_Type_Definition: Area Spatial File
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\All_Returns
Entity_Type_Definition: LAS 1.2 files
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Charles_PreFlight Report
Entity_Type_Definition: Digital Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Charles_PostFlight Report
Entity_Type_Definition: Digitial Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Char_Tile_Index
Entity_Type_Definition: Area Spatial File
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142861\SupplementalData\Region 1 Charles Narragansett partial Blackstone Testing Results FVA CVA
Entity_Type_Definition: Digital Document

Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142861\SupplementalData\Region 1 Quincy Testing Results FVA CVA
Entity_Type_Definition: Digital Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Overview_Description:
Entity_and_Attribute_Overview: The Terrain data package is made up of several data themes containing primarily spatial information. These data supplement the Elevation datasets by providing additional information to aid flood risk evaluation and flood hazard area delineations.
Entity_and_Attribute_Detail_Citation: Appendix M of FEMA Guidelines and Specifications for FEMA Flood Hazard Mapping Partners contains a detailed description of the data themes and references to other relevant information.

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Federal Emergency Management Agency Engineering Library
Contact_Address:
Address_Type: mailing address
Address: Marie Sparrow, Zimmerman Associates, Inc.
Address: 847 South Pickett Street
City: Alexandria
State_or_Province: Virginia
Postal_Code: 22304
Country: USA
Contact_Voice_Telephone: 1-877-336-2627
Contact_Electronic_Mail_Address: miphelp@mapmodteam.com

Distribution_Liability: No warranty expressed or implied is made by FEMA regarding the utility of the data on any other system nor shall the act of distribution constitute any such warranty.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: FEMA-DCS-Terrain
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: http://hazards.fema.gov
Fees: Contact Distributor

Metadata_Reference_Information:

Metadata_Date: 20110405
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: FEMA Representative
Contact_Organization: Federal Emergency Management Agency
Contact_Address:
Address_Type: mailing address
Address: 500 C Street, S.W.
City: Washington
State_or_Province: District of Columbia
Postal_Code: 20472
Country: USA
Contact_Voice_Telephone: 1-877-336-2627
Contact_Electronic_Mail_Address: miphelp@mapmodteam.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Extensions:
Online_Linkage: http://hazards.fema.gov
Online_Linkage: http://www.epsg.org
Profile_Name: FEMA NFIP Metadata Content and Format Standard

Processing Metadata

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Federal Emergency Management Agency
      Publication_Date: 20110405
      Title: TERRAIN, Charles, Massachusetts
      Geospatial_Data_Presentation_Form: FEMA-DCS-Terrain
      Publication_Information:
        Publication_Place: Washington, DC
        Publisher: Federal Emergency Management Agency
      Online_Linkage: http://hazards.fema.gov
      Larger_Work_Citation:
        Citation_Information:
          Originator: Federal Emergency Management Agency
          Publication_Date: 20110405
        Title: FEMA CASE 11-01-0717S
  Description:
    Abstract: The Charles AOI consists of two functional areas, Charles and Quincy. See the Ground Control process step for further information on functional areas. Ground Control is collected throughout the AOI for use in the processing of LiDAR data to ensure data accurately represents the ground surface. QA/QC checkpoints, (FVA and CVA - see Ground Control process step for further information) also collected throughout the AOI, are used for independent quality checks of the processed LiDAR data.

LiDAR acquisition products include Pre- and Post- flight reports which contain information on the flightlines, equipment parameters, and other pertinant acquisition details. The LiDAR product is considered to be point cloud data and consists of 1500mx1500m tiles of LAS points which are partially classified such that the bare earth points can be calibrated to the ground surface and tested via the independent QC to ensure the ground surface is accurately represented.

The Bare Earth deliverables consists of tiles of fully classified LAS points. A full narrative accompanies this deliverable, as well as the independent QC report.

    Purpose: Provide high resolution terrain elevation and land cover elevation data. Terrain data is used to represent the topography of a watershed and/or floodplain environment and to extract useful information for hydraulic and hydrologic models.

  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 20110405
    Currentness_Reference: ground condition
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: Unknown
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -71.611463
      East_Bounding_Coordinate: -70.917567

North_Bounding_Coordinate: 42.466953
South_Bounding_Coordinate: 41.905124
Keywords:
Theme:
Theme_Keyword_Thesaurus: ISO 19115 Topic Category
Theme_Keyword: elevation
Theme:
Theme_Keyword_Thesaurus: FEMA NFIP Topic Category
Theme_Keyword: Land Surface
Theme_Keyword: Topography
Theme_Keyword: Digital Terrain Model
Theme_Keyword: Elevation Data
Theme_Keyword: LIDAR
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Ground Control
Theme_Keyword: Point Cloud
Theme_Keyword: LAS Point Files
Theme_Keyword: Bare Earth
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK
Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY BOSTON, CITY OF
Place_Keyword: FEMA-CID 250286
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK
Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY CHELSEA, CITY OF
Place_Keyword: FEMA-CID 250287
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK
Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY REVERE, CITY OF
Place_Keyword: FEMA-CID 250288
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: REGION I
Place_Keyword: STATE MA
Place_Keyword: COUNTY SUFFOLK

Place_Keyword: COUNTY-FIPS 025
Place_Keyword: COMMUNITY WINTHROP, TOWN OF
Place_Keyword: FEMA-CID 250289

Access_Constraints: None
Use_Constraints: Acknowledgement of FEMA would be appreciated in products derived from these data. This digital data is produced for the purposes of updating/creating a DFIRM database.
Data_Set_Credit: Ground control and quality control checkpoints were collected by CompassData, Inc. LiDAR was acquired and processed by Photo Science, Inc. Quality Control testing was performed by CompassData, Inc. Quality Assurance testing was conducted by Greenhorne & O'Mara, Inc. All firms were under contract to STARR, A Joint Venture which held the FEMA contract and task order for this work.

Data_Quality_Information:
Logical_Consistency_Report: Survey data have been confirmed to be in proper units, coordinate systems and format. The terrain data have been confirmed as complete LAS format data files. Header files are in proper LAS format with content as specified by FEMA Procedural Memo No. 61.
Completeness_Report: Survey data have been checked for completeness, points have been collected in correct vegetation units, and distributed throughout the AOI. The terrain data have been checked for completeness against AOI polygons. No gaps as defined by FEMA Procedural Memo No. 61 are known to exist within the dataset. Positional accuracy was calculated for each of the two functional areas. The Charles area is reported in the Postional Accuracy section of this metadata. The Quincy area accuracy value is 0.143 meters.

Positional_Accuracy:
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: Deliverables were tested by for both vertical and horizontal accuracy. The vertical unit of the data file is in meters with 2-decimal point precision.
Quantitative_Vertical_Positional_Accuracy_Assessment:
Vertical_Positional_Accuracy_Value: 0.186
Vertical_Positional_Accuracy_Explanation: Consolidated Vertical Accuracy (CVA) equal to the 95th percentile confidence level (RMSE[z] x 1.9600) calculated against the bare earth surface in all ground cover classes. Reported in meters.

Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Ground_Control Charles
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110128
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other1

Source_Contribution: Control points for tying LiDAR data to the ground surface.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: FVA_CVA Charles
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110128
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other2
Source_Contribution: Quality Assurance points to confirm LiDAR data meets vertical accuracy requirements.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Charles_Collection_Area
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: Other3
Source_Contribution: Shapefile of Charles LiDAR acquisition area.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: All_Returns
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other4
Source_Contribution: Point Cloud (All Returns) LAS point files named according to Char_Tile_Index.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR

Publication_Date: 2011
Title: Charles_PreFlightReport
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other5
Source_Contribution: Document contains the operations plans for the LiDAR acquisition.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Charles_PostFlightReport
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other6
Source_Contribution: Document contains the acquisition and calibration report for the LiDAR acquisition
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Char_Tile_Index
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other7
Source_Contribution: Shapefile of tile index used to populate and reference the LAS tiled data.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Region 1 Charles Narragansett partial Blackstone Testing Results FVA CVA
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:

Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other8
Source_Contribution: Document contains QC test results for both FVA and CVA blind check point tests against open area and bare earth surfaces generated from All Returns and Bare Earth (respectively) LAS points.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Region 1 Quincy Testing Results FVA CVA
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other9
Source_Contribution: Document contains QC test results for both FVA and CVA blind check point tests against open area and bare earth surfaces generated from All Returns and Bare Earth (respectively) LAS points.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: R1_Charles_Terrain_TSDN
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 20110405
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other10
Source_Contribution: Contains complete narrative on the acquisition and processing of the LiDAR dataset, includes area diagrams, reports and metadata.
Source_Information:
Source_Citation:
Citation_Information:
Originator: STARR
Publication_Date: 2011
Title: Bare_Earth
Type_of_Source_Media: DIGITAL
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:

Calendar_Date: 20110124
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: Other11
Source_Contribution: Bare Earth LAS point files named according to the Char_Tile_Index.

Process_Step:
Process_Description: GPS based surveys were utilized to support both processing and testing of LiDAR data within FEMA designated Areas of Interest (AOIs). Geographically distinct ground points were surveyed using GPS technology throughout the AOIs to provide support for three distinct tasks.
Task 1 was to provide Vertical Ground Control to support the aerial acquisition and subsequent bare earth model processing. To accomplish this, survey-grade Trimble R-8 GPS receivers were used to collect a series of control points located on open areas, free of excessive or significant slope, and at least 5 meters away from any significant terrain break. Most if not all control points were collected at street/road intersections on bare level pavement.
Task 2 was to collect Fundamental Vertical Accuracy (FVA) checkpoints to evaluate the initial quality of the collected point cloud and to ensure that the collected data was satisfactory for further processing to meet FEMA specifications. The FVA points were collected in identical fashion to the Vertical Ground Control Points, but segregated from the point pool to ensure independent quality testing without prior knowledge of FVA locations by the aerial vendor.
Task 3 was to collect Consolidated Vertical Accuracy CVA) checkpoints to allow vertical testing of the bare-earth processed LiDAR data in different classes of land cover, including: Open (pavement, open dirt, short grass), High Grass and Crops, Brush and Low Trees, Forest, Urban. CVA points were collected in similar fashion as Control and FVA points with emphasis on establishing point locations within the predominant land cover classes within each AOI or Functional AOI Group. In order to successfully collect the Forest land cover class, it was necessary to establish a Backsight and Initial Point with the R8 receiver, and then employ a Nikon Total Station to observe a retroreflective prism stationed under tree canopy. This was necessary due to the reduced GPS performance and degradation of signal under tree canopy.
The R-8 receivers were equipped with cellular modems to receive real-time correction signals from the Keystone Precision Virtual Reference Station (VRS) network encompassing the Region 1 AOIs. Use of the VRS network allowed rapid collection times (~3 minutes/point) at 2.54 cm (1 inch) initial accuracy.
All points collected were below the 8cm specification for testing 24cm, Highest category LiDAR data. To ensure valid in-field collections, an NGS monument with suitable vertical reporting was measured using the same equipment and procedures used for Control, FVA and CVA points on a daily basis. The measurement was compared to the NGS published values to ensure that the GPS collection schema was producing valid data and as a physical proof point of quality of collection. Those monument measurements are summarized in the Accuracy report included in the data delivered to FEMA.
In order to meet FEMA budgetary requirements, AOIs were consolidated into Functional Groups: if AOIs were contiguous, they were treated as one large AOI to allow collection of 20 FVA points and 15 additional CVA points across the group of AOIs. 20 FVA points are necessary to allow testing to CE95 – 1 point out of 20 may fail vertical testing and still allow the entire dataset to meet 95% accuracy requirements.
In similar fashion, 20 CVA points are necessary to test to CE95 as discussed above. 15 CVA points were collected per AOI or per Functional Group with the intention at the outset that 5 of the collected FVAs would perform double –duty as Open-class CVA points, to total 20 CVAs per AOI or Functional Group.
The Functional Groups are as follows: Narragansett/Charles/Blackstone(northeast), Nashua, Blackstone(north and west), Quinnipiac, Quincy/Suffolk (while included as part of the FEMA Charles AOI, was physically separated from the Charles AOI polygon and treated as an independent functional area).

The following software packages and utilities were used to control the GPS receiver in the field during data collection, and then ingest and export the collected GPS data for all points: Trimble Survey Controller, Trimble Pathfinder Office.
The following software utilities were used to translate the collected Latitude/Longitude Decimal Degree HAE GPS data for all points into Latitude/Longitude Degrees/Minutes/Seconds for checking the collected monument data against the published NGS Datasheet Lat/Long DMS values and into UTM NAD83 Northings/Eastings: U.S. Army Corps of Engineers CorpsCon, National Geodetic Survey Geoid09NAVD88. MSL values were determined using the most recent NGS-approved geoid model to generate geoid separation values for each Lat/Long coordinate pair. In this fashion, Orthometric heights were determined for each Control, FVA and CVA point by subtracting the generated Geoid Separation value from the Ellipsoidal Height (HAE) for publication and use as MSL NAVD88(09).
Process_Date: 2011
Process_Step:
Process_Description: Using an Optech Gemini LiDAR system, a total 222 flightlines of highest density (Nominal pulse Spacing of 1.0m) were collected over the functional area of Narragansett/charles/Blackstone (northest) and over the Quincy/Suffolk areas. A total of 286 square mils was collected for the Charles area. A total of 24 missions were flown between December 2 and December 17, 2010. Four airborne global positioning system (GPS) base stations were used to support the LiDAR data acquisition: BED A-AI5558, Central-LW0418, ORH A-AI5600, and Mansfield-LW5147. Coordinates are available in the Post-Flight Aerial Acquisition Report.
Process_Date: 2011
Process_Step:
Process_Description: Applanix software was used in the post processing of the airborne GPS and inertial data that is critical to the positioning and orientation of the sensor during all flights. POSPac MMS provides the smoothed best estimate of trajectory (SBET) that is necessary for Optech's post processor to develop the point cloud from the LiDAR missions. The point cloud is the mathematical three dimensional collection of all returns from all laser pulses as determined from the aerial mission. Optech's DASHMap software and Leica's ALS Post Processor software were used to create the Raw LIDAR Flight Line strips. At this point this data is ready for analysis, classification, and filtering to generate a bare earth surface model in which the above ground features are removed from the data set. The GeoCue and TerraScan software packages are then used for the automated data classification. Project specific macros are created to classify the ground and to remove the side overlap between parallel flight lines.
LAS Class 2 (Ground) is used to check the surveyed control points against the Triangulated LIDAR surface. Any bias is then removed using macro functionality within TerraScan.
Unclassified Point Cloud tiles are then created using TerraScan macro functionality. These tiles are populated within GeoCue to ensure correct LAS versioning and LAS Header information.
LAS Class 2 is used to check the independent QC points against the Triangulated LiDAR surface. If RMSE is not within guidelines TerraScan software is utilitzed to remove any bias, and the check is performed again.
Process_Date: 2011
Process_Step:
Process_Description:
Point Cloud data is manually reviewed and any remaining artifacts are removed using functionality provided within the TerraScan and TerraModeler software packages.
Additional project specific macros are created and run within GeoCue/TerraScan to ensure correct LAS classification prior to project delivery.

Final Classified LAS tiles are created within GeoCue to confirm correct LAS versioning and header information.
In-house software is then used to check LAS header information and final LAS classification prior to delivery.
LAS Class 2 is used to check the independent QC points against the Triangulated LiDAR surface.
Process_Date: 2011

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 19
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -69.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000010
Ordinate_Resolution: 0.000010
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.00
Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
Altitude_Datum_Name: North American Vertical Datum of 1988
Altitude_Resolution: 0.01
Altitude_Distance_Units: meters
Altitude_Encoding_Method: Attribute Values

Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142860\SupplementalData\GroundControl Charles
Entity_Type_Definition: Ground Control Survey for LiDAR collection
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:

Entity_Type_Label: Terrain\2142860\SupplementalData\FVA_CVA Charles
Entity_Type_Definition: Survey for Horizontal and Vertical LiDAR QC
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Charles_Collection_Area
Entity_Type_Definition: Area Spatial File
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\All_Returns
Entity_Type_Definition: LAS 1.2 files
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Charles_PreFlightReport
Entity_Type_Definition: Digital Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Charles_PostFlightReport
Entity_Type_Definition: Digitial Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142862\SupplementalData\Char_Tile_Index
Entity_Type_Definition: Area Spatial File
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142861\SupplementalData\Region 1 Charles Narragansett partial Blackstone Testing Results FVA CVA
Entity_Type_Definition: Digital Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)

Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142861\SupplementalData\Region 1 Quincy Testing Results FVA CVA
Entity_Type_Definition: Digital Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142861\SupplementalData\R1_Charles_Terrain_TSDN
Entity_Type_Definition: Digital Document
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Detailed_Description:
Entity_Type:
Entity_Type_Label: Terrain\2142861\Bare_Earth
Entity_Type_Definition: LAS 1.2 files
Entity_Type_Definition_Source: FEMA Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: Data Capture Standards and Data Capture Guidelines (available at http://www.fema.gov/fhm/dl_cgs.shtm)
Overview_Description:
Entity_and_Attribute_Overview: The Terrain data package is made up of several data themes containing primarily spatial information. These data supplement the Elevation datasets by providing additional information to aid flood risk evaluation and flood hazard area delineations.
Entity_and_Attribute_Detail_Citation: Appendix M of FEMA Guidelines and Specifications for FEMA Flood Hazard Mapping Partners contains a detailed description of the data themes and references to other relevant information.

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Federal Emergency Management Agency Engineering Library
Contact_Address:
Address_Type: mailing address
Address: Marie Sparrow, Zimmerman Associates, Inc.
Address: 847 South Pickett Street
City: Alexandria
State_or_Province: Virginia
Postal_Code: 22304
Country: USA
Contact_Voice_Telephone: 1-877-336-2627
Contact_Electronic_Mail_Address: miphelp@mapmodteam.com

Distribution_Liability: No warranty expressed or implied is made by FEMA regarding the utility of the data on any other system nor shall the act of distribution constitute any such warranty.
Standard_Order_Process:

Digital_Form:
Digital_Transfer_Information:
Format_Name: FEMA-DCS-Terrain
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:
Network_Address:
Network_Resource_Name: http://hazards.fema.gov
Fees: Contact Distributor

Metadata_Reference_Information:
Metadata_Date: 20110405
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: FEMA Representative
Contact_Organization: Federal Emergency Management Agency
Contact_Address:
Address_Type: mailing address
Address: 500 C Street, S.W.
City: Washington
State_or_Province: District of Columbia
Postal_Code: 20472
Country: USA
Contact_Voice_Telephone: 1-877-336-2627
Contact_Electronic_Mail_Address: miphelp@mapmodteam.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Extensions:
Online_Linkage: http://hazards.fema.gov
Online_Linkage: http://www.epsg.org
Profile_Name: FEMA NFIP Metadata Content and Format Standard

Appendix C: Pre Flight Planning Report

Charles

Pre-Flight Operations Plan

November 2010

Planned Flight Lines

Photo Science has completed preliminary flight planning for Charles project area. Charles is scheduled to be acquired this fall when the leaves are off and delivered to FEMA in late spring of 2011. The Charles area is 283 square miles and the project area includes portions of Suffolk County and the City of Quincy that was added as an extension. Initial planning details are depicted in Figures 1 and 2 on pages 3 and 4. These Figures detail that STARR expects to collect **58 flight lines covering 644 flight line miles** for the Charles main area and **35 flight lines covering 156 flight line miles** for the Suffolk/Quincy extension. This area warranted a "Highest" vertical accuracy requirement and will be collected with a nominal pulse spacing of 1-meter. Key components of this flight planning include:

- ✓ Generating a plan that takes all specifications into account, and the required Laser settings to meet those specs, review of terrain and water issues, along with potential base station locations at airports with sufficient services available to support the crews.
- ✓ Orientation of flight lines parallel to major terrain features and variation in flight line spacing due to terrain variation (steeper slopes generally require tighter line spacing between adjacent parallel lines to ensure point density and side overlap are maintained)
- ✓ Check Airspace issues, and access issues for Base Stations.
- ✓ Safety considerations, both for flights, and Laser collection.

Acquisition (283 sq. miles @ 1-meter nominal post spacing to meet 24.5 cm FVA, LAS point cloud delivery with metadata, pre-operations flight plan, and post flight aerial acquisition report).

Planned GPS Stations

Normally existing high accuracy monuments at airports are utilized if possible. Typically a Primary Airport Control Monument (or Secondary) is available; otherwise any other high accuracy monument can be used. We typically prefer these on the airport grounds as they can be monitored for security by airport staff. If no monument is available or an existing monument is damaged, we will set a monument with re-bar and use OPUS to control the monument. These are then used for initial field processing of the data.

Planned Control

Twenty-two (22) ground control points will be surveyed to control the LiDAR data and to support a vertical test. Each of these two functions shall remain independent of each other and also be collected by an independent subcontractor (CompassData). Independent check or calibration points will be three times as accurate as the surface being checked. Therefore, in order to validate a 24.5 cm LiDAR surface (consistent with 2 foot contours), STARR will collect elevation control data accurate to 8 cm. This "three times" model for collecting ground control and QA points will be used throughout the task order.

Vertical accuracy checkpoints will be located by another independent STARR contractor (CompassData) to check Photo Science's work in open terrain, where there is a high probability that the sensor will have detected the ground surface without influence from surrounding vegetation. Checkpoints will be located on flat or uniformly sloping terrain and will be at least five (5) meters away from any break line where there is a change in slope. This criterion applies for all QA points for the Fundamental Vertical Accuracy (FVA) Assessment as well.

Blind vertical QA points for the Consolidated Accuracy Check (CVA) will also be collected by CompassData to check Photo Science's work randomly across different land use types using the ASPRS NSSDA land cover types. The points will be located in flat areas with no substantial elevation breaks within a 3-5 meter radius. We expect to normally pick one area and get 3-5 different land use classes from a single setup. We expect to normally use GPS to position an occupation and backsight point and then use a total station to get the other classes from that setup. The CVA assessment will incorporate a representative sample of the FVA assessment into the dataset to save on the total number of points collected. Figure 1 and 2 on the following pages has location maps of the flight lines and ground control points.

Planned Airport Locations

Photo Science will be utilizing one airport for Charles for mobilization and demobilization. The airport will be ORH-Worcester Regional. We may also utilize BVY; Beverly Municipal as a backup and for portions of the Charles extended area.

Calibration Plans

Periodic detailed boresighting of the LiDAR sensor is performed at a boresight facility established in Lexington, Kentucky for both our LiDAR and imagery platforms. Over 95 high-accuracy control points are located within this facility. The area also has numerous pitched roofs that are necessary in boresighting LiDAR instruments. Local boresights are also carried out at individual project sites. Typically these are established at local airports and consist of opposing and cross flights conducted at multiple flight elevations. The boresight data is processed by our Lead LiDAR Specialist with the results for all boresight parameters applied to the project acquisition. Figure 3 below outlines some of the basic principles that Photo Sciences conducts for LiDAR boresighting.

Figure3

Sensor Calibration Boresighting
✦ Photo Science routinely performs a Comprehensive Calibration process from our permanent boresighting location at the Capital City Airport in Frankfort, KY, as well as daily, local project specific boresighting locations.
✦ Photo Science established GPS survey points for LiDAR ground truthing and reflective survey analysis.
✦ Our calibration methodology adheres to the basic survey principle of *"working for the whole of the parts"* ensuring that residual values of the calibration are reduced, *not* multiplied.
✦ Photo Science calibration process validates roll, pitch, heading, pitch at swath edge, and torsion.

Calibration – all of our sensors are calibrated by flying lines at multiple altitudes and at varying directions over features on land, typically at the airport where the acquisition is staged. These lines are used to remove angular errors between the IMU and scanning mirror and to determine the precise positioning of the sensor in relationship with the phase center of the GPS antenna mounted on the fuselage of the aircraft.

Calibration of the Elevation Surface – the raw LiDAR surface is compared against ground points that are established for the calibration of the elevation surface. System biases are identified and removed during this calibration. An early statistical analysis takes place that provides an indication of the precision of the acquired data.

Additionally, each lift requires a cross flight over the lines collected during that flight. This also acts as a daily calibration and is used if any anomalies are discovered with processed data.

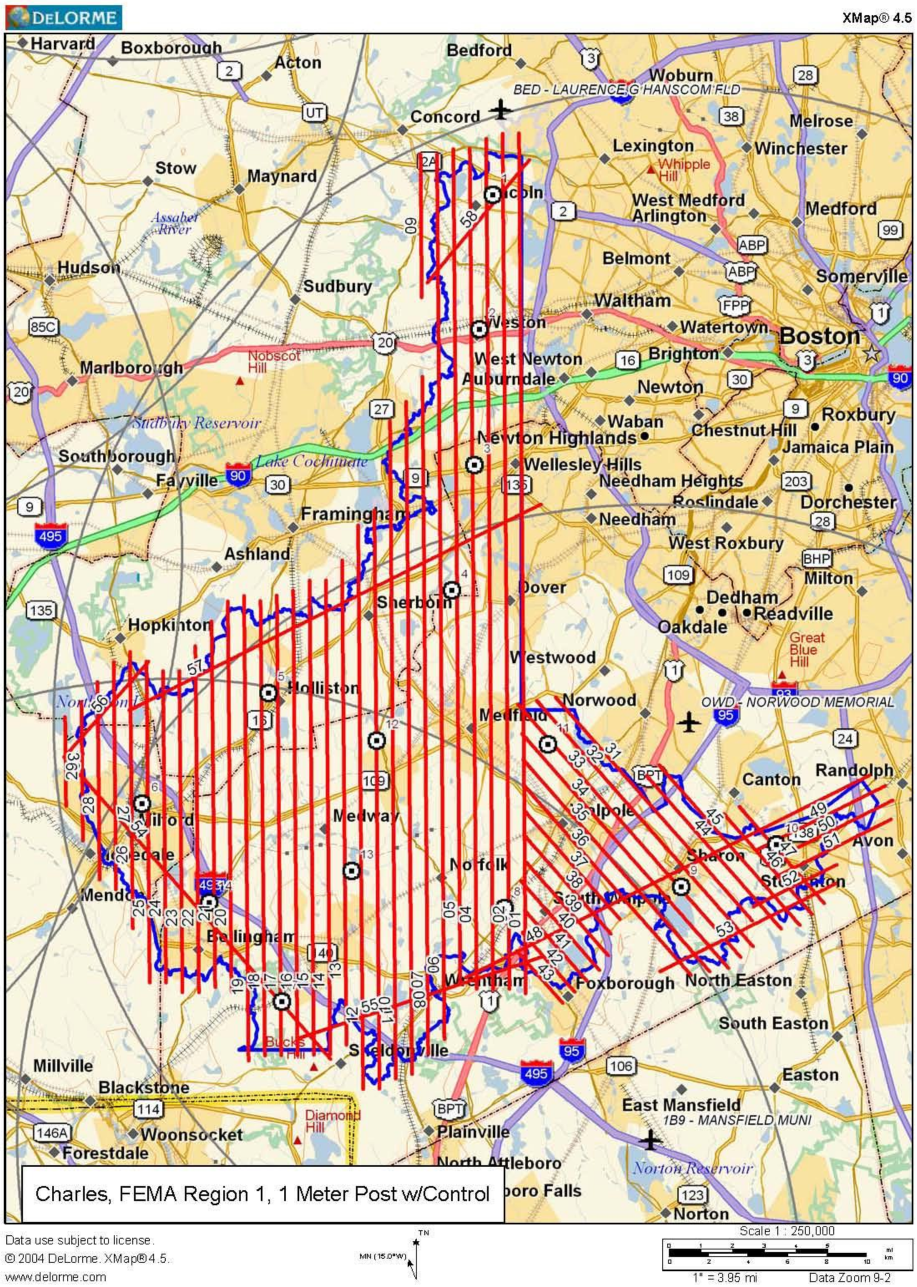


Figure 1-Charles Flight Lines, Ground Control, and Airport Locations

Figure 2-Suffolk/Quincy Extension Flight Lines, Ground Control, and Airport Locations

Quality Control Procedures for Flight Crew

Acquisition Crews

An experienced and knowledgeable acquisition crew is also critical to a successful LiDAR project. We will bring two capable crews to the project site with three more in reserve should any unexpected health issues or similar complications arise.

General Flight Mission Procedures

On a lift by lift basis the flight crew will check cloud conditions, atmospheric conditions (fog or probability of fog) and winds and turbulence. If any of those factors would make acquisition difficult they will wait a few hours and review again.

LiDAR crews can fly at night or during the day. Night flights can be smoother in some cases, but extra care must be used as it is easy to lose orientation with the ground if in very rural areas or over large expanses of water. Additionally, if there are fog probabilities then flights will not take place as fog will block the laser. It must be clear below the aircraft at all times.

The initial item is to set the base station properly over the monument, verify it is secure and running. Prior to setting the crew will have ascertained that it has storage space on the hard drives and full battery life. They will also verify that it is running with proper collection parameters. PDOP is also reviewed as collection will not take place during times of high PDOP.

The LiDAR system (controller hard drives and Laser) is connected to the flight management system and once the project plan is loaded the parameters for collection will load as well. The sensor operator will verify that everything loaded correctly before flight.

Once the LiDAR has been started the crew will taxi to the run up area and wait for the IMU, GPS and the rest of the system level out. They will collect data in a stationary position for about 5-10 minutes until the POS (position and orientation system) provides good level characteristics (Green Lights!).

After this they crew will take off and start collection data, avoiding hard steep turns (banks typically <20 degrees). Collection requires that speeds be maintained, sometimes quite slow depending on the accuracy requirements. Additionally altitudes must be watched closely.

During flights the sensor operator must monitor the laser to sure that temperatures are consistent and within guidelines, that pulsing is taking place correctly and returns are consistent and within guidelines while watching atmospheric conditions, speeds and monitoring the pilot.

Planned ScanSet (Laser Collection Parameters)

Parameters	15cm RMSE, 1m
Flying Height	5000
Aircraft Ground Speed (knots)	94
Pulse Rate (KHz)	143.7
Scan Rate (Hz)	48.3
Full Field of View (degrees)	34
Multi-Pulse	Yes
Full Swath Width (meters)	844/961
Swath Overlap (percentage)	30%
Max. Point Spacing Across Track (meters)	1.0
Max. Point Spacing Along Track (meters)	1.0
Across Track/Along Track Ratio	1.0
Average Point Density (M2)	3.10
Average Point Area (M2)	.32
Average Point Spacing (Meters)	.57
Nadir Point Density (pts/m2)	2.00
Illuminated Foot Print Diameter (meters)	.35

Acquisition (283 sq. miles @ 1-meter nominal post spacing to meet 24.5 cm FVA, LAS point cloud delivery with metadata, pre-operations flight plan, and post flight aerial acquisition report)

Type of Aircraft

All of our LiDAR sensors are currently flown in specially modified single-engine Cessna 206 platforms. This platform provides a very stable platform for LiDAR data acquisition, with the ability to easily achieve altitudes and speeds that are most common for LiDAR collection. Achieving an accurate, dense posting of LiDAR returns on the ground is most often associated with altitudes of 2,000 to 7,000 feet above the average terrain height at speeds ranging from 90 to 140 knots. These ranges are ideal for this single-engine platform.

Our platforms also have significant fuel capacity, which allows us considerable time over target for performing data collection. It is also a safe platform, which is important when flying over rugged terrain. The added bonus is this is a very economical platform to fly in terms of operational and maintenance costs. Moreover, that translates to competitive rates for LiDAR data acquisition.

Aircraft Name	Engine Configuration	ABGPS	Flight Management System	Ceiling Feet
Cessna U-206G	Single	Yes	Yes	16,700
Cessna U-206G	Single	Yes	Yes	16,700
Cessna U-206H	Single	Yes	Yes	15,700
Cessna U-206H	Single	Yes	Yes	15,700

Procedure for Tracking, Executing, and Checking Re-flights

All daily flights are tracked with specific logs for each area. These include general logs indicating the lines, date flown etc. as well as very specific mission logs concerning the lift, weather conditions, times, speeds and other criteria critical to the performance of the laser. The daily flight logs are faxed to the office on a daily basis and entered into an access database for tracking purposes. This helps determine where next to move crews and overall project status.

After flight each day, the GPS ground base station data is processed and verified and is then is run against the LiDAR POS data in both a forward and reverse sense. The two solutions are then compared against one another for all GPS epochs and the individual differences for the northing, easting, and elevation components are plotted for easy comparison. This data is then run against the LiDAR returns and a point cloud generated. Any anomalies in the data are quickly analyzed, and if required, re-flights take place for the portions of the flight missions that require remediation.

Once the data is checked it is archived, backed up and a set sent to the office via overnight delivery, while the backup copy remains with the crew.

The flight crews do not leave the area of collection until all data has been verified and shipped.

Considerations for Terrain, Cover, and Weather

Terrain is not an issue for flight planning on this project. The area is very flat. Cover has been considered and collection is scheduled for the Fall of 2010 during leaf-off conditions. Traditional LiDAR weather conditions will be observed for this area.

Appendix D: Ground Control Survey and Vertical Testing Quality Control

Charles Watershed LiDAR Collection

FEMA Region 1 – MA, NH, CT
FVA and CVA Project Report for FEMA
Inc. Narragansett, Charles, Concord, Blackstone, Nashua & Quinnipiac

Project Information

CDI Project Number:	**FSG1508**
Geographic Location:	**New England; MA, NH, CT**
Number of FVA/CVAs Requested:	**210**
Number of GCPs Collected:	**210**

Project Specifications

Precision (Horizontal/Vertical):	**CDI Precision-1 ≤ 8cm H/V**
Coordinate System:	**UTM**
Datum:	**NAD83**
Zone:	**18 & 19**
Altitude Reference:	**HAE (WGS84) and NAVD88 (09)**
Units:	**Meters**

RTK GPS

All FVA and CVA Quality Assurance Points for this project were collected within the boundaries of the Keystone Precision Instruments New England Virtual Reference Station System, which provides continuous real-time broadcast correction signals within a network of 170 base stations encompassing New England and the northern Mid-Atlantic region.

All QA Points were observed for 180 epochs to determine a coordinate location ≤ 8cm in both Horizontal and Vertical to support subsequent LiDAR post-processing and bare earth deliverables generation.

All data collected were well within the confines of the Keystone VRS system with multiple base locations providing position and correction data for each point collected.

Summary

The purpose of this project was to locate and survey photo-identifiable QA test points (FVA/CVAs) in multiple areas of interest as defined by FEMA-supplied shape and kml files. The QA coordinates are to be used to test the vertical aspect of all newly-flown LiDAR data during post-processing and subsequent deliverables creation. CompassData visited the project area, found suitable FVA and CVA locations, and determined accurate coordinates for each point according to the customer's specifications.

Equipment

CompassData used a Trimble R8 to perform the Control survey. This device is accurate to within 1 cm on a position-by-position basis per Trimble specifications. Operating within the VRS network provided accurate coordinate values at or around 5 cm H/V within 3-5 minutes observation times. CompassData has consistently demonstrated this level of accuracy on many GCP collection jobs across North and South America and Africa. Specifications for the Trimble R8 are available upon request.

Survey Methodology

CompassData has met the required precision for this project by using a high-quality GPS receiver with differential corrections provided by a VRS network surrounding the project area. The GPS antenna sat atop a bubble-leveled, fixed-height range pole that was placed over the center of the desired QA point. At least 180 positions (captured at a rate of one per second) were geometrically averaged to calculate a single coordinate for each FVA/CVA point. All required field documentation was filled out and the points were identified on web-based imagery and diagrammed on the CompassData-supplied sketch sheets (FVA points only). Digital pictures of each GCP location were collected in the field.

Quality Control Procedures

CompassData collects QA points with an unobstructed view of the sky to ensure proper GPS operation. CompassData works to avoid potential sources of multipath error such as trees, buildings, and fences that may adversely affect the GPS accuracy.

Additional quality control comes from the fact that at least 180 GPS positions are collected for each point. While operating within a VRS, valid solutions are reached within seconds; however, we continue to collect additional data to ensure meeting collection specifications. To ensure project integrity, an FVA or CVA will be reobserved or moved to a more suitable location if it does not meet project specifications.

In addition to the aforementioned procedures, CompassData "surveys" existing geodetic control monuments to see if our coordinates match the published coordinates to the required accuracy. These monuments are usually established by the National Geodetic Survey (NGS) in the United States. If it is found that our coordinates are outside the acceptable accuracy, the reason for the difference will be found or the GCPs will be reobserved under different GPS constellation constraints. There are certain geodetic considerations that must be taken into account that affect whether a GPS-derived coordinate will line up with a survey monument, especially when these monuments reference local coordinate systems or the systems of another country. Sometimes the published coordinates for a monument are not accurate, although this is very infrequent.

CompassData visited multiple survey monuments during the course of this project. The results of those monument measurements are summarized in the Accuracy Report.

Deliverables

Deliverables for this project include:

- Coordinates (in spreadsheet format)
- Image Chips
- Sketch Sheets (FVA points only)
- Digital Pictures
- QA/QC Data

Project Notes

All collected points were retrieved from the Trimble Survey Controller in Decimal Degrees, NAD83, HAE Meters.

CorpsCon was used to generate files in the following format:

Degrees Minutes Decimal Seconds, NAD83 HAE (QC purposes)
UTM Meters, NAD83 HAE

Geoid09 was then used to generate the geoid separation at every Lat/Long location. NAVD88(09) orthometric heights were then generated in spreadsheet form using the formula HAE - Geoid = Orthometric Height. Those values were then included into the final delivery coordinate CSV files and have been tested against NGS monuments collected during the course of this survey and are showing millimeter-level agreement.

The Horizontal and Vertical accuracies reported in the Final Coordinates file were obtained from the Survey Report generated by Trimble Survey Controller. The report contains all points collected during each daily survey deployment, including CVAs, FVAs and NGS Monuments.

Contact Information

Hayden Howard Phone: (303) 627-4058 E-mail: haydenh@compassdatainc.com

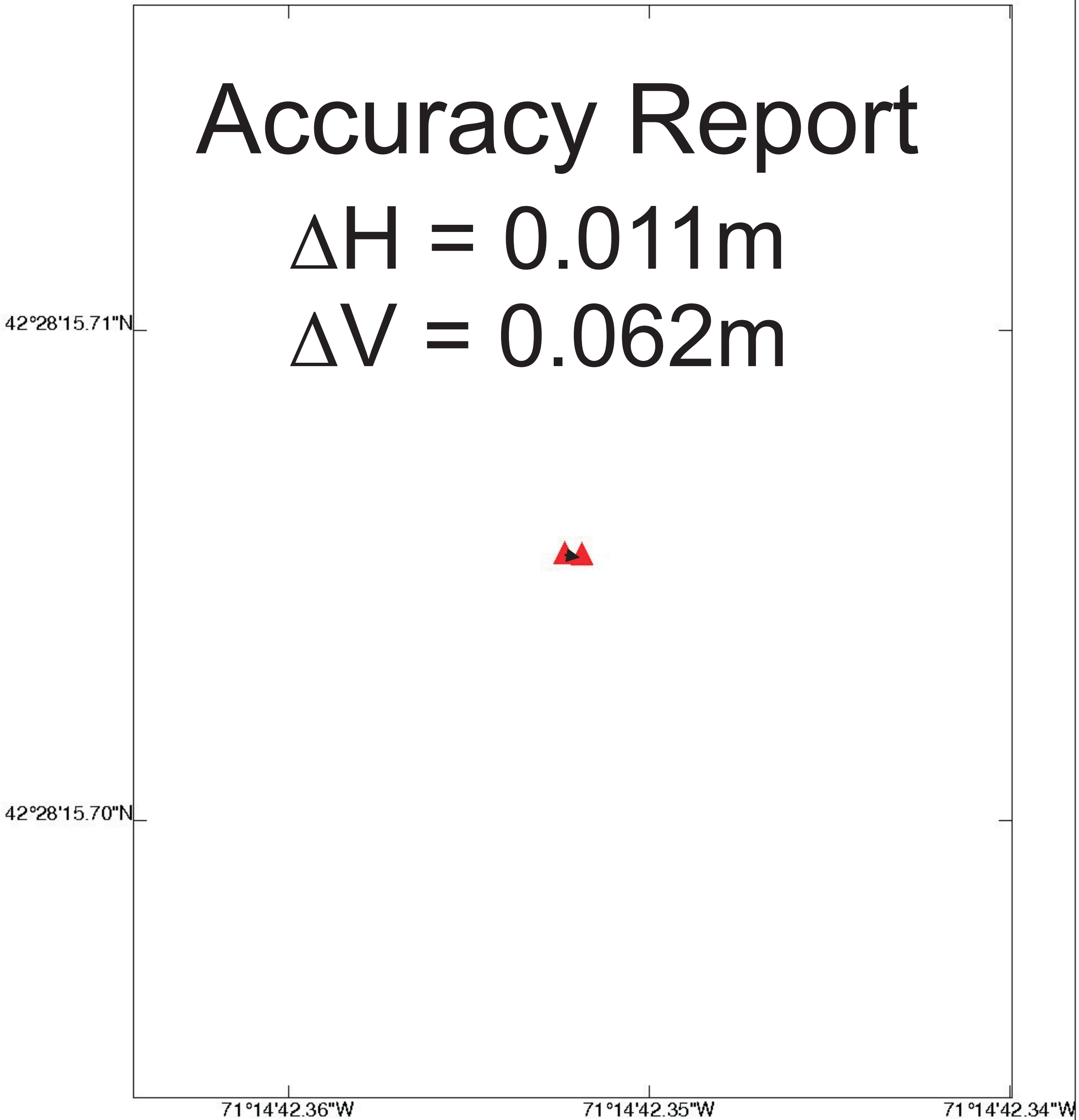
December 29, 2010

CompassData

Accuracy Report

$\Delta H = 0.011m$

$\Delta V = 0.062m$



NGS_MY6363 10_15_2010

Lat/Long
WGS 1984

N

Scale 1:4.00

0 0.150

Meters

10/28/2010

GPS Pathfinder Office

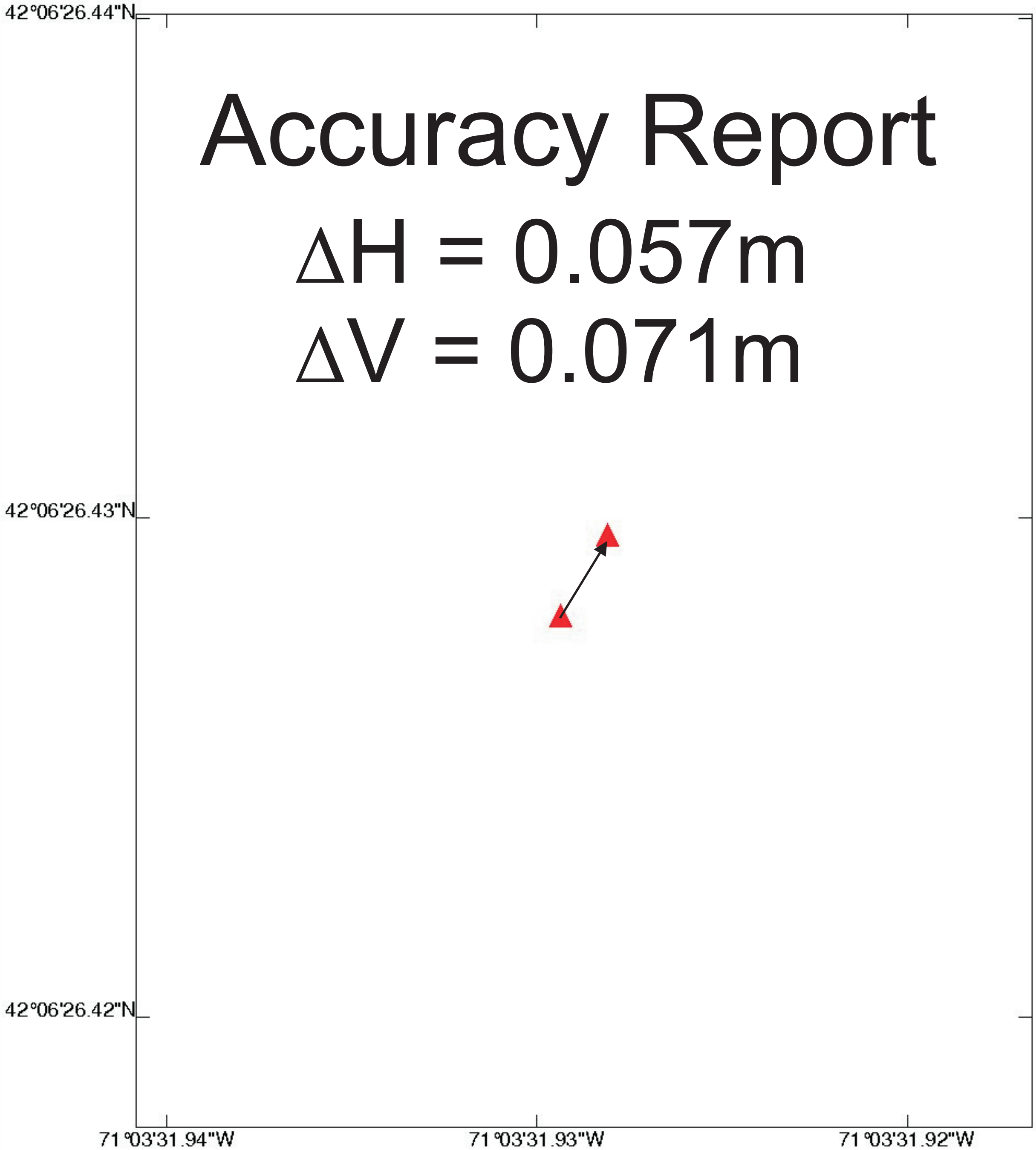
Trimble

CompassData

Accuracy Report

$\Delta H = 0.057m$

$\Delta V = 0.071m$



NGS_AJ4042 10_17_2010

Lat/Long
WGS 1984

N

Scale 1:4.00

0 0.150

Meters

10/28/2010

GPS Pathfinder® Office

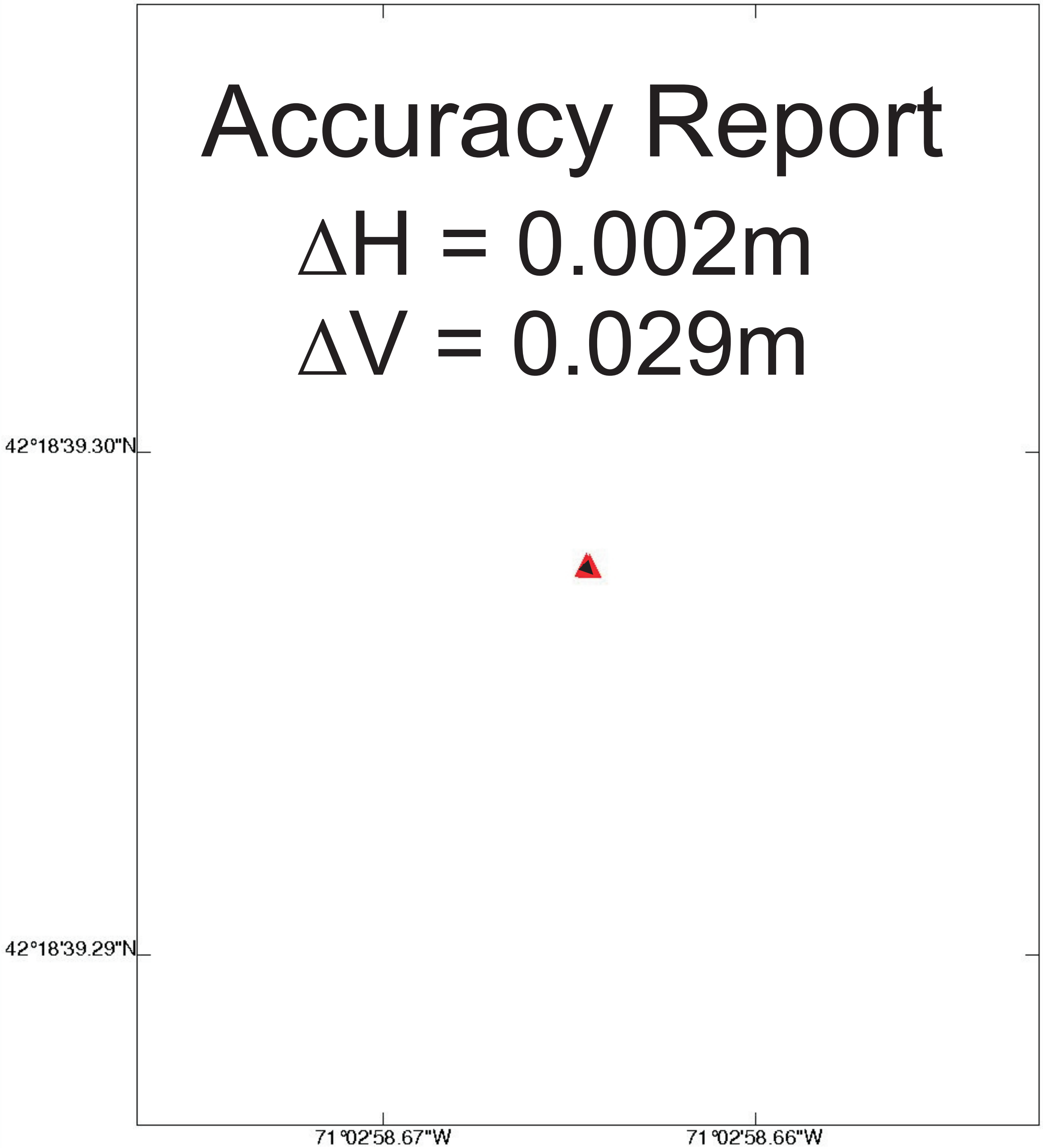
Trimble.

CompassData

Accuracy Report

$\Delta H = 0.002m$

$\Delta V = 0.029m$



NGS_MY2936 10_16_2010

Lat/Long
WGS 1984

N

Scale 1:4.00

0 0.150

Meters

10/28/2010

GPS Pathfinder® Office

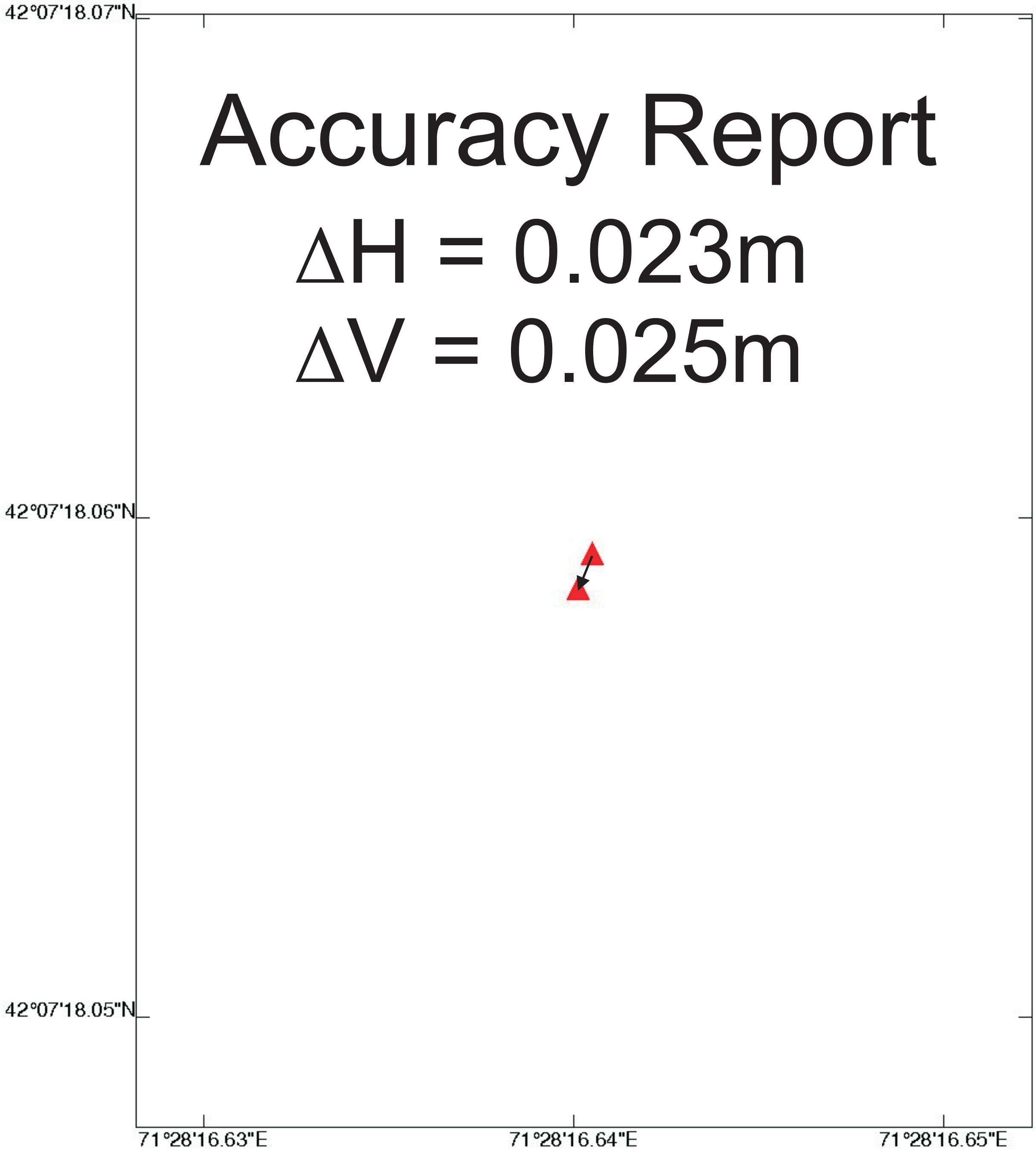
Trimble

CompassData

Accuracy Report

$\Delta H = 0.023m$

$\Delta V = 0.025m$



NGS_AJ4046 10_15_2010

Lat/Long
WGS 1984

N

Scale 1:4.00

0 0.150

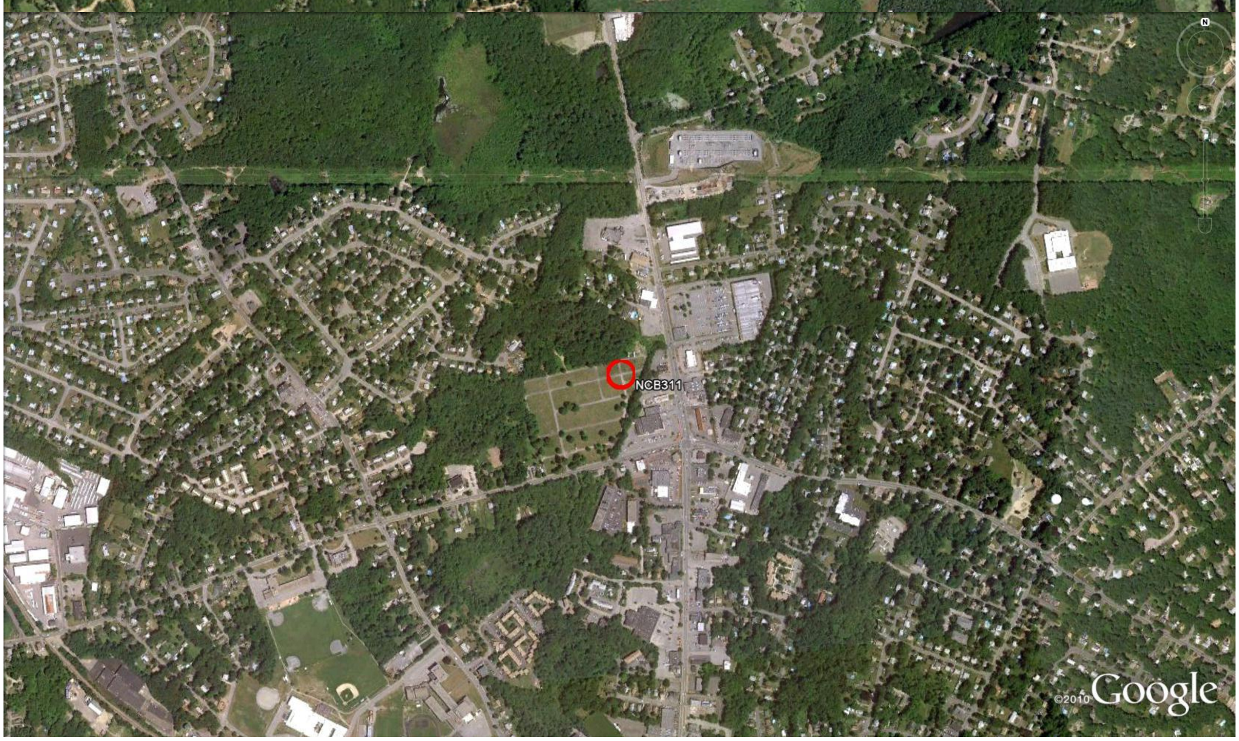
Meters

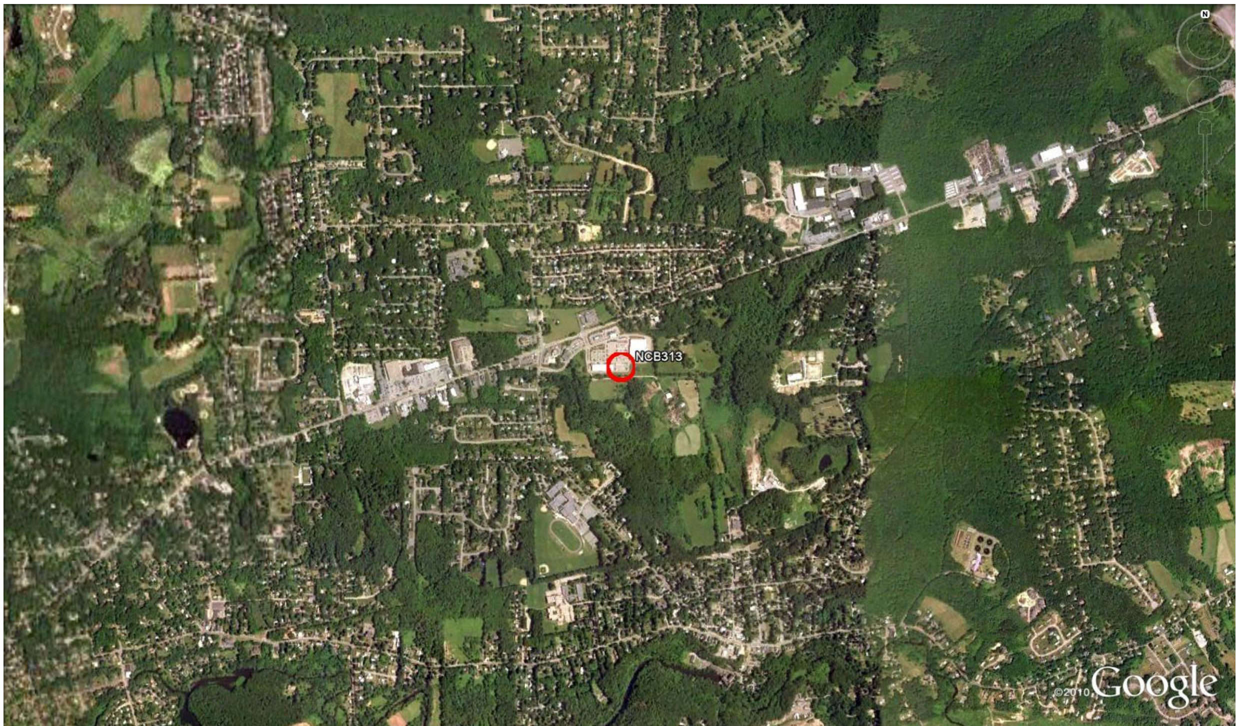
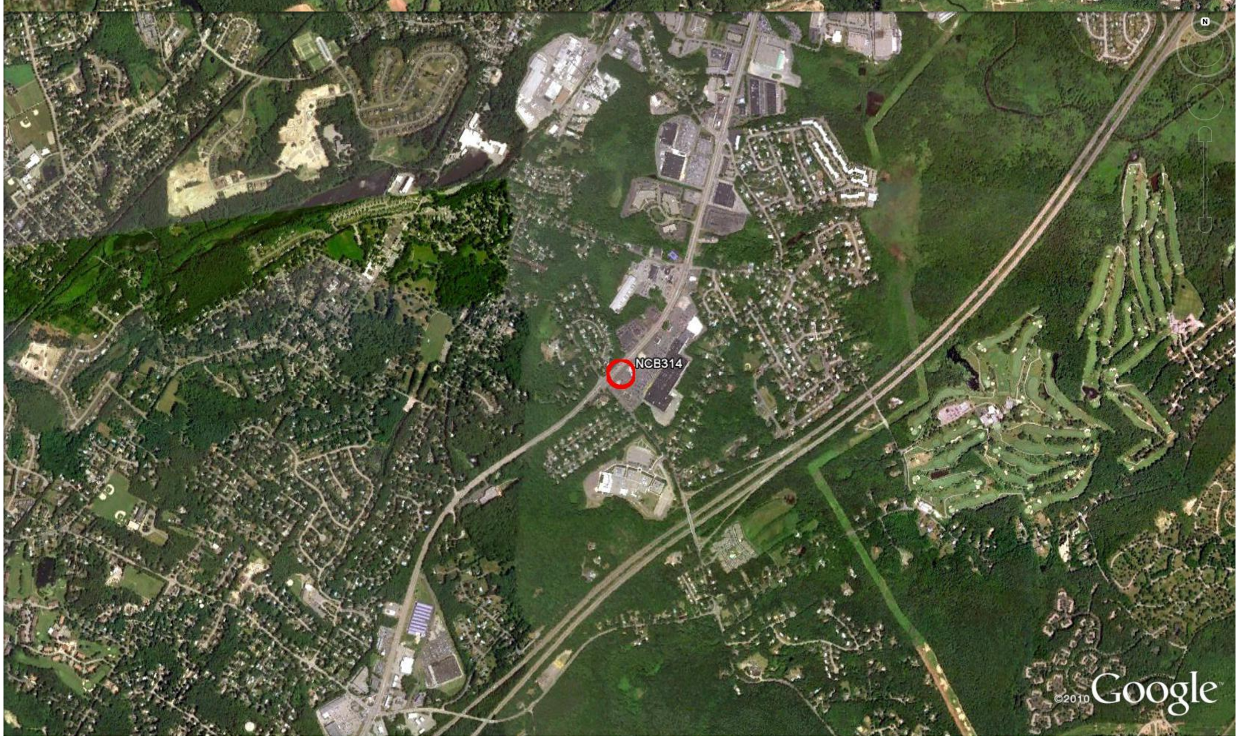
10/28/2010

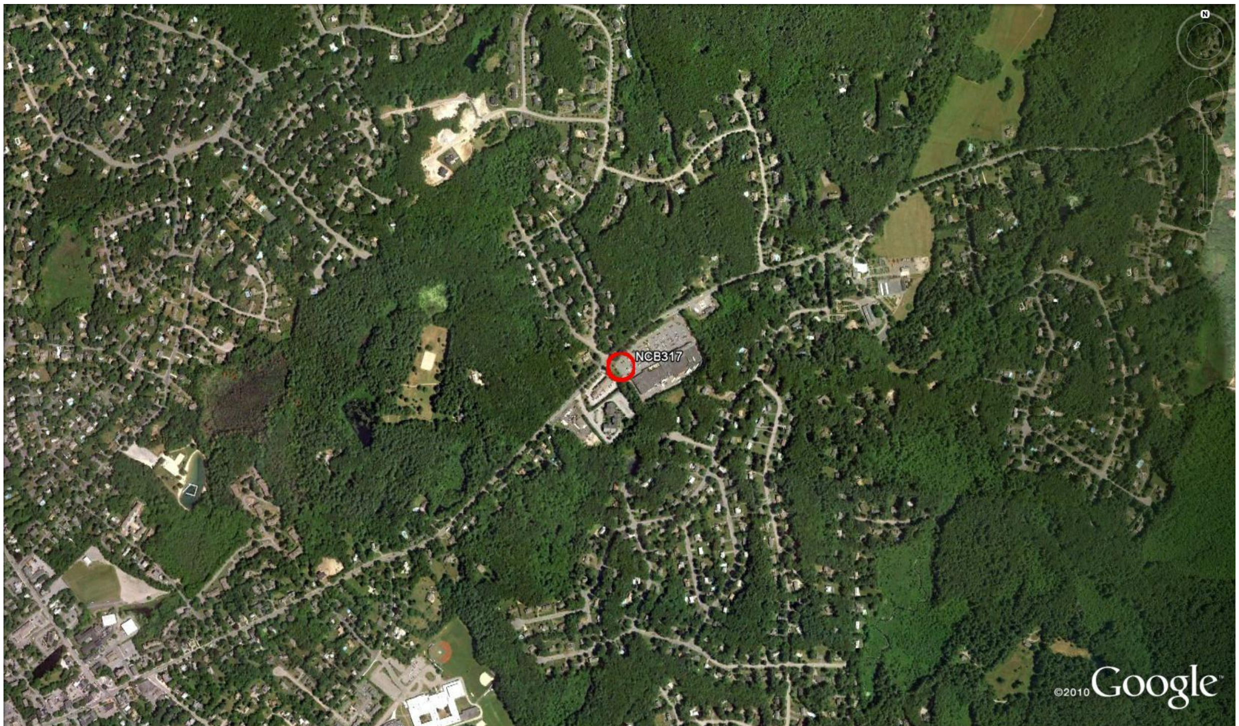
GPS Pathfinder® Office

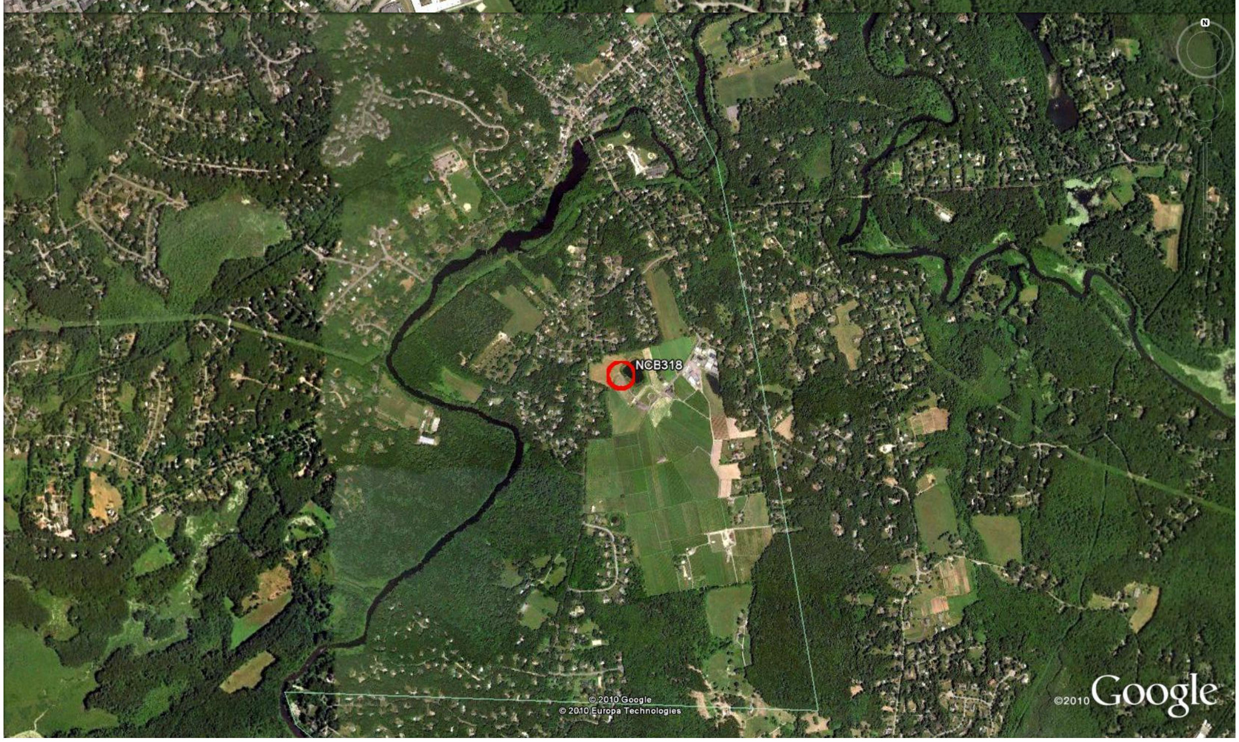
Trimble

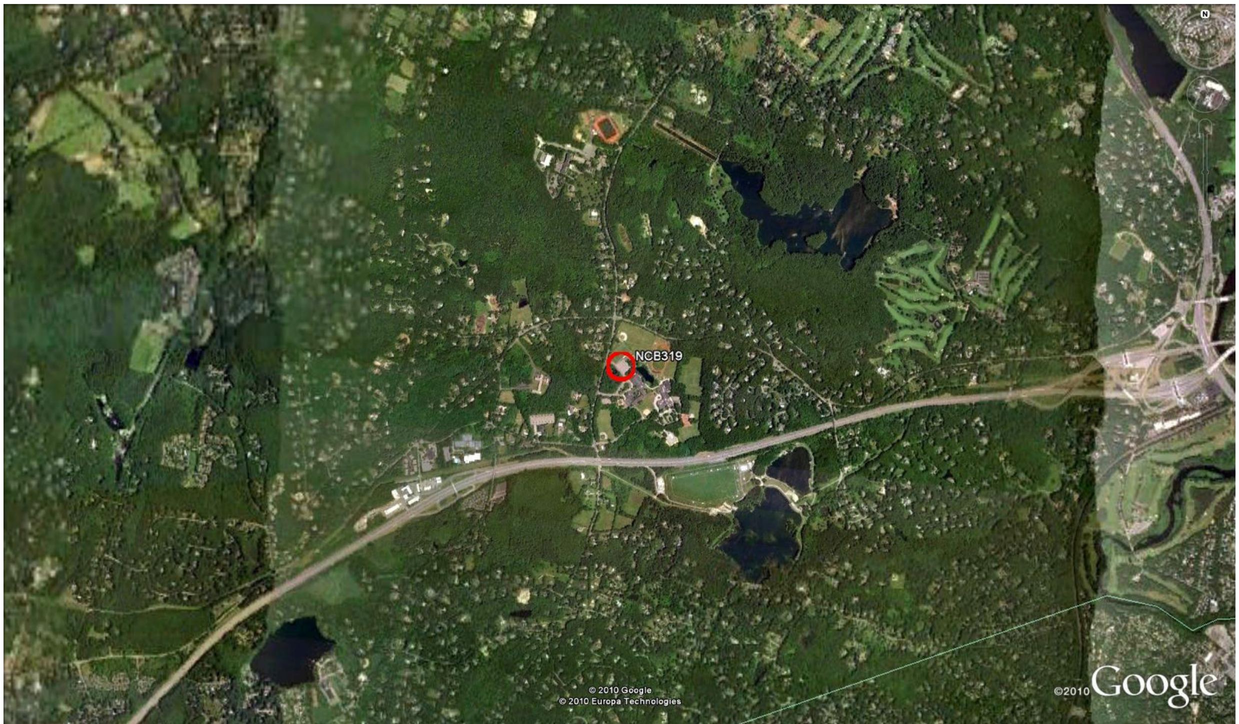
Image Chips



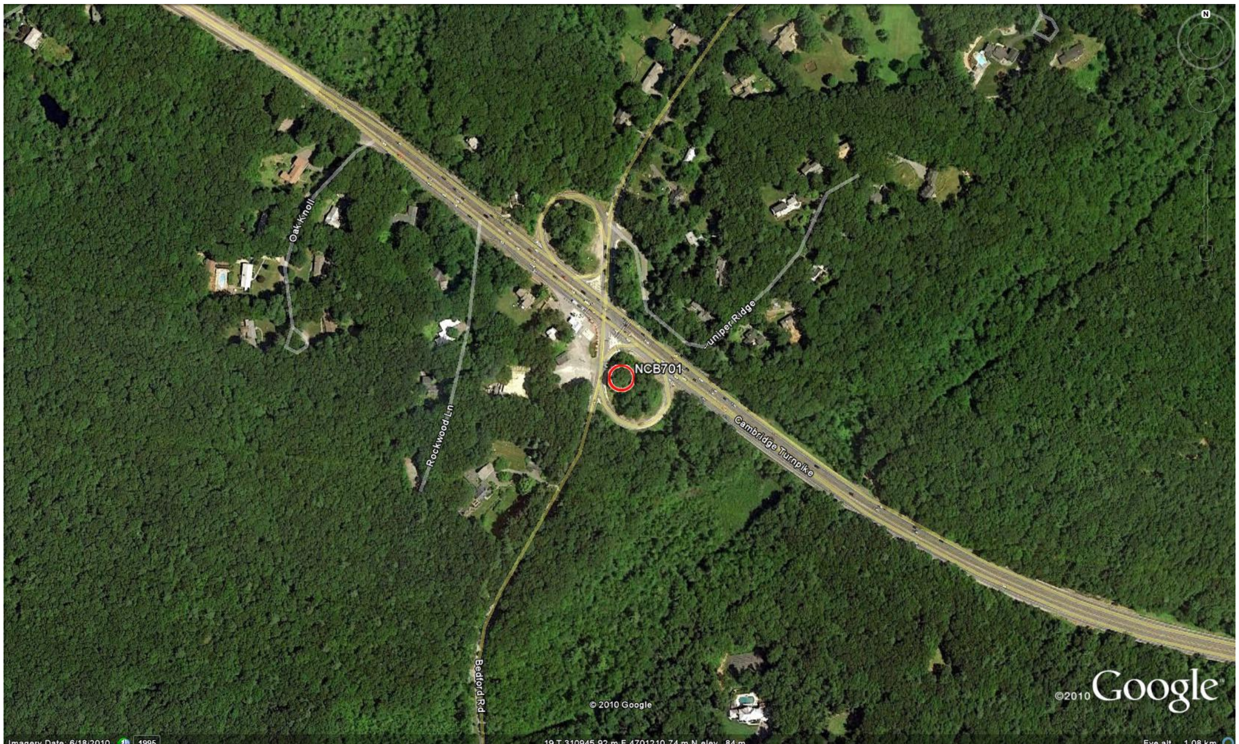

NCB313
©2010
Google

NCB314
©2010
Google


NCB317
©2010 Google

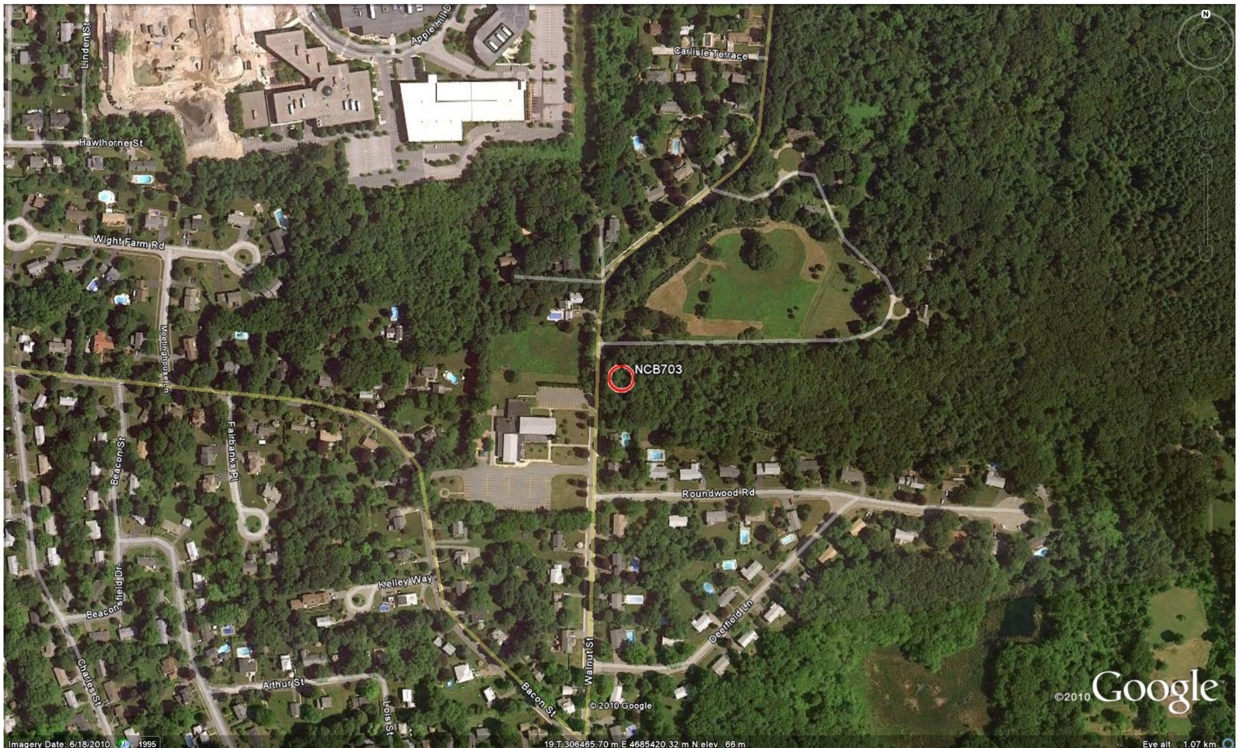

NCB318
©2010 Google
© 2010 Google
© 2010 Europa Technologies


NCB319
© 2010 Google
© 2010 Europa Technologies
©2010 Google


NCB320
©2010 Google


NCB701
Oak Knoll
Rockwood Ln
Cambridge Turnpike
Bedford Rd
© 2010 Google
©2010 Google
Imagery Date: 6/18/2010
1995
19 T 310945.92 m E 4701210.74 m N elev 84 m
Eye alt 1.08 km

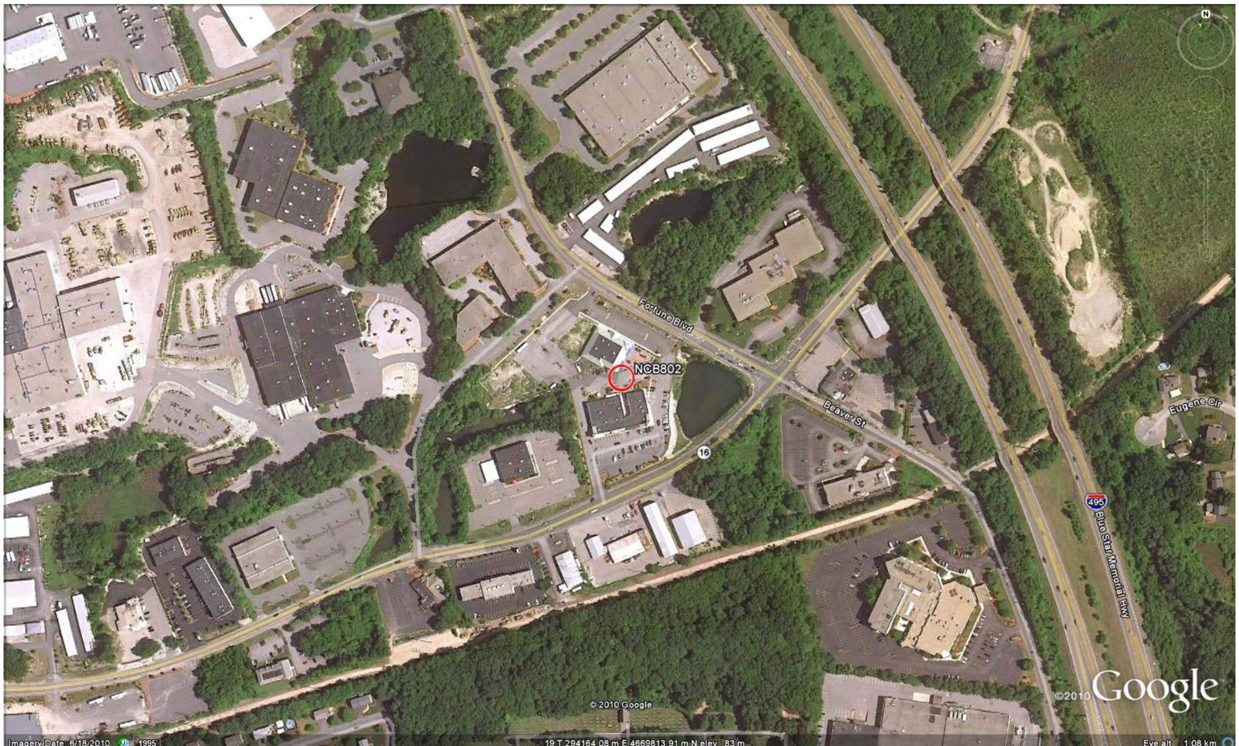

NCB702
Weston Rd
Round Hill Rd
Lincoln St
Stoney Brook Rd
Old N Ave
117
North Ave
Bayberry Ln
Merriam St
© 2010 Google
©2010 Google
Imagery Date: 6/18/2010
1995
19 T 310730.83 m E 4696716.38 m N elev 41 m
Eye alt 1.04 km


Linden St
Carlisle Terrace
Hawthorne St
Wight Farm Rd
NCB703
Fairbanks Pl
Bacon St
Roundwood Rd
Kelley Way
Beaconsfield Dr
Deerfield Ln
Charles St
Arthur St
Lois St
Bacon St
Walnut St
© 2010 Google
©2010 Google
Imagery Date: 6/18/2010
1995
19 T 306465.70 m E 4685420.32 m N elev 66 m
Eye alt 1.07 km

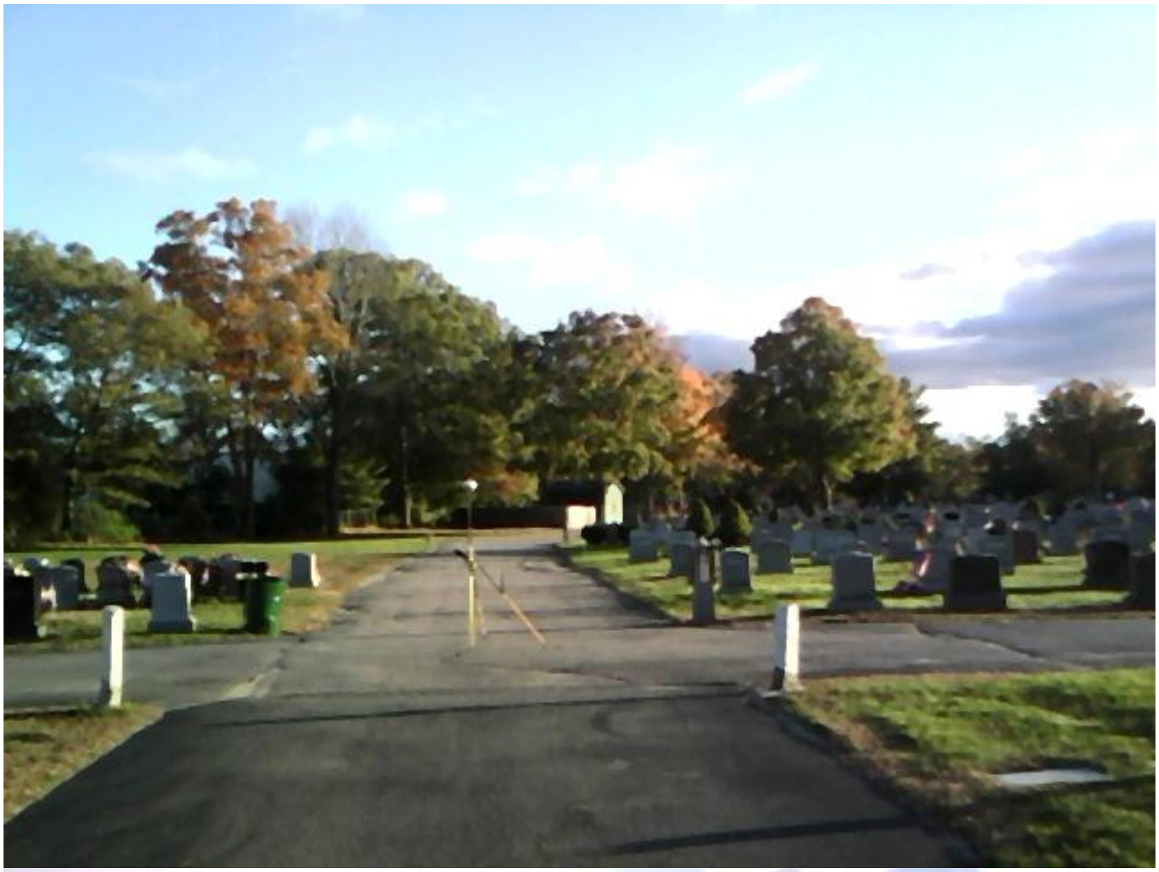
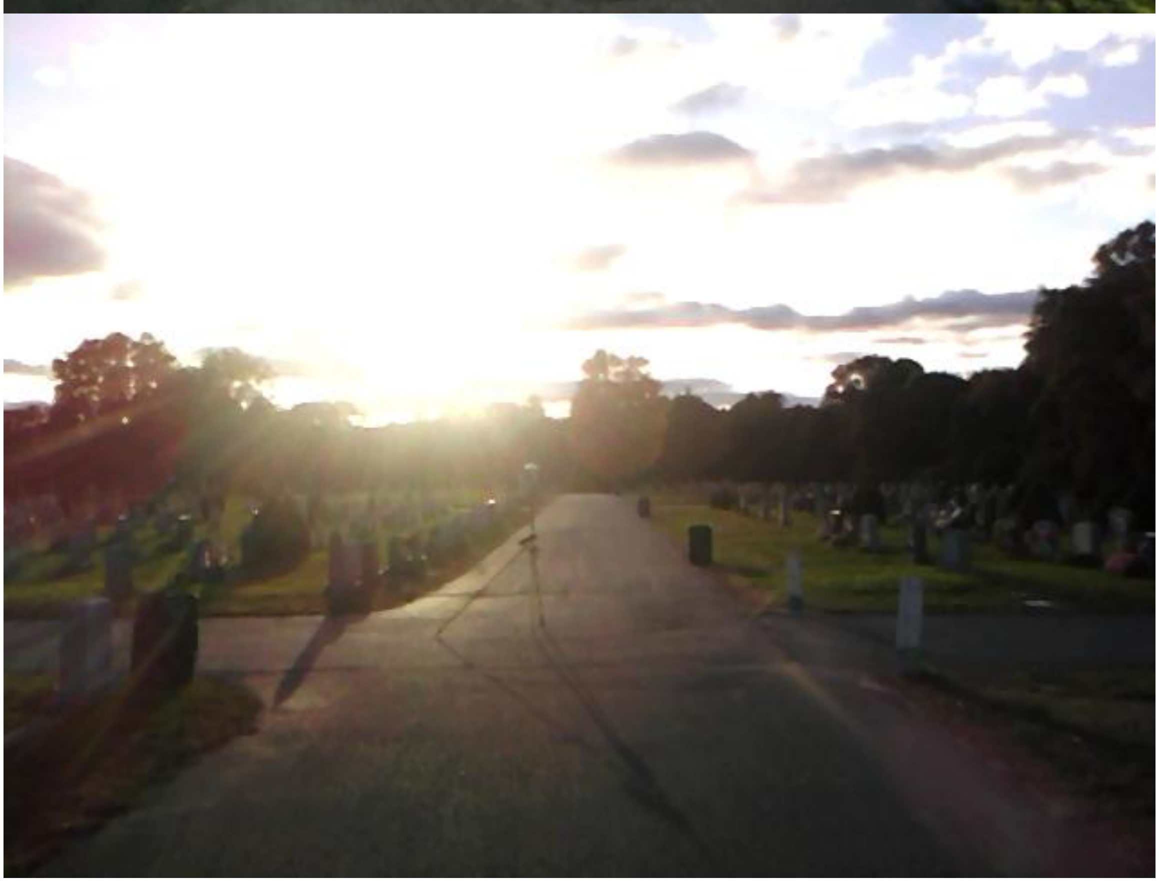

Jayar Rd
Industrial Park Rd
NCB705
109
Main St
Oakland St
© 2010 Google
©2010 Google
Imagery Date: 6/18/2010
1995
19 T 302862.87 m E 4670062.47 m N elev 42 m
Eye alt 1.04 km


NCB706
Whippoorwill Rd
Heather Way
Aspen Rd
Sherwood Cir
Forsythia Cir
Dogwood Rd
Michael Ln
Hampton Rd
© 2010 Google
©2010 Google
Imagery Date: 6/18/2010
1995
19 T 321927.39 m E 4663291.78 m N elev 92 m
Eye alt 1.09 km

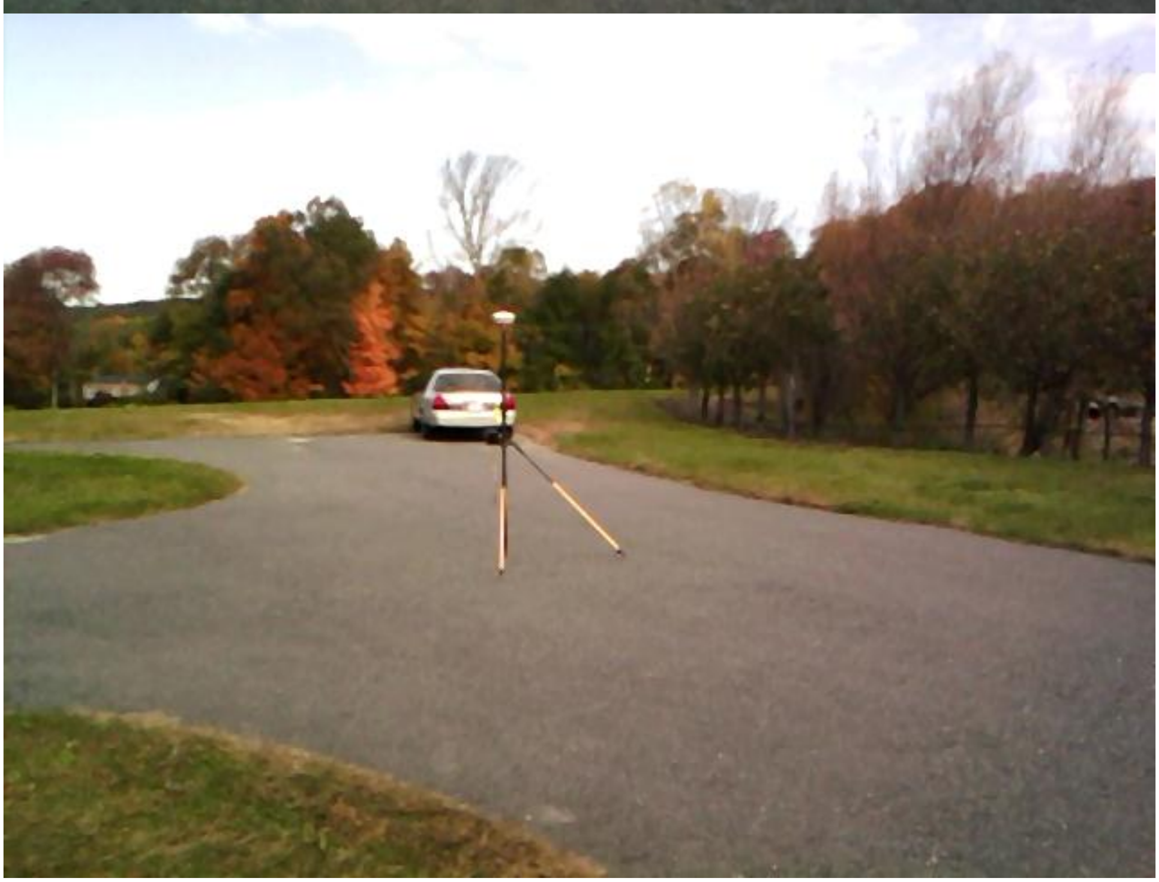

NCB801
Oxford St
Upland Rd
Edgemoor Ave
Beechwood Rd
Cedar Brook Rd
Frost Cir
Orchard Rd
Naples Rd
Browning Rd
Byron Rd
Worcester St
Grove Rd
Shore Rd
Cooper Rd
Gannett Rd
Bass Rd
Bass Terrace
Keane Rd
Rhode Island Ave
Oak St
Stuart Rd
© 2010 Google
©2010 Google
Imagery Date: 6/18/2010
1995
19 T 308267.45 m E 4686251.29 m N elev 39 m
Eye alt 1.04 km


NCB802
Fortune Blvd
Beaver St
16
495
Blue Star Memorial Hwy
Eugene Cir
© 2010 Google
©2010 Google
Imagery Date 6/18/2010
1995
19 T 294164.08 m E 4669813.91 m N elev 83 m
Eye alt 1.08 km


NCB803
Island St
Island Ct
Tosca Dr
Central St
27
Canton St
Buckley Rd
Evans Dr
Brook St
© 2010 Google
©2010 Google
Imagery Date 6/18/2010
1995
19 T 324338.78 m E 4666682.63 m N elev 55 m
Eye alt 1.06 km









Details


THE DANCE ACADEMY


THE DANCE ACA

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Charles	**GCP Number:** NCB310
CDI Project Number: 1508	**Date:** 10/17/2010

N

GPS Antenna Height: 2m

Comments:

Point taken in parking lot south of Main St.
Norfolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Nate Yannacone	**Checked By:**

LiDAR

CompassData

GCP Station Diagram for LiDAR

Project Name: Charles	**GCP Number:** NCB311
CDI Project Number: 1508	**Date:** 10/16/2010

GPS Antenna Height: 2m

Comments:

Point taken at road intersection in the NE part of Holy Sepulchre Cemetary.
Norfolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

LiDAR

CompassData

GCP Station Diagram for LiDAR

Project Name: Charles	**GCP Number:** NCB313
CDI Project Number: 1508	**Date:** 10/17/2010

GPS Antenna Height: 2m

Comments:

Point taken in parking lot South of Main street, East of Builing and SW of another building.
Norfolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Nate Yannacone	**Checked By:**

LiDAR LiDAR

CompassData

GCP Station Diagram for LiDAR

Project Name: Charles	**GCP Number:** NCB314
CDI Project Number: 1508	**Date:** 10/16/2010

GPS Antenna Height: 2m

Comments:

Point taken in the SW corner of The Mall at Walpole parking lot off of Providence Highway.
Norfolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

Project Name: Charles	GCP Number: NCB317
CDI Project Number: 1508	Date: 10/17/2010

GPS Antenna Height: 2m

Comments:

Point taken in the SE part of the parking lot, East of the shopping center building and S of Main St.
Norfolk County, MA

Disk (Roll) / Frame Number:	Sketch 1 of 1
Collected By: Nate Yannacone	Checked By:

CompassData

GCP Station Diagram for LiDAR

Project Name: Charles	**GCP Number:** NCB318
CDI Project Number: 1508	**Date:** 10/17/2010

GPS Antenna Height: 2m

Comments:

Point taken at an intersection of roads.
Norfolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Nate Yannacone	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Charles	**GCP Number:** NCB319
CDI Project Number: 1508	**Date:** 10/17/2010

GPS Antenna Height: 2m

Comments:

Point takenin parking lot S of South Ave and the soccer field and E of Wellesley St.
Norfolk County, MA

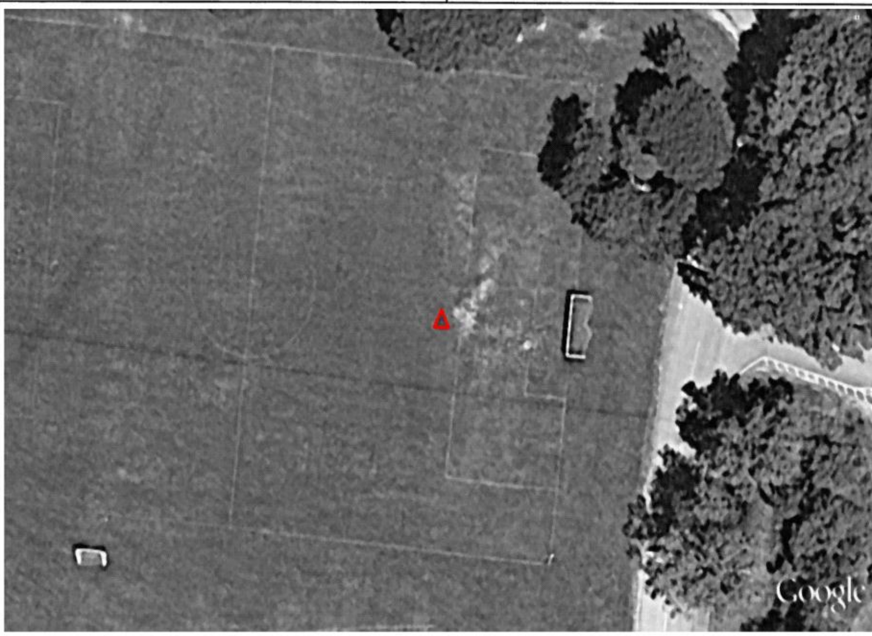
Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Nate Yannacone	**Checked By:**

LiDAR

CompassData

GCP Station Diagram for LiDAR

Project Name: Charles	**GCP Number:** NCB320
CDI Project Number: 1508	**Date:** 10/16/2010



GPS Antenna Height: 2m

Comments:

Point taken in Sports field South and West of Ballfield Rd.
Middlesex County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Nate Yannacone	**Checked By:**

LiDAR

LiDAR

CHARLES, MASSACHUSETTS

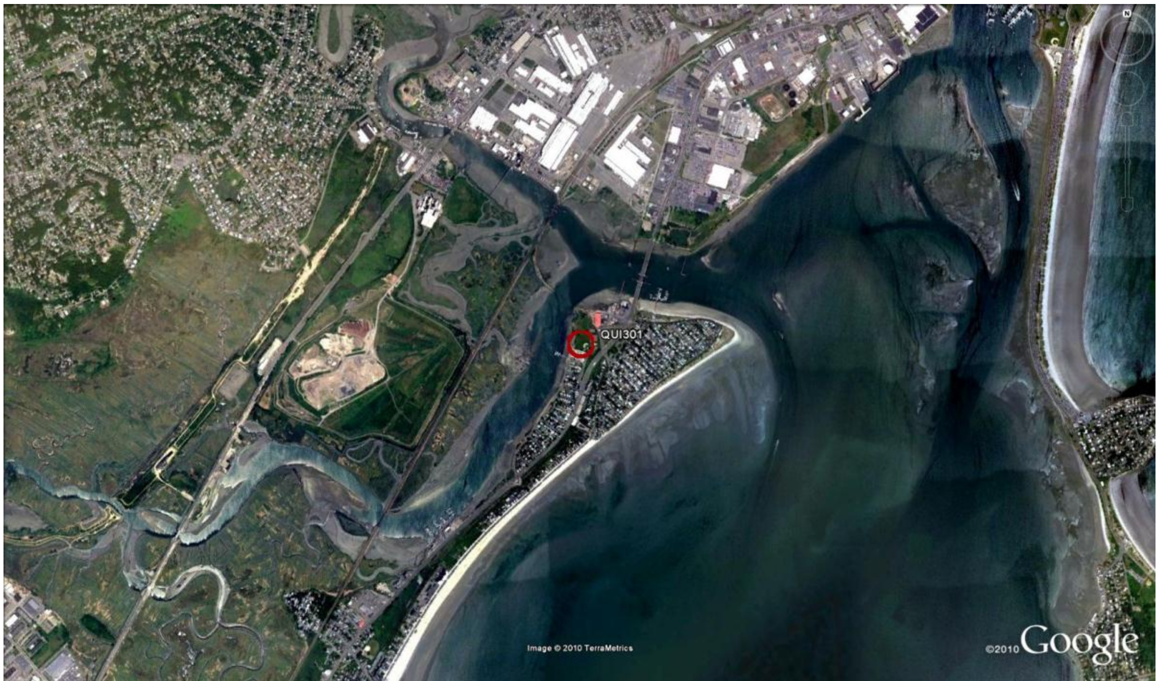
CVAs/FVAs	Date	Vert_Prec	Horz_Prec	Latitude	Longitude	Easting	Northing	HAE	GEOID09	NAVD88
NCB310	10/17/2010	0.0082	0.0055	42.11785	-71.3307873	307320.864	4665489.855	46.9018039	-28.715	75.6168
NCB311	10/15/2010	0.0085	0.0055	42.13692	-71.103503	326162.869	4667120.1	42.8546613	-28.342	71.1967
NCB313	10/17/2010	0.0058	0.004	42.15138	-71.4041706	301359.001	4669381.293	33.745695	-28.746	62.4917
NCB314	10/16/2010	0.007	0.0055	42.15446	-71.2047054	317849.221	4669278.445	12.5233428	-28.441	40.9643
NCB317	10/17/2010	0.0177	0.0122	42.19412	-71.2896349	310950.283	4673867.749	41.2002036	-28.447	69.6472
NCB318	10/17/2010	0.0085	0.0058	42.26185	-71.3135827	309177.06	4681441.377	27.8791976	-28.29	56.1692
NCB319	10/17/2010	0.0094	0.0061	42.34035	-71.3052306	310102.157	4690139.969	34.928931	-28.05	62.9789
NCB320	10/16/2010	0.011	0.0076	42.4242	-71.3136755	309660.02	4699469.255	38.9775976	-27.884	66.8616
NCB701	12/3/2010			42.44018	-71.2986303	310945.898	4701210.743	83.864	-27.832	111.696
NCB701_BK	12/3/2010	0.0043	0.003	42.44033	-71.29893739	310921.102	4701228.49	54.358	-27.832	82.19
NCB701_TP	12/3/2010	0.0064	0.004	42.44009	-71.29899028	310916.03	4701201.947	54.348	-27.833	82.181
NCB702	12/3/2010			42.39968	-71.2997642	310730.807	4696716.338	41.222	-27.905	69.127
NCB702_BK	12/3/2010	0.003	0.0021	42.39939	-71.30038351	310678.966	4696685.498	14.242	-27.907	42.149
NCB702_TP	12/3/2010	0.0043	0.0027	42.39948	-71.29996951	310713.3	4696694.175	14.127	-27.906	42.033
NCB703	12/3/2010			42.29699	-71.3477593	306465.675	4685420.328	66.446	-28.234	94.68
NCB703_BK	12/3/2010	0.003	0.0015	42.2963	-71.34812364	306433.54	4685345.026	38.255	-28.236	66.491
NCB703_TP	12/3/2010	0.003	0.0015	42.29689	-71.34809596	306437.633	4685410.586	38.894	-28.235	67.129
NCB705	12/3/2010			42.15789	-71.3862152	302862.852	4670062.45	42.068	-28.701	70.769
NCB705_BK	12/3/2010	0.0015	0.0009	42.15806	-71.38567157	302908.319	4670080.88	14.145	-28.7	42.845
NCB705_TP	12/3/2010	0.0021	0.0012	42.15794	-71.38604299	302877.259	4670068.368	13.946	-28.701	42.647
NCB706	12/3/2010			42.10152	-71.1535517	321927.411	4663291.743	93.695	-28.498	122.193
NCB706_BK	12/3/2010	0.0027	0.0018	42.1015	-71.15402269	321888.423	4663291.004	64.583	-28.498	93.081
NCB706_TP	12/3/2010	0.0024	0.0015	42.10154	-71.15375952	321910.292	4663294.709	64.820	-28.498	93.318
NCB801	12/3/2010	0.0027	0.0018	42.30491	-71.32619498	308267.45	4686251.323	10.729	-28.179	38.908
NCB802	12/3/2010	0.0015	0.0006	42.15341	-71.49132552	294164.121	4669813.905	54.356	-28.848	83.204
NCB803	12/3/2010	0.0021	0.0015	42.13258	-71.12542878	324338.795	4666682.629	28.097	-28.386	56.483

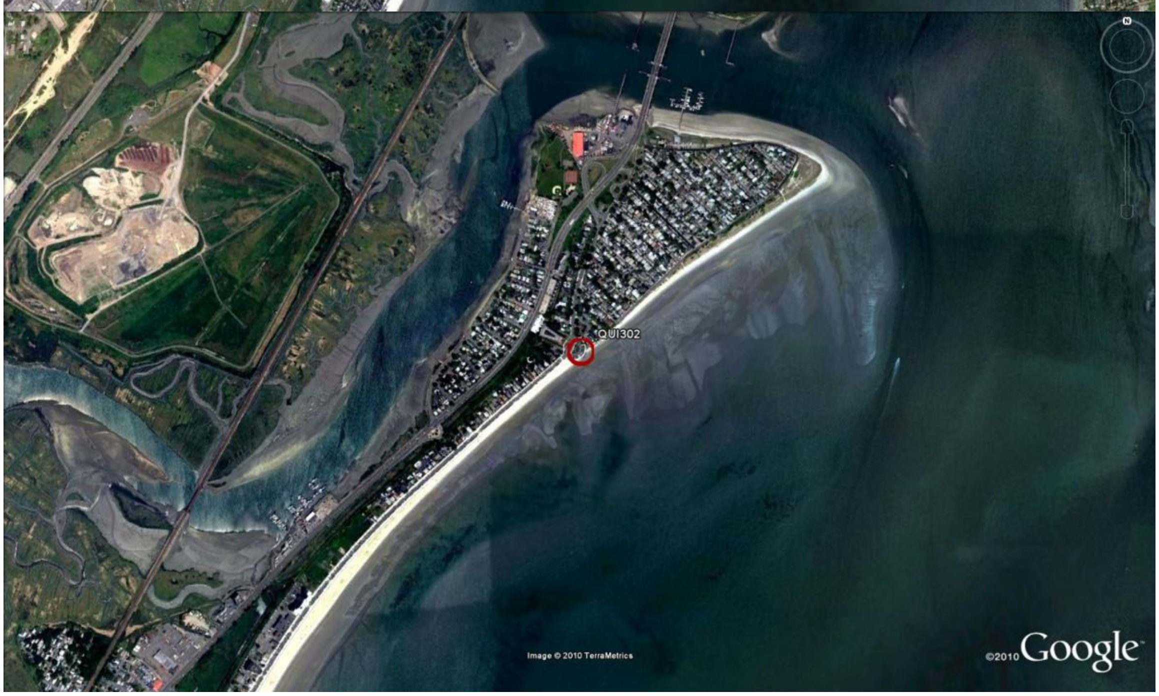
Survey Control										
NGS_AJ4042	10/17/2010	0.057	0.071	42.10734	-71.0588689	329772.470	4663745.593	46.4823982	-28.349	74.8314
NGS_MY2936	10/16/2010	0.007	0.0058	42.31092	-71.049629	331079.973	4686332.119	7.33776995	-27.861	35.1988
NGS_AJ4046	10/15/2010	0.058	0.0043	42.12168	-71.471289	295717.625	4666242.523	40.57902	-28.923	69.502
NGS_MY6363	10/16/2010	0.0122	0.0073	42.47103	-71.2450977	315439.609	4704518.423	17.6193042	-27.7	45.3193

Metadata

UTM 19 North, NAD83, NAVD88
All units in meters where applicable.
HAE - GEOID09 = NAVD88

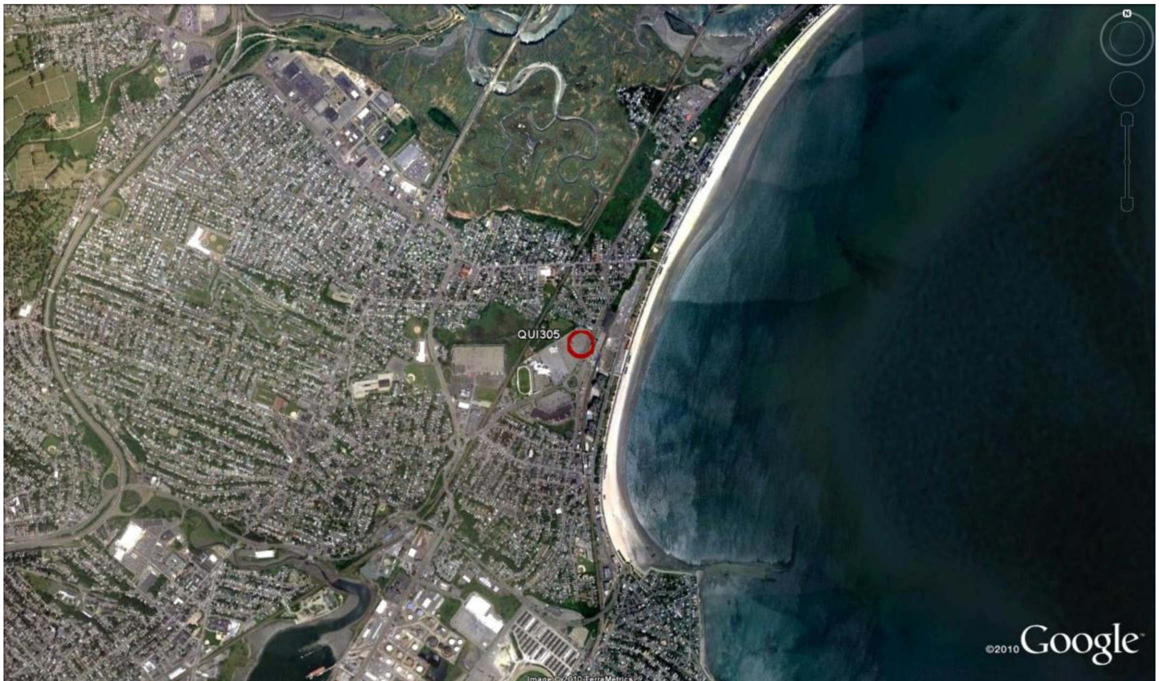
Charles Suffolk/Quincy Extension LiDAR Collection


QUI301
Image © 2010 TerraMetrics
©2010 Google

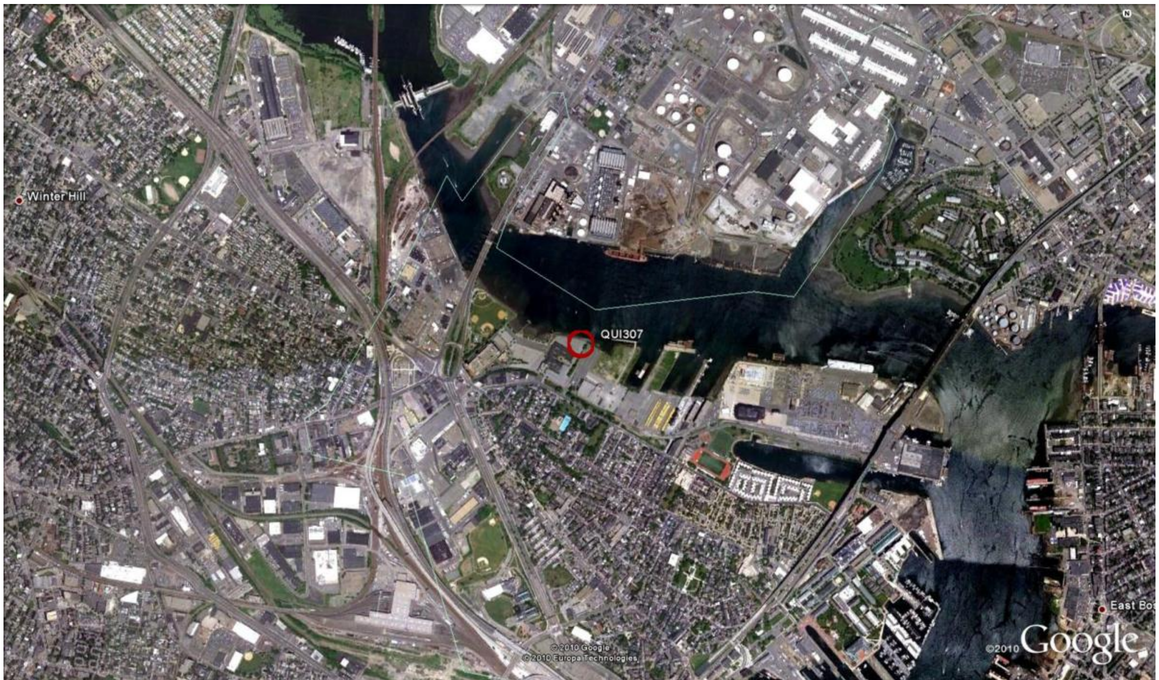

QUI302
Image © 2010 TerraMetrics
©2010 Google

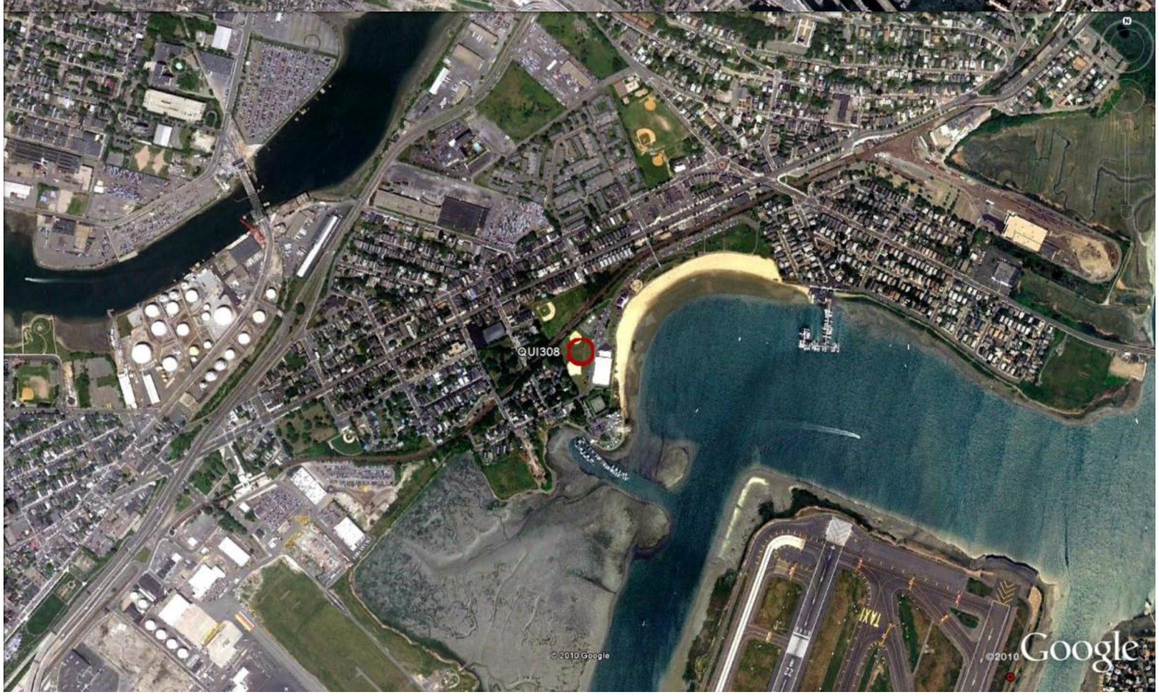

QUI303
©2010 Google

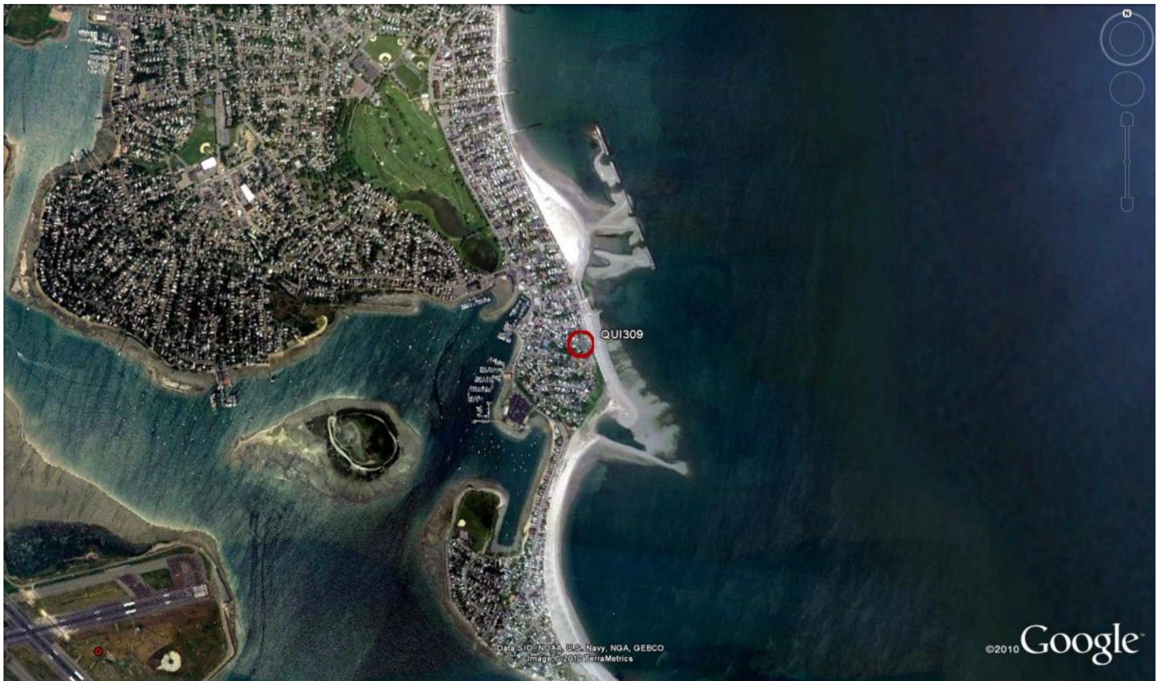

QUI304
©2010 Google

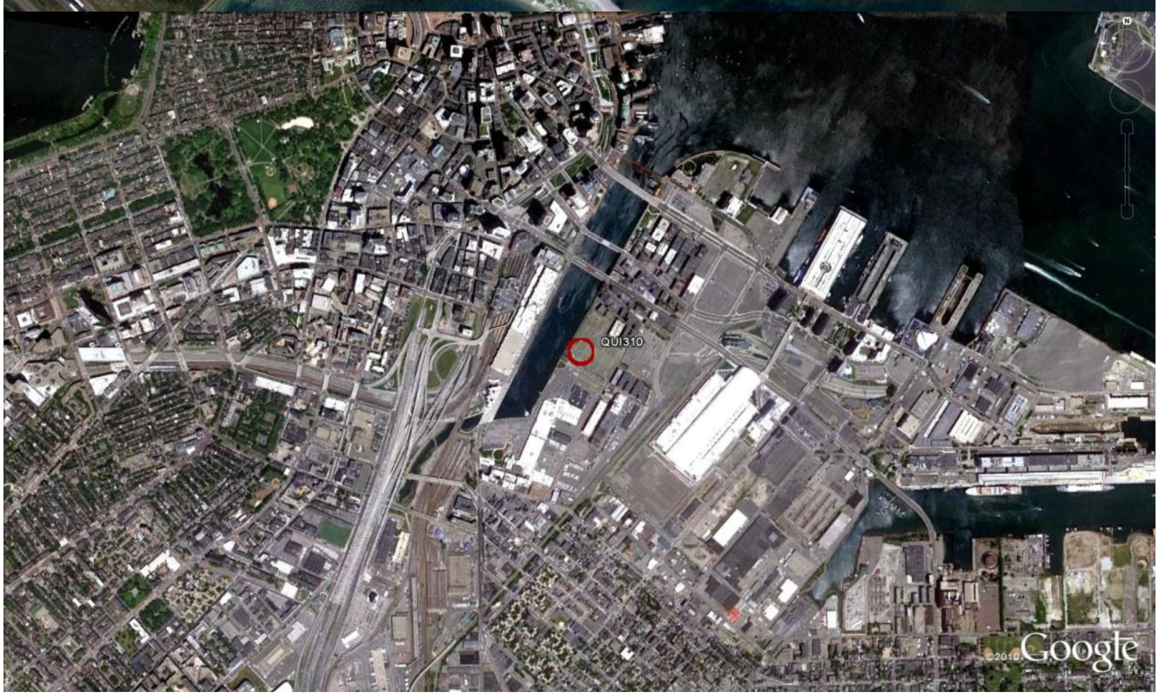

QUI305
©2010 Google
Image © 2010 TerraMetrics

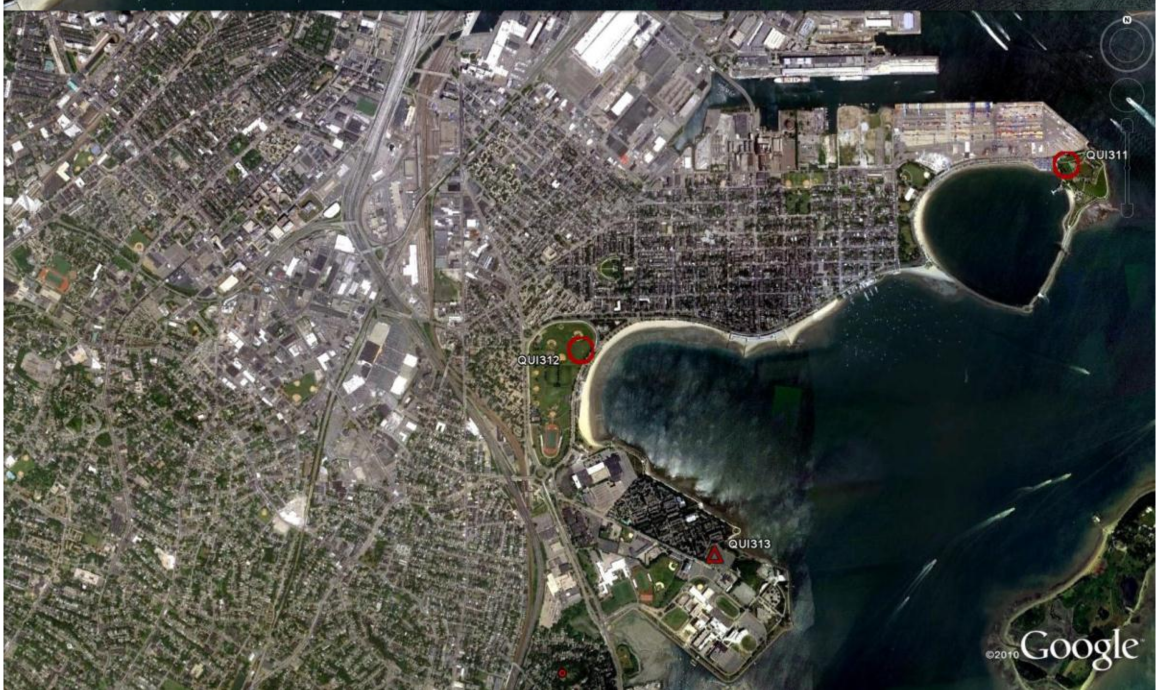

QUI306
QUI308
Image © 2010 TerraMetrics
Google

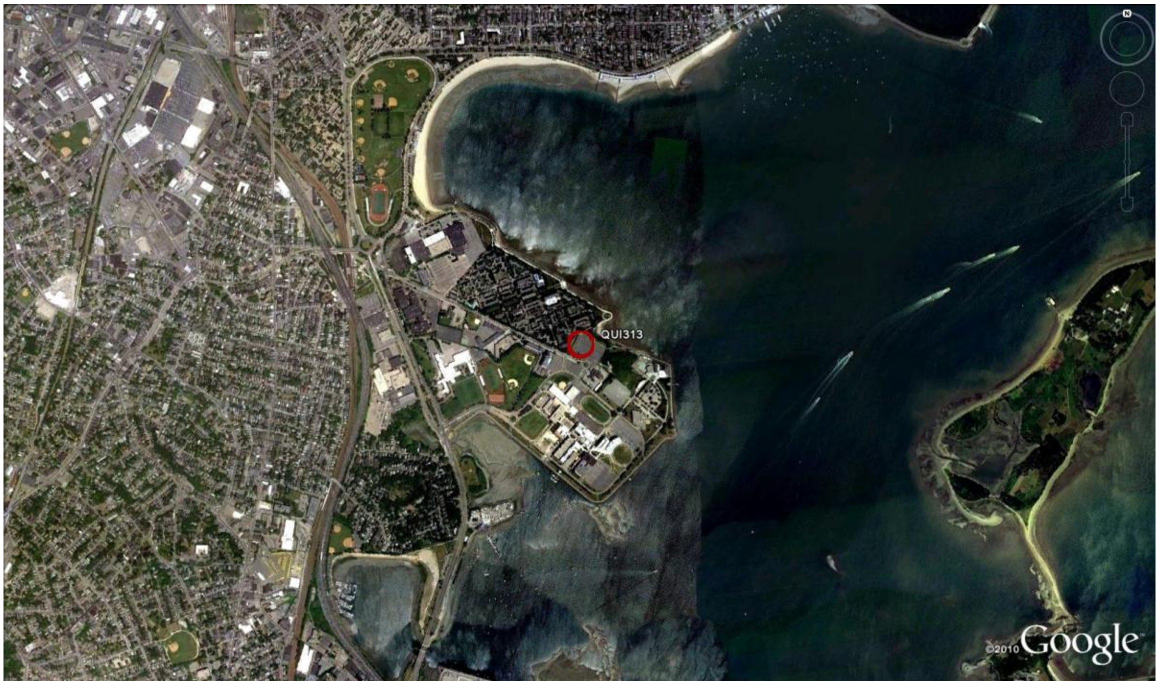
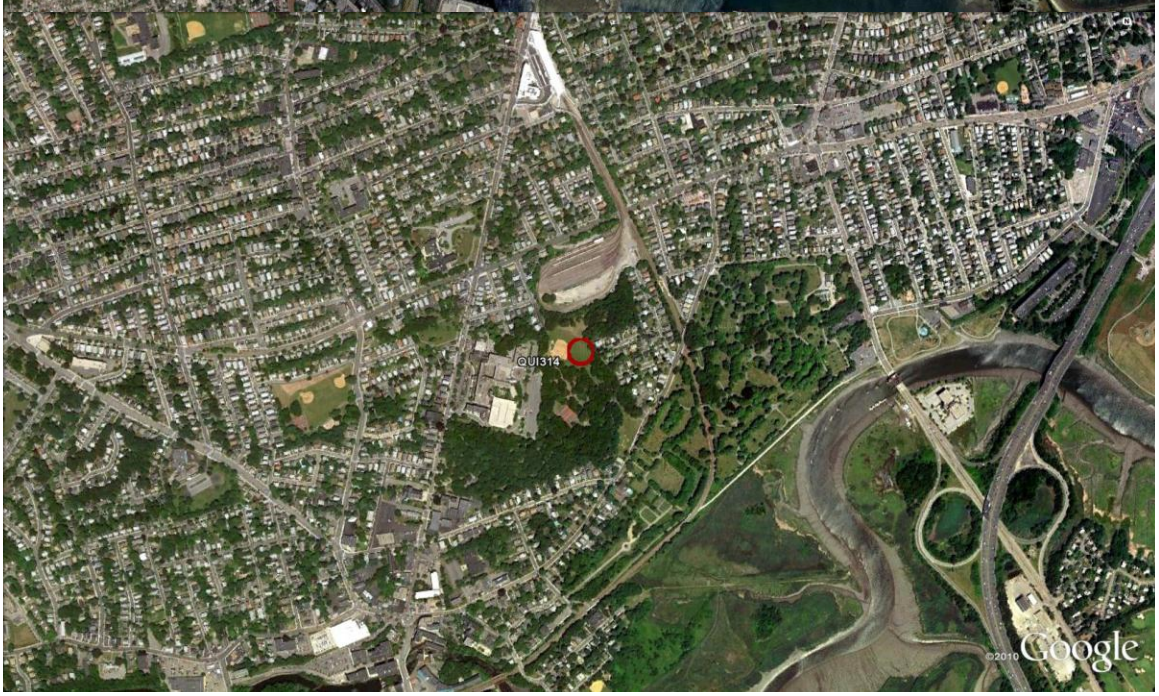

Winter Hill
QUI307
© 2010 Google
© 2010 Europa Technologies
©2010 Google

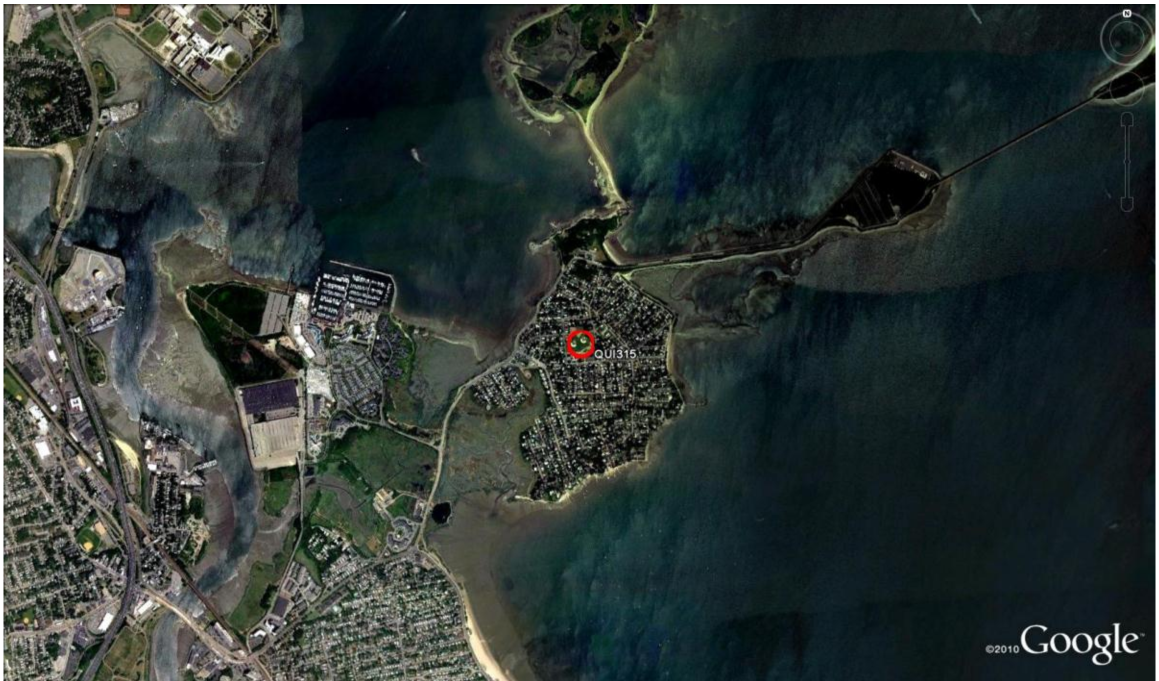
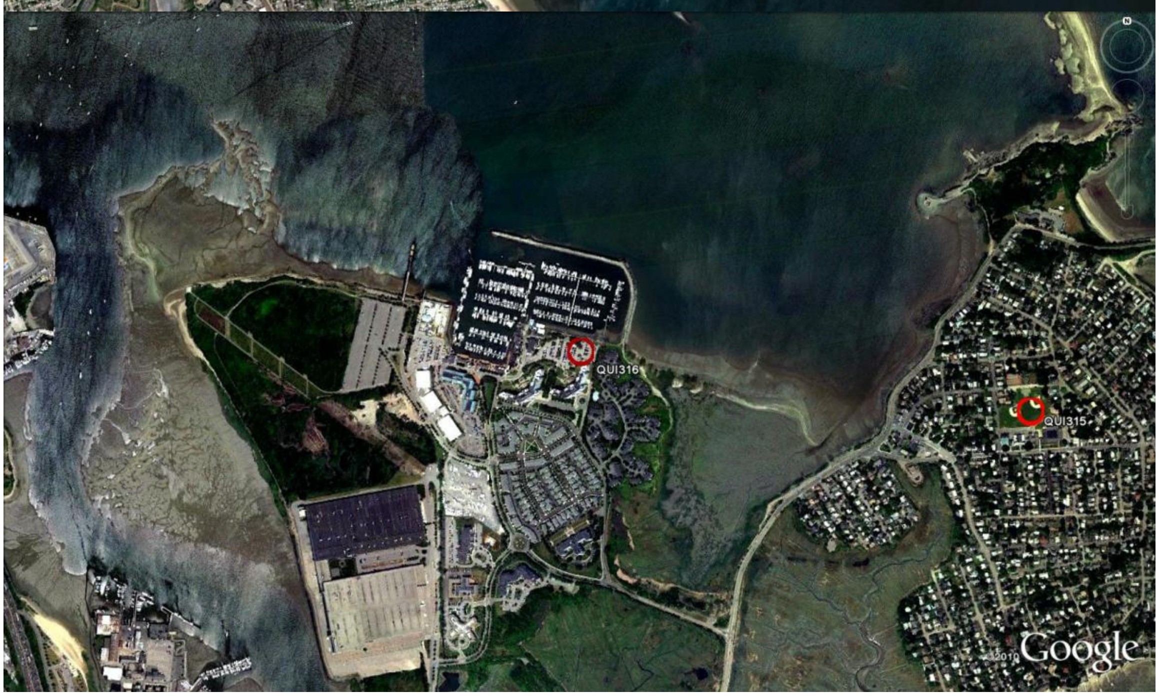

QUI308
© 2010 Google
©2010 Google

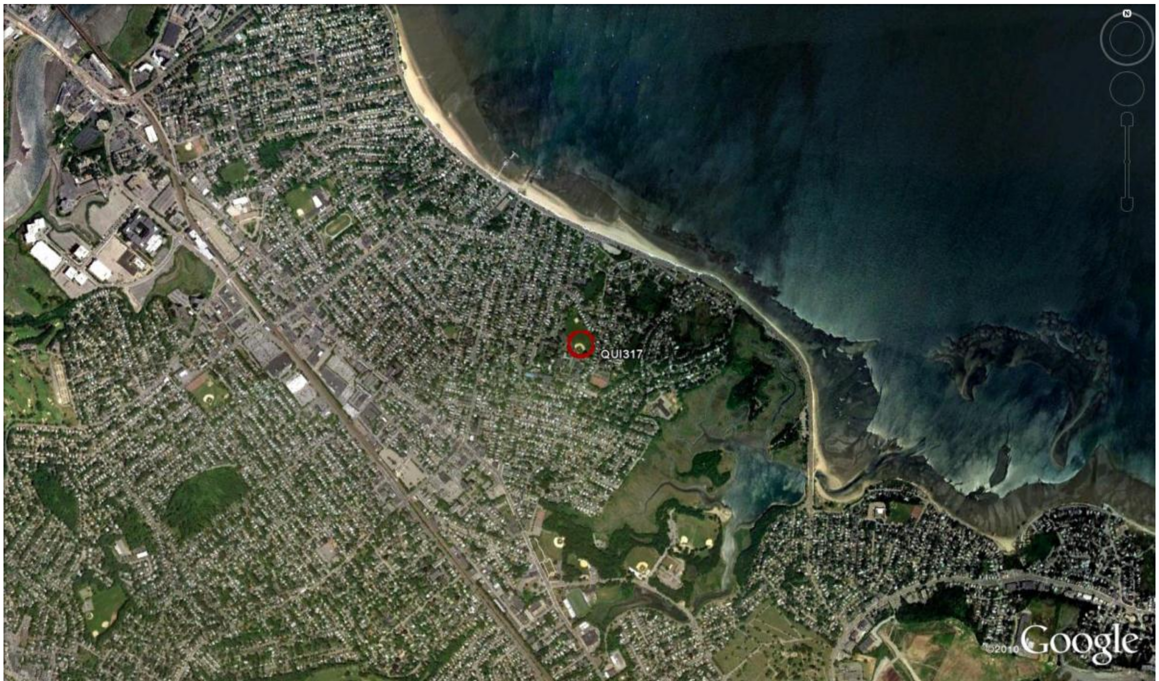

QUI309
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2010 TerraMetrics
©2010 Google

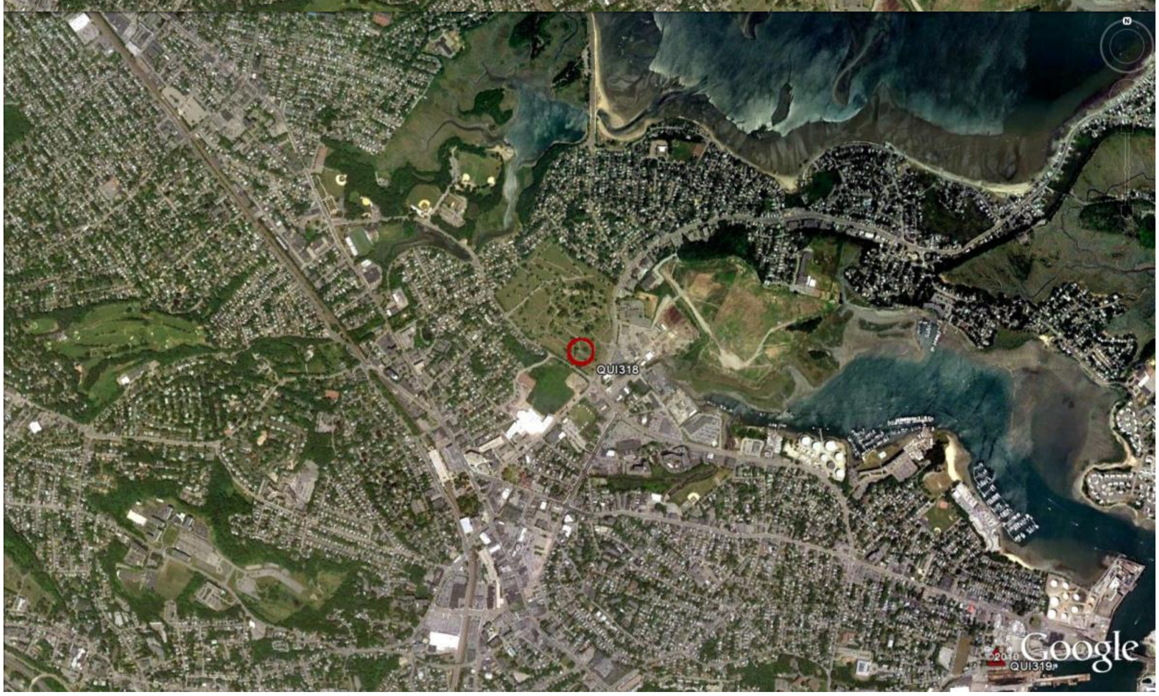

QUI310
©2010 Google


QUI311
©2010 Google

QUI311
QUI312
QUI313
©2010 Google

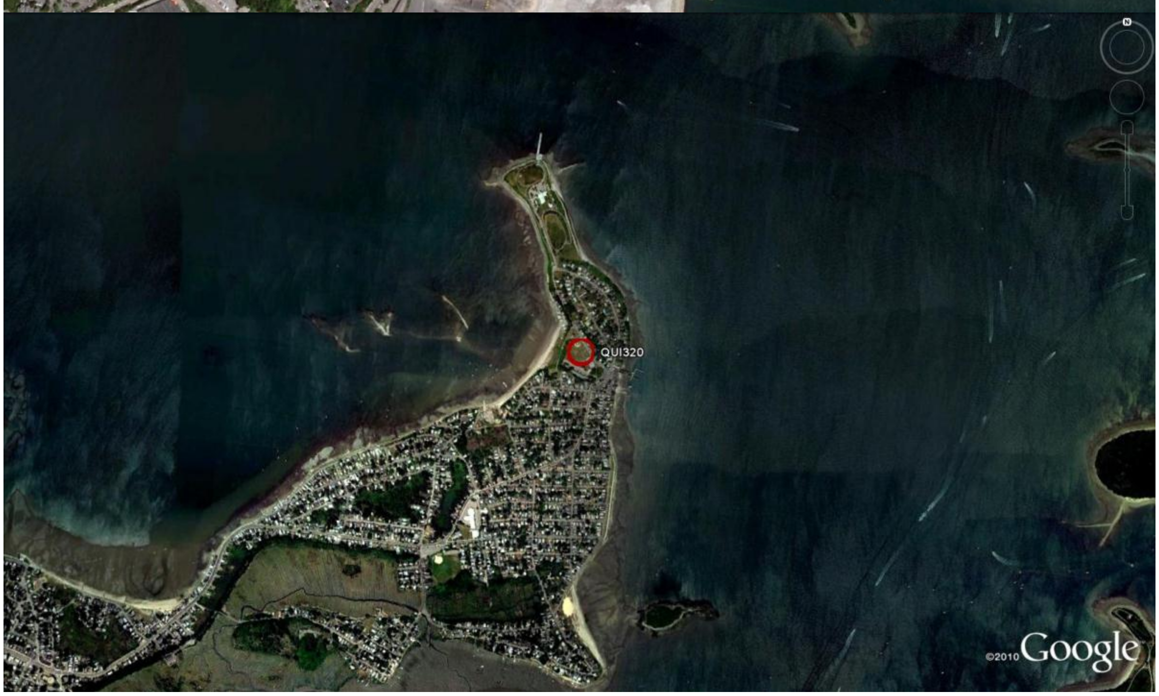

QUI313
©2010 Google

QUI314
©2010 Google

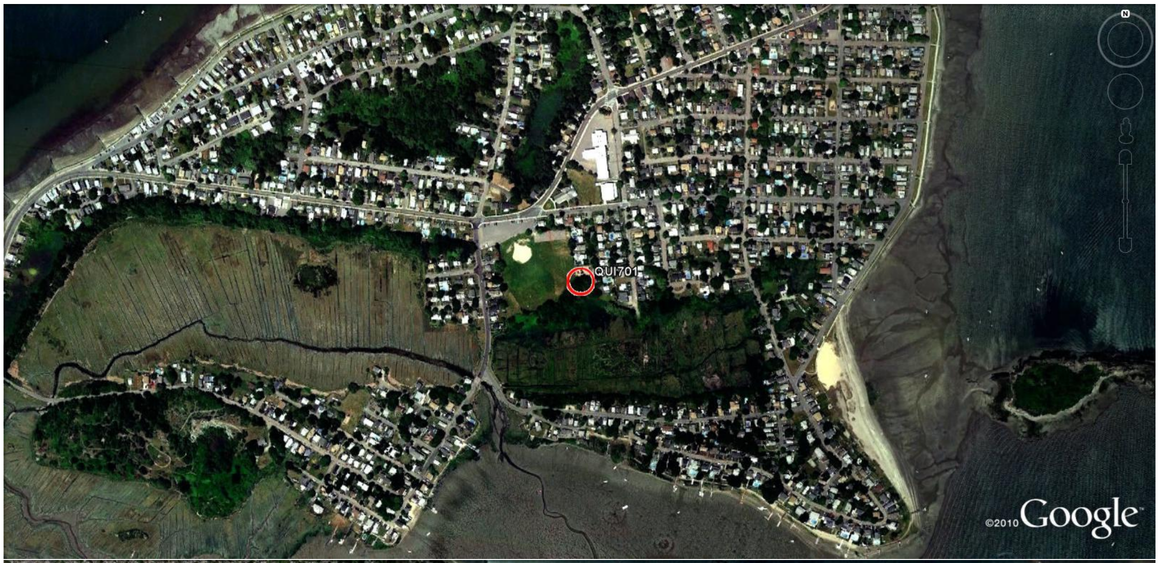

QUI315
©2010 Google

QUI316
QUI315
©2010 Google

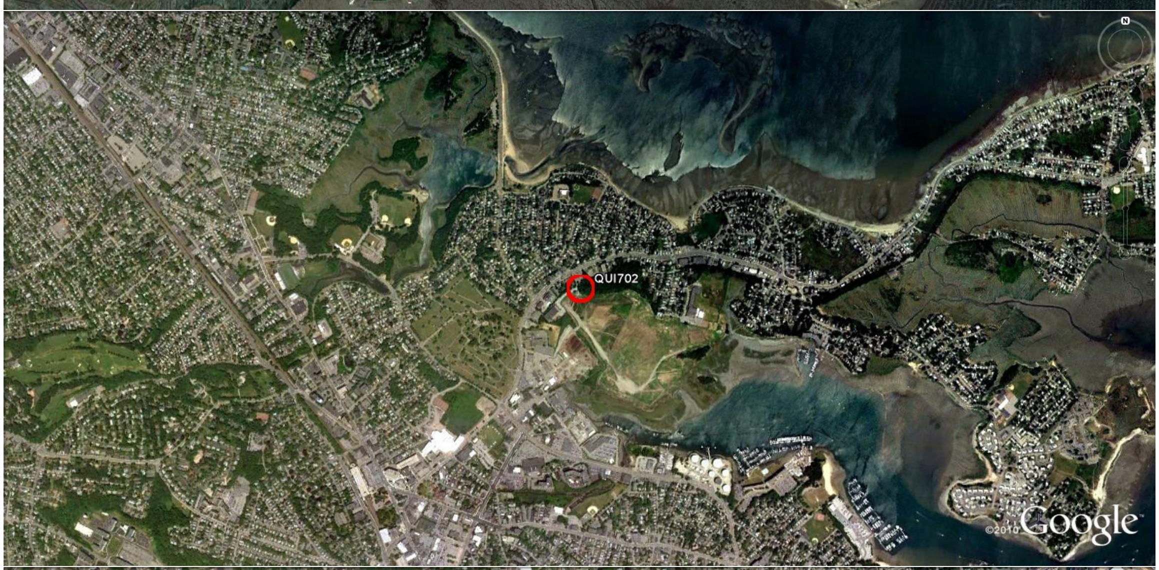

QUI317
Google

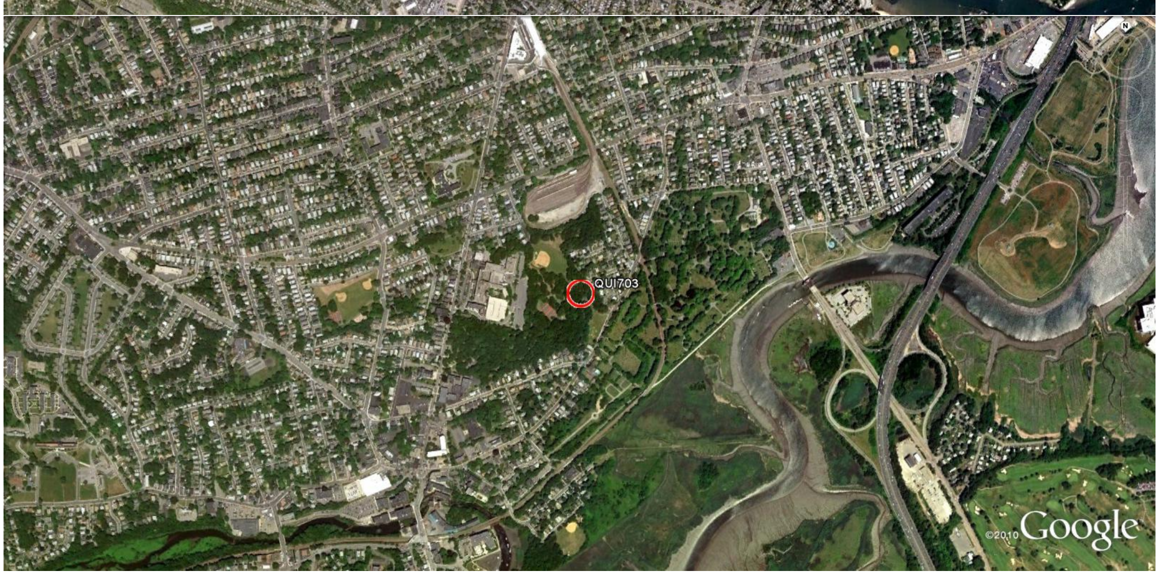

QUI318
QUI319
Google

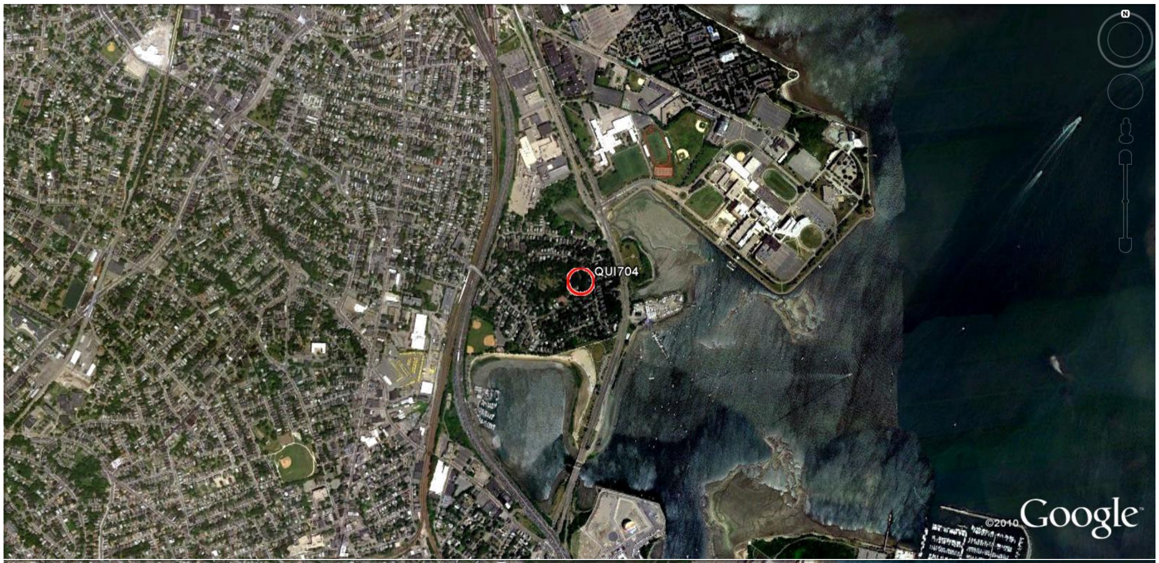

QUI319
©2010 Google

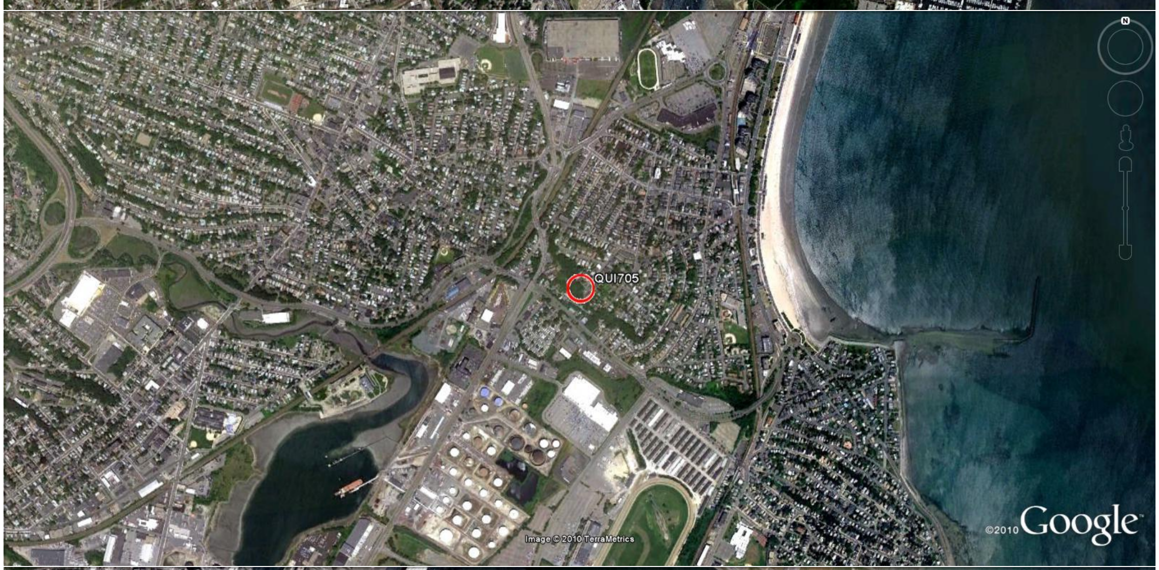

QUI320
©2010 Google

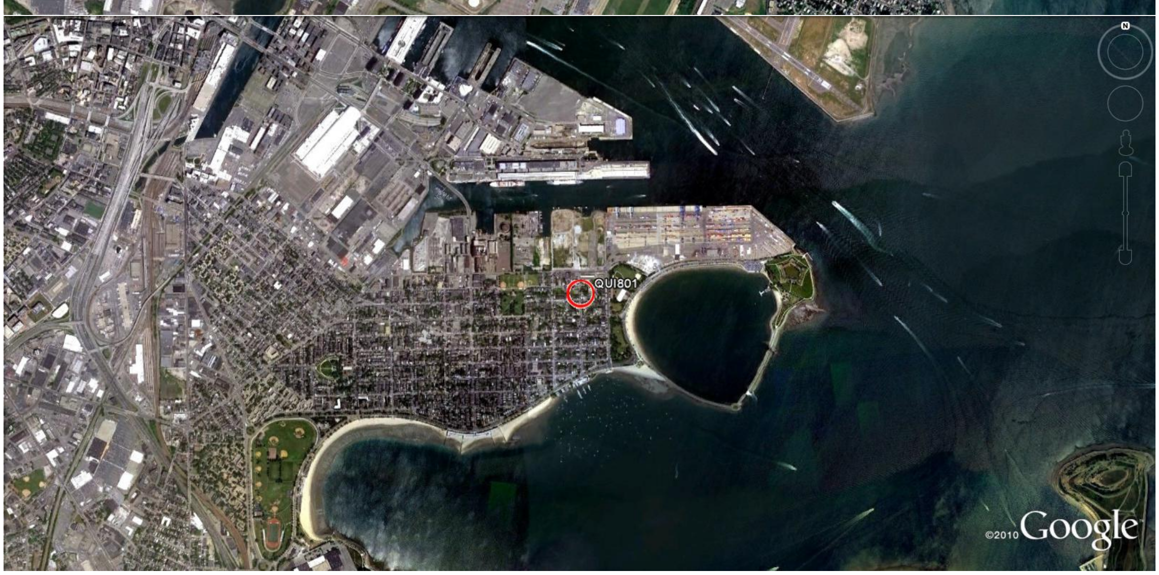

QUI701
©2010 Google

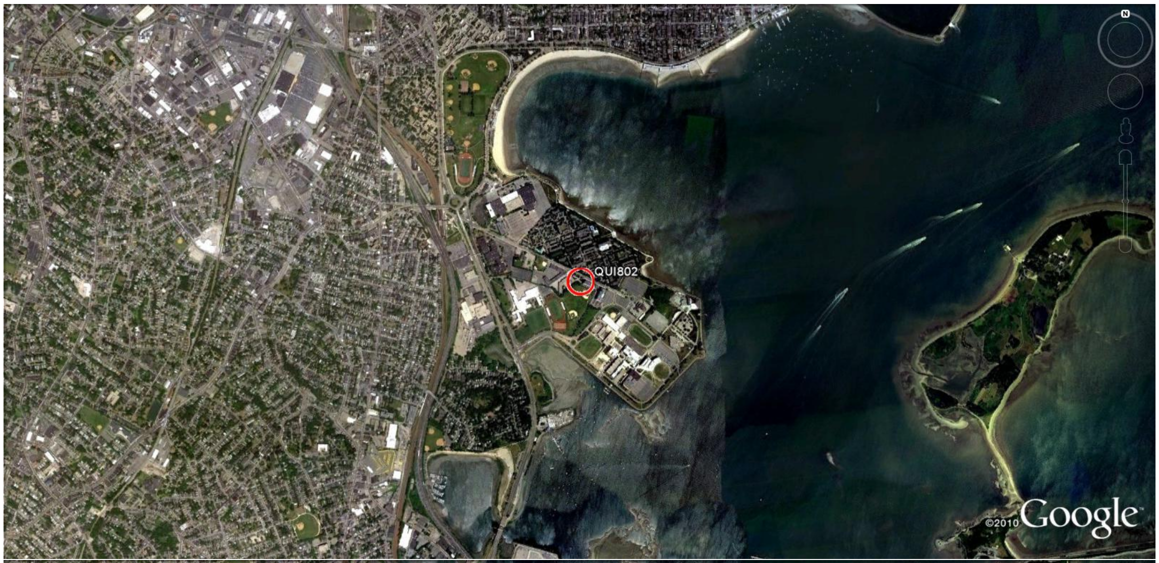

QUI702
©2010 Google

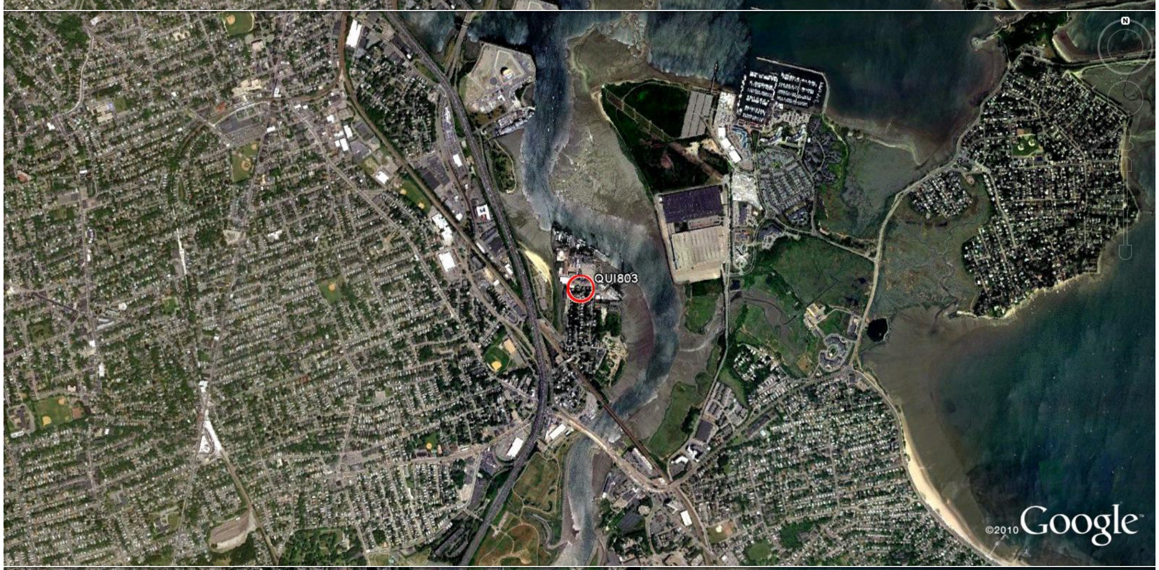

QUI703
©2010 Google

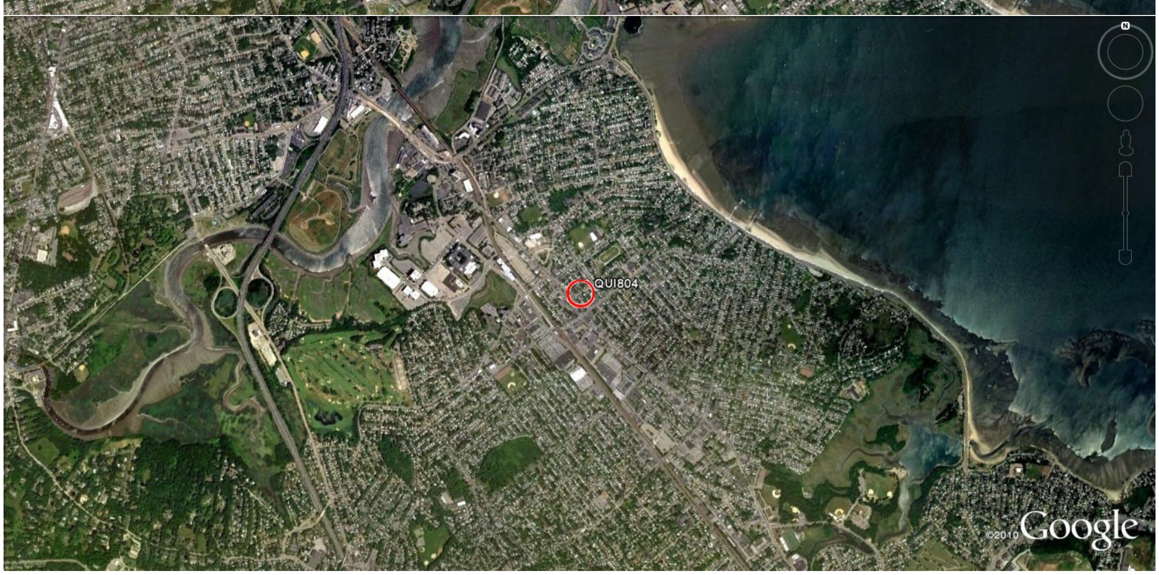

QUI704
©2010 Google

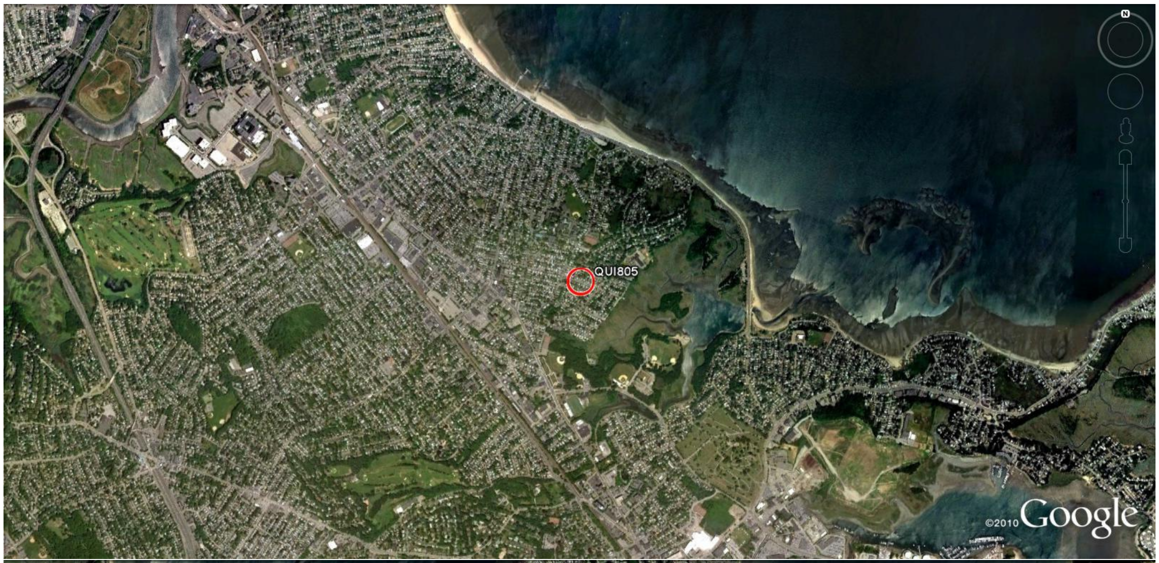

QUI705
Image © 2010 TerraMetrics
©2010 Google

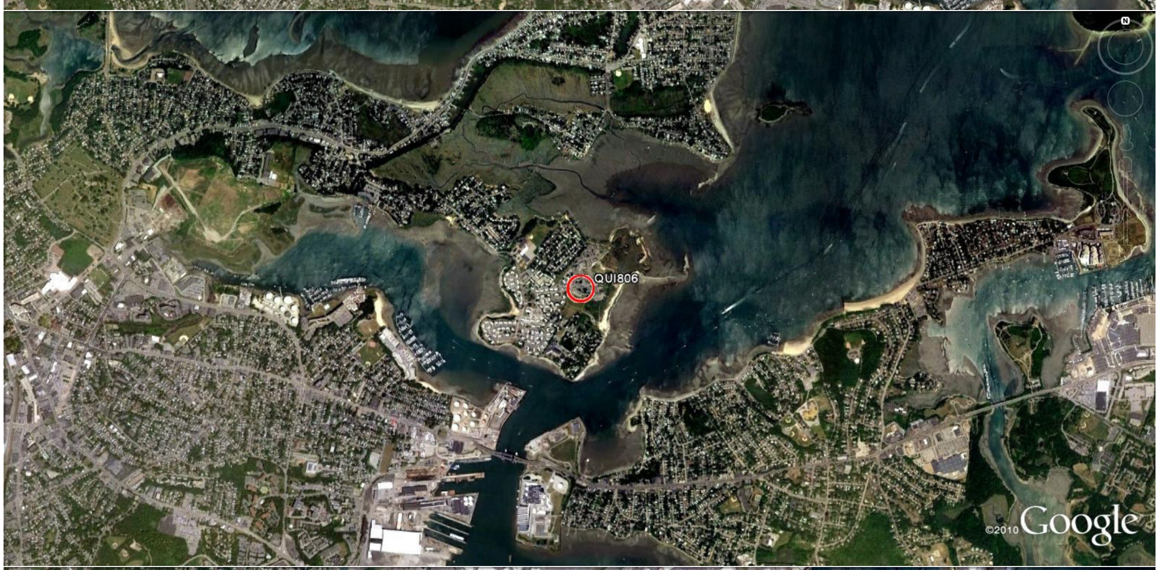

QUI801
©2010 Google

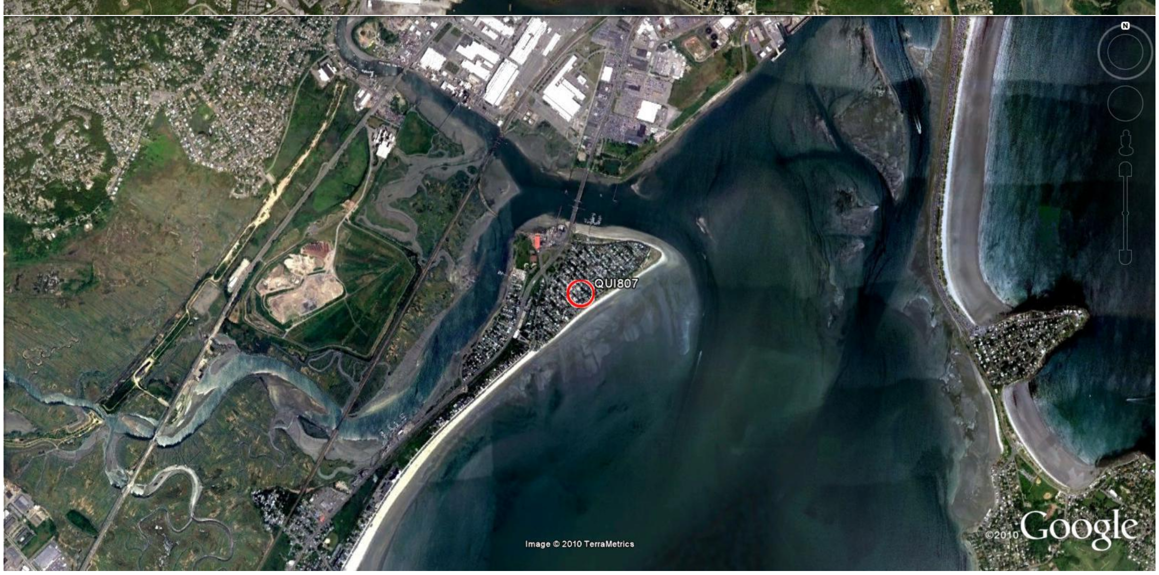

QUI802
©2010 Google

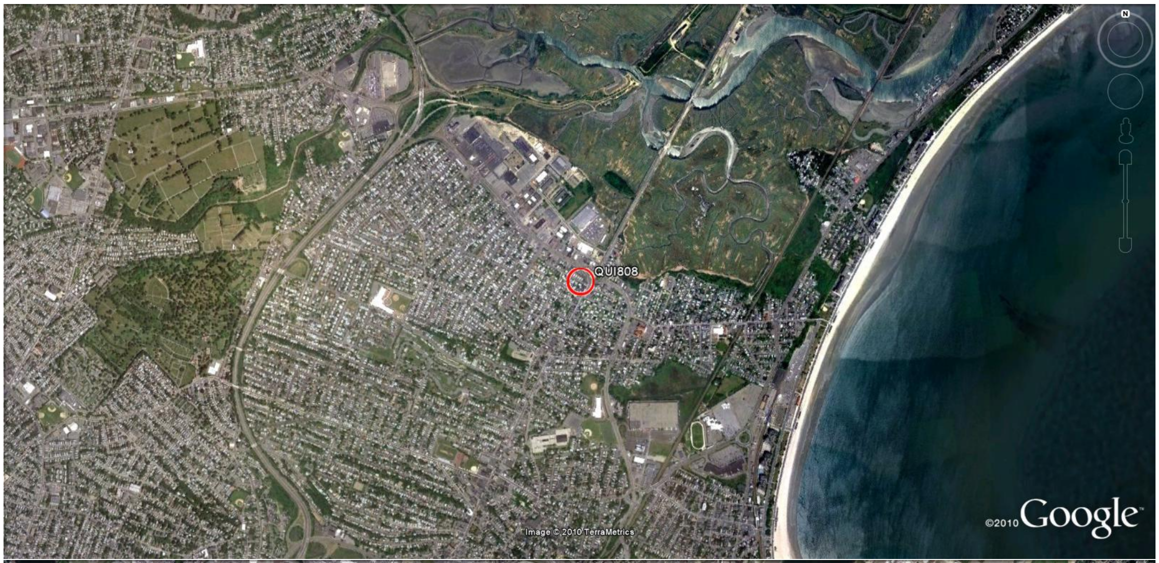

QUI803
©2010 Google

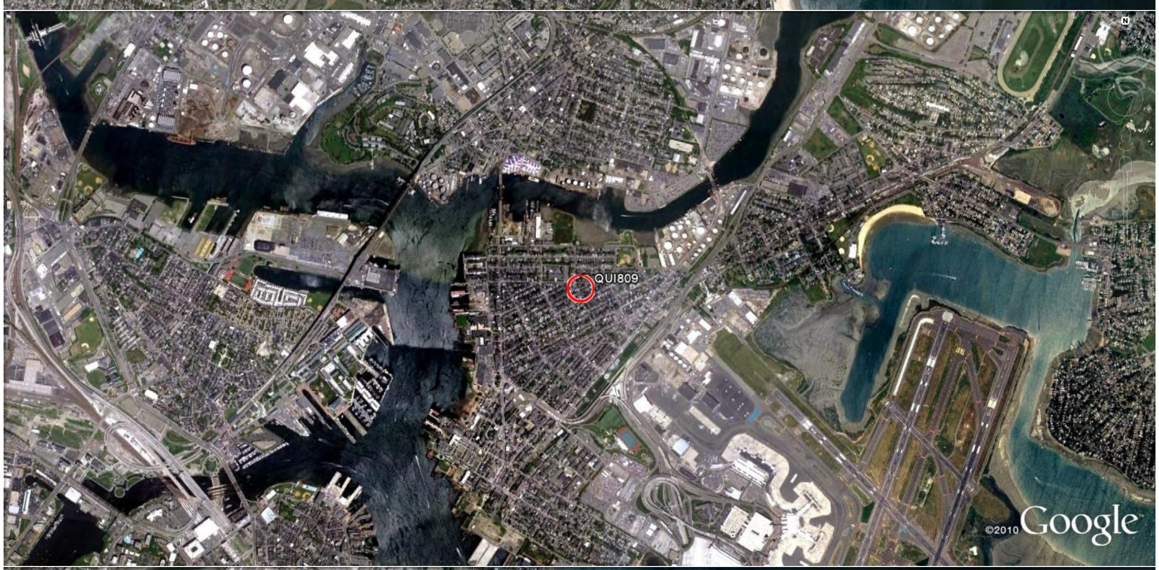

QUI804
©2010 Google

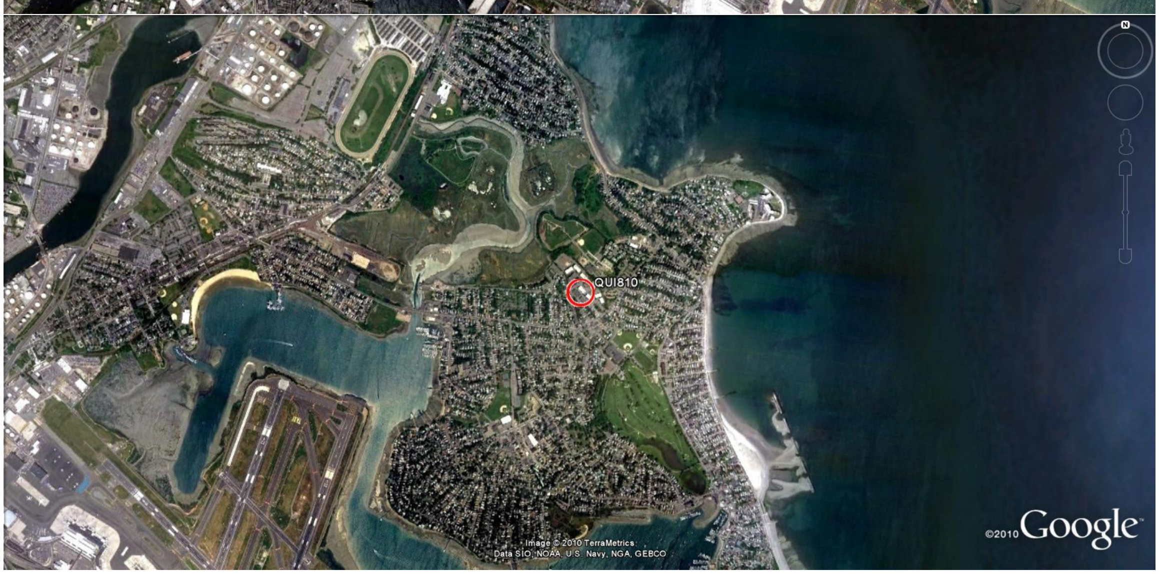

QUI805
©2010 Google


QUI806
©2010 Google


QUI807
Image © 2010 TerraMetrics
©2010 Google


QUI808
Image © 2010 TerraMetrics
©2010 Google

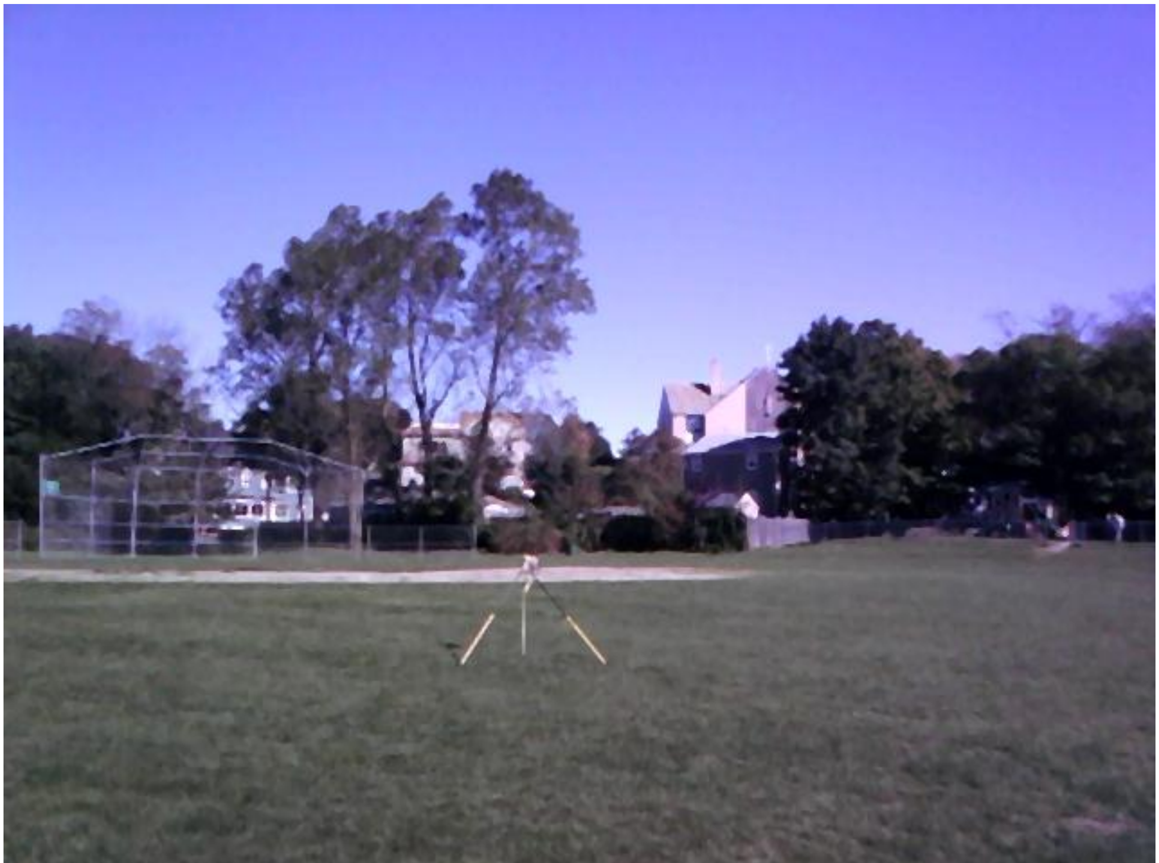

QUI809
©2010 Google


QUI810
Image © 2010 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2010 Google

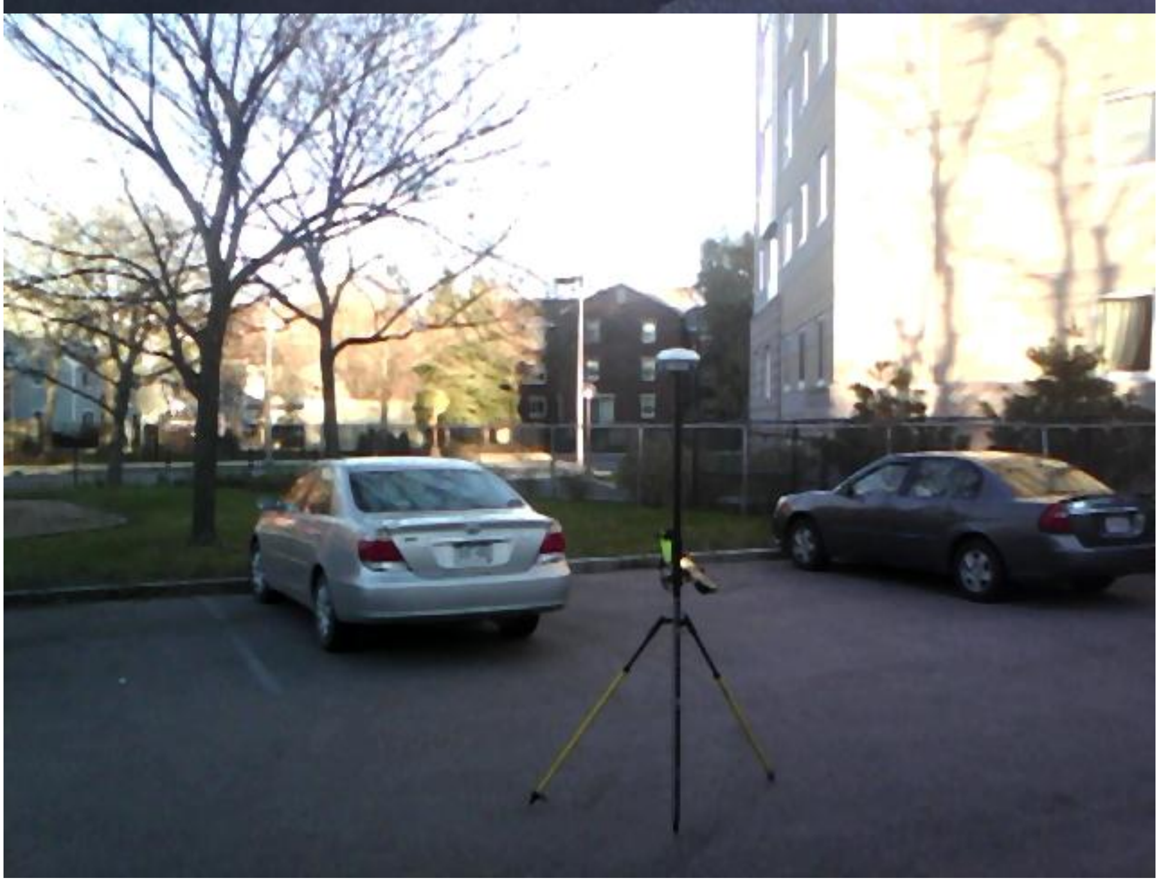




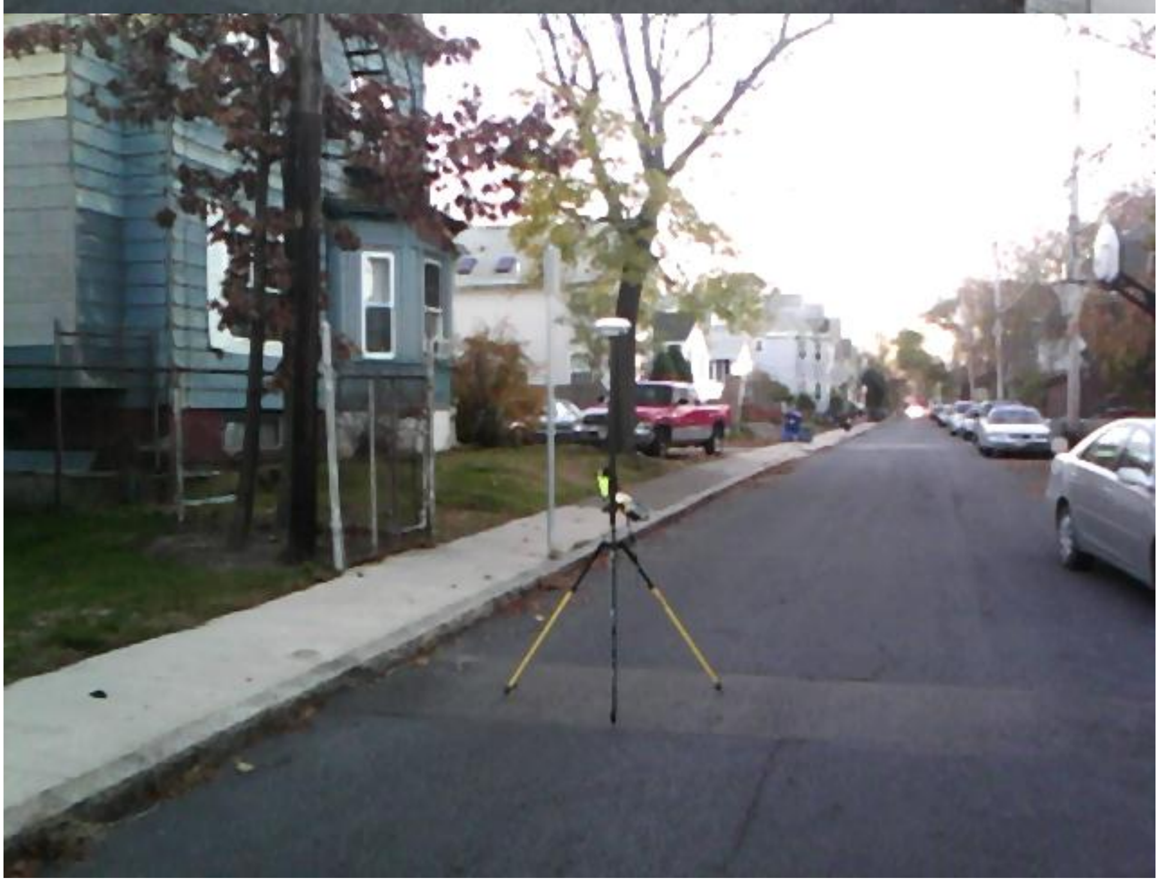




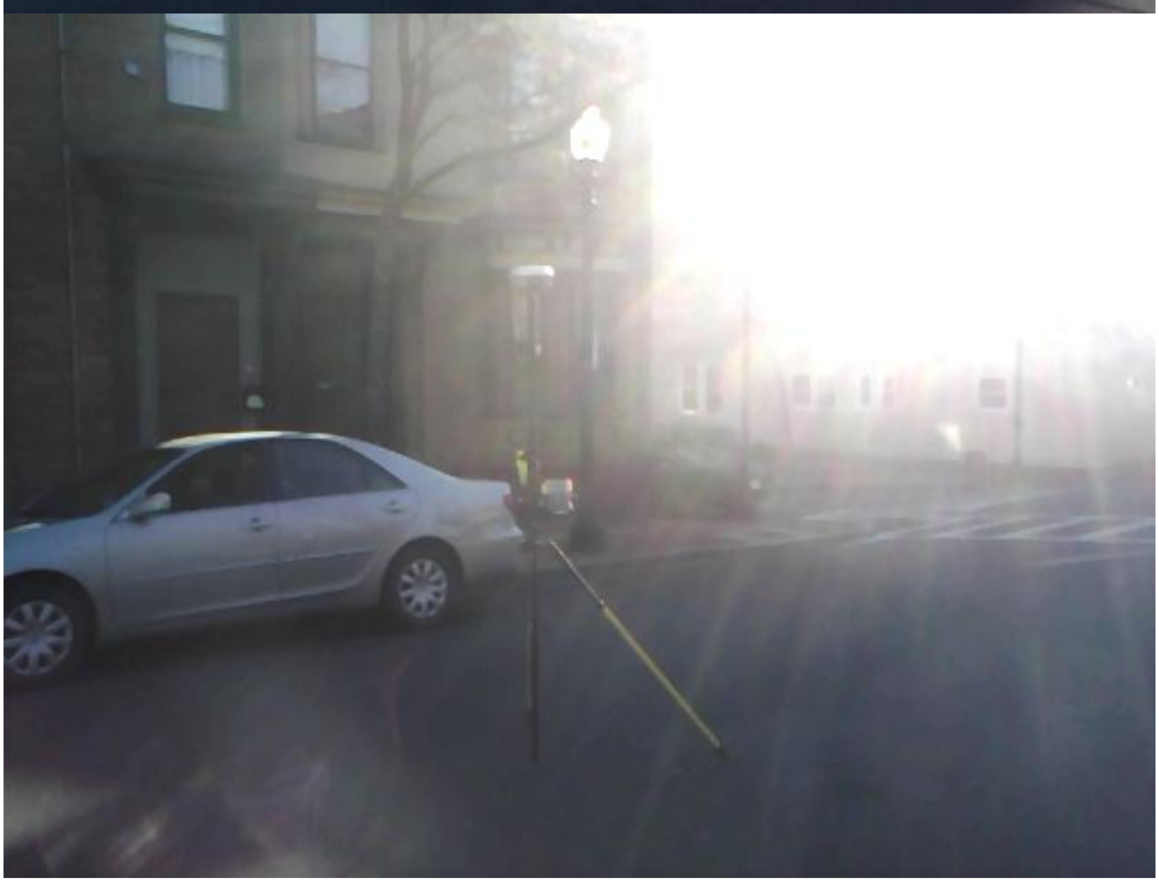





STOP



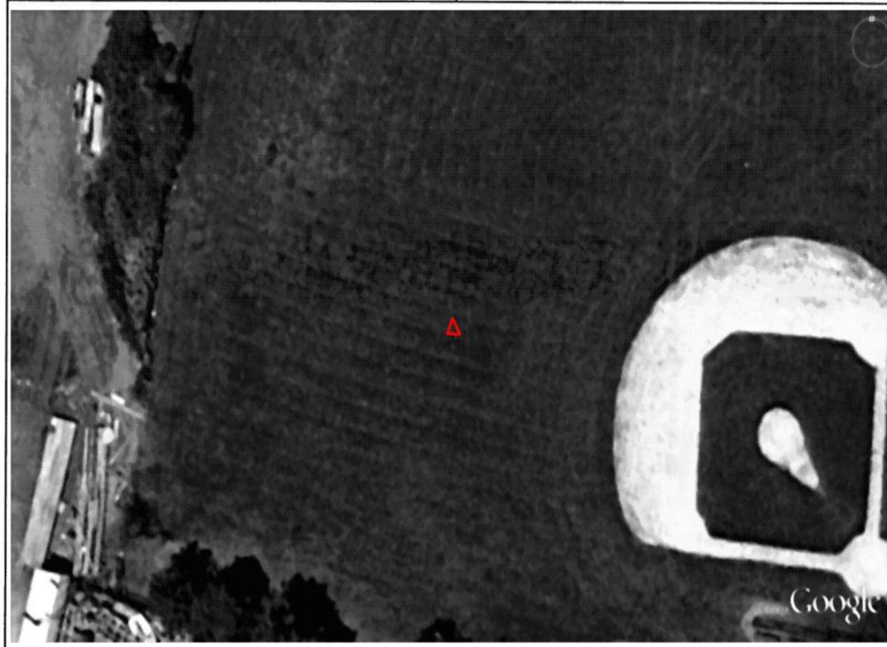




CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI301
CDI Project Number: 1508	**Date:** 10/16/2010



LiDAR

LiDAR

GPS Antenna Height: 2m

Comments:

Point taken in out in left field of baseball field of Gibson Field off of Hayes Ave.
Suffolk, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI302
CDI Project Number: 1508	**Date:** 10/16/2010

GPS Antenna Height: 2m

Comments:

Point taken in parking lot SE of Revere Beach Blvd and
NE part of Revere Beach Reservation.
Suffolk, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

LiDAR

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI303
CDI Project Number: 1508	**Date:** 10/16/2010

N

GPS Antenna Height: 2m

Comments:

Point taken in Nothern part of parking lot, NW of Movie Theater (Showcase Cinemas)
Suffolk, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	GCP Number: QUI304
CDI Project Number: 1508	Date: 10/16/2010

N

GPS Antenna Height: 2m

Comments:

Point taken in SE part of parking lot, NE of State Highyway 107
and NW of Ward Street
Suffolk, MA

Disk (Roll) / Frame Number:	Sketch 1 of 1
Collected By: Bryan Frazier	Checked By:

LiDAR

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	GCP Number: QUI305
CDI Project Number: 1508	Date: 10/16/2010

GPS Antenna Height: 2m

Comments:

Point taken in Wonderland Greyhound Park parking lot, NW of North Shore Rd.
Suffolk, MA

Disk (Roll) / Frame Number:	Sketch 1 of 1
Collected By: Bryan Frazier	Checked By:

LiDAR

LiDAR

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI306
CDI Project Number: 1508	**Date:** 10/16/2010

N

LiDAR

GPS Antenna Height: 2m

Comments:

Point taken in the SW parking lot of Suffolk Downs in the
SW corner of lot
Suffolk County, MA

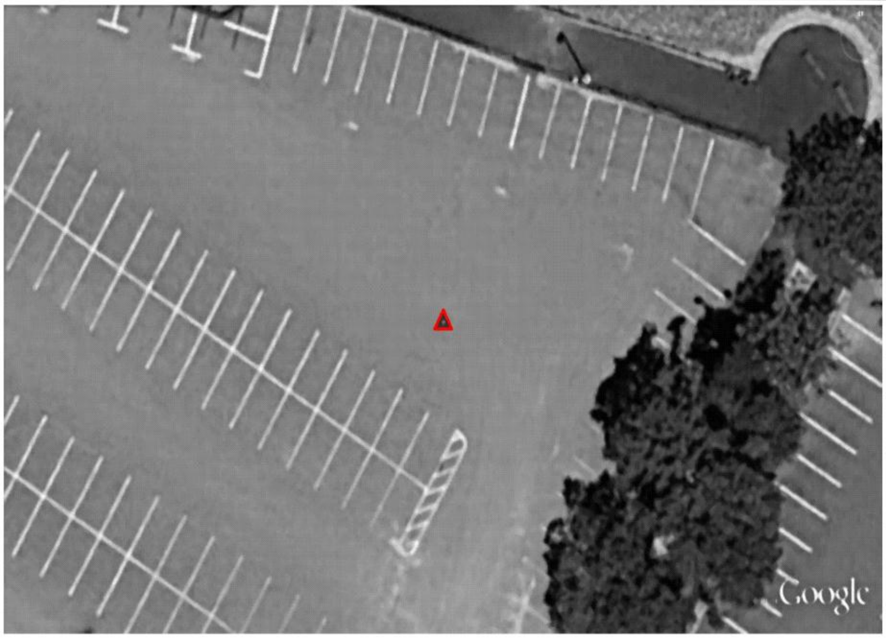
Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData, Inc., 12353 E. Easter Ave., Suite 200, Centennial, CO 80112 CDIGCP-01/04

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI307
CDI Project Number: 1508	**Date:** 10/16/2010



LiDAR

LiDAR

GPS Antenna Height: 2m

Comments:

Point taken in the NE corner of the parking lot
Suffolk County, MA

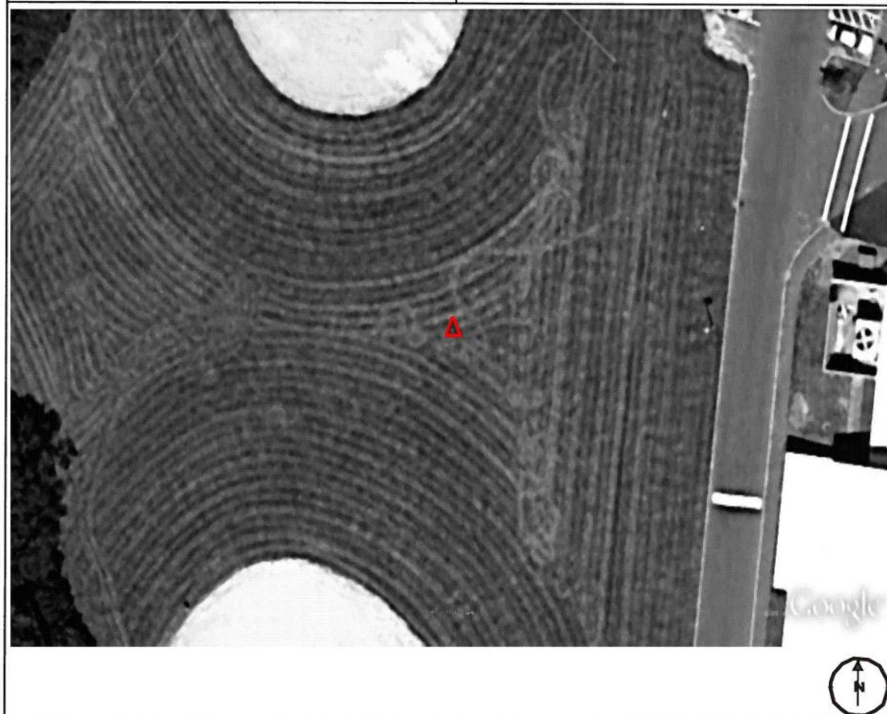
Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI308
CDI Project Number: 1508	**Date:** 10/16/2010



GPS Antenna Height: 2m

Comments:

Point taken in Field between two baseball field of
Constitution Beach Park.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI309
CDI Project Number: 1508	**Date:** 10/16/2010

LiDAR

GPS Antenna Height: 2m	
Comments: Point taken at intersection of turn around on Beacon St. Suffolk County, MA	
Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI310
CDI Project Number: 1508	**Date:** 10/16/2010

GPS Antenna Height: 2m

Comments:

Point taken in parking lot NE of A St.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI311
CDI Project Number: 1508	**Date:** 10/16/2010

LiDAR

GPS Antenna Height: 2m

Comments:

Point taken in field West of Fort Independence and
south of concrete walkway.
Suffolk County, MA

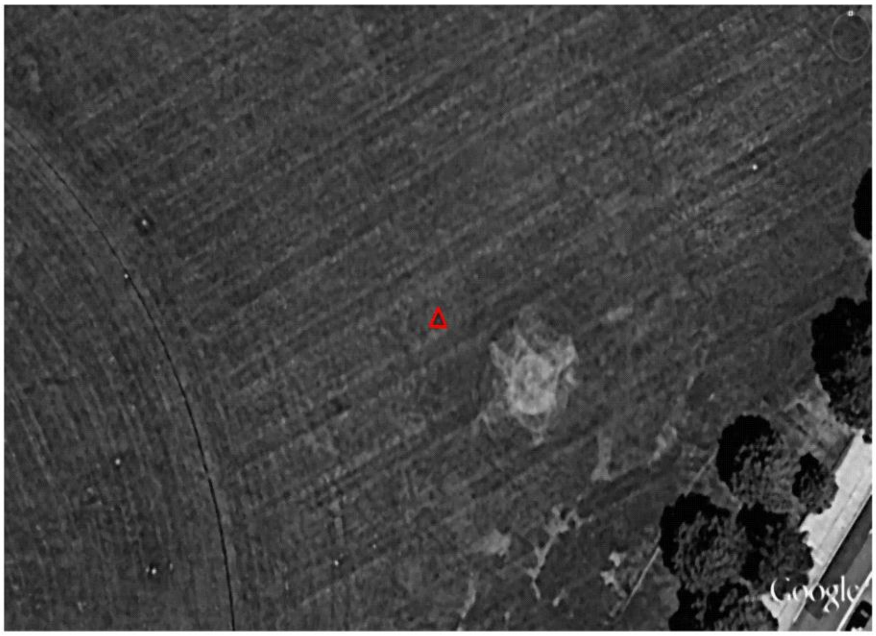
Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	GCP Number: QUI312
CDI Project Number: 1508	Date: 10/16/2010



LiDAR

GPS Antenna Height: 2m

Comments:

Point taken in baseball fields in the NE part of Columbus Park.
Suffolk County, MA

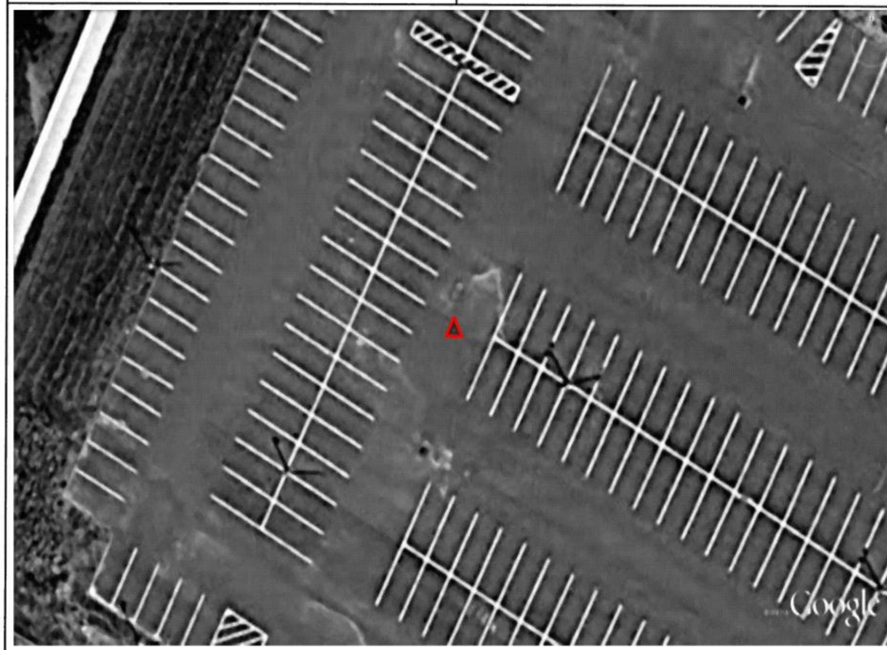
Disk (Roll) / Frame Number:	Sketch 1 of 1
Collected By: Bryan Frazier	Checked By:

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI313
CDI Project Number: 1508	**Date:** 10/16/2010



N

GPS Antenna Height: 2m

Comments:

Point taken in the North most parking lot of the
University of Massachusetts.
Suffolk County, MA

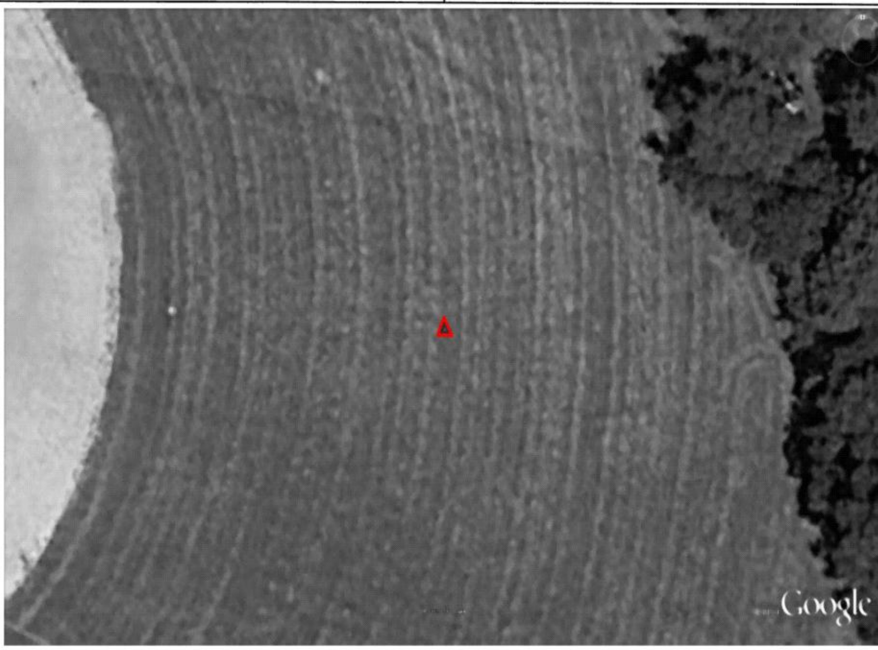
Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI314
CDI Project Number: 1508	**Date:** 10/16/2010



GPS Antenna Height: 2m

Comments:

Point taken in East part of the baseball field of Dorchester Park.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

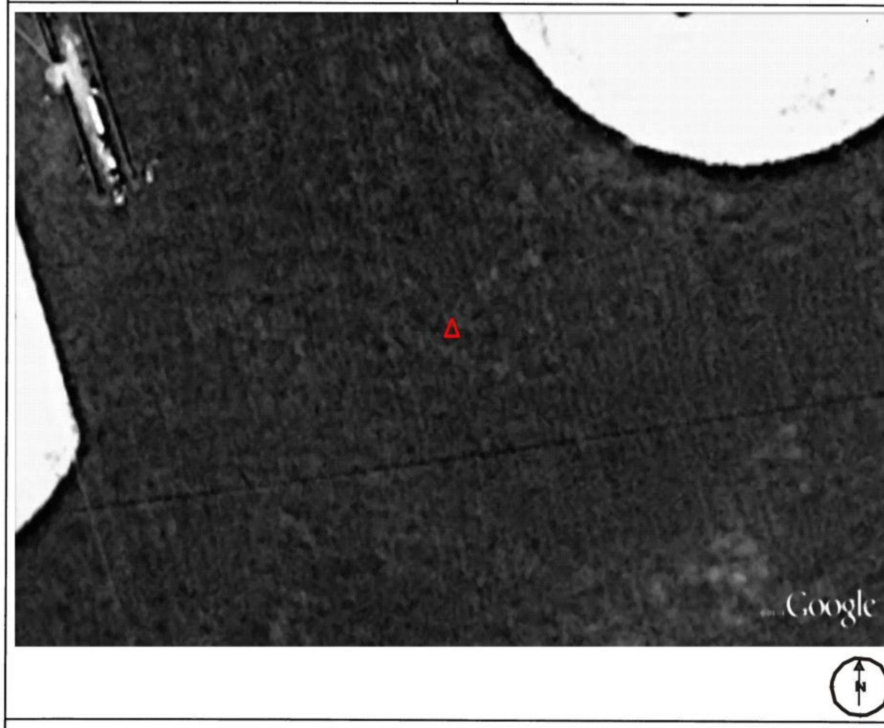
LiDAR

CompassData

GCP Station Diagram for LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI315
CDI Project Number: 1508	**Date:** 10/16/2010



GPS Antenna Height: 2m

Comments:

Point taken in baseball field North of Winslow Rd and South of Parke Ave.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

CompassData, Inc., 12353 E. Easter Ave., Suite 200, Centennial, CO 80112 CDIGCP-01/04

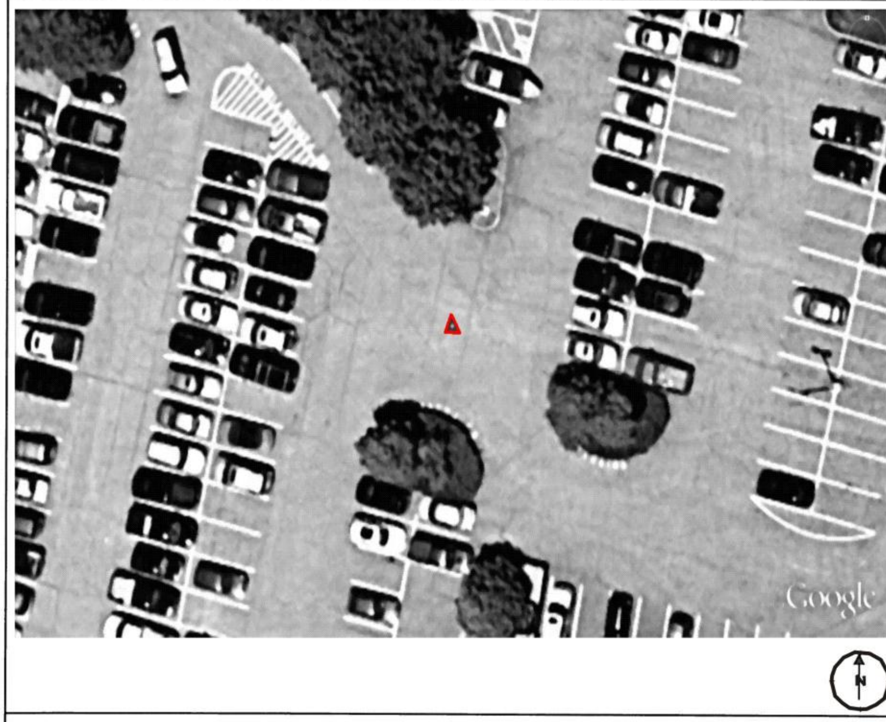
CompassData

LiDAR

LiDAR

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI316
CDI Project Number: 1508	**Date:** 10/16/2010



GPS Antenna Height: 2m

Comments:

Point taken in the West part of the parking lot.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

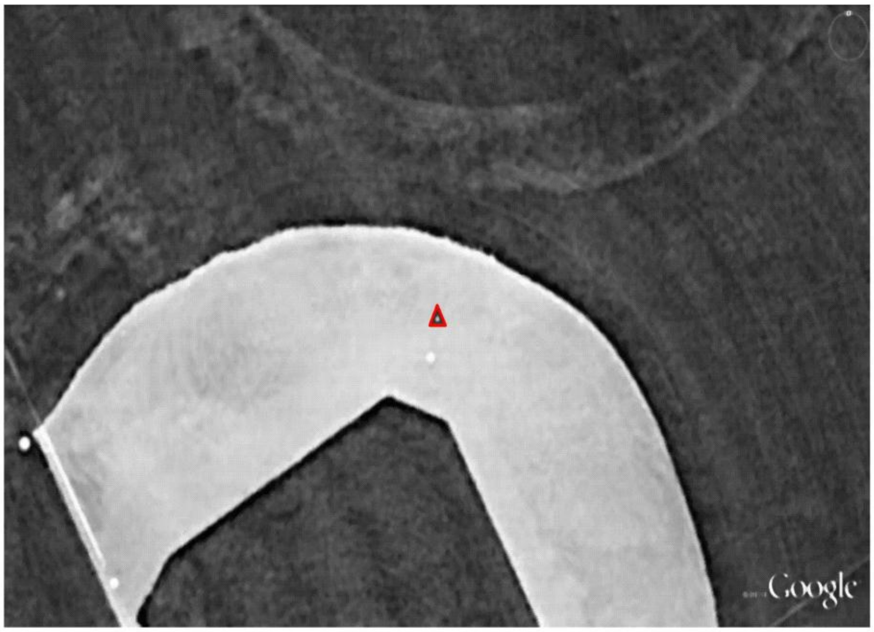
CompassData

GCP Station Diagram for LiDAR

LiDAR

LiDAR

Project Name: Quincy	**GCP Number:** QUI317
CDI Project Number: 1508	**Date:** 10/16/2010



GPS Antenna Height: 2m

Comments:

Point taken in baseball field just north of second base..
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI318
CDI Project Number: 1508	**Date:** 10/16/2010

GPS Antenna Height: 2m

Comments:

Point taken in the South part of Mt. Wollaston Cemetary. NE of Southern Artery and SW of Sea St.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

LiDAR

LiDAR

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI319
CDI Project Number: 1508	**Date:** 10/16/2010

GPS Antenna Height: 2m

Comments:

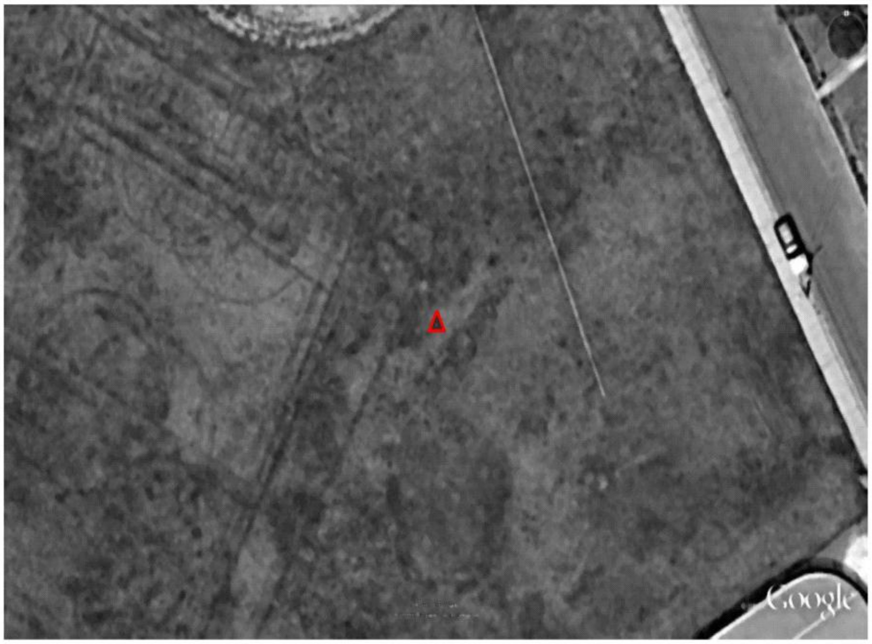
Point taken in parking lot South of Nash Ave.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData

GCP Station Diagram for LiDAR

Project Name: Quincy	**GCP Number:** QUI320
CDI Project Number: 1508	**Date:** 10/16/2010



GPS Antenna Height: 2m

Comments:

Point taken in field between the baseball field and basketball/hocky courts.
Suffolk County, MA

Disk (Roll) / Frame Number:	**Sketch** 1 **of** 1
Collected By: Bryan Frazier	**Checked By:**

CompassData, Inc., 12353 E. Easter Ave., Suite 200, Centennial, CO 80112 CDIGCP-01/04

QUINCY, MASSACHUSETTS

CVAs/FVAs	Date	Vert_Prec	Horz_Prec	Latitude	Longitude	Easting	Northing	HAE	GEOID09_Separation	NAVD88
QUI301	10/16/2010	0.0192	0.0131	42.44038	-70.9702869	4700553.367	337952.519	-24.845	-27.372	2.527
QUI302	10/16/2010	0.0119	0.0073	42.4358	-70.9690233	4700042.956	338044.661	-23.879	-27.382	3.503
QUI303	10/16/2010	0.0116	0.0073	42.43336	-71.0207643	4699871.796	333782.262	-23.787	-27.471	3.684
QUI304	10/16/2010	0.0125	0.007	42.4237	-71.0042218	4698767.163	335117.7	-23.613	-27.472	3.859
QUI305	10/16/2010	0.0155	0.0104	42.41435	-70.992876	4697706.271	336026.737	-26.03	-27.479	1.449
QUI306	10/16/2010	0.0104	0.0067	42.39279	-71.0026168	4695331.519	335168.795	-23.872	-27.553	3.681
QUI307	10/16/2010	0.0107	0.0073	42.38526	-71.0664898	4694621.573	329891.003	-25.446	-27.664	2.218
QUI308	10/16/2010	0.0091	0.0061	42.3827	-71.0124383	4694230.51	334333.846	-24.652	-27.595	2.943
QUI309	10/16/2010	0.0104	0.007	42.36964	-70.9681651	4692694.558	337944.999	-23.848	-27.563	3.715
QUI310	10/16/2010	0.0079	0.0055	42.34807	-71.052375	4690462.959	330953.199	-25.213	-27.753	2.54
QUI311	10/16/2010	0.0067	0.0049	42.33852	-71.0125307	4689324.585	334210.081	-19.17	-27.721	8.551
QUI312	10/16/2010	0.0073	0.0049	42.32842	-71.0483316	4688273.395	331233.703	-25.457	-27.806	2.349
QUI313	10/16/2010	0.0085	0.0049	42.31732	-71.0384301	4687020.782	332019.994	-21.489	-27.825	6.336
QUI314	10/16/2010	0.0101	0.0046	42.27812	-71.0628357	4682716.864	329903.226	-13.423	-27.979	14.556
QUI315	10/16/2010	0.008	0.0046	42.29803	-71.0120346	4684827.337	334144.604	-15.405	-27.843	12.438
QUI316	10/21/2010	0.0061	0.0058	42.29944	-71.0264438	4685011.997	332960.508	-24.967	-27.862	2.895
QUI317	10/16/2010	0.0064	0.0046	42.27193	-71.0097901	4681925.206	334261.206	-26.218	-27.919	1.701
QUI318	10/16/2010	0.0076	0.0055	42.25668	-70.9976222	4680208.183	335224.959	-17.976	-27.945	9.969
QUI319	10/16/2010	0.0061	0.004	42.24411	-70.9743968	4678766.805	337108.419	-21.673	-27.946	6.273
QUI320	10/16/2010	0.0064	0.004	42.27297	-70.9519998	4681929.002	339029.74	-25.558	-27.826	2.268
QUI701	11/18/2010			42.2647	-70.9579774	4681022.644	338515.684	-27.86	-55.72	27.86
QUI701_BK	11/18/2010	0.0018	0.0012	42.26548	-70.9592518	4681111.541	338412.567	-21.814	-27.86	6.046
QUI701_TP	11/18/2010	0.0018	0.0012	42.26474	-70.9583318	4681027.184	338486.544	-22.835	-27.861	5.026
QUI702	11/18/2010			42.2607	-70.992066	4680643.478	335693.723	-27.925	-55.85	27.925
QUI702_BK	11/18/2010	0.0018	0.0012	42.26062	-70.992637	4680642.219	335674.503	-24.166	-27.926	3.76
QUI702_TP	11/18/2010	0.0021	0.0015	42.26069	-70.9922985	4680635.093	335646.397	-24.223	-27.925	3.702
QUI703	11/18/2010			42.2772	-71.0620091	4682613.346	329968.93	-27.98	-55.96	27.98
QUI703_BK	11/18/2010	0.0034	0.0021	42.27682	-71.0614726	4682593.476	329989.462	-16.948	-27.981	11.033
QUI703_TP	11/18/2010	0.0024	0.0015	42.27703	-71.0617544	4682569.738	330012.138	-14.931	-27.98	13.049
QUI704	11/18/2010			42.31078	-71.0477136	4686312.869	331237.468	-27.859	-55.718	27.859
QUI704_BK	11/18/2010	0.0027	0.0015	42.31082	-71.0487304	4686319.538	331153.775	-3.997	-27.86	23.863
QUI704_TP	11/18/2010	0.003	0.0018	42.31103	-71.0483565	4686341.692	331185.148	-6.948	-27.859	20.911
QUI705	11/18/2010			42.40425	-71.0003654	4696598.94	335384.071	-27.518	-55.036	27.518
QUI705_BK	11/18/2010	0.003	0.0021	42.40443	-70.9999737	4696619.082	335416.796	7.371	-27.517	34.888
QUI705_TP	11/18/2010	0.004	0.0021	42.40439	-71.0002062	4696615.256	335397.56	6.057	-27.517	33.574
QUI801	11/18/2010	0.0027	0.0015	42.33702	-71.0271838	4682569.738	330012.138	-22.33	-27.748	5.418
QUI802	11/18/2010	0.0021	0.0018	42.31735	-71.0419642	4686319.538	331153.775	-24.451	-27.83	3.379
QUI803	11/18/2010	0.0027	0.0021	42.2914	-71.0405154	4686341.692	331185.148	-24.206	-27.908	3.702
QUI804	11/18/2010	0.0024	0.0015	42.27471	-71.0254808	4696619.082	335416.796	-19.146	-27.935	8.789
QUI805	11/18/2010	0.0021	0.0015	42.26811	-71.0095461	4696615.256	335397.56	-23.74	-27.93	4.19
QUI806	11/18/2010	0.0018	0.0012	42.25341	-70.962052	4679776.416	338150.73	-24.892	-27.901	3.009
QUI807	11/18/2010	0.004	0.0024	42.43877	-70.9659333	4700366.445	338306.459	-25.147	-27.369	2.222
QUI808	11/18/2010	0.0027	0.0018	42.42089	-71.0056998	4698457.32	334988.721	-21.924	-27.481	5.557
QUI809	11/18/2010	0.003	0.0018	42.38016	-71.033015	4693988.54	332633.137	-8.123	-27.632	19.509
QUI810	11/18/2010	0.0037	0.0024	42.38367	-70.9819535	4694279.082	336845.995	-23.823	-27.547	3.724
Survey Control										
NGS_MY2936	10/21/2010	0.029	0.002	42.31092	-71.049629	331079.973	4686332.119	7.33776995	-27.861	35.1988
NGS_MY6363	10/16/2010	0.062	0.011	42.47103	-71.2450977	315439.609	4704518.423	17.6193042	-27.7	45.3193

Metadata

UTM 19 North, NAD83, NAVD88
All units in meters where applicable.
HAE - GEOID09 = NAVD88

Appendix E: Post Flight Reports

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive
Lexington, Kentucky 40503
Phone 859-277-8700 + Fax 859-277-8901
www.photoscience.com

March 30, 2011

Post Flight Report
PSI Project 7556-005
Charles (includes Quincy), MA LiDAR

FEMA Task Order Number: HSFEHQ-10-J0005
Client: STARR (Project Number: 40000058)
Project Name: Charles - Quincy
Attached Reference files: 7556-005 Charles-Quincy_MA_Background
7556-005_Bed-Charles_MA_Background.ZIP
7556-005_Orh-Charles_MA_Background.ZIP
7556-005_1B9-Narragansett_MA_Background.ZIP
7556-005_SFZ-Blackstone_MA_Background.ZIP
7556-005_OWD-Quincy_MA_Background.ZIP

General Specifications: 1-meter nominal spacing LiDAR Acquisition and processing with a 24.5 cm vertical accuracy at 95% confidence level.

Acquisition Dates: LiDAR data for the Charles Quincy area was acquired over several different dates and encompassed five (5) sub-block areas. Data for these areas are included in the background files listed above and a part of this report.

Equipment Used: The data was collected with Optech Gemini LiDAR systems, Serial Numbers 246 and 247, Base GPS Receiver used was a Trimble 5700 collecting data at half second intervals. The aircraft used were Cessna 206 models, tail numbers N2448G and N7266Z. The pilots were Cameron Caldwell, Mark Young and Nick Greenwell and the Operators were Jeremy Berry and Nathan Galieti. This information is also included in the background files attached and included as a part of this report.

Project: The project was flown at an altitude of 5,000 feet above ground and at a planned average speed of 116 knots with a field of view of 36 degrees. The scan rates used was 30.1 Hz with a Laser Pulse Rate of 71,429 Hz with Multi-Pulse enabled. The full swath width was 989.18 meters with a planned sidelap of 30%. The point spacing was <1 meter with a NADIR point density of 1.2 points per square meter and an average point density of 3.03 points per square meter. The area covered consisted of 285.53 square miles.

GPS Base Station / Monument:. The Base Stations used are included in the area reports attached.

Control: 16 control points were collected as part of the project and used to calibrate the project data, remove any bias and verify accuracy. This data is compared to the collected model and results indicated below. This control data in included in the attached .ZIP file under “Control”.

Flight Files: The planned flight files are included as reference in the attached .ZIP file under “Flight Files” for each of the sub-blocks.

Flight Logs: Flight Logs used by the crew are included in the attached .ZIP file under “Flight Logs” for each sub-block and include the following type information:

- job #/name
- block or AOI
- date (s) flown
- aircraft tail #
- lines - #
- lines - direction
- lines – altitude
- lines – speed
- conditions
- comments
- pilot name
- operator name
- AGC switch
- GPS base station used

Processing Summary: Data is included in the attached .ZIP file under “Processing Summary” for each sub-block and includes the GPS / IMU processing summary data including at a minimum:

- Processing Logs
- Message Logs
- Extract Logs
- Laser configuration files for each lift
- Max Horizontal GPS Variance (cm)
- Max Vertical GPS Variance (cm)
- Notes on GPS quality (High, Good, etc.)
- GPS separation plot
- GPS altitude plot
- PDOP plot
- Plot of GPS distance from base station/s

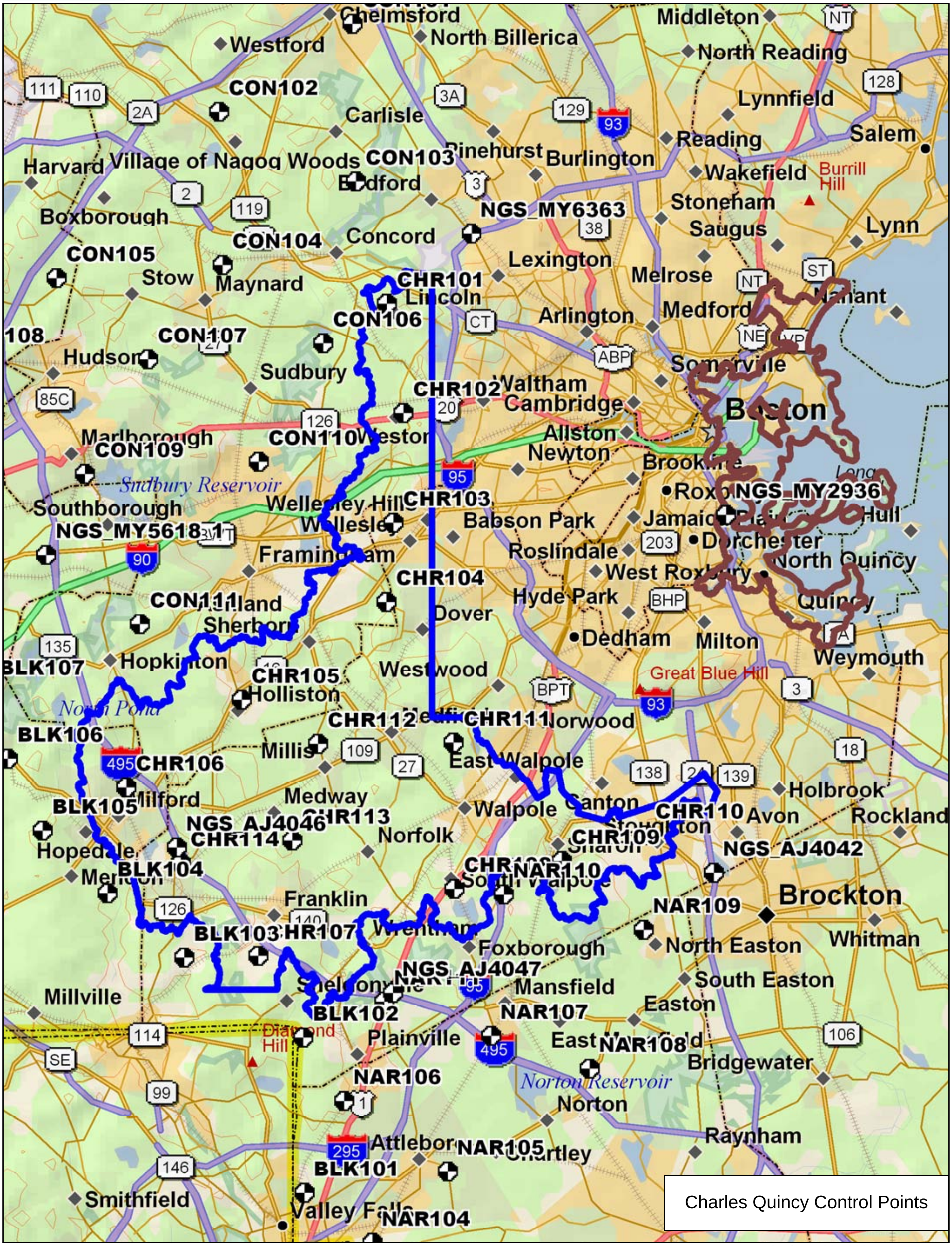
Project Coverage: within the attached .ZIP file in the "Project Coverage" directory is the overall boundary Shape File and the as flown trajectory Shape Files which include the project calibration flight lines (cross flights) for each sub-block.

Accuracy: The LiDAR data was tested against the Control check points indicated above and the results are included in the "Accuracy Results" directory in the attached .ZIP file. All control points in the Charles Quincy area and the surrounding project areas were used to generate the accuracy results.

The LiDAR data as collected tested at 0.095 (meters) fundamental vertical accuracy at 95% confidence level. Within the accuracies indicated in the specifications, as provided.

Sincerely,

Forrest Godby
Senior Project Manager / Flight Operations Manager



TN
MN (15.0°W)

Scale 1 : 325,000
1" = 5.13 mi
Data Zoom 8-5

Easting,Northing,NCB
308290.407,4717984.180,CON101
299738.368,4712669.202,CON102
308228.727,4708010.935,CON103
299672.693,4702971.732,CON104
289180.262,4702479.550,CON105
305880.913,4697849.713,CON106
294786.931,4697154.676,CON107
282002.666,4697551.565,CON108
290592.814,4690009.547,CON109
301581.418,4690462.151,CON110
293786.079,4680440.852,CON111
278950.309,4685371.437,CON112
287979.209,4684987.001,NGS_MY5618_1
309969.340,4700241.164,CHR101
310821.172,4693298.802,CHR102
309992.295,4686382.206,CHR103
309412.207,4681404.480,CHR104
300103.794,4675484.345,CHR105
292611.158,4670144.776,CHR106
300681.085,4659267.047,CHR107
313252.435,4663151.298,CHR108
320134.840,4664726.147,CHR109
325516.378,4666217.695,CHR110
313419.214,4672383.715,CHR111
304852.892,4672532.364,CHR112
303055.118,4666477.577,CHR113
295918.460,4665248.732,CHR114
329772.470,4663745.593,NGS_AJ4042
331079.973,4686332.119,NGS_MY2936
295717.625,4666242.523,NGS_AJ4046
315439.609,4704518.423,NGS_MY6363
309124.282,4627858.758,NAR101
315137.563,4629447.784,NAR102
316540.020,4637360.832,NAR103
307444.558,4640935.406,NAR104
312364.097,4645307.560,NAR105
305881.822,4649935.227,NAR106
315387.709,4653817.278,NAR107
321582.876,4651547.084,NAR108
325222.773,4660253.857,NAR109
316403.925,4662726.093,NAR110
308587.341,4656165.114,NAR111
329772.470,4663745.593,NGS_AJ4042
309178.594,4656697.394,NGS_AJ4047
303200.755,4644199.418,BLK101
303394.093,4654017.192,BLK102
295982.179,4659289.723,BLK103
291228.967,4663494.424,BLK104
287229.936,4667574.602,BLK105
285162.451,4672187.736,BLK106
284125.943,4676481.986,BLK107
276080.770,4684007.612,BLK108
272661.364,4687508.325,BLK109

```
275180.053,4690501.622,BLK110
268397.949,4689200.400,BLK111
264307.129,4689723.325,BLK112
259840.267,4687622.113,BLK113
262127.838,4674974.673,BLK114
266263.162,4672283.265,BLK115
267375.890,4659929.876,BLK116
272552.118,4659106.184,BLK117
274284.768,4655737.024,BLK118
263319.547,4657956.388,NGS_MY5929
309178.594,4656697.394,NGS_AJ4047
295429.204,4720356.823,NGS_AI9590
295717.625,4666242.523,NGS_AJ4046
```

Accuracy Results NCB

L:\7556005\full_area.ctl

Number	Easting	Northing	Known Z	Laser Z	Dz
CON101	308290.407	4717984.180	38.753	38.710	-0.043
CON102	299738.368	4712669.202	58.662	58.580	-0.082
CON103	308228.727	4708010.935	61.308	61.260	-0.048
CON104	299672.693	4702971.732	53.701	53.680	-0.021
CON105	289180.262	4702479.550	80.051	80.090	+0.039
CON106	305880.913	4697849.713	57.022	56.980	-0.042
CON107	294786.931	4697154.676	62.126	62.120	-0.006
CON108	282002.666	4697551.565	143.231	143.260	+0.029
CON109	290592.814	4690009.547	92.717	92.700	-0.017
CON110	301581.418	4690462.151	57.186	57.180	-0.006
CON111	293786.079	4680440.852	104.987	104.930	-0.057
CON112	278950.309	4685371.437	131.373	131.380	+0.007
NGS_MY5618_1	287979.209	4684987.001	147.438	147.380	-0.058
CHR101	309969.340	4700241.164	82.990	83.060	+0.070
CHR102	310821.172	4693298.802	54.683	55.080	+0.397
CHR103	309992.295	4686382.206	49.654	49.780	+0.126
CHR104	309412.207	4681404.480	66.157	66.170	+0.013
CHR105	300103.794	4675484.345	56.104	56.130	+0.026
CHR106	292611.158	4670144.776	86.237	86.400	+0.163
CHR107	300681.085	4659267.047	95.556	95.510	-0.046
CHR108	313252.435	4663151.298	77.668	77.530	-0.138
CHR109	320134.840	4664726.147	79.852	79.840	-0.012
CHR110	325516.378	4666217.695	65.112	65.090	-0.022
CHR111	313419.214	4672383.715	73.956	73.920	-0.036
CHR112	304852.892	4672532.364	47.011	46.990	-0.021
CHR113	303055.118	4666477.577	54.661	54.570	-0.091
CHR114	295918.460	4665248.732	76.165	76.310	+0.145
NGS_AJ4042	329772.470	4663745.593	74.831	74.680	-0.151
NGS_MY2936	331079.973	4686332.119	35.199	outside	*
NGS_AJ4046	295717.625	4666242.523	69.502	69.320	-0.182
NGS_MY6363	315439.609	4704518.423	45.319	outside	*
NAR101	309124.282	4627858.758	4.179	4.210	+0.031
NAR102	315137.563	4629447.784	30.450	30.430	-0.020
NAR103	316540.020	4637360.832	37.428	37.410	-0.018
NAR104	307444.558	4640935.406	28.971	28.960	-0.011
NAR105	312364.097	4645307.560	41.206	41.190	-0.016
NAR106	305881.822	4649935.227	81.734	81.730	-0.004
NAR107	315387.709	4653817.278	46.450	46.530	+0.080
NAR108	321582.876	4651547.084	29.837	29.830	-0.007
NAR109	325222.773	4660253.857	53.100	53.130	+0.030
NAR110	316403.925	4662726.093	78.038	78.020	-0.018
NAR111	308587.341	4656165.114	71.086	71.100	+0.014
NGS_AJ4042	329772.470	4663745.593	74.831	74.680	-0.151
NGS_AJ4047	309178.594	4656697.394	61.369	61.140	-0.229
BLK101	303200.755	4644199.418	26.044	26.040	-0.004
BLK102	303394.093	4654017.192	96.164	96.180	+0.016
BLK103	295982.179	4659289.723	65.459	65.600	+0.141
BLK104	291228.967	4663494.424	77.013	76.900	-0.113
BLK105	287229.936	4667574.602	136.798	136.720	-0.078

BLK106	285162.451	4672187.736	87.158	87.230	+0.072
BLK107	284125.943	4676481.986	181.487	181.620	+0.133
BLK108	276080.770	4684007.612	167.718	167.760	+0.042
BLK109	272661.364	4687508.325	130.336	130.290	-0.046
BLK110	275180.053	4690501.622	152.623	152.650	+0.027
BLK111	268397.949	4689200.400	222.202	222.110	-0.092
BLK112	264307.129	4689723.325	277.189	277.170	-0.019
BLK113	259840.267	4687622.113	349.406	349.420	+0.014
BLK114	262127.838	4674974.673	215.573	215.600	+0.027
BLK115	266263.162	4672283.265	189.193	189.160	-0.033
BLK116	267375.890	4659929.876	247.272	247.280	+0.008
BLK117	272552.118	4659106.184	182.791	182.790	-0.001
BLK118	274284.768	4655737.024	154.529	154.520	-0.009
NGS_MY5929	263319.547	4657956.388	157.091	outside	*
NGS_AJ4047	309178.594	4656697.394	61.369	61.140	-0.229
NGS_AI9590	295429.204	4720356.823	85.908	outside	*
NGS_AJ4046	295717.625	4666242.523	76.143	removed	*

Average dz	-0.009
Minimum dz	-0.229
Maximum dz	+0.397
Average magnitude	0.063
Root mean square	0.095
Std deviation	0.095

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive
Lexington, Kentucky 40503
Phone 859-277-8700 + Fax 859-277-8901
www.photoscience.com

March 29, 2011

Post Flight Report
PSI Project 7556-005
BED Charles, MA LiDAR

CONTRACT: ______________________
Client: ____________________________
Project Name: Bedford Charles Sub Block
Attached Reference file: *7556-005_Bed-Charles_MA_Background.ZIP*

General Specifications: 1-meter nominal spacing LiDAR Acquisition and processing with a 24.5 cm vertical accuracy at 95% confidence level.

Acquisition Dates: LiDAR data for the BED-Charles data was acquired on the dates of 12/02, 12/3, 12/7, 12/12, 12/10, and 12/11 2010 over 9 lifts. Crews had been on site previously without success due to weather and ground condition issues (low clouds, snow and rain).

Equipment Used: The data was collected with Optech Gemini LiDAR systems, Serial Numbers 246 and 247, Base GPS Receiver used was a Trimble 5700 collecting data at half second intervals. The aircraft used were Cessna 206 models, tail numbers N2448G and N7266Z. The pilots were Cameron Caldwell, Mark Young and Nick Greenwell and the Operators were Jeremy Berry and Nathan Galieti. The Base Station was set on the monument “BED A, AI5558” at the Laurence G Hanscom Field Airport (BED) set by the crews.

Project: The project consisted of 50 flight lines of 1008.55 miles. The project was flown at an altitude of 5,000 feet above ground and at a planned average speed of 116 knots with a field of view of 36 degrees. The scan rates used was 30.1 Hz with a Laser Pulse Rate of 71,429 Hz with Multi-Pulse enabled. The full swath width was 989.18 meters with a planned sidelap of 30%. The point spacing was <1 meter with a NADIR point density of 1.2 points per square meter and an average point density of 3.03 points per square meter. The planned vertical accuracy was 0.13 meters.

GPS Base Station / Monument:. The Base Station was set on the monument “BED A, AI5558” at the Laurence G Hanscom Field Airport (BED) and the Base Station was set by the flight crews. Information on this monument is included in the attached .ZIP file under “Base Station Data”.

Control: Control points were collected as part of the project and used to calibrate the project data, remove any bias and verify accuracy. This data is compared to the collected model and results indicated below. This control data in included in the attached .ZIP file under “Control”.

Flight Files: The planned flight files are included as reference in the attached .ZIP file under “Flight Files”.

Flight Logs: Flight Logs used by the crew are included in the attached .ZIP file under “Flight Logs” and include the following type information:

- job #/name
- block or AOI
- date (s) flown
- aircraft tail #
- lines - #
- lines - direction
- lines – altitude
- lines – speed
- conditions
- comments
- pilot name
- operator name
- AGC switch
- GPS base station used

Processing Summary: Data is included in the attached .ZIP file under “Processing Summary” which includes GPS / IMU processing summary data including at a minimum:

- Processing Logs
- Message Logs
- Extract Logs
- Laser configuration files for each lift
- Max Horizontal GPS Variance (cm)
- Max Vertical GPS Variance (cm)
- Notes on GPS quality (High, Good, etc.)
- GPS separation plot
- GPS altitude plot
- PDOP plot
- Plot of GPS distance from base station/s

Project Coverage: within the attached .ZIP file in the "Project Coverage" directory is the overall boundary Shape File and the as flown trajectory Shape Files which include the project calibration flight lines (cross flights).

Accuracy: The LiDAR data was tested against the Control check points indicated above and the results are included in the "Accuracy Results" directory in the attached .ZIP file.

The LiDAR data as collected tested at 0.095 (meters) fundamental vertical accuracy at 95% confidence level. Within the accuracies indicated in the specifications, as provided.

Sincerely,

Forrest Godby
Senior Project Manager / Flight Operations Manager

BED_MA_Concord_FEMA_Base Station Monument

See file dsdata.txt for more information about the datasheet.

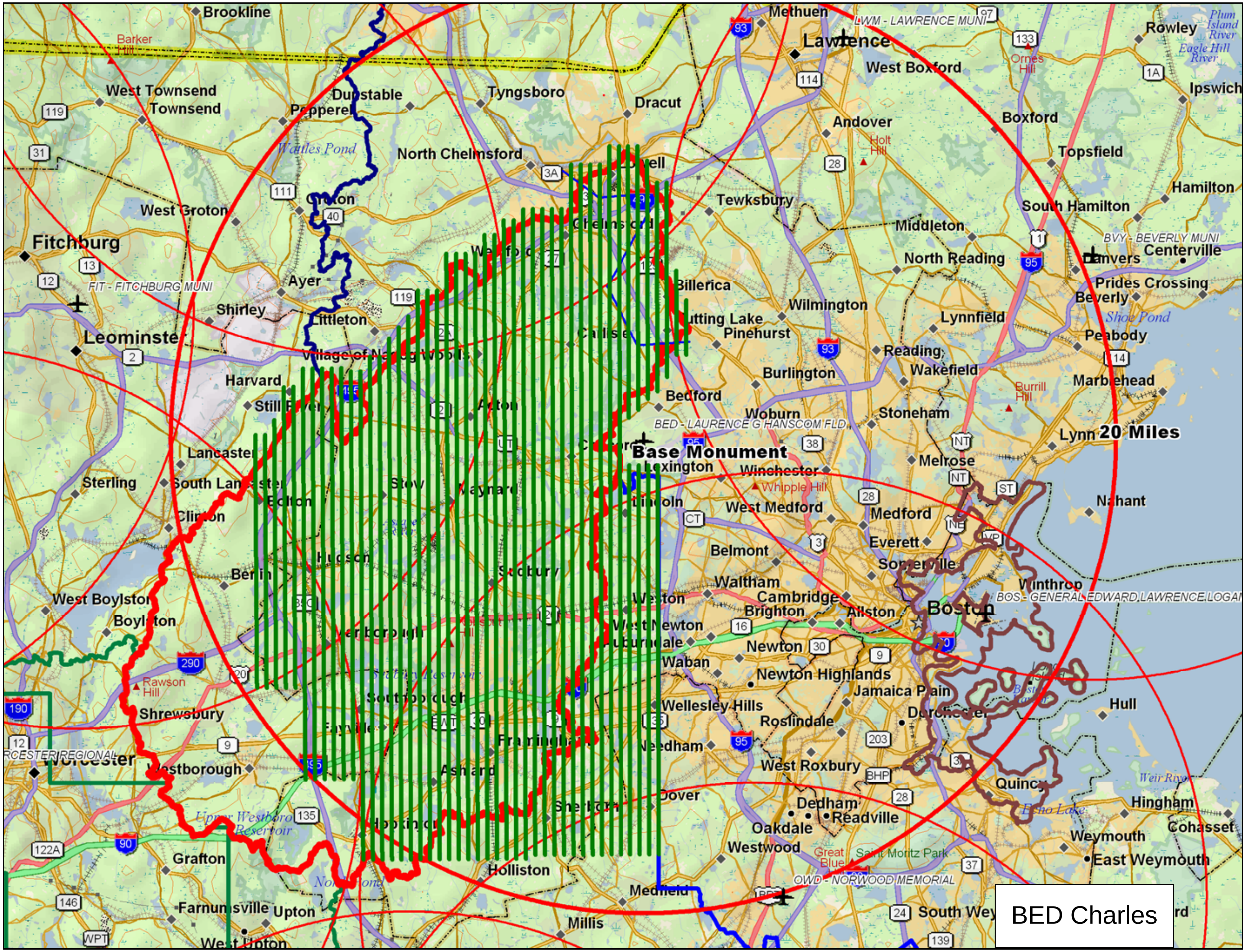
```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1         National Geodetic Survey,   Retrieval Date = OCTOBER 29, 2010
 AI5558 ***********************************************************************
 AI5558  PACS         -  This is a Primary Airport Control Station.
 AI5558  DESIGNATION -  BED A
 AI5558  PID          -  AI5558
 AI5558  STATE/COUNTY-  MA/MIDDLESEX
 AI5558  USGS QUAD    -
 AI5558
 AI5558                          *CURRENT SURVEY CONTROL
 AI5558  ___________________________________________________________________
 AI5558* NAD 83(2007)-  42 28 07.77843(N)    071 16 59.30167(W)     ADJUSTED
 AI5558* NAVD 88     -        42.05   (meters)     138.0    (feet)  GPS OBS
 AI5558  ___________________________________________________________________
 AI5558  EPOCH DATE  -        2002.00
 AI5558  X           -   1,512,043.591 (meters)                     COMP
 AI5558  Y           -  -4,462,815.458 (meters)                     COMP
 AI5558  Z           -   4,284,170.733 (meters)                     COMP
 AI5558  LAPLACE CORR-           4.06  (seconds)                    DEFLEC09
 AI5558  ELLIP HEIGHT-          14.280 (meters)         (02/10/07) ADJUSTED
 AI5558  GEOID HEIGHT-         -27.77  (meters)                     GEOID09
 AI5558
 AI5558  ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
 AI5558  Type    PID    Designation                      North   East  Ellip
 AI5558  -------------------------------------------------------------------
 AI5558  NETWORK AI5558 BED A                             1.00   0.86   2.27
 AI5558  -------------------------------------------------------------------
 AI5558
 AI5558.This mark is at Laurence G Hanscom Fld Airport (BED)
 AI5558
 AI5558.The horizontal coordinates were established by GPS observations
 AI5558.and adjusted by the National Geodetic Survey in February 2007.
 AI5558
 AI5558.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
 AI5558.See National Readjustment for more information.
 AI5558.The horizontal coordinates are valid at the epoch date displayed above.
 AI5558.The epoch date for horizontal control is a decimal equivalence
 AI5558.of Year/Month/Day.
 AI5558
 AI5558.The orthometric height was determined by GPS observations and a
 AI5558.high-resolution geoid model.
 AI5558
 AI5558.GPS derived orthometric heights for airport stations designated as
 AI5558.PACS or SACS are published to 2 decimal places.  This maintains
 AI5558.centimeter relative accuracy between the PACS and SACS.  It does
 AI5558.not indicate centimeter accuracy relative to other marks which are
 AI5558.part of the NAVD 88 network.
 AI5558
 AI5558.Photographs are available for this station.
```

```
AI5558
AI5558.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AI5558
AI5558.The Laplace correction was computed from DEFLEC09 derived deflections.
AI5558
AI5558.The ellipsoidal height was determined by GPS observations
AI5558.and is referenced to NAD 83.
AI5558
AI5558.The geoid height was determined by GEOID09.
AI5558
AI5558;                    North         East     Units Scale Factor Converg.
AI5558;SPC MA M     -   913,166.589   217,834.126   MT  0.99997548   +0 08 44.4
AI5558;SPC MA M     - 2,995,947.38    714,677.46   sFT  0.99997548   +0 08 44.4
AI5558;UTM  19      - 4,704,357.395   312,305.643   MT  1.00003346   -1 32 31.2
AI5558
AI5558!             -  Elev Factor  x  Scale Factor =   Combined Factor
AI5558!SPC MA M     -   0.99999776  x   0.99997548  =   0.99997324
AI5558!UTM  19      -   0.99999776  x   1.00003346  =   1.00003122
AI5558
AI5558:                Primary Azimuth Mark                       Grid Az
AI5558:SPC MA M     -  BED B                                      098 36 23.5
AI5558:UTM  19      -  BED B                                      100 17 39.1
AI5558
AI5558|---------------------------------------------------------------------|
AI5558| PID    Reference Object                     Distance      Geod. Az  |
AI5558|                                                           dddmmss.s |
AI5558| AI5559 BED B                               458.707 METERS 0984507.9 |
AI5558| MY0669 BED ARP                             APPROX. 0.5 KM 2854318.4 |
AI5558|---------------------------------------------------------------------|
AI5558
AI5558                          SUPERSEDED SURVEY CONTROL
AI5558
AI5558  ELLIP H (06/04/02)   14.273  (m)                         GP(       ) 4 1
AI5558  NAD 83(1996)-  42 28 07.77845(N)    071 16 59.30211(W) AD(       ) B
AI5558  ELLIP H (05/22/00)   14.281  (m)                         GP(       ) 4 1
AI5558
AI5558.Superseded values are not recommended for survey control.
AI5558.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AI5558.See file dsdata.txt to determine how the superseded data were derived.
AI5558
AI5558_U.S. NATIONAL GRID SPATIAL ADDRESS: 19TCH1230504357(NAD 83)
AI5558_MARKER: DD = SURVEY DISK
AI5558_SETTING: 66 = SET IN ROCK OUTCROP
AI5558_STAMPING: BED A 1999
AI5558_MARK LOGO: NOS
AI5558_MAGNETIC: N = NO MAGNETIC MATERIAL
AI5558_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
AI5558+STABILITY: POSITION/ELEVATION WELL
AI5558_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AI5558+SATELLITE: SATELLITE OBSERVATIONS - May 20, 2002
AI5558
AI5558  HISTORY     - Date     Condition        Report By
AI5558  HISTORY     - 1999     MONUMENTED       WOOLPT
AI5558  HISTORY     - 20020520 GOOD             INDIV
AI5558
AI5558                          STATION DESCRIPTION
AI5558
```

```
AI5558'DESCRIBED BY WOOLPERT CONSULTANTS 1999 (ARL)
AI5558'THE STATION IS LOCATED ABOUT 4.95 MI (7.97 KM) EAST OF CONCORD, 3.00
AI5558'MI (4.83 KM) WEST-NORTHWEST OF LEXINGTON, AT THE L.G.  HANSCOM FIELD
AI5558'AIRPORT, IN THE HIGHEST POINT OF HILL IN THE WEST ANGLE FORMED BY THE
AI5558'INTERSECTION OF RUNWAYS.  OWNERSHIP--MASSACHUSETTS PORT AUTHORITY, C/O
AI5558'AIRPORT MANAGER BARBARA PATZNER, CIVIL AIR TERMINAL, HANSCOM FIELD,
AI5558'BEDFORD MA 01730.  PHONE (617) 274-7200.  CONTACT THE AIRPORT MAMAGER
AI5558'AT LEAST 24 HOURS PRIOR TO ACCESS TO ARRANGE FOR AN ESCORT.
AI5558'TO REACH THE STATION FROM THE JUNCTION OF INTERSTATE HIGHWAY 95 AND
AI5558'STATE HIGHWAY 2A, EXIT 45, GO WEST FOR 1.60 MI (2.57 KM) ON HIGHWAY 2A
AI5558'TO A PAVED ROAD ON THE RIGHT.  TURN RIGHT AND GO NORTH FOR 0.50 MI
AI5558'(0.80 KM) ON THE PAVED ROAD TO A FORK.  BEAR LEFT AND GO NORTH FOR
AI5558'0.55 MI (0.89 KM) ON THE PAVED ROAD, FOLLOWING SIGNS TO THE CIVIL AIR
AI5558'TERMINAL, AND A GATE AT THE NORTHWEST CORNER OF THE AIRPORT TERMINAL
AI5558'BUILDING.  PASS THROUGH THE GATE AND PROCEED NORTH 0.10 MI (0.16 KM)
AI5558'ACROSS THE WEST RAMP TO TWY SIERRA.  GO NORTHEAST 0.5 MI (0.8 KM)
AI5558'ALONG TWY SIERRA TO TWY ECHO.  HEAD EAST 0.3 MI (0.5 KM) ALONG TWY
AI5558'ECHO, PAST TWY GULF TO STATION ON THE LEFT, SET ON THE EAST SIDE OF
AI5558'THE HILL NEAR THE CROWN.
AI5558'THE STATION IS LOCATED ONLINE WITH THE THIRD SET OF TWY LIGHTS WEST OF
AI5558'A TWY LEADING TO THE EAST RAMP, 121.20 M (397.64 FT) SOUTH SOUTHWEST
AI5558'OF THE EDGE OF PAVEMENT OF RWY 11-29, ROCK OUTCROP, 73.34 M (240.62
AI5558'FT) NORTH NORTHEAST OF THE EDGE OF PAVEMENT OF TWY ECHO, 48.23 M
AI5558'(158.23 FT) SOUTHWEST OF A SAFETY BOUNDARY MARKER FOR RWY 11-29, AND
AI5558'7.50 M (24.61 FT) EAST OF THE TOP OF SLOPE THE STATION IS A STANDARD
AI5558'NOS DISK STAMPED-- BED A 1999-- SET IN A EXPOSED PORTION OF THE ROCK
AI5558'LEDGE, AND IS SUBSET 3 CM INTO THE ROCK.  THIS STATION IS DESIGNATED
AI5558'AS THE PRIMARY AIRPORT CONTROL STATION.
AI5558
AI5558                          STATION RECOVERY (2002)
AI5558
AI5558'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2002 (KL)
AI5558'FOUND IN GOOD CONDITION BY MASSPORT - HANSCOM FIELD AIRPORT OPERATIONS
AI5558'
AI5558'(KL)  CONTACT NUMBER FOR ACCESS TO SURVEY MARK HAS CHANGED.  NEW
AI5558'NUMBER IS 781-869-8000  BARBARA PATZNER, AIRPORT MANAGER
AI5558'

*** retrieval complete.
Elapsed Time = 00:00:00
```

Reformatory Branch Trail
Hartwell Rd
Shaw Cir
Charles St
Evergreen Ave
Nellian St
Minuteman Commuter Bikeway
Summer St
Sarah Ave
S Rd
Lynnfield St
Fayette Rd
Maguire
BED ARP
BED ARP
BED A
Fuller Ln
Dow St
Hunter St
Robbins St
Chenault St
Grenier St
Hartwell Pl
Forbes St
Barksdale St
Hartwell Ave
E Ramp
Eglin St
Arnold St
Marrett St
Old Bedford Rd
Virginia Rd
Shadyside Ave
Airport Rd
Bestic Dr
McCord St
Wood St
Schilling Cir
Hanscom Dr
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Google
© 2011 Europa Technologies
Google
42°28'09.97" N 71°17'09.84" W
elev 127 ft
Jun 19, 2010
Eye alt 12317 ft

XMap® 4.5



Scale 1 : 350,000

1" = 5.52 mi Data Zoom 9-0

STATE(s): MASSACHUSETTS

Project Numbers 7556-005 A004

AREA ID: BED-CHARLES / CONCORD

AREA NAME: BED-CHARLES (BEDFORD, MA)

FILE TYPES/NAMES: ☒ OPTECH: BED_CHARLES ☒ LEICA: BED_CHARLES

Lines: 50 FL Miles: 1008 Square Miles: ______ Flight Altitudes: 5000' Tide Coord: Yes *See Notes* NO

AIRPORT ID: BED Name: HANSCOMB FIELD

Services: FULL ☒ Self ☒ None ☐ *See Notes* RUNWAY Length: 7001 Ft

Contact Name(s): Barbara Patzner / Menzger

Phone(s): (781) 869-8000 (___) ___-_____ e-mail: ______

Hotels: ALL MAJOR

Rentals: ALL MAJOR

EXIST BASE Station: A15558 Name: BED A

TYPE: PACS ☒ SACS ☐ Other ☐ *Data Sheet Attached* ☒

SET BASE STATION Name: ______ Date Set: ______

What was Set: Re-Bar ☐ or: ______ CAP: ______

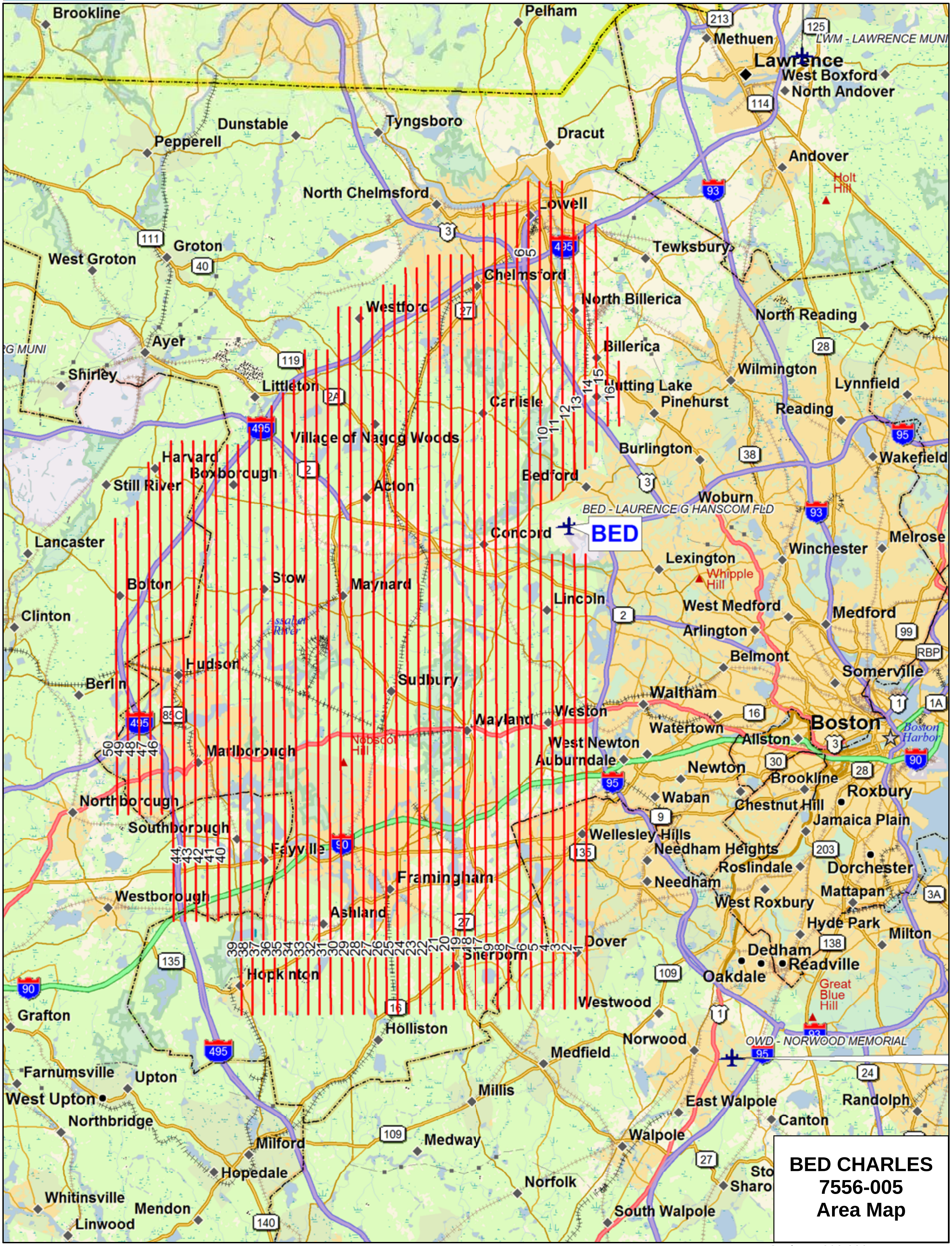
Who Set: ______ Where Set: ______ *Attach Data Sheet*

Logs ☑ by: LR Sectional ☐ by: LR Lo En-route ☑ by: LR Database ☑ by: LR OPTECH ☒ by: PB LEICA ☒ by: PB

Accuracy: Vert; 24.5 Horiz; ____cm Post Spacing: 1.0 Points Sq Meter: ______

NOTES: TOWERED AIRPORT

CALL AHEAD FOR SECURITY ACCESS



Data use subject to license.

www.delorme.com

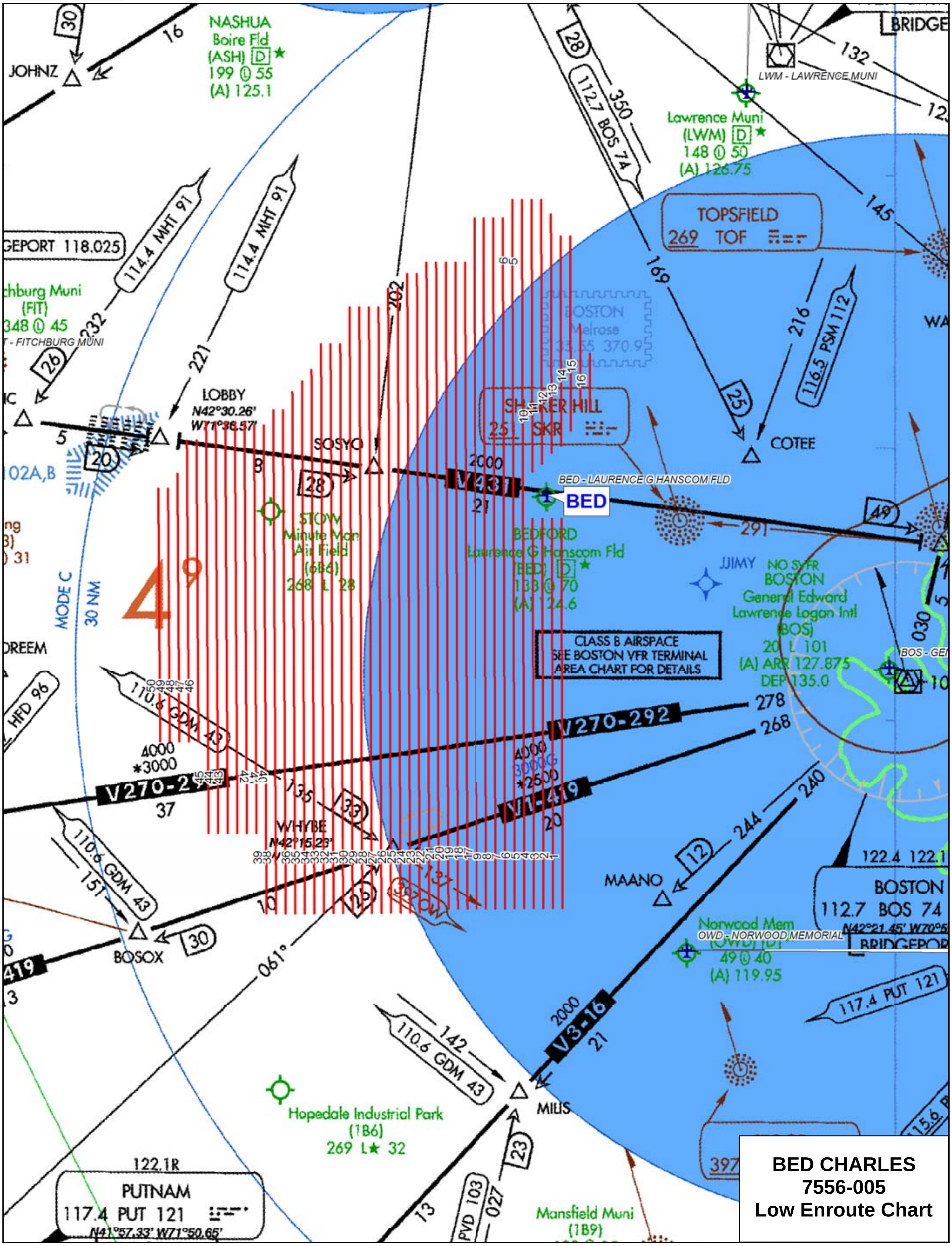
TN

MN (15.0°W)

Scale 1 : 300,000

1" = 4.73 mi

Data Zoom 9-2



BED CHARLES
7556-005
Low Enroute Chart

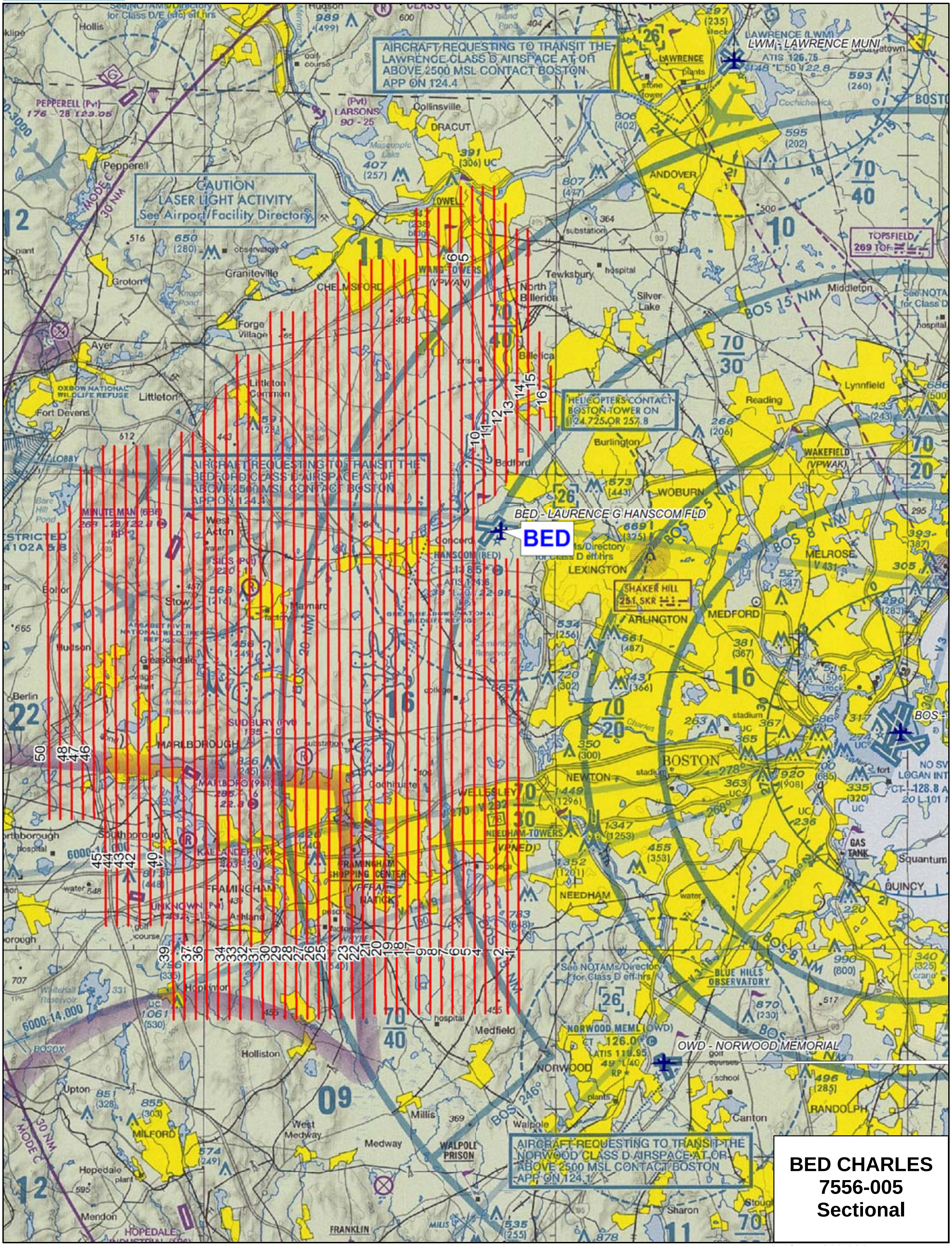
Scale 1 : 350,000

1" = 5.52 mi
Data Zoom 9-2

TN
MN (15.0°W)

DELORME

XMap® 4.5



Scale 1 : 300,000

1" = 4.73 mi

Data Zoom 9-2

MN (15.0°W)

TN

Mass Area: BED-Charles Project No 7556-005

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

Flight Logs

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	16.4	5180	BED A	BED_Charles. BED_CHARLE				
2	16.4	5190	BED A	BED_Charles. BED_CHARLE				
3	16.4	5190	BED A	BED_Charles. BED_CHARLE				
4	16.4	5200	BED A	BED_Charles. BED_CHARLE				
5	29.9	5170	BED A	BED_Charles. BED_CHARLE				
6	29.9	5170	BED A	BED_Charles. BED_CHARLE				
7	29.1	5180	BED A	BED_Charles. BED_CHARLE				
8	29.1	5170	BED A	BED_Charles. BED_CHARLE				
9	29.1	5170	BED A	BED_Charles. BED_CHARLE				
10	11.5	5140	BED A	BED_Charles. BED_CHARLE				
11	11.2	5140	BED A	BED_Charles. BED_CHARLE				
12	10.0	5150	BED A	BED_Charles. BED_CHARLE				
13	8.8	5160	BED A	BED_Charles. BED_CHARLE				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________________ AIRCRAFT Tail Number: ____________________

Pilot: ____________________ Sensor Serial Number: ____________________ Date: ____________________

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	8.2	5170	BED A	BED_Charles. BED_CHARLE				
15	3.5	5200	BED A	BED_Charles. BED_CHARLE				
16	2.3	5190	BED A	BED_Charles. BED_CHARLE				
17	29.1	5170	BED A	BED_Charles. BED_CHARLE				
18	27.3	5180	BED A	BED_Charles. BED_CHARLE				
19	27.3	5180	BED A	BED_Charles. BED_CHARLE				
20	27.3	5170	BED A	BED_Charles. BED_CHARLE				
21	27.3	5170	BED A	BED_Charles. BED_CHARLE				
22	27.4	5180	BED A	BED_Charles. BED_CHARLE				
23	27.0	5190	BED A	BED_Charles. BED_CHARLE				
24	27.0	5190	BED A	BED_Charles. BED_CHARLE				
25	26.4	5190	BED A	BED_Charles. BED_CHARLE				
26	26.4	5190	BED A	BED_Charles. BED_CHARLE				
27	25.5	5200	BED A	BED_Charles. BED_CHARLE				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________________ AIRCRAFT Tail Number: ____________________

Pilot: ____________________ Sensor Serial Number: ____________________ **Date:** ____________________

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	25.5	5210	BED A	BED_Charles. BED_CHARLE				
29	25.5	5230	BED A	BED_Charles. BED_CHARLE				
30	25.5	5240	BED A	BED_Charles. BED_CHARLE				
31	24.0	5240	BED A	BED_Charles. BED_CHARLE				
32	24.0	5240	BED A	BED_Charles. BED_CHARLE				
33	24.0	5250	BED A	BED_Charles. BED_CHARLE				
34	22.9	5260	BED A	BED_Charles. BED_CHARLE				
35	22.4	5260	BED A	BED_Charles. BED_CHARLE				
36	22.0	5280	BED A	BED_Charles. BED_CHARLE				
37	21.2	5300	BED A	BED_Charles. BED_CHARLE				
38	21.2	5300	BED A	BED_Charles. BED_CHARLE				
39	20.6	5310	BED A	BED_Charles. BED_CHARLE				
40	17.2	5300	BED A	BED_Charles. BED_CHARLE				
41	17.4	5300	BED A	BED_Charles. BED_CHARLE				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________ *AIRCRAFT Tail Number:* ____________

Pilot: ____________ *Sensor Serial Number:* ____________ **Date:** ____________

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
42	17.4	5310	BED A	BED_Charles. BED_CHARLE				
43	17.4	5340	BED A	BED_Charles. BED_CHARLE				
44	17.4	5360	BED A	BED_Charles. BED_CHARLE				
45	17.4	5360	BED A	BED_Charles. BED_CHARLE				
46	12.7	5370	BED A	BED_Charles. BED_CHARLE				
47	12.7	5370	BED A	BED_Charles. BED_CHARLE				
48	11.3	5370	BED A	BED_Charles. BED_CHARLE				
49	10.7	5360	BED A	BED_Charles. BED_CHARLE				
50	10.7	5360	BED A	BED_Charles. BED_CHARLE				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________ *AIRCRAFT Tail Number:* ____________

Pilot: ____________ *Sensor Serial Number:* ____________ **Date:** ____________

BED

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

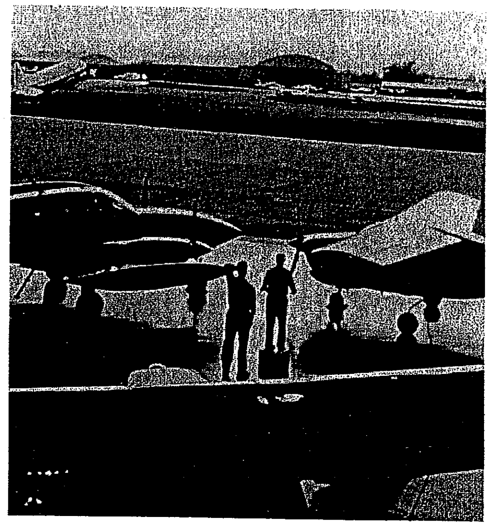
Project: Fema Mass

Location: KBED (Hanscom Field)

Project Number: 7556-005

Completed by: Berry / Galieti

Date: December 2, 2010



Receiver: Trimble

Receiver Type: 5700

Antenna Type: Zephyr Geodetic

Station ID: BEDA

Start -- H.I. (m): 1.384 m / 1.382 m / 1.383m

End -- H.I. (m): 1.383m

H.I. (ft): 4.54 ft.

Start Time: 1809 Z / 109 pm

End Time: 440 pm

Time Zone: EST

Operator: Berry / Galieti

Comments 101202a-246
101202a-247

PSI\FORMS\Station Occupation Report August 9, 2010

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	FEMA MAS
Project Number	7556-005
ALTM-NAV .pln File	BED_Charles.pln

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	
Scan Rate:	30.10 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	–
		Range	–

Pilot	Caldwell
Operator	Berry
Aircraft	N7266Z

Data Information	
LiDAR Unit	Optech Gemini sn246
HD #	246 HD
POS File Name	101202a
from, to	000 → 012

Date Flown: December 02, 2010			
Takeoff Time (Z): 1900Z	Local: 200 PMEST	Airport BED	
Landing Time (Z) 2020Z	Local: 320 PMEST	Airport BED	

	Ground	Airport
Begin Temp	6	BED
Begin Dewpoint	-4	
Begin Pressure	2994	
End Temp		BED
End Dewpoint		
End Pressure		

GPS Base Location(s)	BED A
PDOP Avoidance	On grnd @ 330 PMEST
Static or Flyover?	Static --> if flyovers, times: -

101202a-246

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
26	1920	1920	——	S	——	——		Aborted
26	1925	1932	5150'	S	116	100%	9	Half line
27	1937	1950	5190'	N	116	100%	-8	Clear Smooth
28	1954	2007	5070'	S	116	100%	6	Clear Smooth
Improv	2009	2010	5100'	E	116	100%	-6	" "

Sheet 1 of 1

ODD North
EVEN South

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	BED_charles
Project Number	7556-005
ALTM-NAV .pln File	bed_charles.pln

Pilot	Greenwell
Operator	Galichi
Aircraft	N2448G

Date Flown: 12/2/2010		
Takeoff Time (Z):	Local:	Airport BED
Landing Time (Z):	Local:	Airport

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5183
Scan Rate:	30.1 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples / Range	

Data Information

LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	101202a
from, to	0 → 14

	Ground	Airport
Begin Temp	6°C	KBED
Begin Dewpoint	-4°C	
Begin Pressure	29.95Hg	
End Temp	6°C	KBED
End Dewpoint	-4°C	
End Pressure	2996Hg	

101202a-247

GPS Base Location(s)		
PDOP Avoidance	3:30 pm local	2030 Z
Static or Flyover?	static	--> if flyovers, times: —

A

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
1	1910	1918	5132	359	118	~100%	6	
13	1919	1924	5164	359	120	~100%	5	
14	1928	1933	5167	179	116	~100%	5	possibly fast at south end of line
15	1937	1940	5250	359	118	~100%	4	
16	1945	1949	5186	179	114	~100%	6	
12	1955	2001	5180	179	115	~100%	5	
11	2004	2010	5170	359	114	~100%	4	
cross line	2015	2017	5112	090	122	~100%	2	

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report For Airborne GPS

Project: FEMA MASS

Location: KBED HANSCOM FIELD

Project Number: 7556-005

Completed by: Berry / Galieti

Date: December 3, 2010

Receiver: Trimble

Receiver Type: 5700

Antenna Type: Zephyr Geodetic

Station ID: BED A

Start -- H.I. (m): 1.444m / 1.445m / 1.445m

End -- H.I. (m): 1.445 m

H.I. (ft): 4.74 ft.

Start Time: 7:30 AM

End Time: 1042 AM

Time Zone: EST

Operator: Berry

Comments 1012039-246
1012030-247

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	FEMA - MASS
Project Number	7556-005
ALTM-NAV pln File	BED - Charles .pln

Pilot	Caldwell
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 03, 2010		
Takeoff Time (Z): 1340Z	Local: 840AMEST	Airport BED	
Landing Time (Z) 1455Z	Local: 955AMEST	Airport BED	

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	4500'
Scan Rate:	30.10 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples — / Range —

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD2
POS File Name	101203a
from, to	000 → 012

	Ground	Airport
Begin Temp	2°C	BED
Begin Dewpoint		
Begin Pressure	2995	
End Temp		BED
End Dewpoint		
End Pressure		

GPS Base Location(s)	BED A	
PDOP Avoidance	Good all day	
Static or Flyover?	Static	--> if flyovers, times: —

101203a246

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
29	1353	1405	5200	N	116	100%	-3	Calm; Smooth
30	1409	1421	5200'	S	116	100%	1	" "
31	1425	1437	5200'	N	116	100%	-3	" " Clouds
Improv	1439	1440	5200'	E	116	100%	-9	" "

Sheet 1 of 1

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	BED-Charles
Project Number	7556-005
ALTM-NAV pln File	BED-Charles.pln

Pilot	Greenwell
Operator	Galieft
Aircraft	N2448G

Date Flown:	12/3/2010				
Takeoff Time (Z):	1340	Local:	840 EST	Airport	KBED
Landing Time (Z):	1507	Local:	1007 EST	Airport	KBED

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5006
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	–
		Range	–

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	101203a
from, to	0 → 15

	Ground	Airport
Begin Temp	-1 °C	KBED
Begin Dewpoint	-4°C	
Begin Pressure	29.96	
End Temp	2 °C	KBED.
End Dewpoint	-3°C	
End Pressure	29.95 Hg	

GPS Base Location(s)	BED A (PAC)	
PDOP Avoidance	none	
Static or Flyover?	static	--> if flyovers, times: –

101203a-247

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
9	1401	1415	5186	179	119	~100%	5	
17	1419	1433	5150	359	115	~100%	6	clouds possible @ North end line, laser cut out @top.
18	1436	1450	5160	179	115	~100%	3	cloud interf. possible on line (5 (toward start) -10, 12 (end))
cross line	1454	1455	5060	080	123	~100%	5	

Redo top 10mi

Sheet 1 of 1

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: FEMA - MASS

Location: KBED HANSCOMB FIELD

Project Number: 7556-005

Completed by: Berry/Galieti

Date: December 7, 2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr

Station ID: BEDA

Start -- H.I. (m): 1.433

End -- H.I. (m): 1.433

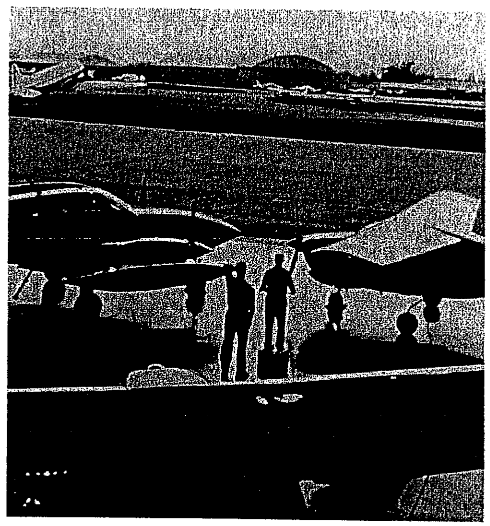
H.I. (ft): 4.695

Start Time: 750AM

End Time: 11:51AM

Time Zone: EST

Operator: Berry



Comments

101207a-246
101207a-247

PSI\FORMS\Station Occupation Report August 9, 2010

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE *Geospatial Solutions*

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	FEMA MASS
Project Number	7556-005
ALTM-NAV pln File	BED_Charles.pln

Pilot	YOUNG
Operator	BERRY
Aircraft	N7266Z

Date Flown:	December 7, 2010			
Takeoff Time (Z):	1315Z	Local: 815AM EST	Airport	BED
Landing Time (Z)	1545Z	Local: 1045AM EST	Airport	BED

Project's Scanning Requirements

FOV (half-degrees):	± 18.00 °	Altitude AGL (ft): 5000'
Scan Rate:	30.0 Hz	MPiA or SPiA
Pulse Rate:	71 kHz	Fixed or Auto
Ground Speed:	116 kts	A.R.F. : Samples – Range –

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD2
POS File Name	101207a
from, to	000 → 023

	Ground	Airport
Begin Temp	-3°C	BED
Begin Dewpoint	-10°C	
Begin Pressure	2933	
End Temp	0°C	BED
End Dewpoint	-11°C	
End Pressure	2935	

GPS Base Location(s)	BED A	
PDOP Avoidance	Good all day	
Static or Flyover?	Static	--> if flyovers, times: –

101207a-246

Refly

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
26	1327	1333	5300'	S	116	100%	8	Smooth Calm: Clouds above and SE/SW
31	1338	1341	5250'	N	116	100%	-9	Just the N end for patching
32	1345	1357	5250'	S	116	100%	8	Some turbulence on South End
33	1401	1412	5250'	N	116	100%	-9	Some turbulence on South end
34	1417	1428	5250'	S	116	100%	7	" "
35	1432	1442	5250'	N	116	100%	-9	" "
36	1446	1456	5300'	S	116	100%	7	" "
37	1501	1511	5300'	N	116	100%	-8	" "
38	1515	1522	5300'	S	116	100%	11	" " Partial 3/4 completed
39	1526	1534	5320'	N	116	100%	-7	" " Partial 3/4 complete
Impov	1537	1539	5300'	E	116	100%	-12	" "

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	BED-Charles
Project Number	7556-005
ALTM-NAV .pln File	BED-Charles.pln

Pilot	Greenwell
Operator	Galicth
Aircraft	N2448G

Date Flown:	12/7/2010				
Takeoff Time (Z):	1346	Local:	840	Airport	KBed
Landing Time (Z):	1636	Local:	1130	Airport	KBed

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5,000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples / Range	

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	101207a
from, to	0 → 24

	Ground	Airport
Begin Temp	-3 C	KBED
Begin Dewpoint	-10 C	
Begin Pressure	29.33Hg	
End Temp		KBED.
End Dewpoint		
End Pressure		

notes: line 17 N heading top 10 min

GPS Base Location(s)	Bed A	
PDOP Avoidance	none	
Static or Flyover?	static	-> if flyovers, times:

101207a-247

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
10	1352	1358	5103	179	120	~100%	10	
4	1358	1406	5122	179	109	~100%	9	
3	1411	1419	5173	359	113	~100%	7	
2	1424	1432	5224	179	112	~100%	9	
5	1436	1450	5140	359	110	~100%	7	
6	1455	1509	5184	179	118	~100%	8	
7	1513	1527	5218	357	114	~100%	7	
R 8	1531	1543	5180	179	121	~100%	9	10 mi. from S end possible clds; left partial @ Se
cross line	1547	1549	5193	080	124	~100%	6	
R 17	1554	1601	5054	359	110	~100%	6	

Sheet 1 of 1

10 5

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: FEMA-MASS

Location: KBED

Project Number: 7556-005

Completed by: Berry

Date: 12-10-2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr

Station ID: BED A

Start -- H.I. (m): 1.410

End -- H.I. (m): 1.410

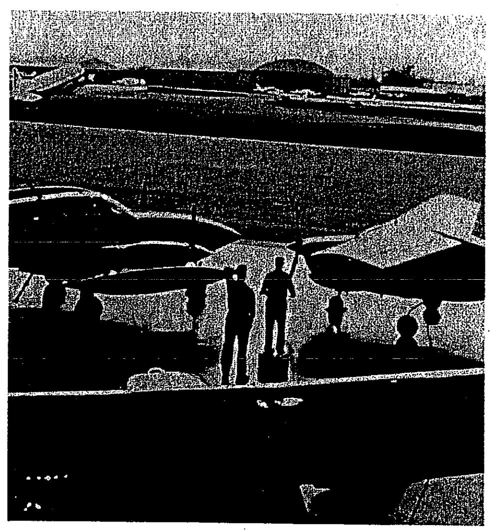
H.I. (ft): 4.625

Start Time: 11:35AM EST

End Time: 5:53 PM EST

Time Zone: EST

Operator: Berry



Comments 101210b-246
101210b-247

PSI\FORMS\Station Occupation Report August 9, 2010

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema - Mass
Project Number	7556-005
ALTM-NAV plnFile	Bed-Charles.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 12, 2010				
Takeoff Time (Z):	1735Z	Local:	1235 PM EST	Airport	BED
Landing Time (Z)	2045Z	Local:	345PM EST	Airport	BED

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000'
Scan Rate:	30.10 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	–
		Range	–

Data Information	
LiDAR Unit	Optech Gemini sn246
HD #	246HD1
POS File Name	101210b
from, to	000 → 027

	Ground	Airport
Begin Temp	-7°c	BED
Begin Dewpoint	-14°c	
Begin Pressure	30.39	
End Temp	-4°c	BED
End Dewpoint	-15°c	
End Pressure	30.38	

GPS Base Location(s)	BED A	
PDOP Avoidance	Good all day	
Static or Flyover?	Static	--> if flyovers, times: –

101210b-246

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
36	1744	1754	5300'	S	116	100%	5	Clear below and smooth; Hazy
37	1758	1808	5300'	N	116	100%	-7	
38	1811	1821	5300'	S	116	100%	6	
39	1825	1834	5300'	N	116	100%	-6	
40	1837	1846	5300'	S	116	100%	5	
41	1849	1857	5300'	N	116	100%	-6	
42	1900	1908	5300'	S	116	100%	4	
43	1911	1919	5300	N	116	100%	-7	
44	1923	1931	5300'	S	116	100%	5	
45	1934	1942	5300	N	116	100%	-6	
46	1947	1953	5300	S	116	100%	5	
47	1956	2003	5370'	N	116	100%	-9	
48	2006	2012	5350'	S	116	100%	6	
49	2015	2020	5350	N	116	100%	-7	
50	2024	2029	5400'	S	116	100%	5	
Improv	2032	2035	5400'	E	116	100%	7	

Sheet 1 of 1

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions
2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	BED Charles. 1
Project Number	7556-005
ALTM-NAV pln File	Bed_charles.pln

Pilot	Greenwell
Operator	Galicki
Aircraft	N2448G

Date Flown: 12/10/2010 #2		
Takeoff Time (Z): 1730	Local: 1230	Airport KBED
Landing Time (Z): 2200	Local: 500	Airport KBED

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft): 5000	
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples
			Range

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	2
POS File Name	1012106
from, to	0 → 35

	Ground	Airport
Begin Temp	-7 C	KBED
Begin Dewpoint	-14 C	
Begin Pressure	30.39 Hg	
End Temp	-4 C	KBED.
End Dewpoint	-14 C	
End Pressure	30.35 Hg	

GPS Base Location(s)	BED A
PDOP Avoidance	none during day
Static or Flyover?	static --> if flyovers, times:

1012106-247

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
R 5	1754	1808	5130	359	116	100	6	
R 6	1813	1828	5140	179	116	100	7	
R 7	1832	1846	5170	359	116	100	6	
R 8	1851	1905	5150	179	114	100	5	
19	1909	1922	5190	359	119	~100	6	high drops might be. lakes? @ S-end
20	1927	1940	5180	179	119	100	5	
21	1945	1958	5190	359	119	100	5	
22	2003	2016	5180	179	115	100	6	
23	2021	2033	5200	359	115	100	6	
24	2039	2052	5190	179	112	100	8	3mi S of N end HZ/thin cloud.
X 25	2057	—	5230	359	122	—	7	software cropped out mid line.
25	2109	2121	5183	359	125	100	8	
R 17	2132	2137	5190	359	118	~	7	Reshoot North 10mi of line (high returns prob bad data)
Crossline	2149	2146	5000	270	114	100	6	

whole line Reshoot

Redo middle 1/3

Sheet ___ of ___

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: BED-Charles FEMA-MASS 7556-005

Location: KBED
Project Number: 7556-005
Completed by: Nathan Galieti
Date: 12/11/2010

Receiver:
Receiver Type: trimble 5700
Antenna Type:
Station ID: KBED A (PAC)
Start -- H.I. (m): 1.471 m.
End -- H.I. (m): 1.469 / 1.470 m
H.I. (ft): 4.83 ft.
Start Time: 845 AM
End Time: 10:35 AM
Time Zone: EST
Operator: Nathan Galieti

Comments 101211a-247

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	BED_charles
Project Number	7556-005
ALTM NAV .pln File	BED_Charles.pln

Pilot	Greenwell
Operator	Galicki
Aircraft	N2448G

Date Flown:	12/11/10				
Takeoff Time (Z):	1400	Local:	9:00 AM	Airport	KBED
Landing Time (Z):	1525	Local:	10:25 AM	Airport	KBED

Project's Scanning Requirements		
FOV (half-degrees):	± 18 °	Altitude AGL (ft): 5000
Scan Rate:	30 Hz	MPiA or SPiA
Pulse Rate:	70 kHz	Fixed or Auto
Ground Speed:	116 kts	A.R.F.: Samples / Range

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	101211a
from, to	0 →

	Ground	Airport
Begin Temp	-2 C	KBED
Begin Dewpoint	-6 C	
Begin Pressure	30.25 Hg	
End Temp	-2	KBED
End Dewpoint	-4	
End Pressure	30.25 Hg	

GPS Base Location(s)	KBED A (PAC)	
PDOP Avoidance	none during day.	
Static or Flyover?	static	--> if flyovers, times:

101211a-247 winds clm clear

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
R 17	1425	1431	5160	359	117	100	14	
R 24	1435	1448	5190	179	116	100	15	
R 25	1453	1505	5190	359	120	100	12	
crossline	1509	1510	5180	090	125	100	2	

Sheet 1 of 1

Mass Area: BED-Charles Project No 7556-005 Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

	FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments	
	1	16.4	5180	BED A	BED_Charles. BED_CHARLE	12/2/2010	247			
	2	16.4	5190	BED A	BED_Charles. BED_CHARLE	12/7/2010	247			
	3	16.4	5190	BED A	BED_Charles. BED_CHARLE	12/7/2010	247			
	4	16.4	5200	BED A	BED_Charles. BED_CHARLE	12/7/2010	247			
N	5	29.9	5170	BED A	BED_Charles. BED_CHARLE	12/7 12/10	247	X	flew on 12/7 but Atmospheric returns line will be reflown	Good ✓
S	6	29.9	5170	BED A	BED_Charles. BED_CHARLE	12/7 12/10	247	X	same as line 5 ~~Refly~~	Good ✓
N	7	29.1	5180	BED A	BED_Charles. BED_CHARLE	12/7 12/10	247	X	same as line 5 ~~Refly~~	Good ✓
S	8	29.1	5170	BED A	BED_Charles. BED_CHARLE	12/7 12/10	247	X	same as line 5 ~~Refly~~	Good ✓
	9	29.1	5170	BED A	BED_Charles. BED_CHARLE	12/3/2010	247			
	10	11.5	5140	BED A	BED_Charles. BED_CHARLE	12/7/2010	247			
	11	11.2	5140	BED A	BED_Charles. BED_CHARLE	12/2/2010	247			
	12	10.0	5150	BED A	BED_Charles. BED_CHARLE	12/2/2010	247			
	13	8.8	5160	BED A	BED_Charles. BED_CHARLE	12/2/2010	247			

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galiefi **AIRCRAFT Tail Number:** N2448G

Pilot: Greenwell **Sensor Serial Number:** 247

Date:

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	8.2	5170	BED A	BED_Charles. BED_CHARLE	12/2/2010	247		possible fast ground speed at south end of line
15	3.5	5200	BED A	BED_Charles. BED_CHARLE	12/2/2010	247		
16	2.3	5190	BED A	BED_Charles. BED_CHARLE	12/2/2010	247		
17	29.1	5170	BED A	BED_Charles. BED_CHARLE	12/3/2010	247		Reflew on 12/7/10 But data bad 12/1/10 GOOD ✓ ~~Refly Again~~
18	27.3	5180	BED A	BED_Charles. BED_CHARLE	12/3/2010	247		
19	27.3	5180	BED A	BED_Charles. BED_CHARLE	12/10/2010	247		
20	27.3	5170	BED A	BED_Charles. BED_CHARLE	12/10/2010	247		
21	27.3	5170	BED A	BED_Charles. BED_CHARLE	12/10/2010	247		
22	27.4	5180	BED A	BED_Charles. BED_CHARLE	12/10/2010	247		
23	27.0	5190	BED A	BED_Charles. BED_CHARLE	12/10/2010	247		
24	27.0	5190	BED A	BED_Charles. BED_CHARLE	12/10 12/11	247		~~Refly~~ high returns GOOD ✓
25	26.4	5190	BED A	BED_Charles. BED_CHARLE	12/10 12/11	247		~~Refly~~ middle 1/3 of lines high returns. GOOD ✓
26	26.4	5190	BED A	BED_Charles. BED_CHARLE	—			
27	25.5	5200	BED A	BED_Charles. BED_CHARLE				

Redo Top 10 mi ? N

N

?

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galieti
Pilot: Greenwell
AIRCRAFT Tail Number: N24486
Sensor Serial Number: 247
Date:

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	8.2	5170	BED A	BED_Charles. BED_CHARLE				
15	3.5	5200	BED A	BED_Charles. BED_CHARLE				
16	2.3	5190	BED A	BED_Charles. BED_CHARLE				
17	29.1	5170	BED A	BED_Charles. BED_CHARLE				
18	27.3	5180	BED A	BED_Charles. BED_CHARLE				
19	27.3	5180	BED A	BED_Charles. BED_CHARLE				
20	27.3	5170	BED A	BED_Charles. BED_CHARLE				
21	27.3	5170	BED A	BED_Charles. BED_CHARLE				
22	27.4	5180	BED A	BED_Charles. BED_CHARLE				
23	27.0	5190	BED A	BED_Charles. BED_CHARLE				
24	27.0	5190	BED A	BED_Charles. BED_CHARLE				
25	26.4	5190	BED A	BED_Charles. BED_CHARLE				
26	26.4	5190	BED A	BED_Charles. BED_CHARLE	12-2-10	246	JB	Complete 12-7-10 HALFLINE ✱ ✱ ✱
27	25.5	5200	BED A	BED_Charles. BED_CHARLE	↓	↓	↓	

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry **AIRCRAFT Tail Number:** N72662

Pilot: Caldwell / Young **Sensor Serial Number:** 846

Date: 12-2-2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	25.5	5210	BED A	BED_Charles. BED_CHARLE	12-2-2010	246	JB	
29	25.5	5230	BED A	BED_Charles. BED_CHARLE	12-3-2010	246	JB	
30	25.5	5240	BED A	BED_Charles. BED_CHARLE				
31	24.0	5240	BED A	BED_Charles. BED_CHARLE				Patched for Clouds
32	24.0	5240	BED A	BED_Charles. BED_CHARLE	12-7-2010	246	JB	
33	24.0	5250	BED A	BED_Charles. BED_CHARLE				
34	22.9	5260	BED A	BED_Charles. BED_CHARLE				
35	22.4	5260	BED A	BED_Charles. BED_CHARLE				
36	22.0	5280	BED A	BED_Charles. BED_CHARLE	12-10-2010	246	JB	Flown but too many atmospheric return
37	21.2	5300	BED A	BED_Charles. BED_CHARLE				
38	21.2	5300	BED A	BED_Charles. BED_CHARLE				
39	20.6	5310	BED A	BED_Charles. BED_CHARLE				
40	17.2	5300	BED A	BED_Charles. BED_CHARLE				
41	17.4	5300	BED A	BED_Charles. BED_CHARLE				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry

Pilot: Caldwell / Young

AIRCRAFT Tail Number: N72662

Sensor Serial Number: 246

Date: 12-2-2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
42	17.4	5310	BED A	BED_Charles. BED_CHARLE	10-12-2010	246	93	
43	17.4	5340	BED A	BED_Charles. BED_CHARLE				
44	17.4	5360	BED A	BED_Charles. BED_CHARLE				
45	17.4	5360	BED A	BED_Charles. BED_CHARLE				
46	12.7	5370	BED A	BED_Charles. BED_CHARLE				
47	12.7	5370	BED A	BED_Charles. BED_CHARLE				
48	11.3	5370	BED A	BED_Charles. BED_CHARLE				
49	10.7	5360	BED A	BED_Charles. BED_CHARLE				
50	10.7	5360	BED A	BED_Charles. BED_CHARLE				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young
AIRCRAFT Tail Number: N72663
Sensor Serial Number: 246

Date: 10-12-2010

```
           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KBED
Mission       : 101210B
Wheels Up     : 1735
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -7C
Visibility    : GOOD
Clouds        : 11000FT
Precipitation : NEGATIVE
Wind Dir      : CALM
Wind Speed    : CALM
Pressure      : 3039
           Statistics
------------------------------
Laser Time    : 01:59:12

=======================================
12:49:39.923 GMT : 00:00:02 (212) GPS 1PPS Lost
12:49:39.923 GMT : 00:00:03 (166) Divergence Error
12:49:39.923 GMT : 00:00:03 (107) Rx Shutter Closed
12:49:39.923 GMT : 00:00:03 (109) Tx Shutter Closed
12:49:39.923 GMT : 00:00:04 (164) Beam Wide
12:49:39.923 GMT : 00:00:09 (120) Laser PS Comm Ok
12:49:39.923 GMT : 00:00:09 (112) Laser Emission Off
12:49:39.923 GMT : 00:00:12 (204) POSAV Connected
12:49:39.923 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
12:49:39.923 GMT : 00:00:13 (211) POSAV new status
12:49:39.923 GMT : 00:00:14 (213) GPS 1PPS Ok
12:49:39.923 GMT : 00:00:17 (212) GPS 1PPS Lost
12:49:39.923 GMT : 00:00:23 (213) GPS 1PPS Ok
12:49:39.923 GMT : 00:00:36 (208) POSAV Rate Is 50 Hz
12:49:39.923 GMT : 00:00:36 (211) POSAV new status
12:49:39.923 GMT : 00:00:37 (211) POSAV new status
12:49:39.923 GMT : 00:00:38 (215) Nav Data Ok
12:49:39.923 GMT : 00:02:12 (211) POSAV new status
17:23:43.364 GMT : 00:04:48 (307) Format Disk
17:23:50.364 GMT : 00:04:55 (211) POSAV new status
17:24:00.865 GMT : 17:23:59 (153) Eyesafety Disabled
17:24:00.965 GMT : 17:23:59 (162) Roll Comp On
17:24:00.965 GMT : 17:24:00 (164) Beam Wide
```

```
17:24:01.165 GMT : 17:24:00 (144) MultiPulse Mode Varies
17:24:05.465 GMT : 17:24:04 (165) Beam Narrow
17:29:09.869 GMT : 17:29:08 (211) POSAV new status
17:42:54.782 GMT : 17:42:54 (106) Rx Shutter Open
17:42:54.982 GMT : 17:42:54 (108) Tx Shutter Open
17:44:24.183 GMT : 17:44:23 (113) Laser Emission On
17:54:54.093 GMT : 17:54:53 (112) Laser Emission Off
17:58:31.496 GMT : 17:58:30 (113) Laser Emission On
18:08:21.606 GMT : 18:08:20 (112) Laser Emission Off
18:11:32.61 GMT : 18:11:31 (113) Laser Emission On
18:21:37.521 GMT : 18:21:36 (112) Laser Emission Off
18:25:11.325 GMT : 18:25:10 (113) Laser Emission On
18:34:40.836 GMT : 18:34:39 (112) Laser Emission Off
18:38:00.24 GMT : 18:37:59 (113) Laser Emission On
18:46:07.45 GMT : 18:46:06 (112) Laser Emission Off
18:49:04.454 GMT : 18:49:03 (113) Laser Emission On
18:57:21.364 GMT : 18:57:20 (112) Laser Emission Off
19:00:35.168 GMT : 19:00:34 (113) Laser Emission On
19:08:48.679 GMT : 19:08:47 (112) Laser Emission Off
19:11:39.282 GMT : 19:11:38 (113) Laser Emission On
19:19:57.493 GMT : 19:19:56 (112) Laser Emission Off
19:23:19.098 GMT : 19:23:18 (113) Laser Emission On
19:31:43.408 GMT : 19:31:41 (112) Laser Emission Off
19:34:31.112 GMT : 19:34:30 (113) Laser Emission On
19:42:34.623 GMT : 19:42:33 (112) Laser Emission Off
19:47:19.929 GMT : 19:47:18 (113) Laser Emission On
19:53:20.037 GMT : 19:53:18 (112) Laser Emission Off
19:56:40.141 GMT : 19:56:38 (113) Laser Emission On
20:02:47.949 GMT : 20:02:46 (112) Laser Emission Off
20:06:51.454 GMT : 20:06:50 (113) Laser Emission On
20:12:27.061 GMT : 20:12:25 (112) Laser Emission Off
20:15:48.766 GMT : 20:15:47 (113) Laser Emission On
20:20:53.772 GMT : 20:20:51 (112) Laser Emission Off
20:24:09.277 GMT : 20:24:08 (113) Laser Emission On
20:29:21.683 GMT : 20:29:19 (112) Laser Emission Off
20:32:50.788 GMT : 20:32:49 (113) Laser Emission On
20:35:37.592 GMT : 20:35:36 (112) Laser Emission Off
20:36:37.793 GMT : 20:36:36 (107) Rx Shutter Closed
20:36:37.793 GMT : 20:36:36 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KBED
Mission       : 101210B
Wheels Up     : 1735
Flight Length :
HOBBS Start   :
HOBBS End     :
```

Weather

Date : December 10, 2010
Julian Day : 344
Temperature : -7C
Visibility : GOOD
Clouds : 11000FT
Precipitation : NEGATIVE
Wind Dir : CALM
Wind Speed : CALM
Pressure : 3039

Statistics

Laser Time : 01:59:12

==

Flight Log

Project Number: 7556-005
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : KBED
Mission : 101210B
Wheels Up : 1735
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 10, 2010
Julian Day : 344
Temperature : -7C
Visibility : GOOD
Clouds : 11000FT
Precipitation : NEGATIVE
Wind Dir : CALM
Wind Speed : CALM
Pressure : 3039

Statistics

Laser Time : 01:59:12

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
17:44:24.883	17:54:55.493	37	1609	70	30.10	18.00	ON	NAR	ON	0.00	359.68

17:58:32.396	18:08:22.806	37	1611	70	30.10	18.00	ON	NAR	ON	0.00	359.68
18:11:33.31	18:21:38.821	39	1616	70	30.10	18.00	ON	NAR	ON	0.00	359.67
18:25:12.125	18:34:41.836	40	1613	70	30.10	18.00	ON	NAR	ON	0.00	359.67
18:38:01.14	18:46:08.15	41	1613	70	30.10	18.00	ON	NAR	ON	0.00	179.66
18:49:05.354	18:57:18.564	42	1612	70	30.10	18.00	ON	NAR	ON	0.00	359.65
19:00:35.868	19:08:48.879	43	1616	70	30.10	18.00	ON	NAR	ON	0.00	359.65
19:11:40.082	19:19:58.493	43	1622	70	30.10	18.00	ON	NAR	ON	0.00	359.65
19:23:19.698	19:31:43.208	45	1631	70	30.10	18.00	ON	NAR	ON	0.00	359.64
19:34:32.012	19:42:35.723	46	1632	70	30.10	18.00	ON	NAR	ON	0.00	359.63
19:47:20.429	19:53:21.237	47	1632	70	30.10	18.00	ON	NAR	ON	0.00	359.62
19:56:40.741	20:02:49.249	48	1640	70	30.10	18.00	ON	NAR	ON	0.00	179.61
20:06:51.954	20:12:25.161	0	1635	70	30.10	18.00	ON	NAR	ON	0.00	179.83
20:15:48.966	20:20:54.872	50	1632	70	30.10	18.00	ON	NAR	ON	0.00	359.61
20:24:10.177	20:29:22.483	50	1636	70	30.10	18.00	ON	NAR	ON	0.00	179.61
20:32:50.588	20:35:39.092	50	1636	70	30.10	18.00	ON	NAR	ON	0.00	179.61

Flight Log

Project Number: 7556-005
S/N : 247
Operator : Galieti
Pilot(s) : Greenwell
Aircraft : N2448G
Airport : KBED & 1B9
Mission : 1
Wheels Up : 1300 Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 10, 2010
Julian Day : 344
Temperature : -14 C
Visibility : clear
Clouds : High OVC
Precipitation : none
Wind Dir :

```
Wind Speed    :
Pressure      : 30.43 HG
           Statistics
------------------------------
Laser Time    : 01:14:32

=======================================
13:01:35.751 GMT : 00:00:02 (212) GPS 1PPS Lost
13:01:35.751 GMT : 00:00:03 (166) Divergence Error
13:01:35.751 GMT : 00:00:03 (107) Rx Shutter Closed
13:01:35.751 GMT : 00:00:03 (109) Tx Shutter Closed
13:01:35.751 GMT : 00:00:04 (164) Beam Wide
13:01:35.751 GMT : 00:00:12 (204) POSAV Connected
13:01:35.751 GMT : 00:00:13 (207) POSAV Rate Not 50 Hz
13:01:35.751 GMT : 00:00:13 (211) POSAV new status
13:01:35.751 GMT : 00:00:14 (213) GPS 1PPS Ok
13:01:35.751 GMT : 00:00:23 (120) Laser PS Comm Ok
13:01:35.751 GMT : 00:00:23 (112) Laser Emission Off
13:01:35.751 GMT : 00:00:45 (208) POSAV Rate Is 50 Hz
13:01:35.751 GMT : 00:00:45 (211) POSAV new status
13:01:35.751 GMT : 00:00:46 (215) Nav Data Ok
13:01:35.751 GMT : 00:00:47 (211) POSAV new status
13:01:35.751 GMT : 00:01:33 (211) POSAV new status
13:01:35.751 GMT : 00:01:45 (211) POSAV new status
13:01:35.751 GMT : 12:23:55 (211) POSAV new status
12:58:37.175 GMT : 12:58:35 (153) Eyesafety Disabled
12:58:37.275 GMT : 12:58:35 (162) Roll Comp On
12:58:37.875 GMT : 12:58:36 (164) Beam Wide
12:58:37.875 GMT : 12:58:36 (144) MultiPulse Mode Varies
12:58:41.475 GMT : 12:58:40 (165) Beam Narrow
12:59:34.076 GMT : 12:59:32 (157) Safe Unaided Profile
12:59:34.076 GMT : 12:59:32 (157) Safe Unaided Profile
13:05:13.78 GMT : 13:05:12 (157) Safe Unaided Profile
13:05:13.98 GMT : 13:05:12 (157) Safe Unaided Profile
13:05:19.48 GMT : 13:05:17 (106) Rx Shutter Open
13:05:19.48 GMT : 13:05:17 (108) Tx Shutter Open
13:19:45.49 GMT : 13:19:44 (113) Laser Emission On
13:27:52.396 GMT : 13:27:50 (112) Laser Emission Off
13:31:56.099 GMT : 13:31:55 (113) Laser Emission On
13:40:11.905 GMT : 13:40:09 (112) Laser Emission Off
13:45:23.408 GMT : 13:45:22 (113) Laser Emission On
13:53:50.615 GMT : 13:53:49 (112) Laser Emission Off
13:59:24.419 GMT : 13:59:23 (113) Laser Emission On
14:07:56.425 GMT : 14:07:55 (112) Laser Emission Off
14:13:34.23 GMT : 14:13:33 (113) Laser Emission On
14:26:46.44 GMT : 14:26:45 (112) Laser Emission Off
14:32:07.544 GMT : 14:32:06 (113) Laser Emission On
14:45:16.755 GMT : 14:45:15 (112) Laser Emission Off
14:50:39.959 GMT : 14:50:39 (113) Laser Emission On
15:04:08.37 GMT : 15:04:07 (112) Laser Emission Off
15:11:56.777 GMT : 15:11:55 (113) Laser Emission On
15:13:46.778 GMT : 15:13:45 (112) Laser Emission Off
15:15:22.28 GMT : 15:15:21 (157) Safe Unaided Profile
15:15:27.18 GMT : 15:15:25 (107) Rx Shutter Closed
```

```
15:15:27.28 GMT : 15:15:25 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED & 1B9
Mission       : 1
Wheels Up     : 1300 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -14 C
Visibility    : clear
Clouds        : High OVC
Precipitation : none
Wind Dir      :
Wind Speed    :
Pressure      : 30.43 HG
           Statistics
------------------------------
Laser Time    : 01:14:32

=======================================

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED & 1B9
Mission       : 1
Wheels Up     : 1300 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -14 C
Visibility    : clear
Clouds        : High OVC
```

Precipitation : none
Wind Dir :
Wind Speed :
Pressure : 30.43 HG

Statistics

Laser Time : 01:14:32

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
13:19:46.19	13:27:52.696	11	1521	70	30.10	18.00	ON	NAR	ON	0.00	178.54
13:31:57.199	13:40:11.705	10	1585	70	30.10	18.00	ON	NAR	ON	0.00	358.54
13:45:24.008	13:53:51.515	9	1577	70	30.10	18.00	ON	NAR	ON	0.00	178.53
13:59:25.419	14:07:57.725	8	1570	70	30.10	18.00	ON	NAR	ON	0.00	358.53
14:13:35.23	14:26:48.44	7	1583	70	30.10	18.00	ON	NAR	ON	0.00	178.52
14:32:08.144	14:45:17.555	6	1572	70	30.10	18.00	ON	NAR	ON	0.00	358.51
14:50:40.759	15:04:10.07	5	1580	70	30.10	18.00	ON	NAR	ON	0.00	178.51
15:11:57.677	15:13:48.178	5	1585	70	30.10	18.00	ON	NAR	ON	0.00	178.51

Flight Log

Project Number: 7556-005 (BED_Charles)
S/N : 247
Operator : Galieti
Pilot(s) : Greenwell
Aircraft : N2448G
Airport : KBED
Mission : 2
Wheels Up : 1730 Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 10, 2010
Julian Day : 344
Temperature : -7 C
Visibility : -14 C
Clouds : High OVC 090
Precipitation : none
Wind Dir : CLM
Wind Speed : CLM

```
Pressure       : 30.39
           Statistics
------------------------------
Laser Time     : 02:10:20

=======================================
17:41:01.989 GMT : 00:00:02 (212) GPS 1PPS Lost
17:41:01.989 GMT : 00:00:03 (166) Divergence Error
17:41:01.989 GMT : 00:00:03 (107) Rx Shutter Closed
17:41:01.989 GMT : 00:00:03 (109) Tx Shutter Closed
17:41:01.989 GMT : 00:00:04 (164) Beam Wide
17:41:01.989 GMT : 00:00:11 (213) GPS 1PPS Ok
17:41:01.989 GMT : 00:00:12 (204) POSAV Connected
17:41:01.989 GMT : 00:00:14 (207) POSAV Rate Not 50 Hz
17:41:01.989 GMT : 00:00:14 (211) POSAV new status
17:41:01.989 GMT : 00:00:23 (120) Laser PS Comm Ok
17:41:01.989 GMT : 00:00:23 (112) Laser Emission Off
17:41:01.989 GMT : 00:00:28 (208) POSAV Rate Is 50 Hz
17:41:01.989 GMT : 00:00:28 (211) POSAV new status
17:41:01.989 GMT : 00:00:30 (211) POSAV new status
17:41:01.989 GMT : 00:00:30 (215) Nav Data Ok
17:41:01.989 GMT : 00:02:10 (211) POSAV new status
17:41:01.989 GMT : 00:04:30 (211) POSAV new status
17:30:46.68 GMT : 17:30:45 (153) Eyesafety Disabled
17:30:46.78 GMT : 17:30:45 (162) Roll Comp On
17:30:47.58 GMT : 17:30:46 (164) Beam Wide
17:30:47.68 GMT : 17:30:46 (144) MultiPulse Mode Varies
17:30:49.08 GMT : 17:30:48 (165) Beam Narrow
17:36:13.683 GMT : 17:36:12 (211) POSAV new status
17:44:42.388 GMT : 17:44:41 (106) Rx Shutter Open
17:44:42.388 GMT : 17:44:41 (108) Tx Shutter Open
17:54:47.194 GMT : 17:54:45 (113) Laser Emission On
18:08:29.703 GMT : 18:08:28 (112) Laser Emission Off
18:13:54.107 GMT : 18:13:53 (113) Laser Emission On
18:28:08.417 GMT : 18:28:06 (112) Laser Emission Off
18:32:39.72 GMT : 18:32:38 (157) Safe Unaided Profile
18:32:53.32 GMT : 18:32:52 (113) Laser Emission On
18:46:20.23 GMT : 18:46:18 (112) Laser Emission Off
18:51:24.534 GMT : 18:51:23 (113) Laser Emission On
19:05:09.645 GMT : 19:05:08 (112) Laser Emission Off
19:09:39.048 GMT : 19:09:37 (113) Laser Emission On
19:22:09.858 GMT : 19:22:08 (112) Laser Emission Off
19:27:50.863 GMT : 19:27:49 (113) Laser Emission On
19:40:35.273 GMT : 19:40:34 (112) Laser Emission Off
19:45:58.478 GMT : 19:45:57 (113) Laser Emission On
19:58:17.688 GMT : 19:58:16 (112) Laser Emission Off
20:03:57.793 GMT : 20:03:56 (113) Laser Emission On
20:16:44.404 GMT : 20:16:43 (112) Laser Emission Off
20:21:25.608 GMT : 20:21:24 (113) Laser Emission On
20:33:53.118 GMT : 20:33:51 (112) Laser Emission Off
20:39:59.223 GMT : 20:39:58 (113) Laser Emission On
20:52:58.235 GMT : 20:52:56 (112) Laser Emission Off
20:57:22.738 GMT : 20:57:21 (113) Laser Emission On
```

```
           Flight Log
------------------------------
Project Number: 7556-005 (BED_Charles)
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 2
Wheels Up     : 1730 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -7 C
Visibility    : -14 C
Clouds        : High OVC 090
Precipitation : none
Wind Dir      : CLM
Wind Speed    : CLM
Pressure      : 30.39
           Statistics
------------------------------
Laser Time    : 02:10:20

=======================================

           Flight Log
------------------------------
Project Number: 7556-005 (BED_Charles)
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 2
Wheels Up     : 1730 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -7 C
Visibility    : -14 C
Clouds        : High OVC 090
Precipitation : none
Wind Dir      : CLM
```

Wind Speed : CLM
Pressure : 30.39

Statistics

Laser Time : 02:10:20

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
17:54:47.194	18:08:30.403	5	1573	70	30.10	18.00	ON	NAR	ON	0.00	359.81
18:13:54.907	18:28:09.817	7	1573	70	30.10	18.00	ON	NAR	ON	0.00	179.8
18:32:54.12	18:46:20.43	7	1575	70	30.10	18.00	ON	NAR	ON	0.00	359.8
18:51:25.534	19:05:11.045	8	1571	70	30.10	18.00	ON	NAR	ON	0.00	179.79
19:09:40.048	19:22:09.658	20	1581	70	30.10	18.00	ON	NAR	ON	0.00	359.77
19:27:51.363	19:40:37.073	20	1581	70	30.10	18.00	ON	NAR	ON	0.00	179.77
19:45:59.178	19:58:19.488	21	1583	70	30.10	18.00	ON	NAR	ON	0.00	359.77
20:03:58.393	20:16:45.404	22	1578	70	30.10	18.00	ON	NAR	ON	0.00	179.76
20:21:25.908	20:33:54.418	23	1585	70	30.10	18.00	ON	NAR	ON	0.00	359.75
20:40:00.023	20:52:58.835	24	1580	70	30.10	18.00	ON	NAR	ON	0.00	179.74

Flight Log

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

Weather

Date : December 10, 2010
Julian Day : 344
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???

```
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:19:24

=======================================
21:07:01.401 GMT : 20:59:21 (300) ALTM Not Ready
21:12:47.196 GMT : 21:00:15 (300) ALTM Not Ready
21:00:42.241 GMT : 21:00:41 (112) Laser Emission Off
21:09:47.649 GMT : 21:09:46 (113) Laser Emission On
21:21:51.46 GMT : 21:21:50 (112) Laser Emission Off
21:32:03.669 GMT : 21:32:02 (113) Laser Emission On
21:32:29.469 GMT : 21:32:28 (183) Eye Safety Shutoff
21:32:30.869 GMT : 21:32:29 (112) Laser Emission Off
21:32:40.569 GMT : 21:32:39 (113) Laser Emission On
21:32:58.97 GMT : 21:32:58 (183) Eye Safety Shutoff
21:33:00.67 GMT : 21:32:59 (112) Laser Emission Off
21:33:13.27 GMT : 21:33:11 (153) Eyesafety Disabled
21:33:21.87 GMT : 21:33:20 (113) Laser Emission On
21:37:50.874 GMT : 21:37:49 (112) Laser Emission Off
21:43:04.579 GMT : 21:43:03 (113) Laser Emission On
21:46:05.781 GMT : 21:46:04 (112) Laser Emission Off

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

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:19:24
```

```
=======================================

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

           Weather
------------------------------
Date           : December 10, 2010
Julian Day     : 344
Temperature    : ???
Visibility     : ???
Clouds         : ???
Precipitation : ???
Wind Dir       : ???
Wind Speed     : ???
Pressure       : ???
           Statistics
------------------------------
Laser Time     : 00:19:24



        START          STOP LINE#    ALT   PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
=======================================

        START          STOP LINE#    ALT   PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
 21:12:47.196  21:00:42.741    25   1594   70    30.10   18.00   ON  NAR
ON       0.00       359.74
 21:09:48.349   21:21:52.36    25   1595   70    30.10   18.00   ON  NAR
ON       0.00       359.74
  21:33:22.87  21:37:51.874    17   1579   70    30.10   18.00   ON  NAR
ON       0.00       359.78
 21:43:05.579  21:46:06.981     5   1519   70    30.10   18.00   ON  NAR
ON       0.00       359.81

           Flight Log
------------------------------
Project Number: BED_Charles 7556-005
S/N            : 247
Operator       : Galieti
Pilot(s)       : Greenwell
```

```
Aircraft       : N2448G
Airport        : KBED
Mission        : 1
Wheels Up      : 1415 Z
Flight Length :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 11, 2010
Julian Day     : 345
Temperature    : -2 C
Visibility     : Clear
Clouds         : Clear
Precipitation : none
Wind Dir       : CLM
Wind Speed     : CLM
Pressure       : 30.25 HG
           Statistics
------------------------------
Laser Time     : 00:32:10

=======================================
14:14:08.279 GMT : 00:00:02 (212) GPS 1PPS Lost
14:14:08.279 GMT : 00:00:03 (166) Divergence Error
14:14:08.279 GMT : 00:00:03 (107) Rx Shutter Closed
14:14:08.279 GMT : 00:00:03 (109) Tx Shutter Closed
14:14:08.279 GMT : 00:00:04 (164) Beam Wide
14:14:08.279 GMT : 00:00:12 (204) POSAV Connected
14:14:08.279 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
14:14:08.279 GMT : 00:00:12 (211) POSAV new status
14:14:08.279 GMT : 00:00:13 (120) Laser PS Comm Ok
14:14:08.279 GMT : 00:00:13 (112) Laser Emission Off
14:14:08.279 GMT : 00:00:14 (213) GPS 1PPS Ok
14:14:08.279 GMT : 00:00:28 (211) POSAV new status
14:14:08.279 GMT : 00:00:29 (208) POSAV Rate Is 50 Hz
14:14:08.279 GMT : 00:00:30 (211) POSAV new status
14:14:08.279 GMT : 00:00:30 (215) Nav Data Ok
14:14:08.279 GMT : 00:02:25 (211) POSAV new status
14:14:08.279 GMT : 00:05:26 (211) POSAV new status
14:08:12.713 GMT : 14:08:12 (307) Format Disk
14:08:27.413 GMT : 14:08:26 (153) Eyesafety Disabled
14:08:27.613 GMT : 14:08:26 (162) Roll Comp On
14:08:27.613 GMT : 14:08:27 (164) Beam Wide
14:08:27.813 GMT : 14:08:27 (144) MultiPulse Mode Varies
14:08:30.613 GMT : 14:08:30 (165) Beam Narrow
14:08:40.713 GMT : 14:08:39 (157) Safe Unaided Profile
14:08:40.813 GMT : 14:08:39 (157) Safe Unaided Profile
14:12:13.616 GMT : 14:12:12 (211) POSAV new status
14:22:12.923 GMT : 14:22:12 (157) Safe Unaided Profile
14:22:16.323 GMT : 14:22:15 (106) Rx Shutter Open
14:22:16.423 GMT : 14:22:15 (108) Tx Shutter Open
14:25:49.326 GMT : 14:25:48 (113) Laser Emission On
```

```
14:31:50.93 GMT : 14:31:49 (112) Laser Emission Off
14:35:35.433 GMT : 14:35:35 (113) Laser Emission On
14:48:03.143 GMT : 14:48:02 (112) Laser Emission Off
14:53:03.248 GMT : 14:53:02 (113) Laser Emission On
15:05:08.658 GMT : 15:05:08 (112) Laser Emission Off
15:09:10.361 GMT : 15:09:09 (113) Laser Emission On
15:10:59.363 GMT : 15:10:57 (112) Laser Emission Off
15:12:39.965 GMT : 15:12:39 (157) Safe Unaided Profile
15:12:45.765 GMT : 15:12:45 (107) Rx Shutter Closed
15:12:45.865 GMT : 15:12:45 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: BED_Charles 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 1
Wheels Up     : 1415 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 11, 2010
Julian Day    : 345
Temperature   : -2 C
Visibility    : Clear
Clouds        : Clear
Precipitation : none
Wind Dir      : CLM
Wind Speed    : CLM
Pressure      : 30.25 HG
           Statistics
------------------------------
Laser Time    : 00:32:10

=======================================

           Flight Log
------------------------------
Project Number: BED_Charles 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 1
Wheels Up     : 1415 Z
Flight Length :
HOBBS Start   :
```

```
HOBBS End      :

           Weather
------------------------------
Date           : December 11, 2010
Julian Day     : 345
Temperature    : -2 C
Visibility     : Clear
Clouds         : Clear
Precipitation  : none
Wind Dir       : CLM
Wind Speed     : CLM
Pressure       : 30.25 HG
           Statistics
------------------------------
Laser Time     : 00:32:10



        START          STOP LINE#    ALT   PRF     FREQ   ANGLE   MP  DIV
RC         HDG    Plan File
=======================================
 14:25:49.426   14:31:51.23    17   1576   70    30.10   18.00   ON  NAR
ON        0.00        359.78
 14:35:36.533  14:48:04.043    24   1586   70    30.10   18.00   ON  NAR
ON        0.00        179.74
 14:53:03.048  15:05:10.658    25   1582   70    30.10   18.00   ON  NAR
ON        0.00        359.74
 15:09:10.461  15:10:58.963    25   1570   70    30.10   18.00   ON  NAR
ON        0.00        359.74
 15:09:10.461  15:10:58.963    25   1571   70    30.10   18.00   ON  NAR
ON        0.00        359.74

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

           Weather
------------------------------
Date           : December 02, 2010
Julian Day     : 336
Temperature    : ???
Visibility     : ???
Clouds         : ???
```

```
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:33:26

=======================================
14:22:07.31 GMT : 00:00:02 (212) GPS 1PPS Lost
14:22:07.31 GMT : 00:00:03 (166) Divergence Error
14:22:07.31 GMT : 00:00:03 (107) Rx Shutter Closed
14:22:07.31 GMT : 00:00:03 (109) Tx Shutter Closed
14:22:07.31 GMT : 00:00:04 (164) Beam Wide
14:22:07.31 GMT : 00:00:05 (213) GPS 1PPS Ok
14:22:07.31 GMT : 00:00:09 (120) Laser PS Comm Ok
14:22:07.31 GMT : 00:00:09 (112) Laser Emission Off
14:22:07.31 GMT : 00:00:12 (204) POSAV Connected
14:22:07.31 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
14:22:07.31 GMT : 00:00:13 (211) POSAV new status
14:22:07.31 GMT : 00:00:24 (208) POSAV Rate Is 50 Hz
14:22:07.31 GMT : 00:00:25 (211) POSAV new status
14:22:07.31 GMT : 00:00:26 (211) POSAV new status
14:22:07.31 GMT : 00:00:26 (215) Nav Data Ok
18:52:16.491 GMT : 00:02:03 (211) POSAV new status
18:53:55.293 GMT : 00:03:25 (211) POSAV new status
18:53:55.493 GMT : 18:53:54 (153) Eyesafety Disabled
18:53:56.093 GMT : 18:53:54 (162) Roll Comp On
18:53:56.393 GMT : 18:53:55 (164) Beam Wide
18:54:00.593 GMT : 18:54:00 (166) Divergence Error
18:54:02.193 GMT : 18:54:01 (165) Beam Narrow
18:55:03.194 GMT : 18:55:02 (144) MultiPulse Mode Varies
18:59:13.698 GMT : 18:59:12 (211) POSAV new status
19:19:38.718 GMT : 19:19:37 (106) Rx Shutter Open
19:19:38.818 GMT : 19:19:37 (108) Tx Shutter Open
19:20:19.919 GMT : 19:20:18 (113) Laser Emission On
19:20:45.119 GMT : 19:20:44 (112) Laser Emission Off
19:25:19.924 GMT : 19:25:19 (113) Laser Emission On
19:32:43.533 GMT : 19:32:42 (112) Laser Emission Off
19:37:07.038 GMT : 19:37:06 (113) Laser Emission On
19:50:05.754 GMT : 19:50:05 (112) Laser Emission Off
19:54:52.96 GMT : 19:54:52 (113) Laser Emission On
20:07:10.076 GMT : 20:07:08 (112) Laser Emission Off
20:09:14.078 GMT : 20:09:13 (113) Laser Emission On
20:10:04.379 GMT : 20:10:03 (112) Laser Emission Off
20:13:43.284 GMT : 20:13:42 (107) Rx Shutter Closed
20:13:43.484 GMT : 20:13:42 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 0
S/N           : 0
Operator      : ???
Pilot(s)      : ???
```

```
Aircraft      : ???
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 02, 2010
Julian Day    : 336
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:33:26

=======================================

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

           Weather
------------------------------
Date          : December 02, 2010
Julian Day    : 336
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:33:26
```

```
        START          STOP LINE#    ALT  PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
=======================================
 19:20:19.719  19:20:26.919    26   1567   70    30.10   18.00   ON  NAR
ON       0.00        179.73
 19:20:19.719  19:20:46.019    26   1574   70    30.10   18.00   ON  NAR
ON       0.00        179.73
 19:25:20.724  19:32:44.633    27   1562   70    30.10   18.00   ON  NAR
ON       0.00        179.73
 19:37:07.838  19:50:07.154    28   1583   70    30.10   18.00   ON  NAR
ON       0.00        359.72
  19:54:53.46  20:07:10.576    28   1547   70    30.10   18.00   ON  NAR
ON       0.00        179.72
 20:09:14.878  20:10:05.279    28   1555   70    30.10   18.00   ON  NAR
ON       0.00        179.72

           Flight Log
------------------------------
Project Number: BED_Charles
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 111202a-247
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 02, 2010
Julian Day    : 336
Temperature   : 6 C
Visibility    : -4 C
Clouds        : nill
Precipitation : nill
Wind Dir      : 310
Wind Speed    : 9 kts
Pressure      : 29.95 HG
           Statistics
------------------------------
Laser Time    : 00:33:48

=======================================
19:08:29.756 GMT : 18:40:04 (300) ALTM Not Ready
18:40:50.556 GMT : 18:40:49 (153) Eyesafety Disabled
18:40:50.757 GMT : 18:40:49 (162) Roll Comp On
18:40:51.657 GMT : 18:40:50 (164) Beam Wide
18:40:51.657 GMT : 18:40:50 (144) MultiPulse Mode Varies
18:40:53.657 GMT : 18:40:53 (165) Beam Narrow
```

```
18:41:08.457 GMT : 18:41:07 (160) Safe Aided Wide
18:41:08.657 GMT : 18:41:07 (163) Roll Comp Off
18:41:08.757 GMT : 18:41:07 (160) Safe Aided Wide
18:41:09.257 GMT : 18:41:08 (165) Beam Narrow
18:41:09.357 GMT : 18:41:08 (141) MultiPulse Mode Off
18:41:13.657 GMT : 18:41:12 (160) Safe Aided Wide
18:41:13.757 GMT : 18:41:12 (160) Safe Aided Wide
18:41:13.957 GMT : 18:41:13 (165) Beam Narrow
18:41:15.257 GMT : 18:41:14 (164) Beam Wide
18:41:24.057 GMT : 18:41:22 (160) Safe Aided Wide
18:41:24.157 GMT : 18:41:22 (160) Safe Aided Wide
18:41:24.157 GMT : 18:41:23 (144) MultiPulse Mode Varies
18:41:29.457 GMT : 18:41:28 (157) Safe Unaided Profile
18:41:29.657 GMT : 18:41:28 (157) Safe Unaided Profile
18:41:30.457 GMT : 18:41:29 (164) Beam Wide
18:41:33.457 GMT : 18:41:32 (157) Safe Unaided Profile
18:41:33.657 GMT : 18:41:32 (162) Roll Comp On
18:41:33.857 GMT : 18:41:32 (157) Safe Unaided Profile
18:41:34.157 GMT : 18:41:33 (164) Beam Wide
18:41:34.857 GMT : 18:41:34 (165) Beam Narrow
18:53:06.564 GMT : 18:53:05 (211) POSAV new status
18:59:21.468 GMT : 18:59:20 (157) Safe Unaided Profile
18:59:23.768 GMT : 18:59:23 (106) Rx Shutter Open
18:59:23.968 GMT : 18:59:23 (108) Tx Shutter Open
19:10:32.676 GMT : 19:10:31 (113) Laser Emission On
19:18:30.781 GMT : 19:18:29 (112) Laser Emission Off
19:19:06.382 GMT : 19:19:04 (113) Laser Emission On
19:23:45.285 GMT : 19:23:43 (112) Laser Emission Off
19:28:10.588 GMT : 19:28:09 (113) Laser Emission On
19:32:51.892 GMT : 19:32:51 (112) Laser Emission Off
19:37:46.796 GMT : 19:37:46 (113) Laser Emission On
19:40:16.398 GMT : 19:40:15 (112) Laser Emission Off
19:45:15.302 GMT : 19:45:14 (113) Laser Emission On
19:47:03.303 GMT : 19:47:02 (112) Laser Emission Off
19:56:02.21 GMT : 19:56:01 (113) Laser Emission On
20:01:17.515 GMT : 20:01:16 (112) Laser Emission Off
20:04:06.817 GMT : 20:04:05 (113) Laser Emission On
20:09:56.922 GMT : 20:09:56 (112) Laser Emission Off
20:15:43.627 GMT : 20:15:42 (113) Laser Emission On
20:17:14.528 GMT : 20:17:13 (112) Laser Emission Off

           Flight Log
------------------------------
Project Number: BED_Charles
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 111202a-247
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :
```

```
           Weather
------------------------------
Date           : December 02, 2010
Julian Day     : 336
Temperature    : 6 C
Visibility     : -4 C
Clouds         : nill
Precipitation  : nill
Wind Dir       : 310
Wind Speed     : 9 kts
Pressure       : 29.95 HG
           Statistics
------------------------------
Laser Time     : 00:33:48

=======================================

           Flight Log
------------------------------
Project Number: BED_Charles
S/N            : 247
Operator       : Galieti
Pilot(s)       : Greenwell
Aircraft       : N2448G
Airport        : KBED
Mission        : 111202a-247
Wheels Up      : ???
Flight Length  :
HOBBS Start    :
HOBBS End      :
```


```
           Weather
------------------------------
Date           : December 02, 2010
Julian Day     : 336
Temperature    : 6 C
Visibility     : -4 C
Clouds         : nill
Precipitation  : nill
Wind Dir       : 310
Wind Speed     : 9 kts
Pressure       : 29.95 HG
           Statistics
------------------------------
Laser Time     : 00:33:48
```


```
        START          STOP LINE#    ALT   PRF     FREQ   ANGLE   MP  DIV
RC         HDG    Plan File
=======================================
 19:10:32.876  19:18:31.681     1   1569   70    30.10   18.00   ON  NAR
ON       0.00       359.83
```

```
 19:19:07.482  19:23:45.785    13   1567   70    30.10   18.00   ON  NAR
ON       0.00        359.84
 19:28:11.389  19:32:53.092    14   1571   70    30.10   18.00   ON  NAR
ON       0.00        179.81
 19:37:47.596  19:40:17.898    16   1588   70    30.10   18.00   ON  NAR
ON       0.00        359.82
 19:45:16.102  19:47:03.803    16   1586   70    30.10   18.00   ON  NAR
ON       0.00        179.82
  19:56:03.01  20:01:18.915    12   1576   70    30.10   18.00   ON  NAR
ON       0.00        179.82
 20:04:06.617  20:09:58.622    11   1567   70    30.10   18.00   ON  NAR
ON       0.00        359.81
 20:15:43.327  20:17:15.628    11   1569   70    30.10   18.00   ON  NAR
ON       0.00        359.81
 20:15:43.327  20:17:15.628    11   1568   70    30.10   18.00   ON  NAR
ON       0.00        359.81

           Flight Log
------------------------------
Project Number:
S/N            : 0
Operator       : Galieti
Pilot(s)       : Greenwell
Aircraft       : N2448G
Airport        : KBED
Mission        : A
Wheels Up      : 1340Z
Flight Length  :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 03, 2010
Julian Day     : 337
Temperature    : 1
Visibility     : clear
Clouds         : overcast
Precipitation  : nill
Wind Dir       : ???
Wind Speed     : ???
Pressure       : 29.95 HG
           Statistics
------------------------------
Laser Time     : 00:27:49

=======================================
14:03:25.852 GMT : 00:02:52 (121) Laser PS Comm Wait
14:03:25.852 GMT : 00:04:43 (211) POSAV new status
14:03:25.852 GMT : 13:19:32 (120) Laser PS Comm Ok
14:03:25.852 GMT : 13:19:59 (121) Laser PS Comm Wait
14:03:25.852 GMT : 13:20:11 (120) Laser PS Comm Ok
14:03:25.852 GMT : 13:23:54 (121) Laser PS Comm Wait
14:03:25.852 GMT : 13:24:06 (120) Laser PS Comm Ok
```

```
14:03:25.852 GMT : 13:27:44 (121) Laser PS Comm Wait
14:03:25.852 GMT : 13:27:57 (120) Laser PS Comm Ok
13:32:03.255 GMT : 13:32:01 (153) Eyesafety Disabled
13:32:03.255 GMT : 13:32:01 (162) Roll Comp On
13:32:03.455 GMT : 13:32:02 (164) Beam Wide
13:32:03.655 GMT : 13:32:02 (144) MultiPulse Mode Varies
13:32:06.955 GMT : 13:32:06 (165) Beam Narrow
13:35:41.957 GMT : 13:35:40 (211) POSAV new status
13:36:57.058 GMT : 13:36:55 (157) Safe Unaided Profile
13:36:57.258 GMT : 13:36:55 (157) Safe Unaided Profile
13:49:25.364 GMT : 13:49:23 (157) Safe Unaided Profile
13:49:28.664 GMT : 13:49:27 (106) Rx Shutter Open
13:49:28.764 GMT : 13:49:27 (108) Tx Shutter Open
14:01:02.671 GMT : 14:01:01 (113) Laser Emission On
14:15:00.48 GMT : 14:14:58 (112) Laser Emission Off
14:19:12.883 GMT : 14:19:11 (113) Laser Emission On
14:32:49.392 GMT : 14:32:48 (183) Eye Safety Shutoff
14:32:50.792 GMT : 14:32:49 (112) Laser Emission Off
14:36:59.595 GMT : 14:36:58 (113) Laser Emission On
14:50:10.405 GMT : 14:50:09 (112) Laser Emission Off
14:54:59.109 GMT : 14:54:58 (113) Laser Emission On
14:55:50.609 GMT : 14:55:49 (112) Laser Emission Off

           Flight Log
------------------------------
Project Number:
S/N            : 0
Operator       : Galieti
Pilot(s)       : Greenwell
Aircraft       : N2448G
Airport        : KBED
Mission        : A
Wheels Up      : 1340Z
Flight Length  :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 03, 2010
Julian Day     : 337
Temperature    : 1
Visibility     : clear
Clouds         : overcast
Precipitation  : nill
Wind Dir       : ???
Wind Speed     : ???
Pressure       : 29.95 HG
           Statistics
------------------------------
Laser Time     : 00:27:49

=======================================
```

```
           Flight Log
------------------------------
Project Number:
S/N            : 0
Operator       : Galieti
Pilot(s)       : Greenwell
Aircraft       : N2448G
Airport        : KBED
Mission        : A
Wheels Up      : 1340Z
Flight Length  :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 03, 2010
Julian Day     : 337
Temperature    : 1
Visibility     : clear
Clouds         : overcast
Precipitation  : nill
Wind Dir       : ???
Wind Speed     : ???
Pressure       : 29.95 HG
           Statistics
------------------------------
Laser Time     : 00:27:49



        START          STOP LINE#    ALT   PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
=======================================
 14:01:03.771   14:15:02.08     9   1580   70    30.10   18.00   ON  NAR
ON       0.00       179.79
 14:37:00.295  14:50:11.905    18   1585   70    30.10   18.00   ON  NAR
ON       0.00       179.78
 14:37:00.295  14:50:11.905    18   1586   70    30.10   18.00   ON  NAR
ON       0.00       179.78
 14:55:00.309  14:55:52.209    18   1533   70    30.10   18.00   ON  NAR
ON       0.00       179.78

           Flight Log
------------------------------
Project Number: 0
S/N            : 0
Operator       : ???
Pilot(s)       : ???
Aircraft       : ???
Airport        : ???
Mission        : ???
Wheels Up      : ???
Flight Length  :
```

```
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 03, 2010
Julian Day    : 337
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:36:41

=======================================
08:57:52.669 GMT : 00:00:02 (212) GPS 1PPS Lost
08:57:52.669 GMT : 00:00:03 (166) Divergence Error
08:57:52.669 GMT : 00:00:03 (107) Rx Shutter Closed
08:57:52.669 GMT : 00:00:03 (109) Tx Shutter Closed
08:57:52.669 GMT : 00:00:04 (164) Beam Wide
08:57:52.669 GMT : 00:00:11 (213) GPS 1PPS Ok
08:57:52.669 GMT : 00:00:12 (204) POSAV Connected
08:57:52.669 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
08:57:52.669 GMT : 00:00:15 (211) POSAV new status
08:57:52.669 GMT : 00:00:27 (121) Laser PS Comm Wait
08:57:52.669 GMT : 00:00:27 (112) Laser Emission Off
08:57:52.669 GMT : 00:00:28 (208) POSAV Rate Is 50 Hz
08:57:52.669 GMT : 00:00:28 (211) POSAV new status
08:57:52.669 GMT : 00:00:29 (211) POSAV new status
08:57:52.669 GMT : 00:00:30 (215) Nav Data Ok
08:57:52.669 GMT : 00:00:59 (120) Laser PS Comm Ok
08:57:52.669 GMT : 00:02:19 (211) POSAV new status
08:57:52.669 GMT : 00:03:36 (211) POSAV new status
13:27:15.239 GMT : 13:27:14 (153) Eyesafety Disabled
13:27:15.339 GMT : 13:27:14 (162) Roll Comp On
13:27:15.939 GMT : 13:27:15 (164) Beam Wide
13:27:20.639 GMT : 13:27:20 (165) Beam Narrow
13:33:21.643 GMT : 13:33:20 (211) POSAV new status
13:52:24.957 GMT : 13:52:24 (106) Rx Shutter Open
13:52:24.957 GMT : 13:52:24 (108) Tx Shutter Open
13:53:30.758 GMT : 13:53:30 (113) Laser Emission On
14:05:41.769 GMT : 14:05:40 (112) Laser Emission Off
14:09:17.872 GMT : 14:09:17 (113) Laser Emission On
14:21:37.784 GMT : 14:21:37 (112) Laser Emission Off
14:25:42.088 GMT : 14:25:41 (113) Laser Emission On
14:37:05.9 GMT : 14:37:05 (112) Laser Emission Off
14:39:56.504 GMT : 14:39:55 (113) Laser Emission On
14:40:54.905 GMT : 14:40:53 (112) Laser Emission Off
14:41:05.105 GMT : 14:41:04 (107) Rx Shutter Closed
14:41:05.305 GMT : 14:41:04 (109) Tx Shutter Closed
```

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

           Weather
------------------------------
Date          : December 03, 2010
Julian Day    : 337
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
            Statistics
------------------------------
Laser Time    : 00:36:41

=======================================

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

           Weather
------------------------------
Date          : December 03, 2010
Julian Day    : 337
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
```

```
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:36:41



        START          STOP LINE#    ALT  PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
=======================================
 13:53:31.458  14:05:42.769    30   1574   70    30.10   18.00  OFF  NAR
ON       0.00       179.71
 14:09:18.572  14:21:38.884    31   1568   70    30.10   18.00  OFF  NAR
ON       0.00       179.71
 14:25:42.888   14:37:06.8     31   1555   70    30.10   18.00  OFF  NAR
ON       0.00       359.71
 14:39:56.504  14:40:55.305    31   1515   70    30.10   18.00  OFF  NAR
ON       0.00       359.71
 14:39:56.504  14:40:55.305    31   1512   70    30.10   18.00  OFF  NAR
ON       0.00       359.71

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 1
Wheels Up     : 1340Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 07, 2010
Julian Day    : 341
Temperature   : -3 C
Visibility    : CLR
Clouds        : High SCT moving to OVC @ PRJ ALT
Precipitation : nill
Wind Dir      : 240
Wind Speed    : 7 KTS
Pressure      : 29.33
           Statistics
------------------------------
Laser Time    : 01:32:21

=======================================
13:55:26.276 GMT : 13:28:09 (120) Laser PS Comm Ok
```

```
13:55:26.276 GMT : 13:31:01 (121) Laser PS Comm Wait
13:55:26.276 GMT : 13:31:16 (120) Laser PS Comm Ok
13:55:26.276 GMT : 13:34:13 (121) Laser PS Comm Wait
13:55:26.276 GMT : 13:34:28 (120) Laser PS Comm Ok
13:55:26.276 GMT : 13:36:44 (211) POSAV new status
13:38:30.101 GMT : 13:38:29 (153) Eyesafety Disabled
13:38:30.301 GMT : 13:38:29 (162) Roll Comp On
13:38:30.901 GMT : 13:38:30 (164) Beam Wide
13:38:30.901 GMT : 13:38:30 (144) MultiPulse Mode Varies
13:38:35.401 GMT : 13:38:35 (165) Beam Narrow
13:43:24.603 GMT : 13:43:23 (106) Rx Shutter Open
13:43:24.703 GMT : 13:43:23 (108) Tx Shutter Open
13:52:39.408 GMT : 13:52:38 (113) Laser Emission On
13:58:24.611 GMT : 13:58:23 (112) Laser Emission Off
13:58:40.911 GMT : 13:58:39 (113) Laser Emission On
14:06:55.515 GMT : 14:06:55 (112) Laser Emission Off
14:11:45.218 GMT : 14:11:44 (113) Laser Emission On
14:19:42.423 GMT : 14:19:41 (112) Laser Emission Off
14:24:45.426 GMT : 14:24:44 (113) Laser Emission On
14:32:59.632 GMT : 14:32:58 (112) Laser Emission Off
14:34:07.133 GMT : 14:34:06 (152) Invalid Beam
14:34:07.233 GMT : 14:34:06 (152) Invalid Beam
14:34:28.633 GMT : 14:34:27 (152) Invalid Beam
14:34:28.833 GMT : 14:34:27 (152) Invalid Beam
14:36:42.134 GMT : 14:36:41 (113) Laser Emission On
14:50:48.444 GMT : 14:50:47 (112) Laser Emission Off
14:55:23.348 GMT : 14:55:22 (113) Laser Emission On
15:09:49.358 GMT : 15:09:48 (112) Laser Emission Off
15:13:48.462 GMT : 15:13:47 (113) Laser Emission On
15:27:05.672 GMT : 15:27:04 (112) Laser Emission Off
15:31:24.176 GMT : 15:31:22 (113) Laser Emission On
15:43:45.686 GMT : 15:43:45 (112) Laser Emission Off
15:47:45.289 GMT : 15:47:44 (113) Laser Emission On
15:49:13.89 GMT : 15:49:12 (112) Laser Emission Off
15:54:42.295 GMT : 15:54:41 (113) Laser Emission On
16:01:46.501 GMT : 16:01:45 (112) Laser Emission Off

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 1
Wheels Up     : 1340Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 07, 2010
```

```
Julian Day    : 341
Temperature   : -3 C
Visibility    : CLR
Clouds        : High SCT moving to OVC @ PRJ ALT
Precipitation : nill
Wind Dir      : 240
Wind Speed    : 7 KTS
Pressure      : 29.33
           Statistics
------------------------------
Laser Time    : 01:32:21

=======================================

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED
Mission       : 1
Wheels Up     : 1340Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 07, 2010
Julian Day    : 341
Temperature   : -3 C
Visibility    : CLR
Clouds        : High SCT moving to OVC @ PRJ ALT
Precipitation : nill
Wind Dir      : 240
Wind Speed    : 7 KTS
Pressure      : 29.33
           Statistics
------------------------------
Laser Time    : 01:32:21


        START          STOP LINE#    ALT  PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
=======================================
 13:52:40.608  13:58:25.211    10   1560   70    30.10   18.00   ON  NAR
ON       0.00       179.82
 13:52:40.608  13:58:25.211     4   1559   70    30.10   18.00   ON  NAR
ON       0.00       179.82
 13:58:41.111  14:06:57.515     4   1566   70    30.10   18.00   ON  NAR
ON       0.00       179.82
```

13:58:41.111	14:06:57.515	4	1569	70	30.10	18.00	ON	NAR	ON	0.00	179.82
14:11:45.818	14:19:40.223	3	1576	70	30.10	18.00	ON	NAR	ON	0.00	359.82
14:11:45.818	14:19:44.623	2	1575	70	30.10	18.00	ON	NAR	ON	0.00	359.83
14:24:46.226	14:33:01.232	2	1597	70	30.10	18.00	ON	NAR	ON	0.00	179.83
14:36:42.734	14:50:50.144	5	1576	70	30.10	18.00	ON	NAR	ON	0.00	359.81
14:55:24.548	15:09:50.758	6	1597	70	30.10	18.00	ON	NAR	ON	0.00	179.8
14:55:24.548	15:09:50.758	6	1597	70	30.10	18.00	ON	NAR	ON	0.00	179.8
15:13:48.462	15:27:05.472	7	1573	70	30.10	18.00	ON	NAR	ON	0.00	359.8
15:13:48.462	15:27:05.472	7	1569	70	30.10	18.00	ON	NAR	ON	0.00	359.8
15:31:23.775	15:43:47.586	8	1591	70	30.10	18.00	ON	NAR	ON	0.00	179.79
15:31:23.775	15:43:47.586	8	1591	70	30.10	18.00	ON	NAR	ON	0.00	179.79
15:47:45.289	15:49:14.39	8	1574	70	30.10	18.00	ON	NAR	ON	0.00	179.79
15:47:45.289	15:49:14.39	8	1573	70	30.10	18.00	ON	NAR	ON	0.00	179.79
15:54:42.695	16:01:43.701	17	1563	70	30.10	18.00	ON	NAR	ON	0.00	359.78
15:54:42.695	16:01:48.701	17	1563	70	30.10	18.00	ON	NAR	ON	0.00	359.78

Flight Log

Project Number: 7556-005
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : KBED
Mission : 101207A
Wheels Up : 1315Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 07, 2010
Julian Day : 341
Temperature : -3C
Visibility : >10
Clouds : SOME CLDS AROUND
Precipitation : NO
Wind Dir : 240

```
Wind Speed    : 5
Pressure      : 2933
           Statistics
------------------------------
Laser Time    : 01:29:50

=======================================
08:21:43.774 GMT : 00:00:02 (212) GPS 1PPS Lost
08:21:43.774 GMT : 00:00:03 (166) Divergence Error
08:21:43.774 GMT : 00:00:03 (107) Rx Shutter Closed
08:21:43.774 GMT : 00:00:03 (109) Tx Shutter Closed
08:21:43.774 GMT : 00:00:04 (164) Beam Wide
08:21:43.774 GMT : 00:00:09 (120) Laser PS Comm Ok
08:21:43.774 GMT : 00:00:09 (112) Laser Emission Off
08:21:43.774 GMT : 00:00:12 (204) POSAV Connected
08:21:43.774 GMT : 00:00:13 (207) POSAV Rate Not 50 Hz
08:21:43.774 GMT : 00:00:13 (211) POSAV new status
08:21:43.774 GMT : 00:00:14 (213) GPS 1PPS Ok
08:21:43.774 GMT : 00:00:29 (208) POSAV Rate Is 50 Hz
08:21:43.774 GMT : 00:00:30 (211) POSAV new status
08:21:43.774 GMT : 00:00:30 (215) Nav Data Ok
08:21:43.774 GMT : 00:00:31 (211) POSAV new status
08:21:43.774 GMT : 00:02:01 (211) POSAV new status
13:00:53.172 GMT : 00:04:19 (153) Eyesafety Disabled
13:00:53.872 GMT : 00:04:19 (162) Roll Comp On
13:00:54.472 GMT : 00:04:20 (164) Beam Wide
13:00:59.172 GMT : 00:04:25 (165) Beam Narrow
13:01:03.272 GMT : 00:04:28 (106) Rx Shutter Open
13:01:03.372 GMT : 00:04:28 (108) Tx Shutter Open
13:01:19.173 GMT : 00:04:45 (107) Rx Shutter Closed
13:01:19.173 GMT : 00:04:45 (109) Tx Shutter Closed
13:01:19.873 GMT : 00:04:45 (211) POSAV new status
13:08:06.676 GMT : 13:08:05 (211) POSAV new status
13:27:32.99 GMT : 13:27:31 (106) Rx Shutter Open
13:27:33.19 GMT : 13:27:31 (108) Tx Shutter Open
13:27:40.89 GMT : 13:27:39 (113) Laser Emission On
13:33:43.094 GMT : 13:33:41 (112) Laser Emission Off
13:38:48.299 GMT : 13:38:47 (113) Laser Emission On
13:41:15.501 GMT : 13:41:14 (112) Laser Emission Off
13:45:48.905 GMT : 13:45:47 (113) Laser Emission On
13:57:05.615 GMT : 13:57:04 (112) Laser Emission Off
14:01:30.12 GMT : 14:01:29 (113) Laser Emission On
14:13:00.831 GMT : 14:12:59 (112) Laser Emission Off
14:17:31.535 GMT : 14:17:30 (113) Laser Emission On
14:28:14.346 GMT : 14:28:13 (112) Laser Emission Off
14:32:18.851 GMT : 14:32:17 (113) Laser Emission On
14:43:00.763 GMT : 14:42:59 (112) Laser Emission Off
14:46:39.567 GMT : 14:46:38 (113) Laser Emission On
14:56:57.679 GMT : 14:56:56 (112) Laser Emission Off
15:01:24.685 GMT : 15:01:23 (113) Laser Emission On
15:11:34.597 GMT : 15:11:33 (112) Laser Emission Off
15:15:02.702 GMT : 15:15:01 (113) Laser Emission On
15:22:56.912 GMT : 15:22:55 (112) Laser Emission Off
15:26:37.816 GMT : 15:26:36 (113) Laser Emission On
```

```
15:34:03.726 GMT : 15:34:02 (112) Laser Emission Off
15:37:11.03 GMT : 15:37:10 (113) Laser Emission On
15:39:05.432 GMT : 15:39:04 (112) Laser Emission Off

           Flight Log
------------------------------
Project Number: 7556-005
S/N            : 246
Operator       : BERRY
Pilot(s)       : YOUNG
Aircraft       : N7266Z
Airport        : KBED
Mission        : 101207A
Wheels Up      : 1315Z
Flight Length :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 07, 2010
Julian Day     : 341
Temperature    : -3C
Visibility     : >10
Clouds         : SOME CLDS AROUND
Precipitation : NO
Wind Dir       : 240
Wind Speed     : 5
Pressure       : 2933
           Statistics
------------------------------
Laser Time     : 01:29:50

=======================================

           Flight Log
------------------------------
Project Number: 7556-005
S/N            : 246
Operator       : BERRY
Pilot(s)       : YOUNG
Aircraft       : N7266Z
Airport        : KBED
Mission        : 101207A
Wheels Up      : 1315Z
Flight Length :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 07, 2010
Julian Day     : 341
Temperature    : -3C
```

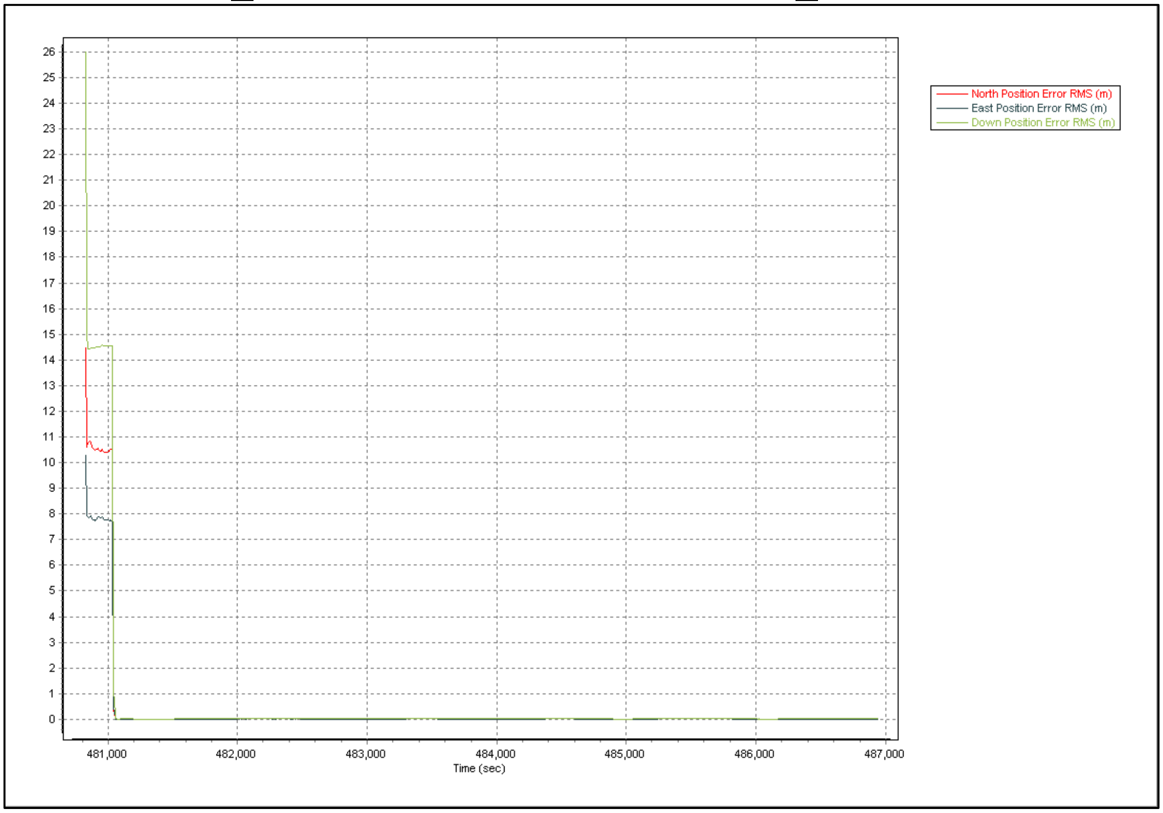
Visibility : >10
Clouds : SOME CLDS AROUND
Precipitation : NO
Wind Dir : 240
Wind Speed : 5
Pressure : 2933

Statistics

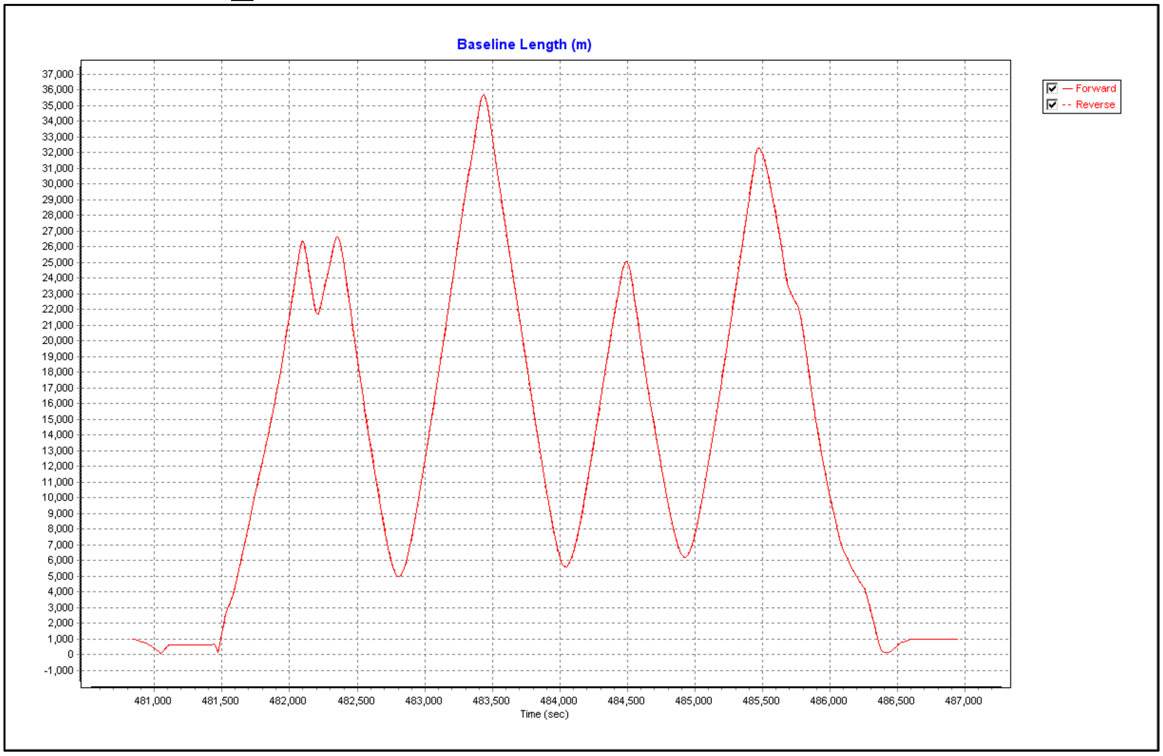
Laser Time : 01:29:50

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
13:27:41.39	13:33:41.094	31	1587	70	30.10	18.00	OFF	NAR	ON	0.00	179.71
13:38:48.899	13:41:16.301	32	1600	70	30.10	18.00	OFF	NAR	ON	0.00	359.7
13:45:49.605	13:57:07.115	33	1595	70	30.10	18.00	OFF	NAR	ON	0.00	179.7
14:01:30.92	14:13:01.731	34	1602	70	30.10	18.00	OFF	NAR	ON	0.00	359.7
14:17:32.035	14:28:15.246	34	1608	70	30.10	18.00	OFF	NAR	ON	0.00	179.7
14:32:18.951	14:43:01.063	35	1601	70	30.10	18.00	OFF	NAR	ON	0.00	359.69
14:46:40.267	14:56:59.679	36	1608	70	30.10	18.00	OFF	NAR	ON	0.00	179.69
15:01:25.485	15:11:36.097	37	1604	70	30.10	18.00	OFF	NAR	ON	0.00	359.68
15:15:03.202	15:22:58.112	38	1616	70	30.10	18.00	OFF	NAR	ON	0.00	179.68
15:26:37.616	15:34:04.026	39	1615	70	30.10	18.00	OFF	NAR	ON	0.00	359.67
15:37:11.93	15:39:06.132	39	1614	70	30.10	18.00	OFF	NAR	ON	0.00	359.67

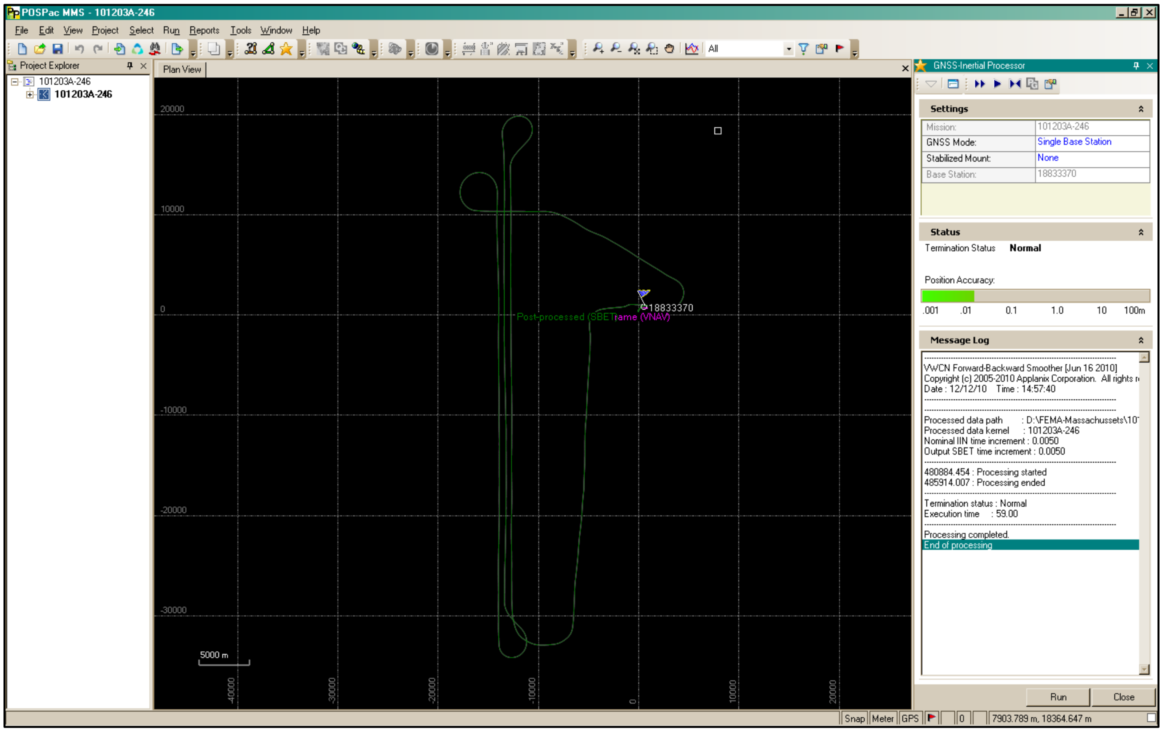
101203A-247_FORWARDPROCPERFMETRIC_NED



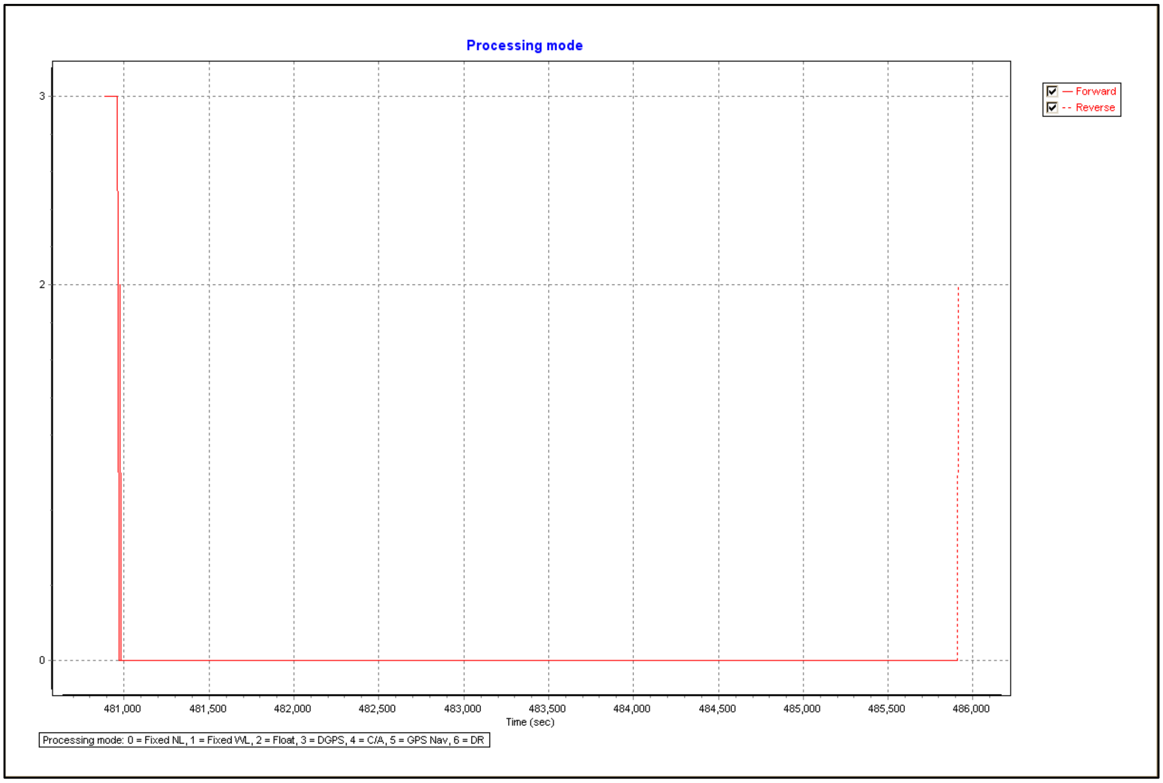
101203A-247_BASELINE



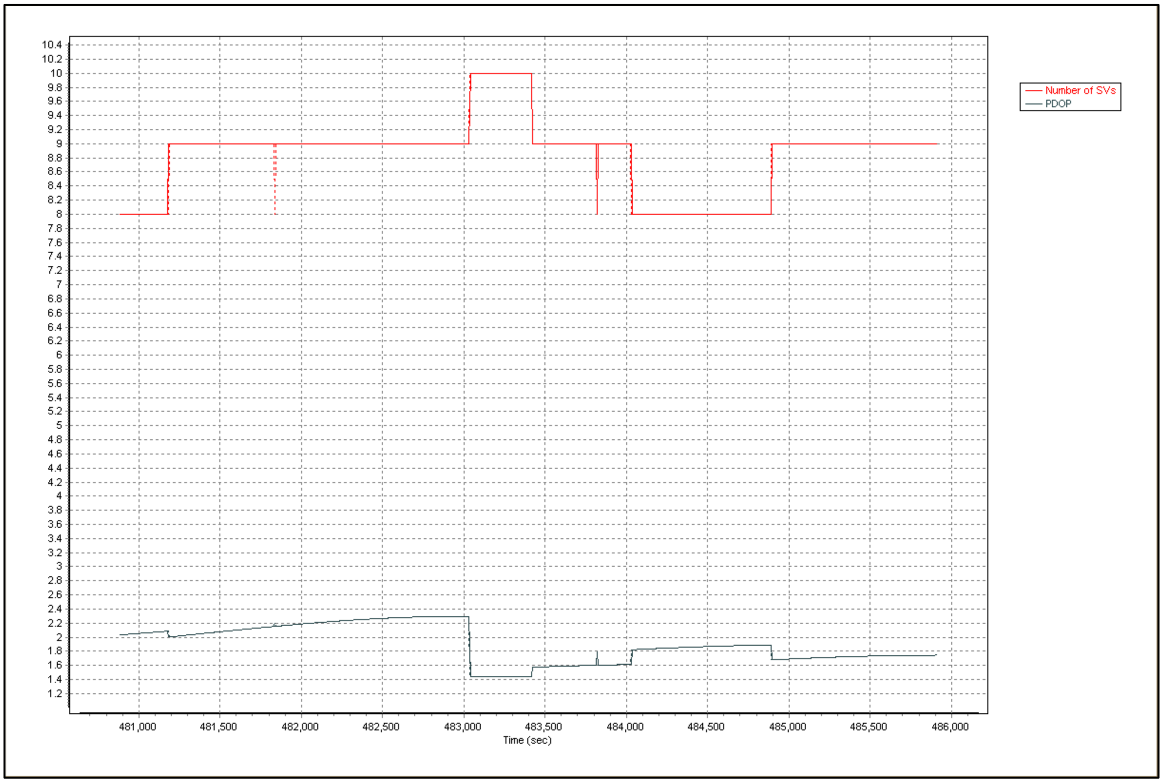
101203A-246-TRAJECTORY



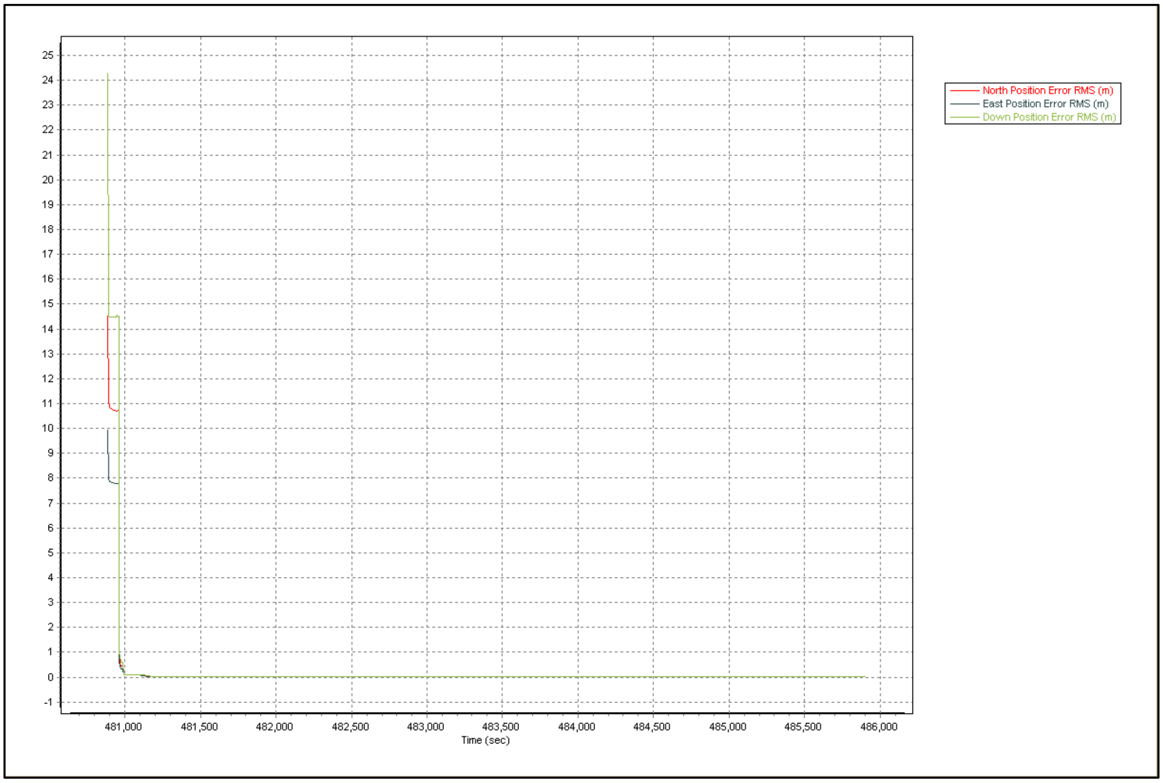
101203A-246-PROCMODE



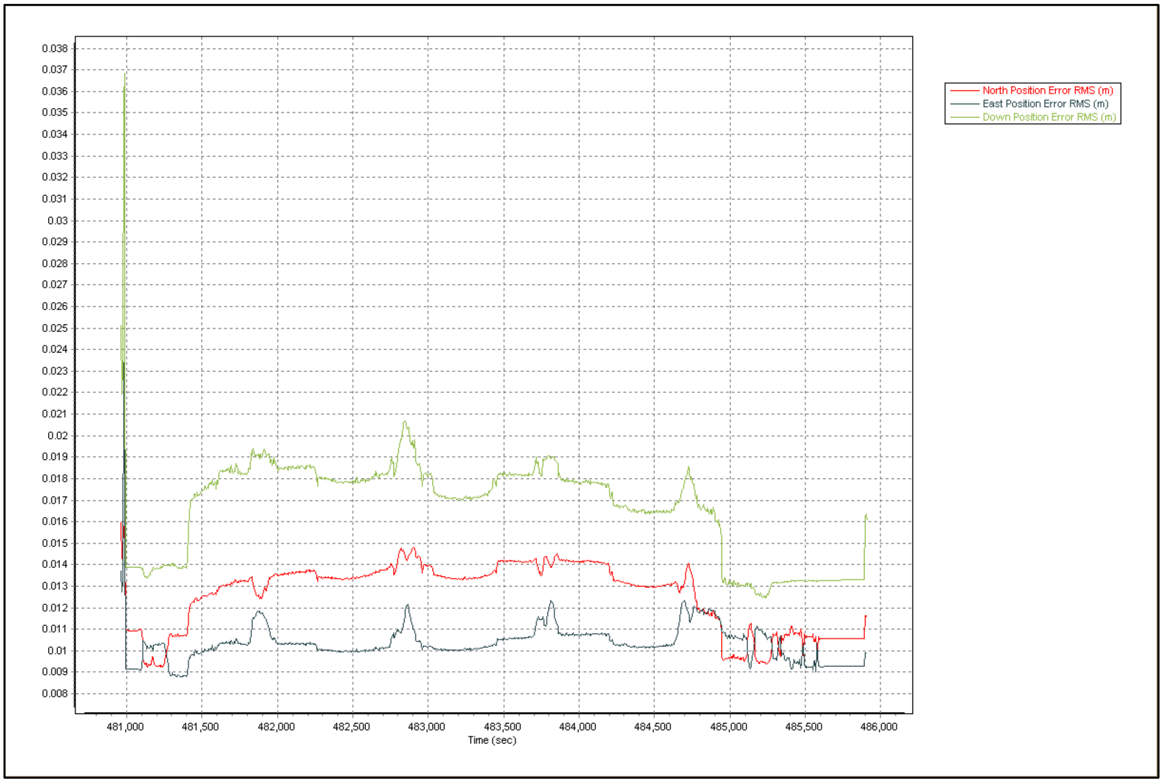
101203A-246-PDOP&SVS



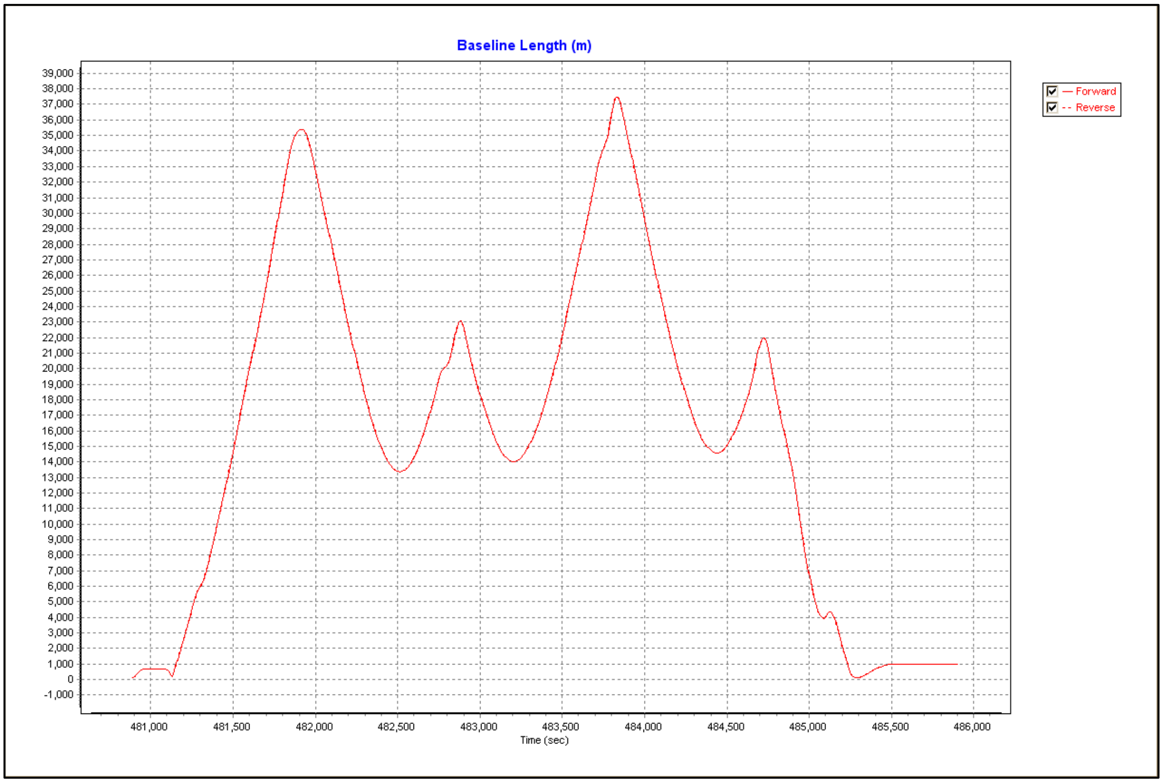
101203A-246-NEDPOSITIONERROR-FORWARD



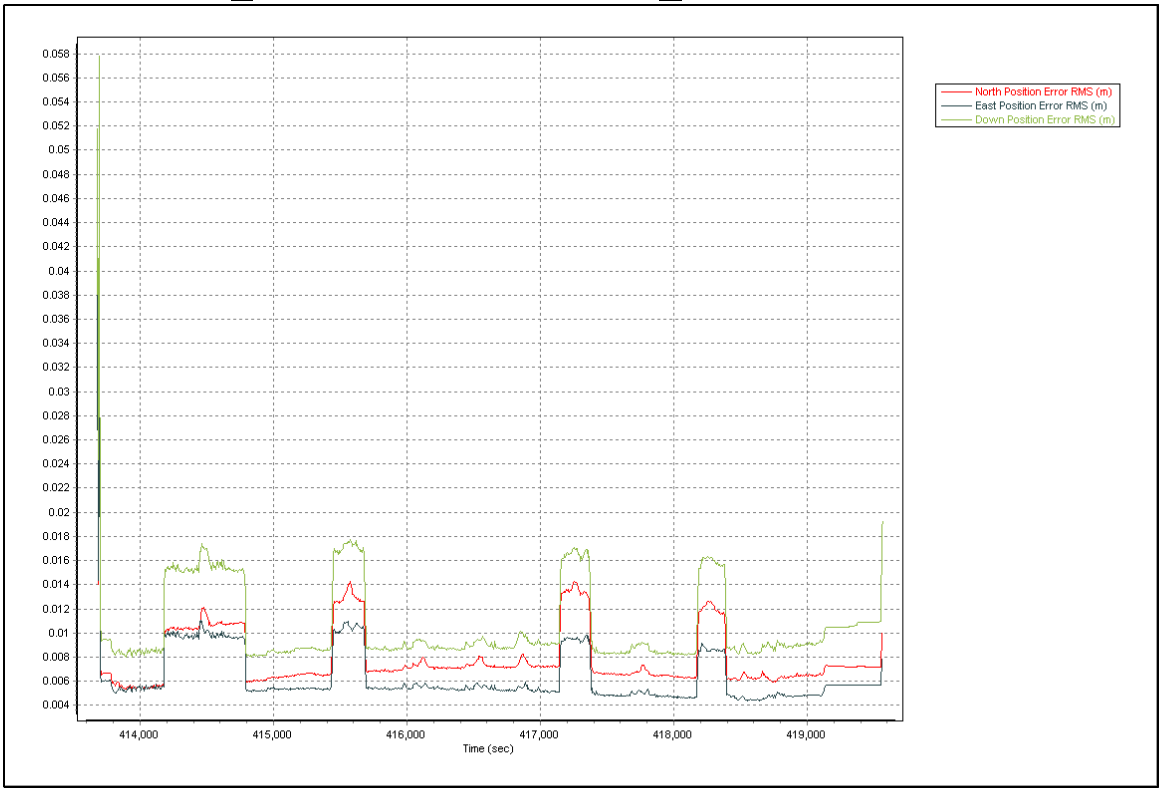
101203A-246-NEDPOSITIONERROR-SMOOTHED



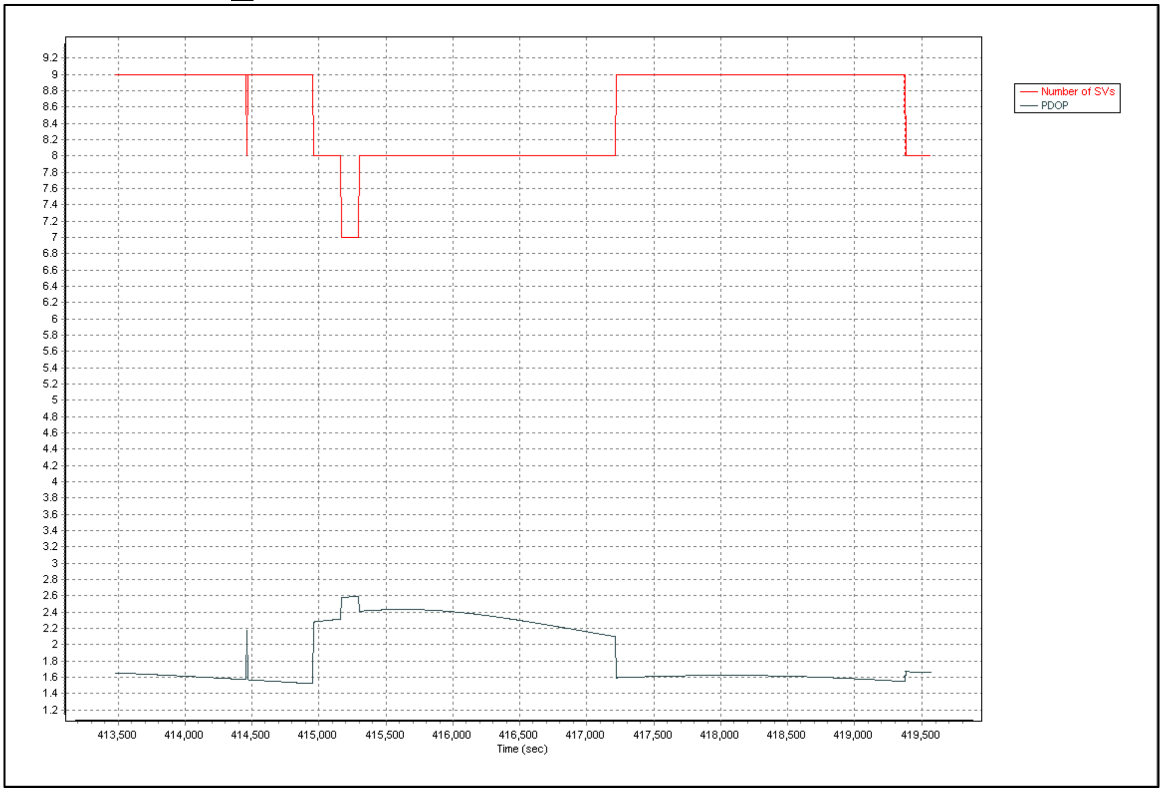
101203A-246-BASELINELENGTH



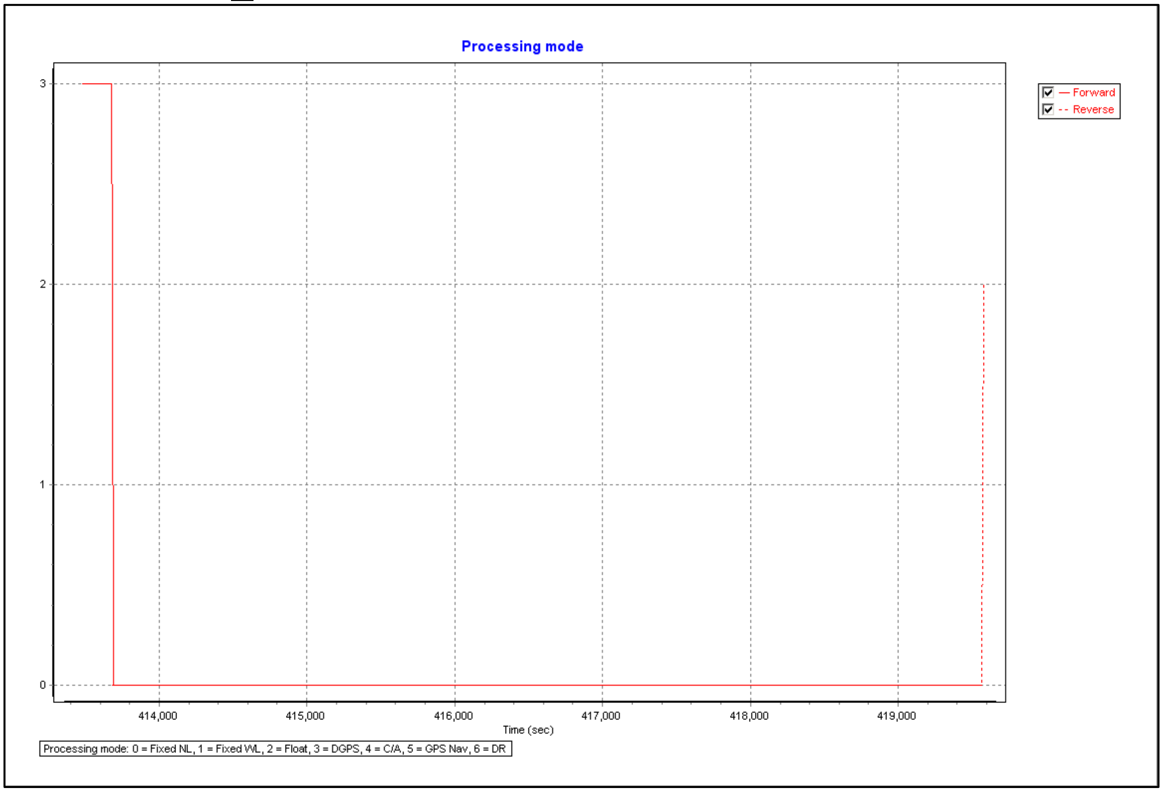
101202A-247_SMOOTHPERFMETRIC_NED



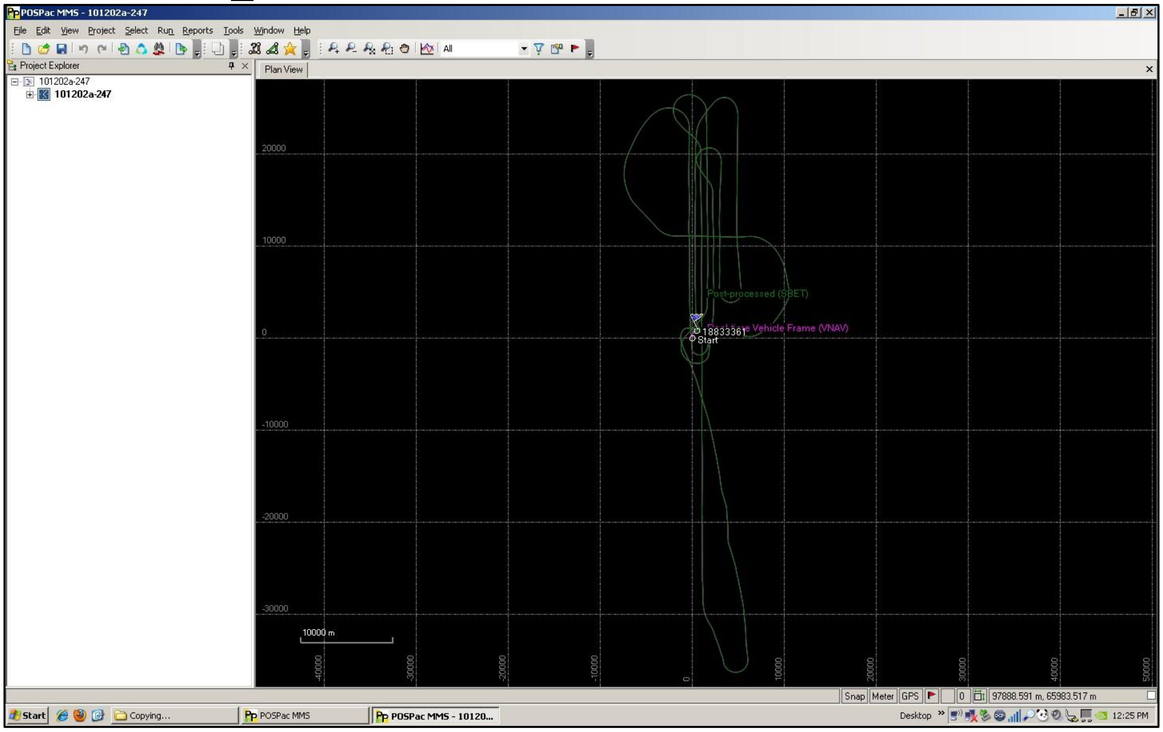
101202A-247_SVS&PDOP



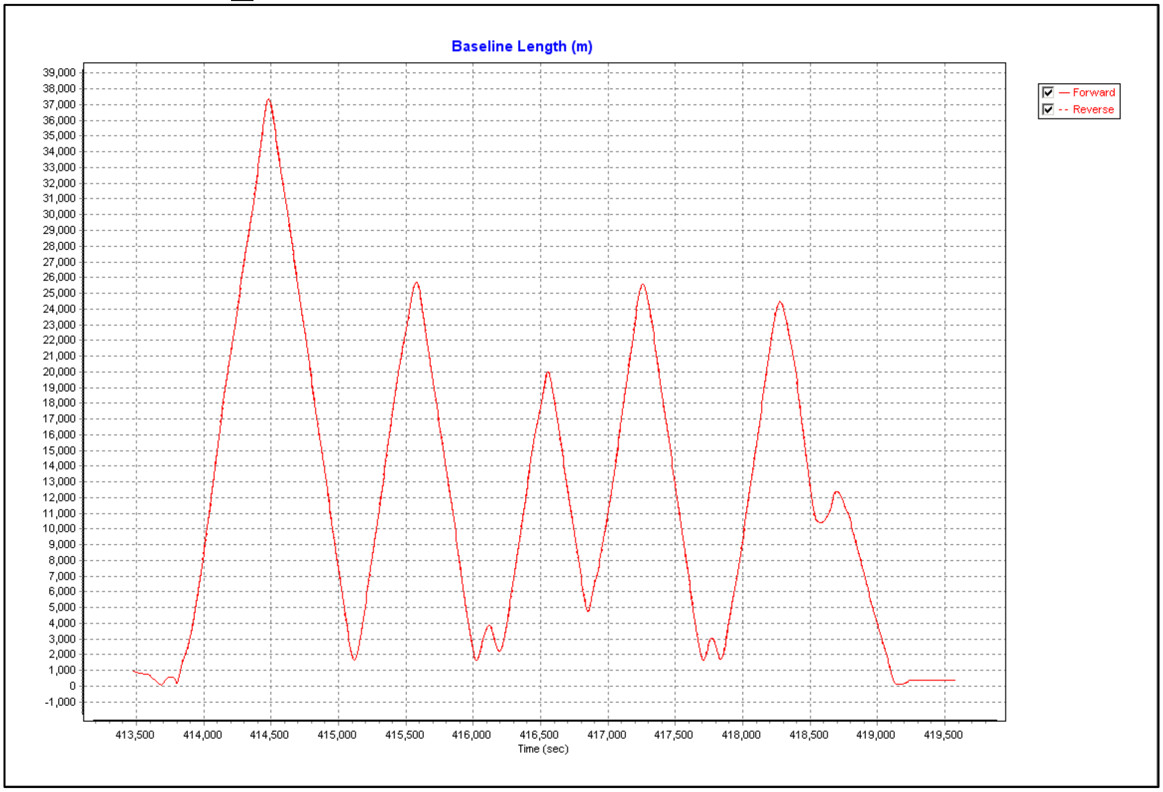
101202A-247_PROCESSMODE



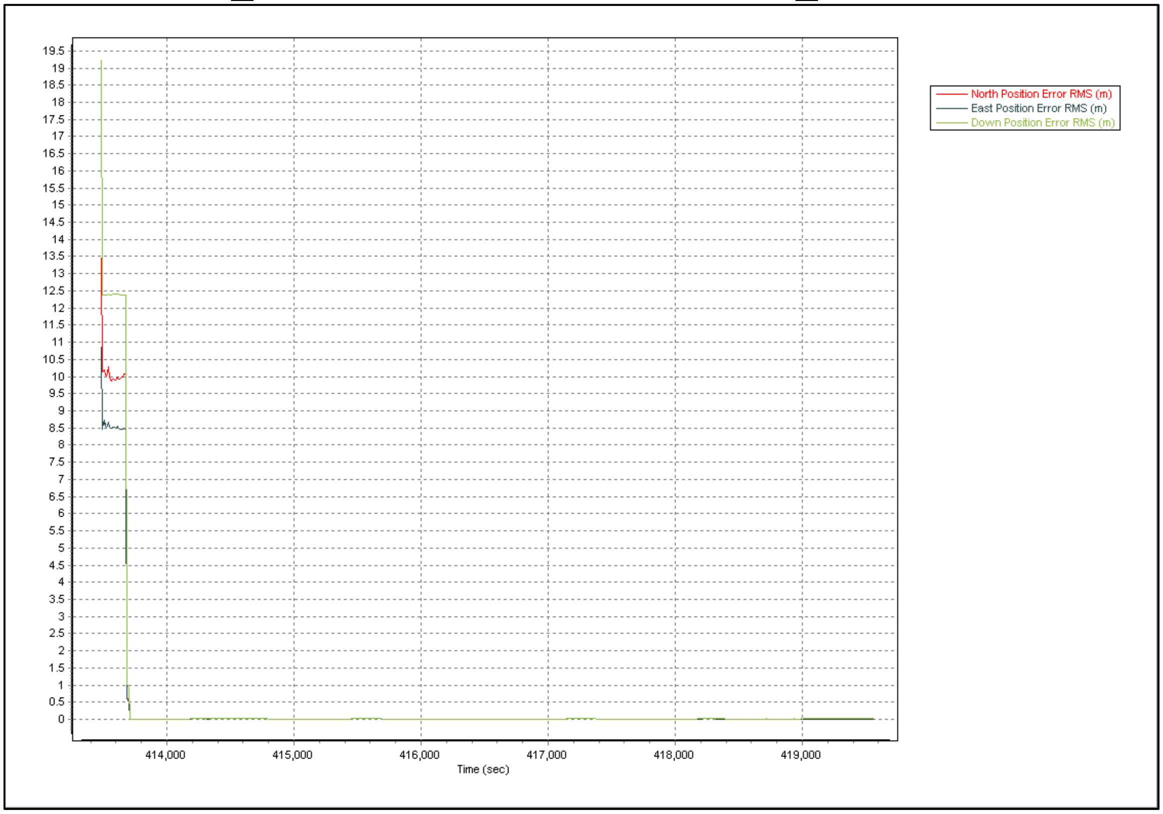
101202A-247_SCREENSHOT



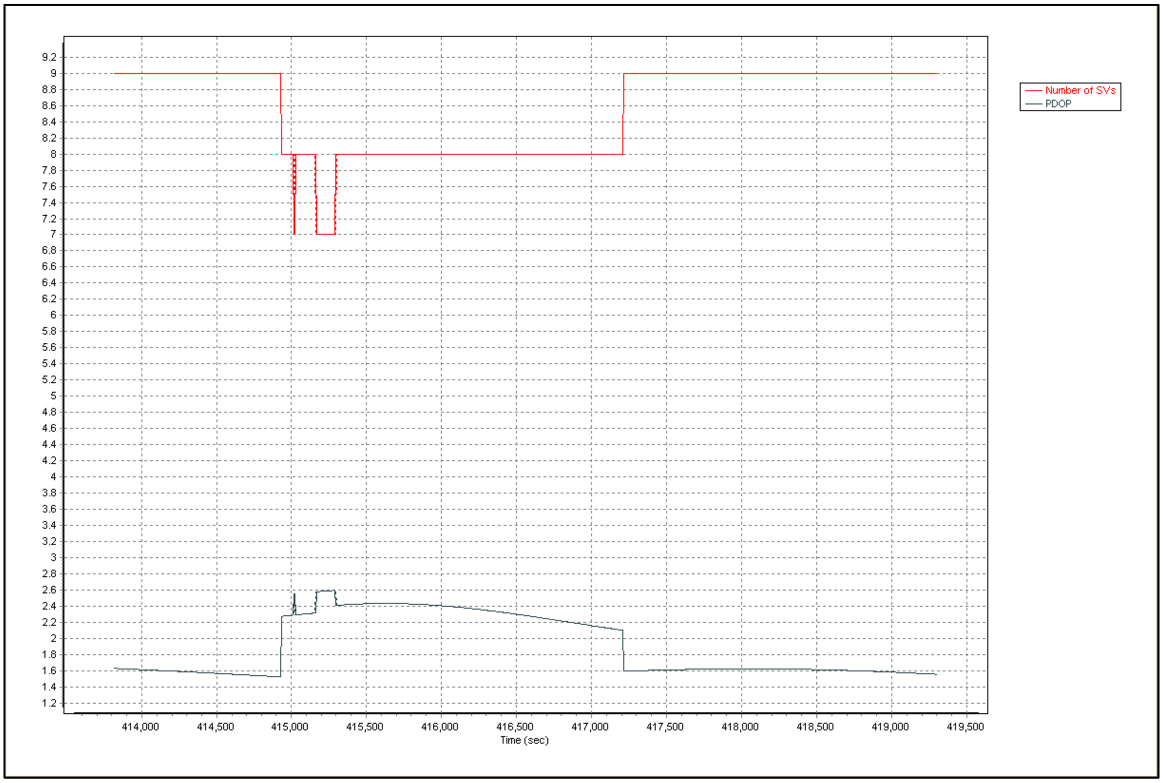
101202A-247_BASELINE



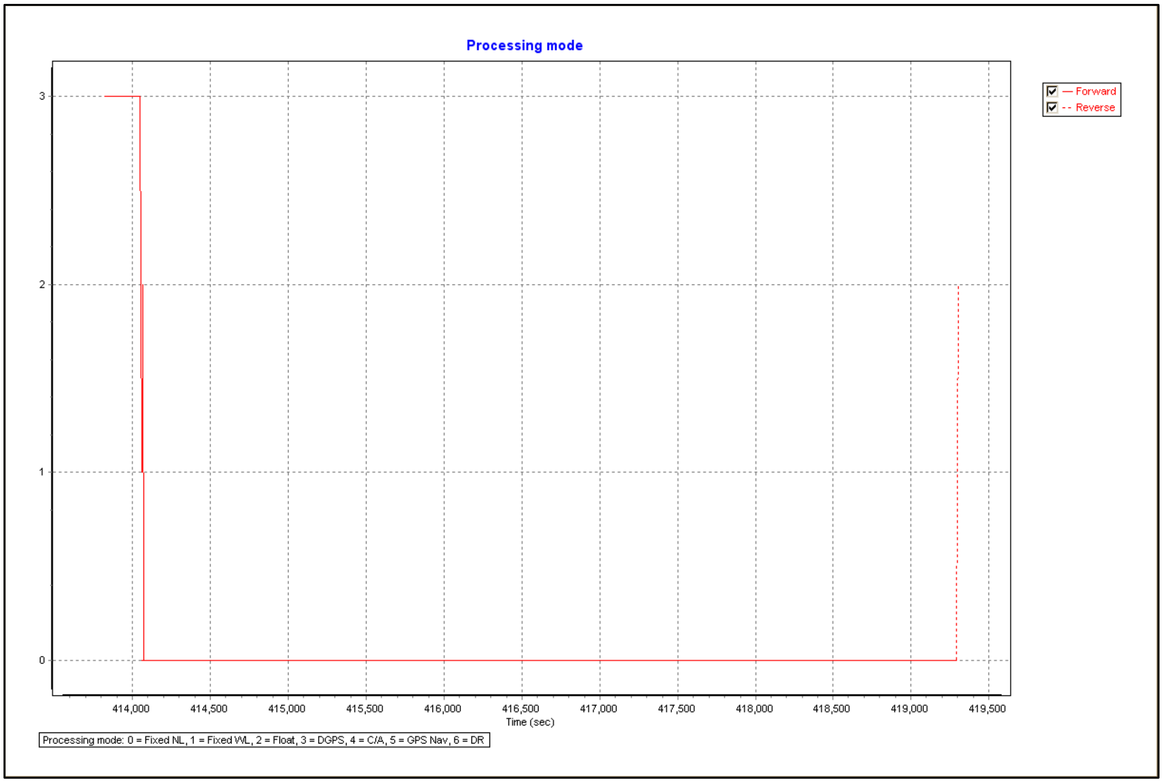
101202A-247_FORWARDPROCPERFMETRIC_NED



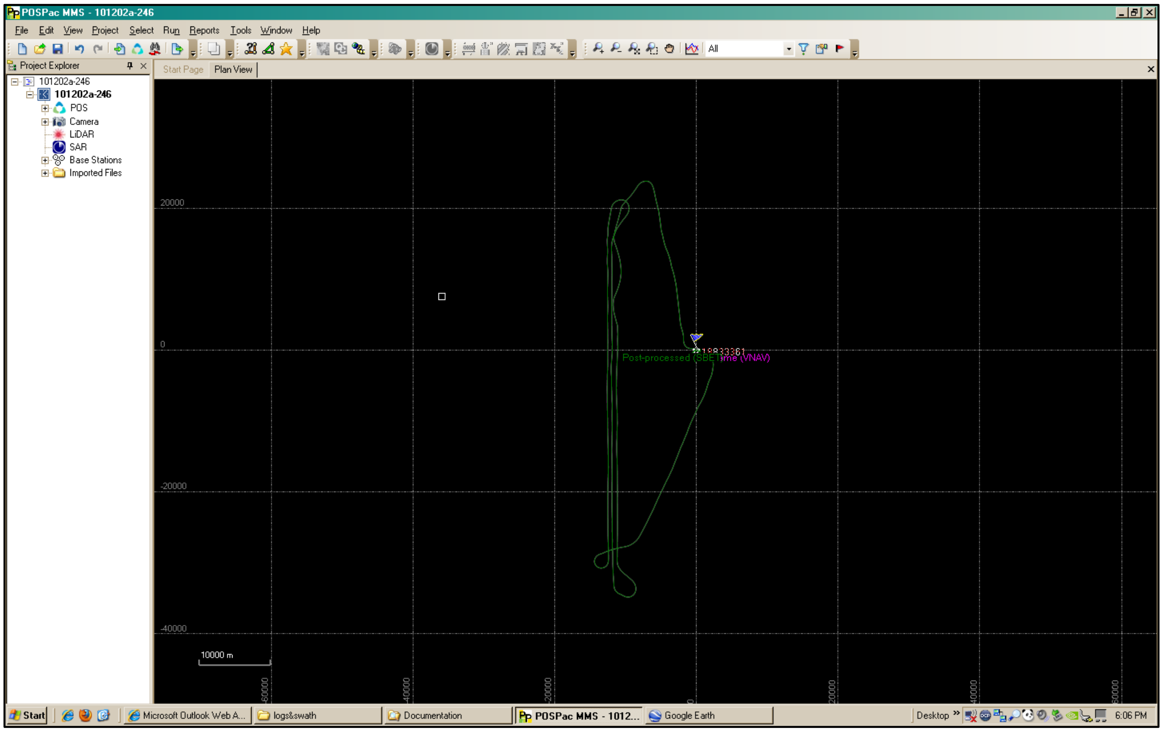
101202A-246-PDOP&SVS



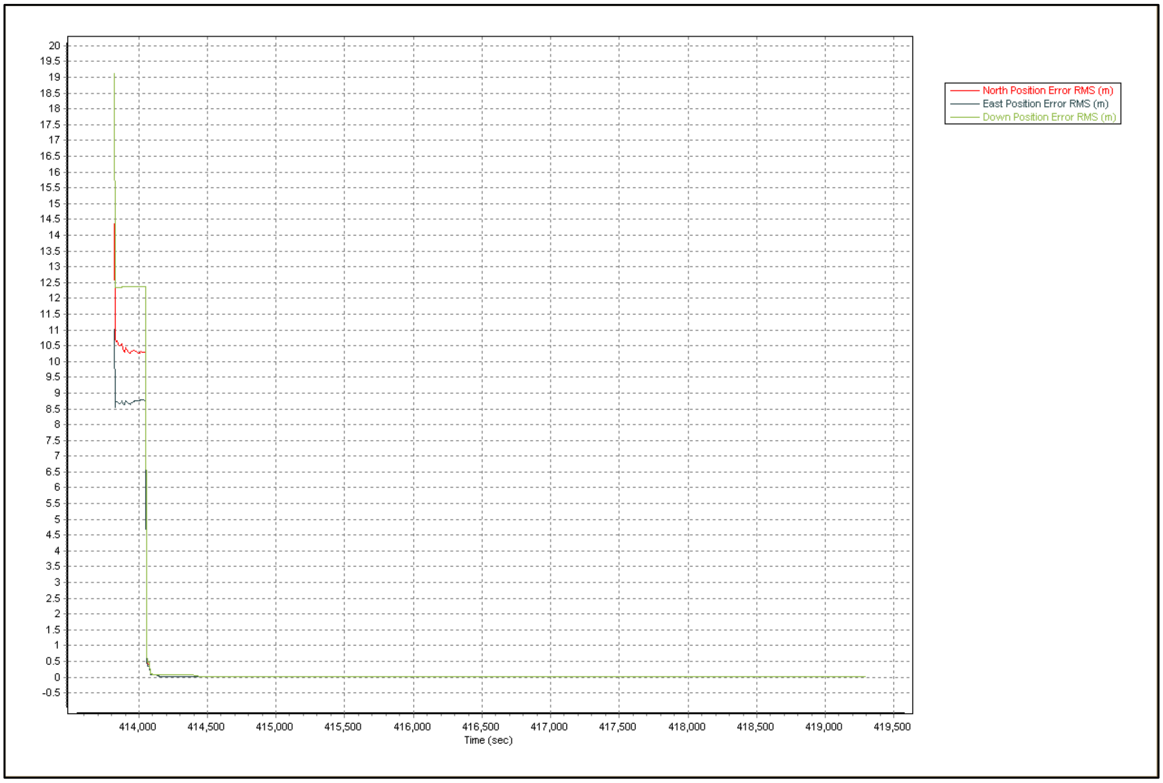
101202A-246-PROCMODE



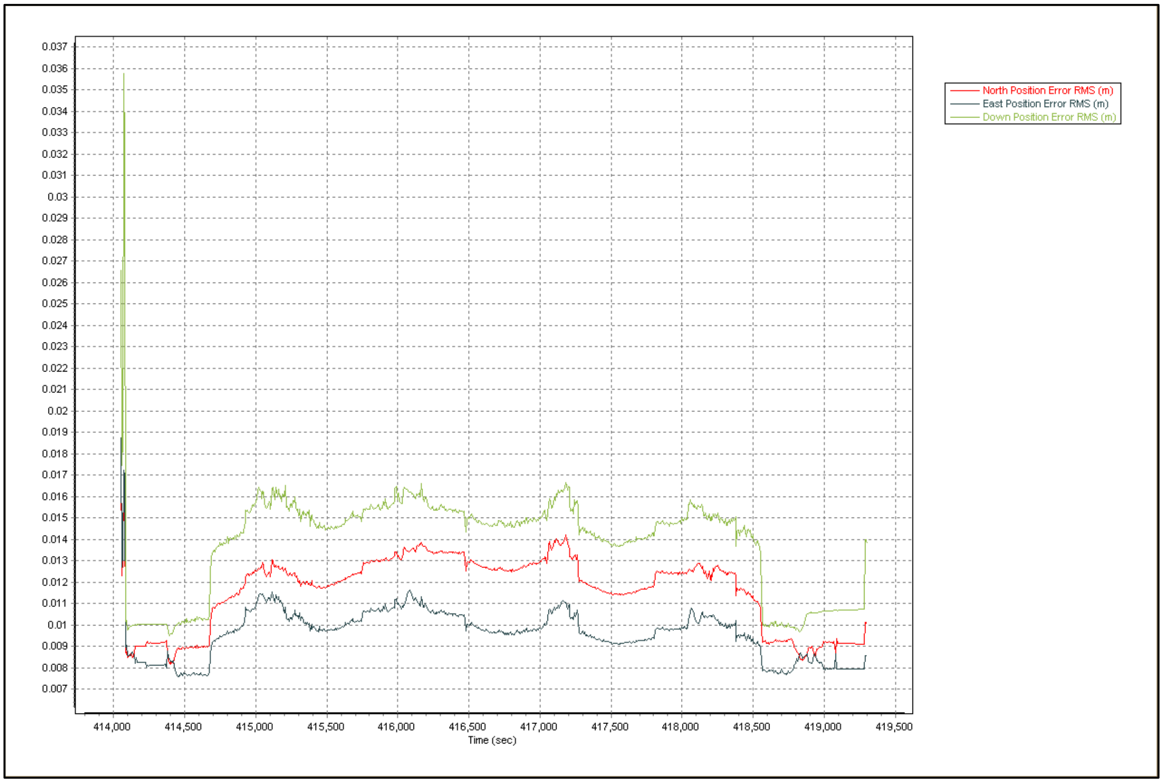
101202A-246-TRAJECTORY



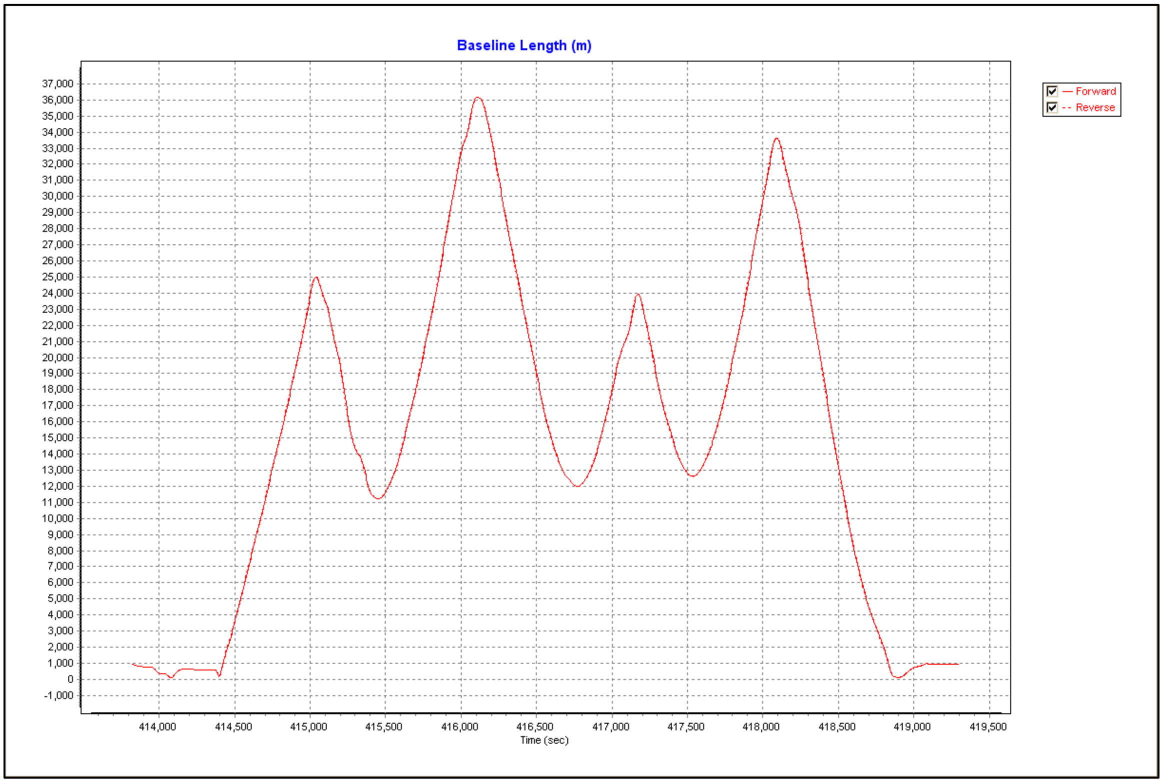
101202A-246-NEDPOSITIONERROR-FORWARD



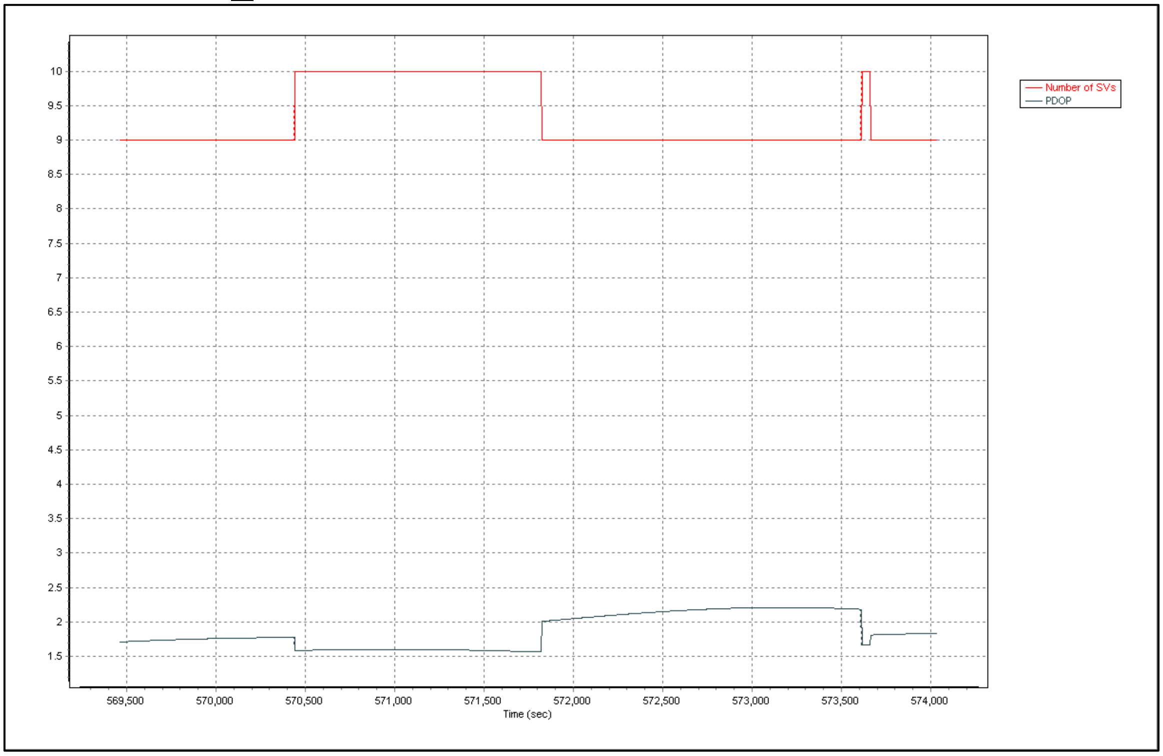
101202A-246-NEDPOSITIONERROR-SMOOTHED



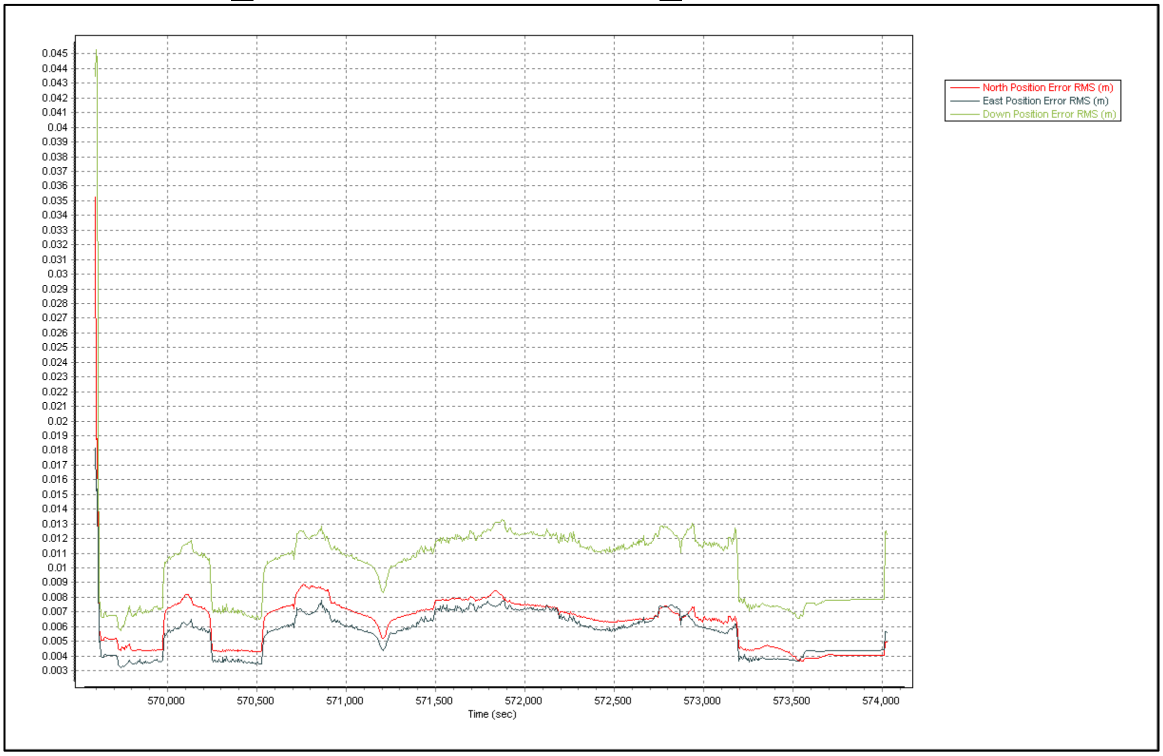
101202A-246-BASELINELENGTH



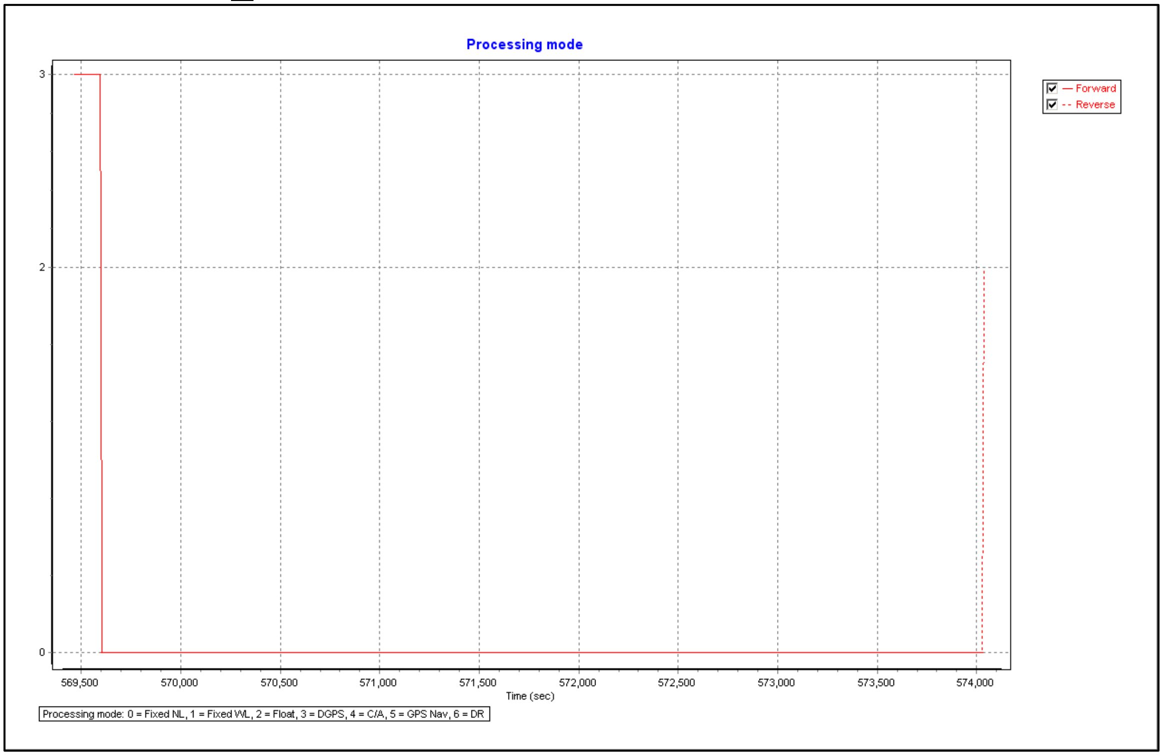
101211A-247_SVS&PDOP



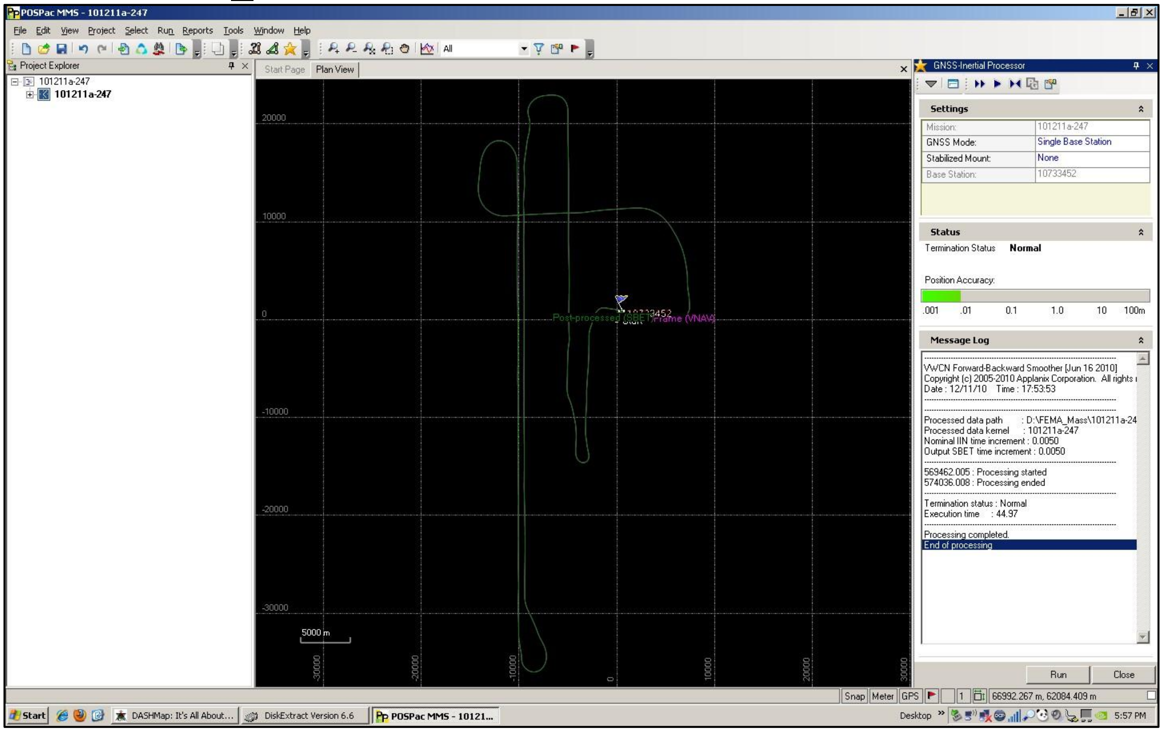
101211A-247_SMOOTHPERFMETRIC_NED



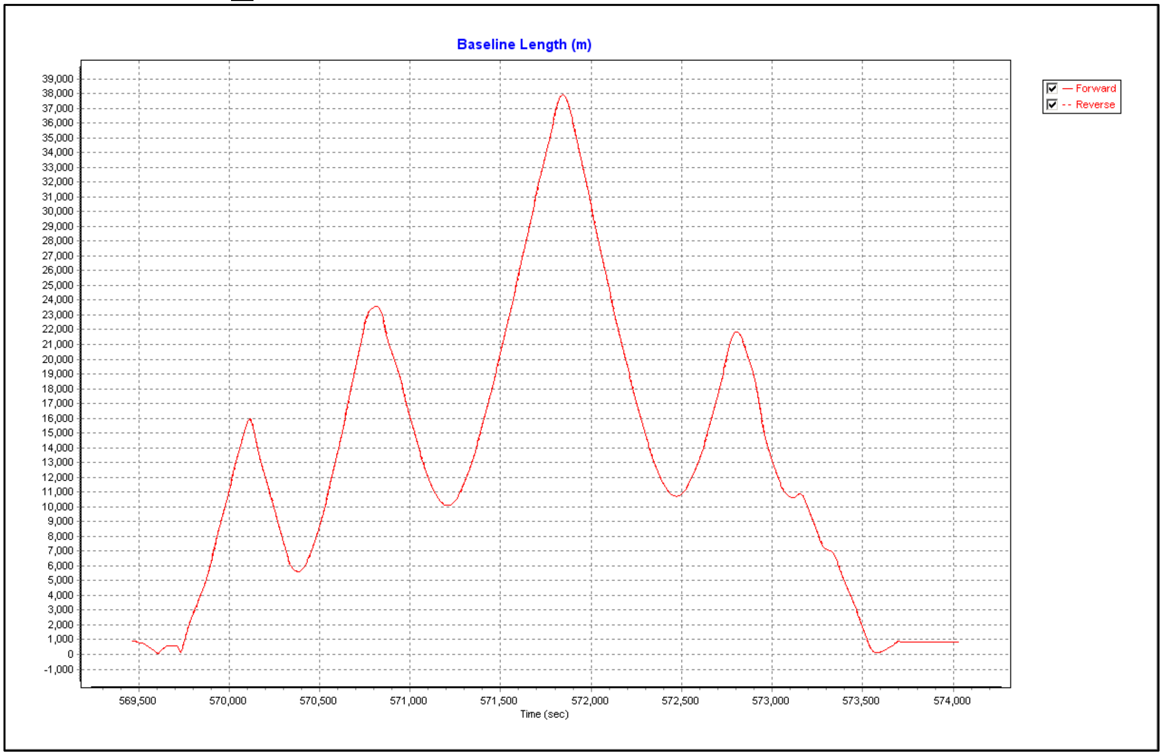
101211A-247_PROCESSMODE



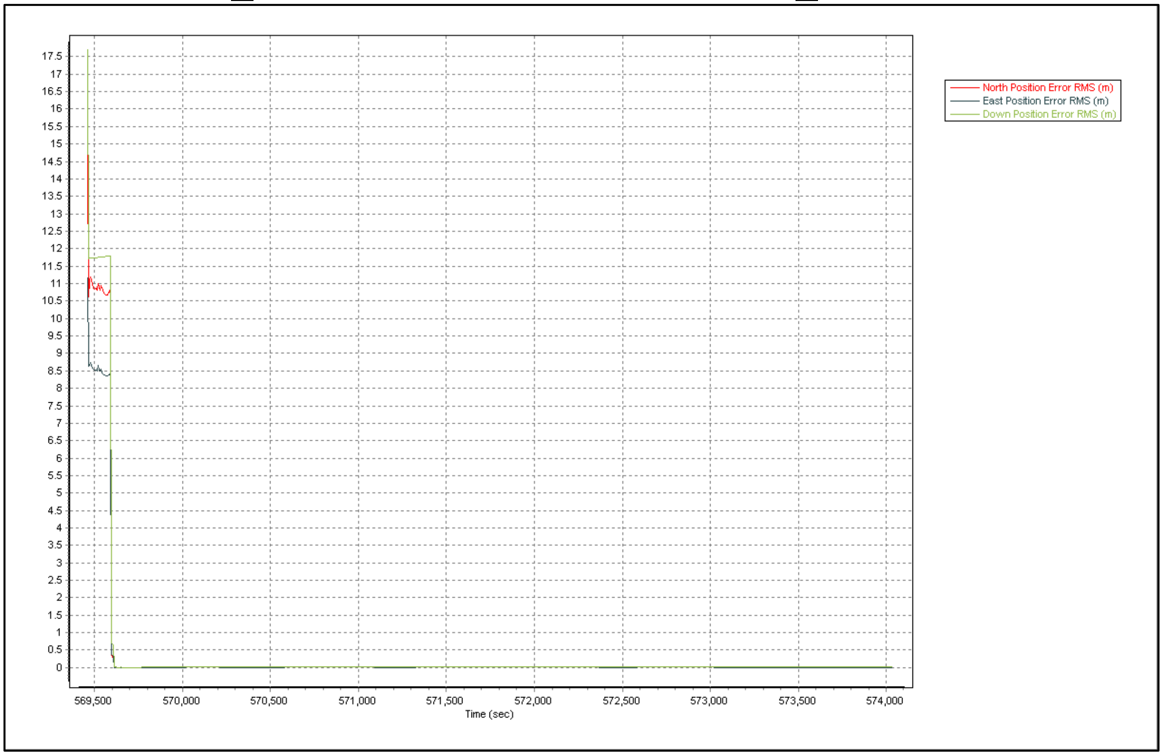
101211A-247_SCREENSHOT



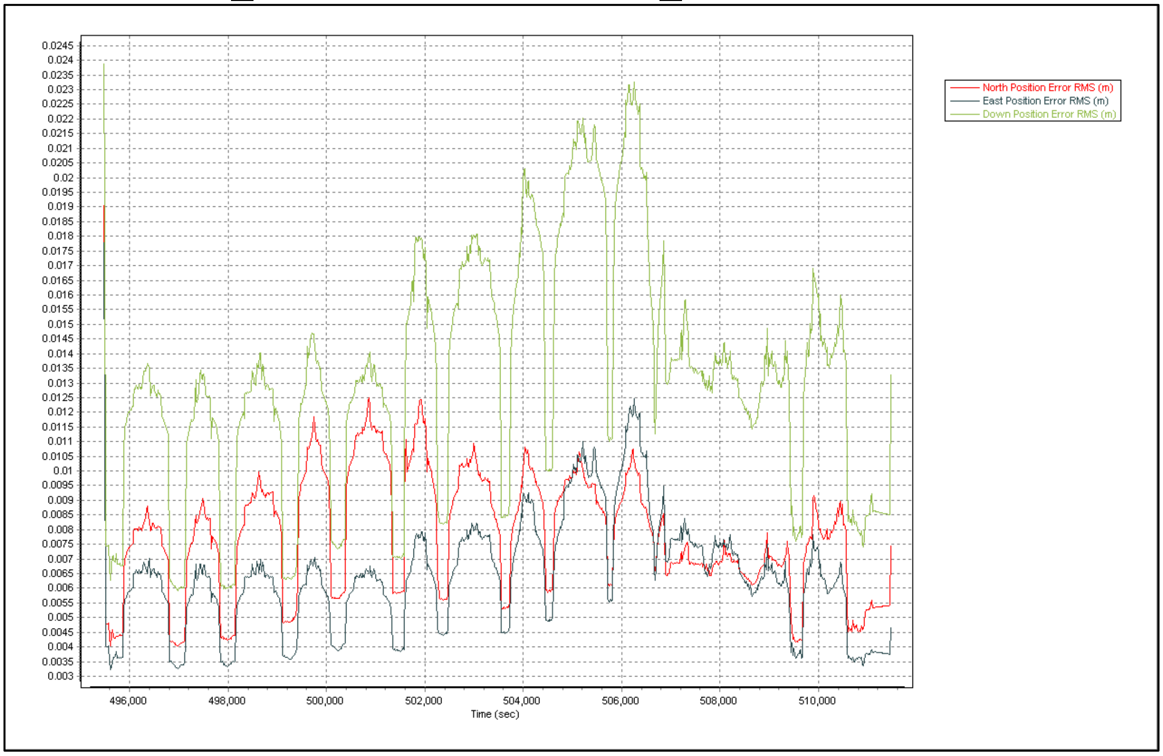
101211A-247_BASELINE



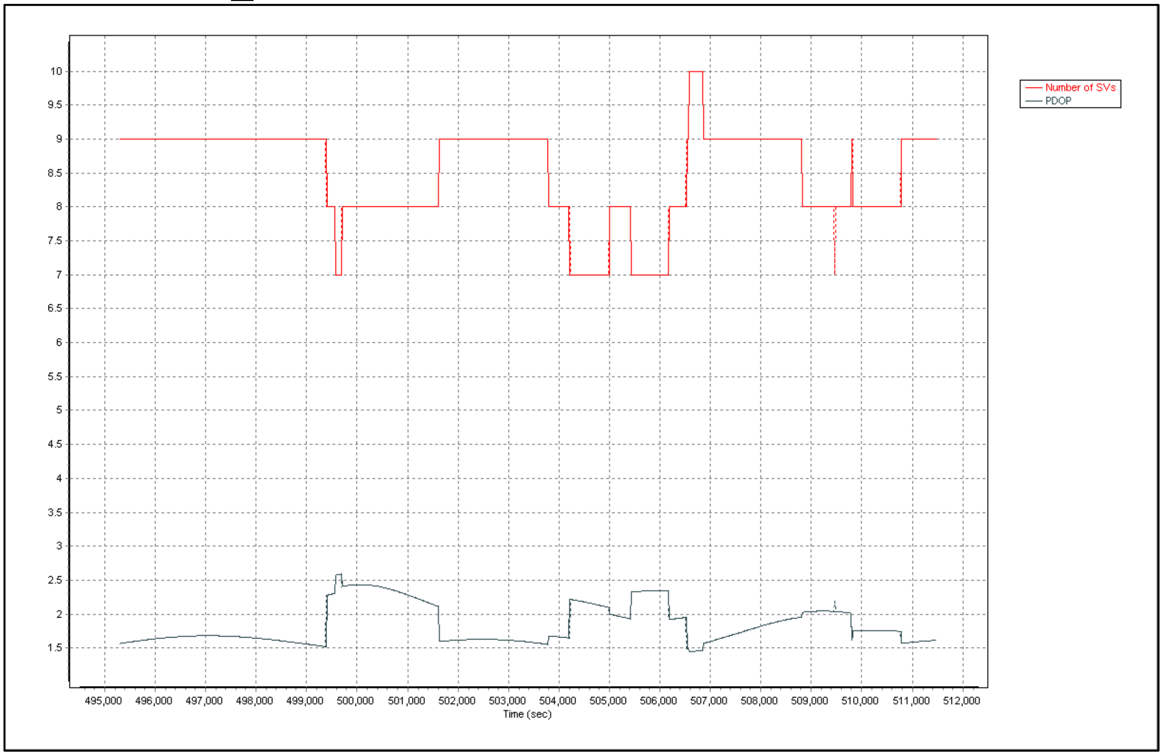
101211A-247_FORWARDPROCPERFMETRIC_NED



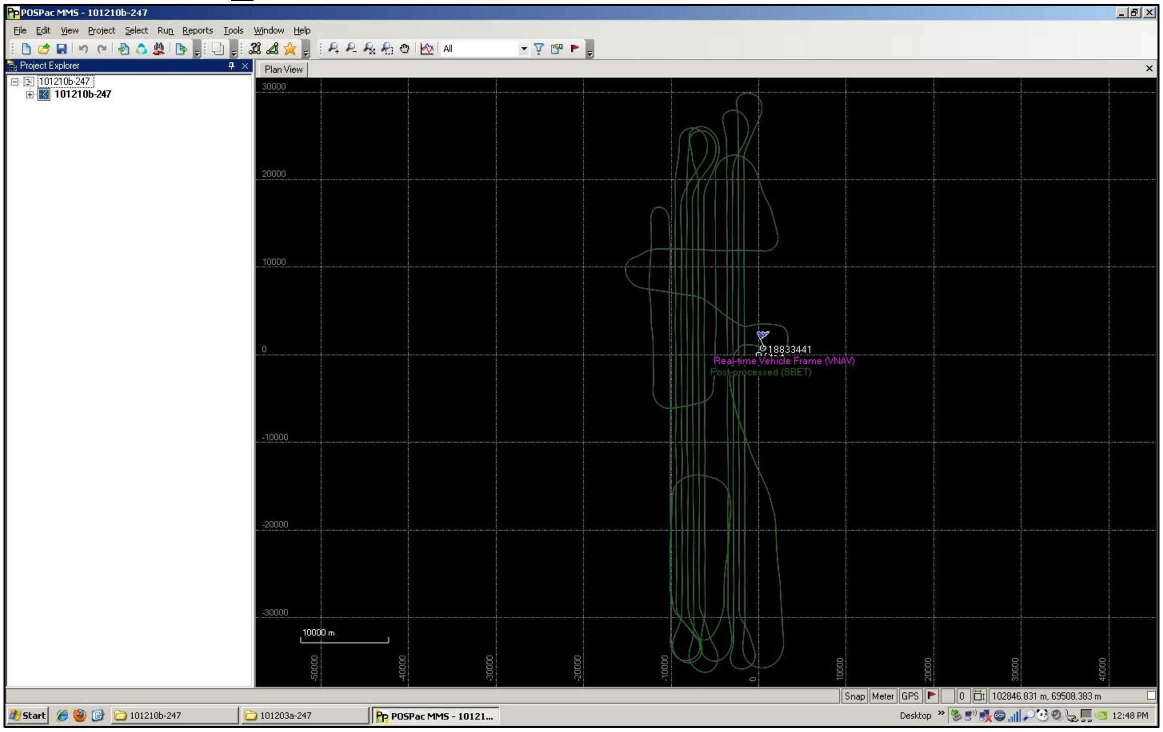
101210B-247_SMOOTHPERFMETRIC_NED



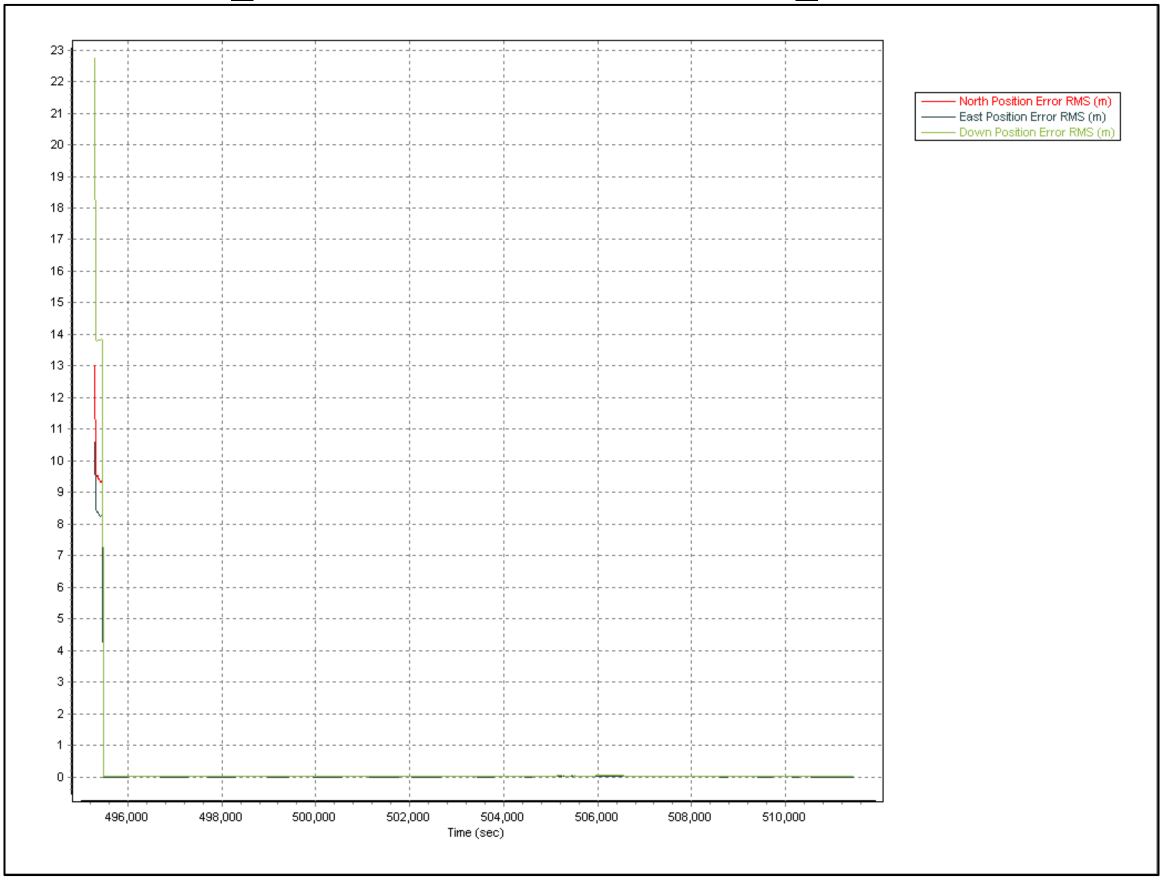
101210B-247_SVS&PDOP



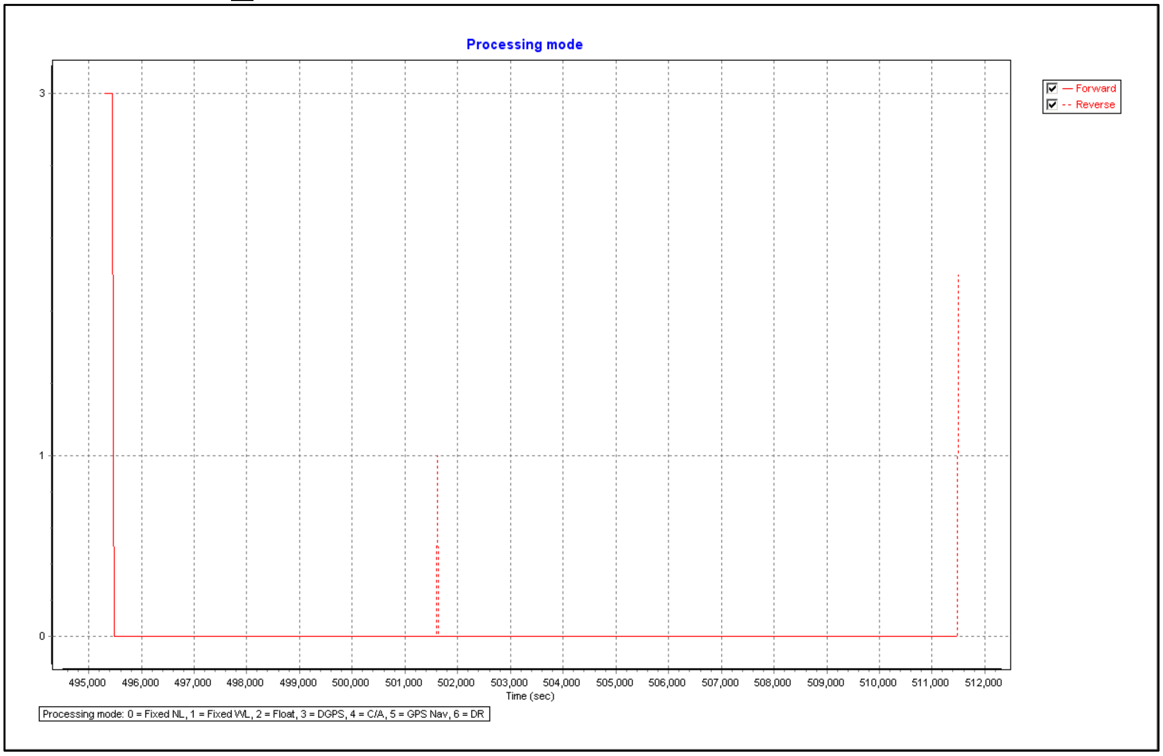
101210B-247_SCREENSHOT



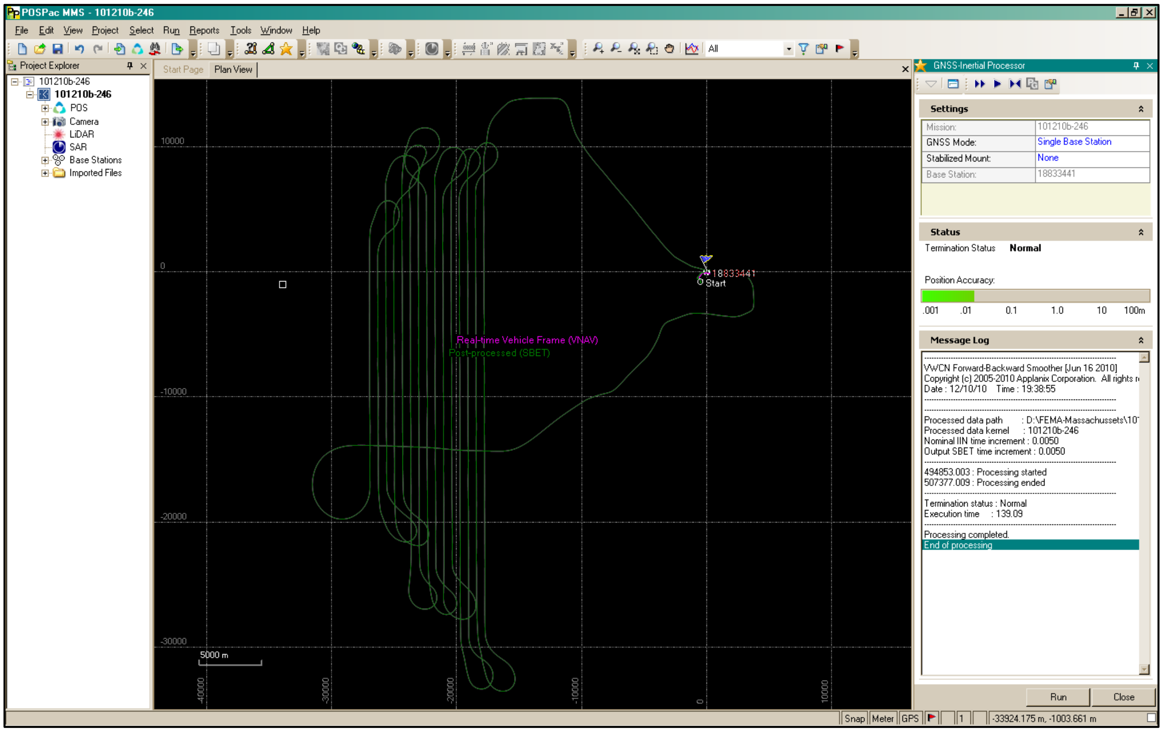
101210B-247_FORWARDPROCPERFMETRIC_NED



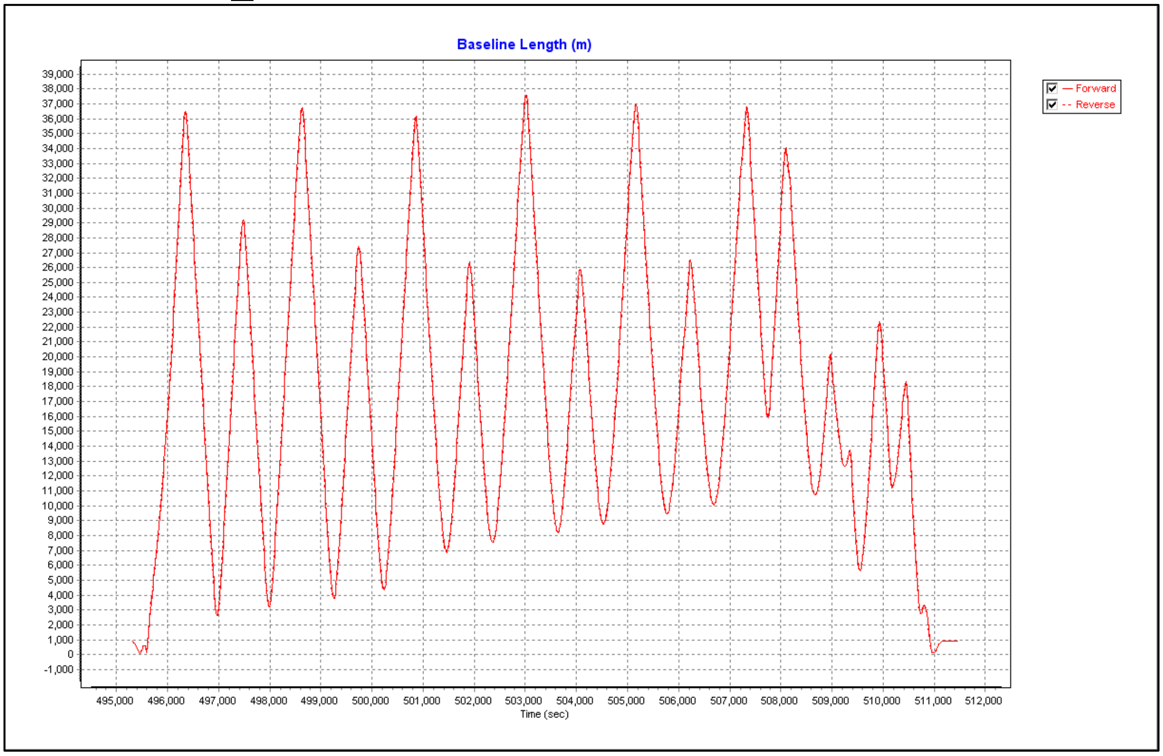
101210B-247_PROCESSINGMODE



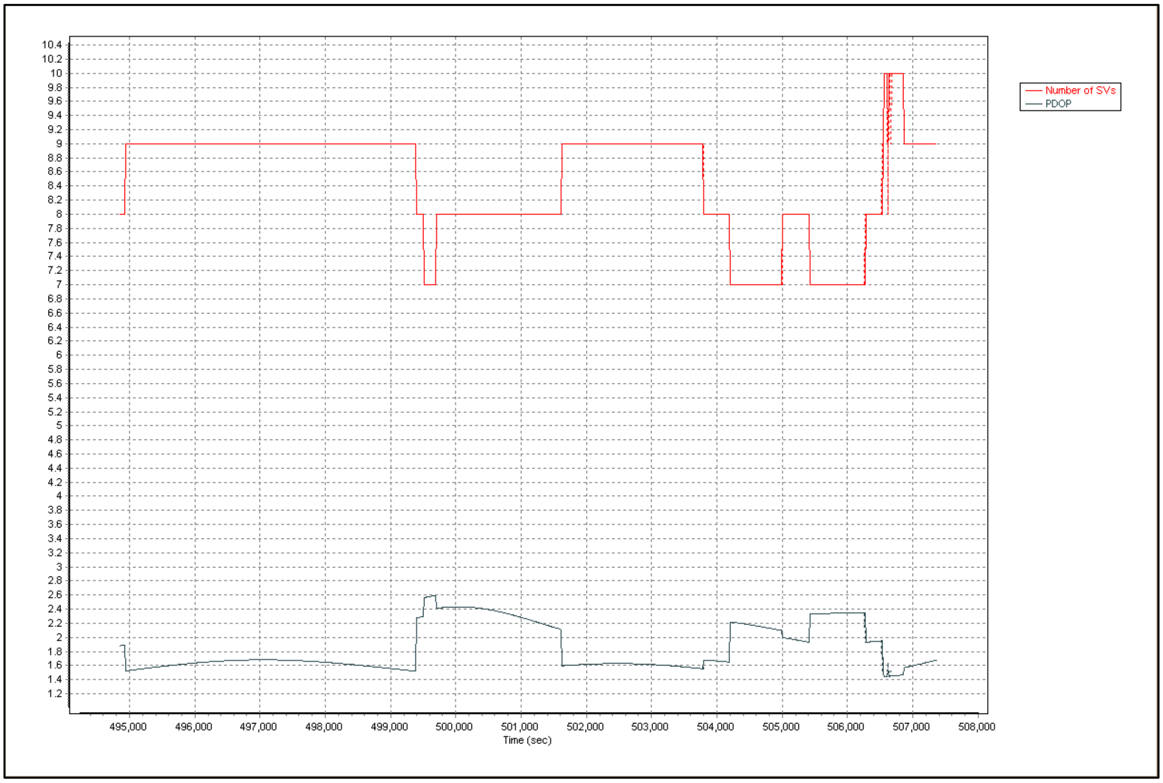
101210B-246-TRAJECTORY



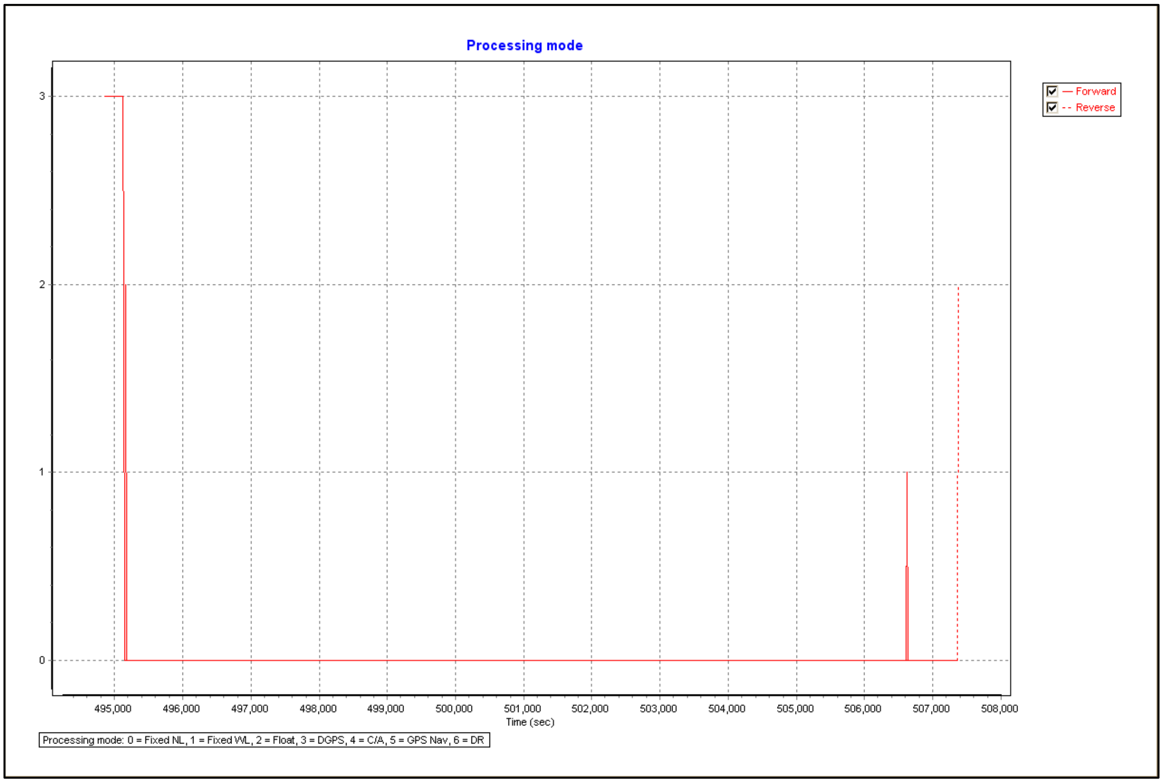
101210B-247_BASELINE



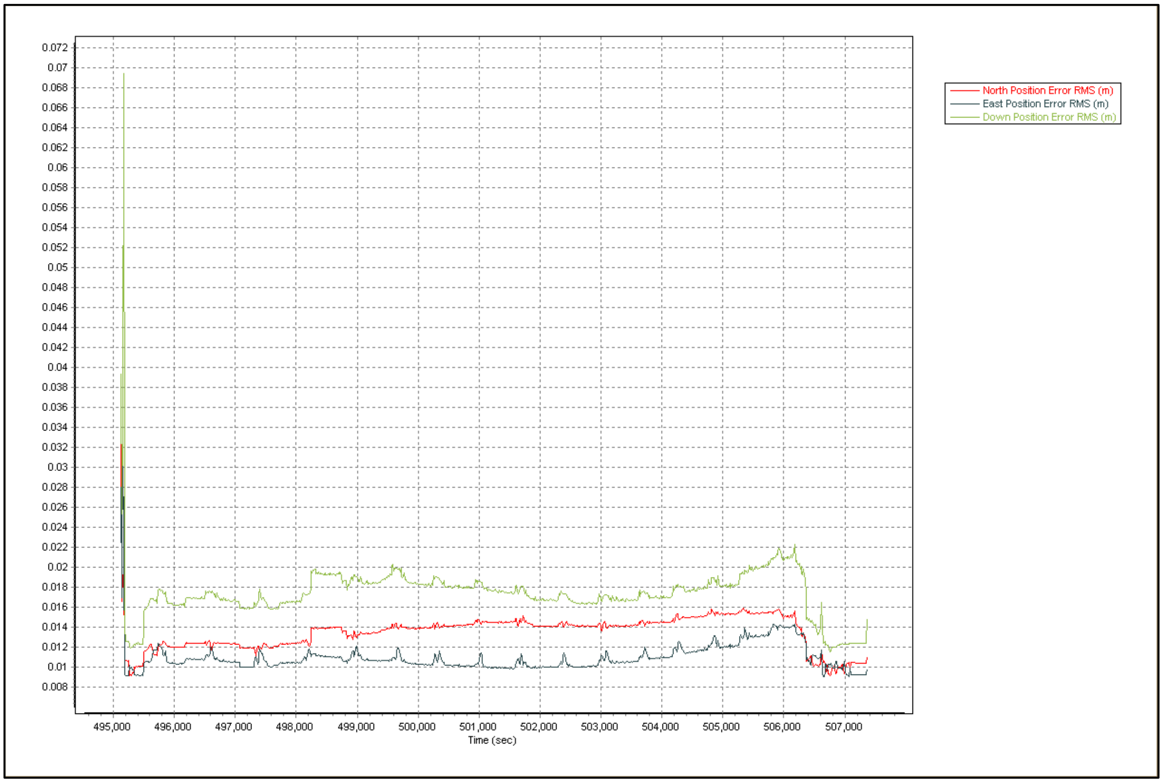
101210B-246-PDOP&SVS



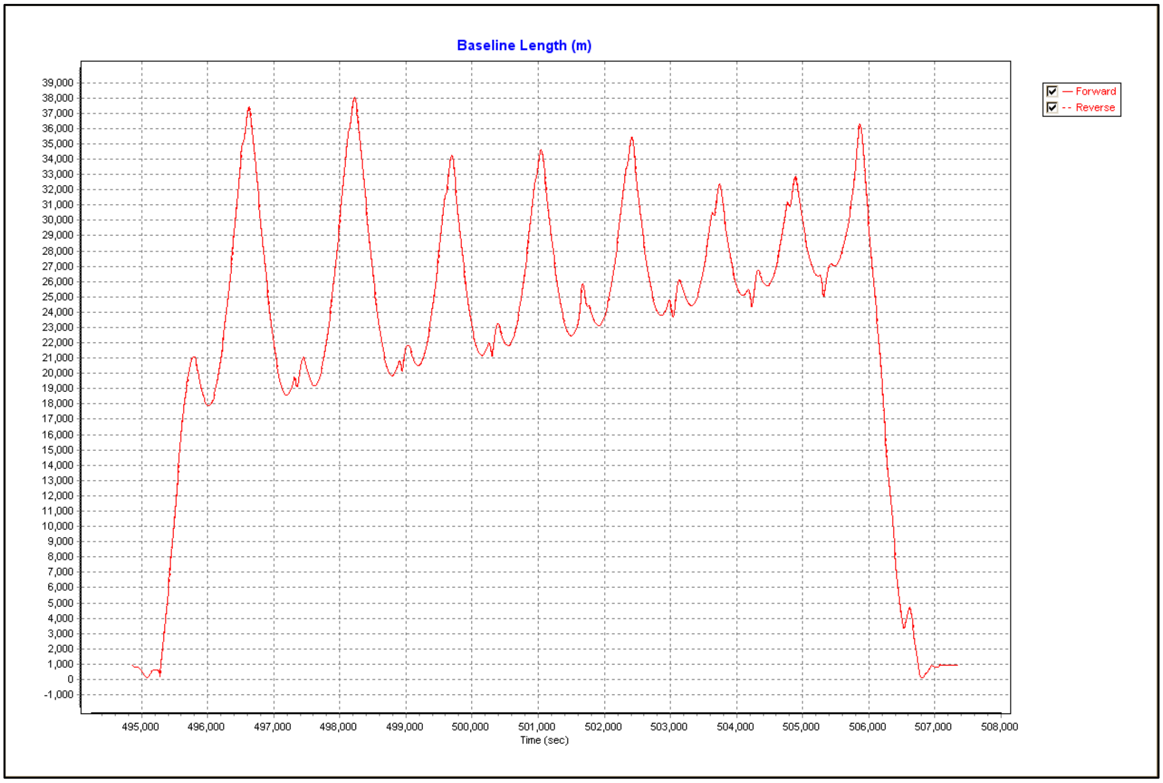
101210B-246-PROCMODE



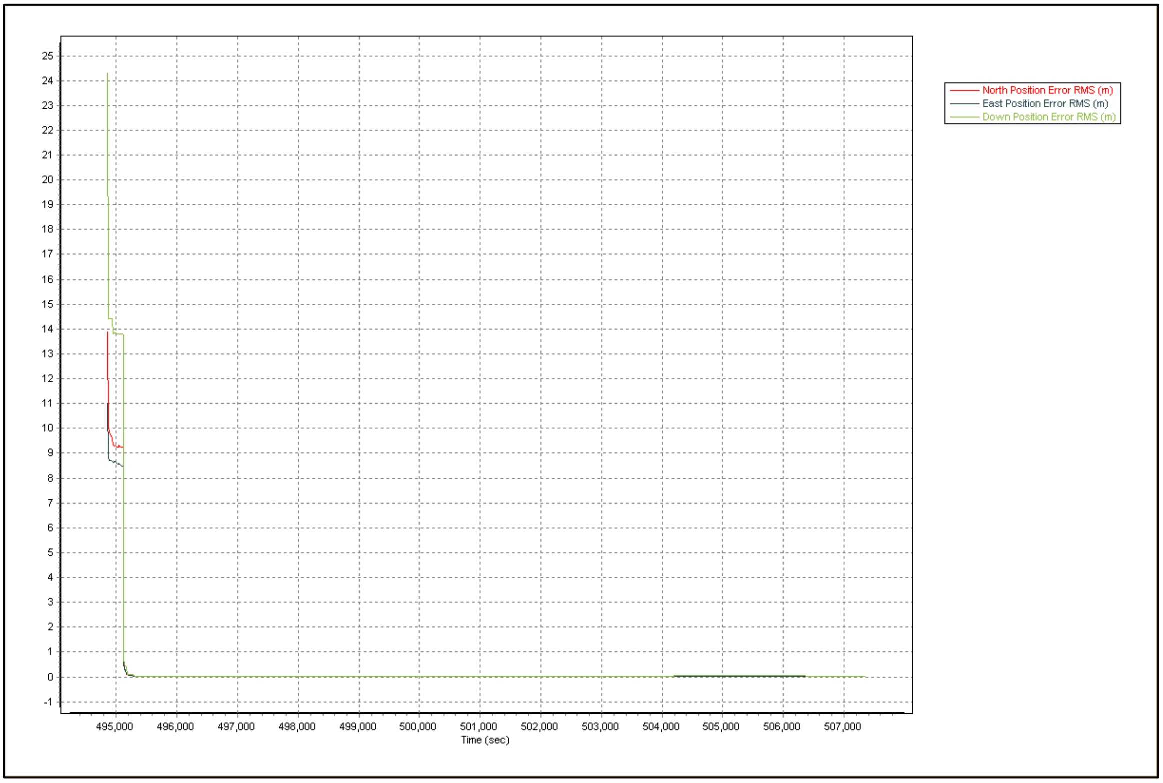
101210B-246-NEDPOSITIONERROR-SMOTHED



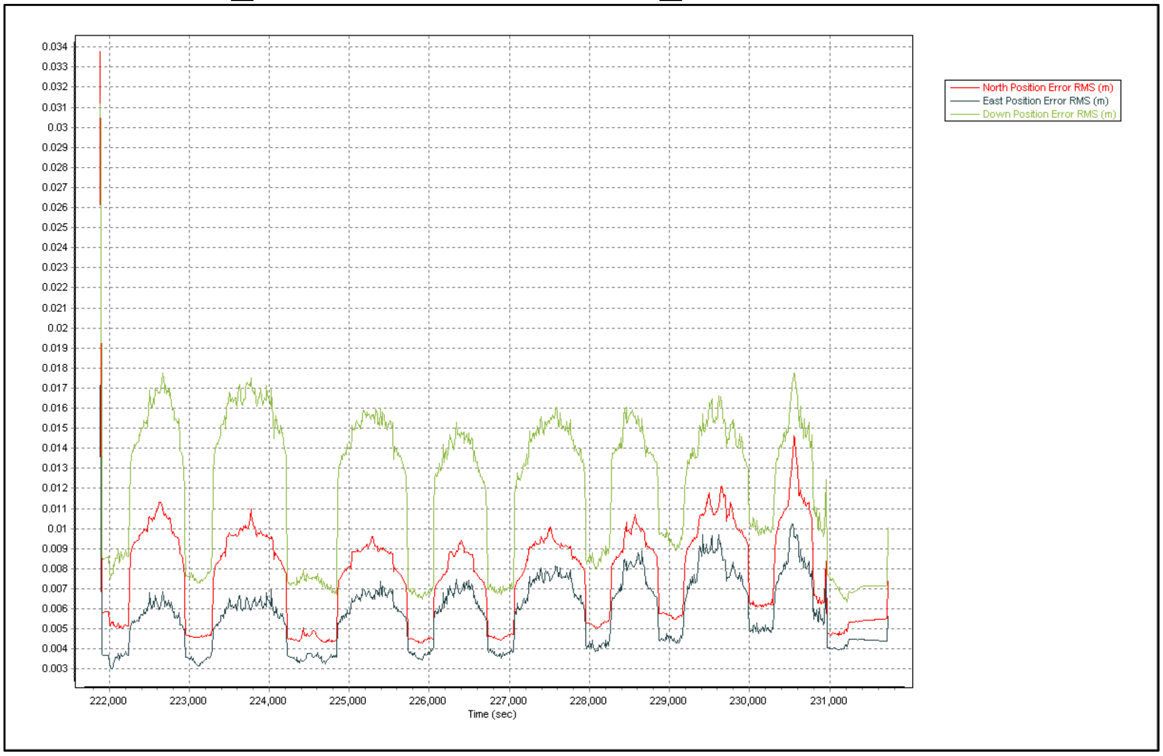
101210B-246-BASELINELENGTH



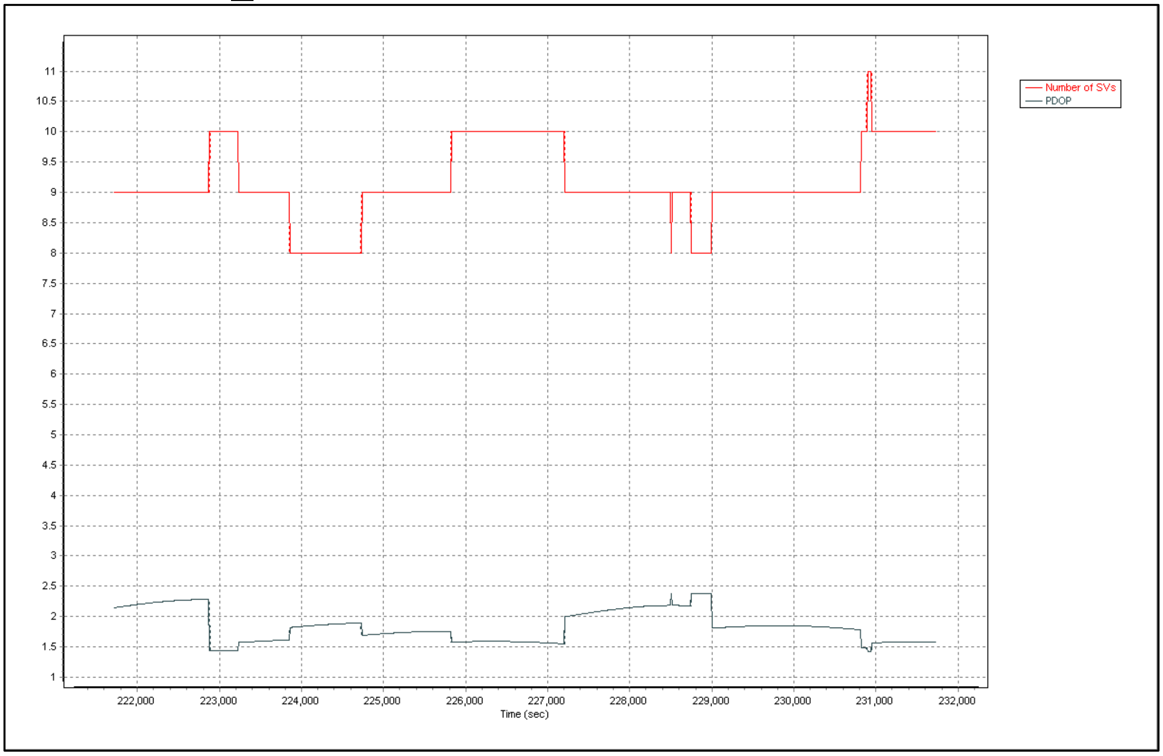
101210B-246-NEDPOSITIONERROR--FORWARD



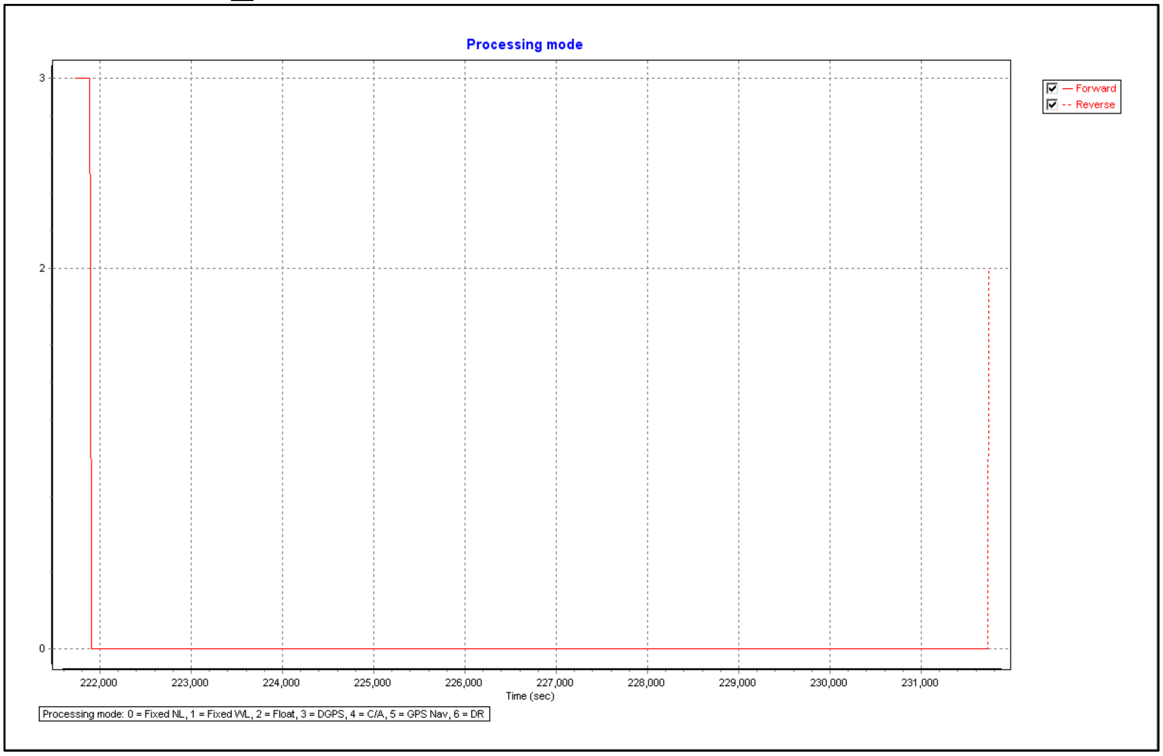
101207A-247_SMOOTHPERFMETRIC_NED



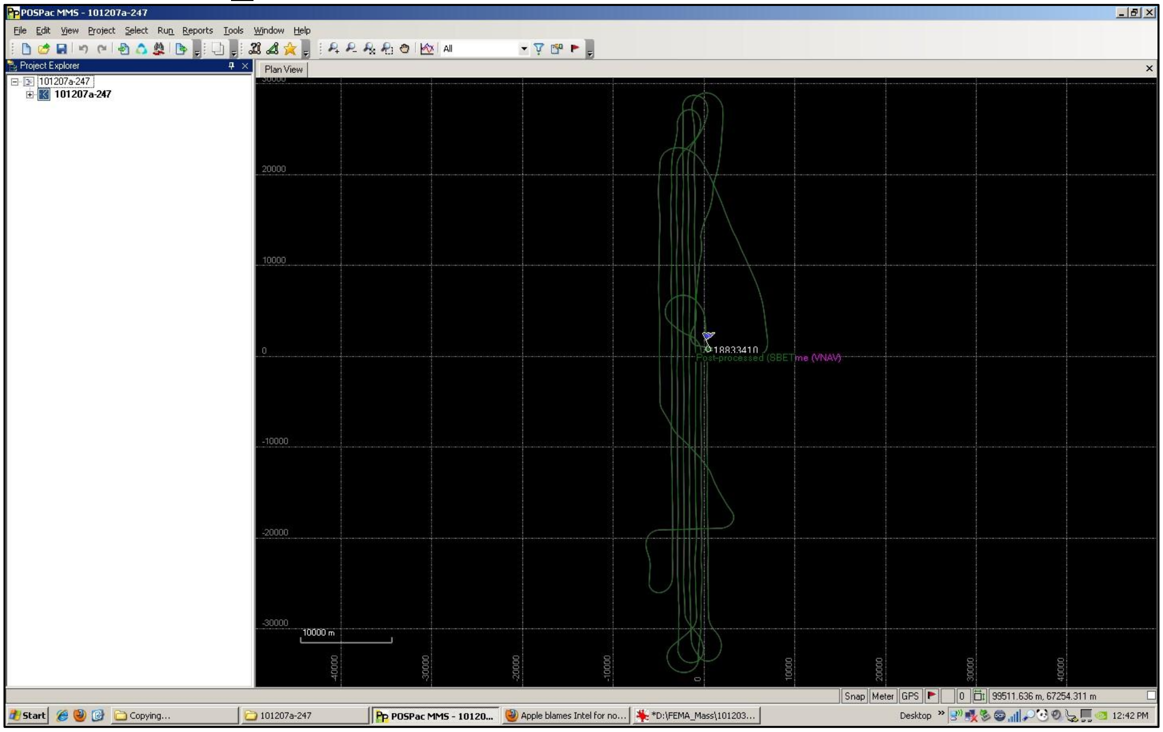
101207A-247_SVS&PDOP



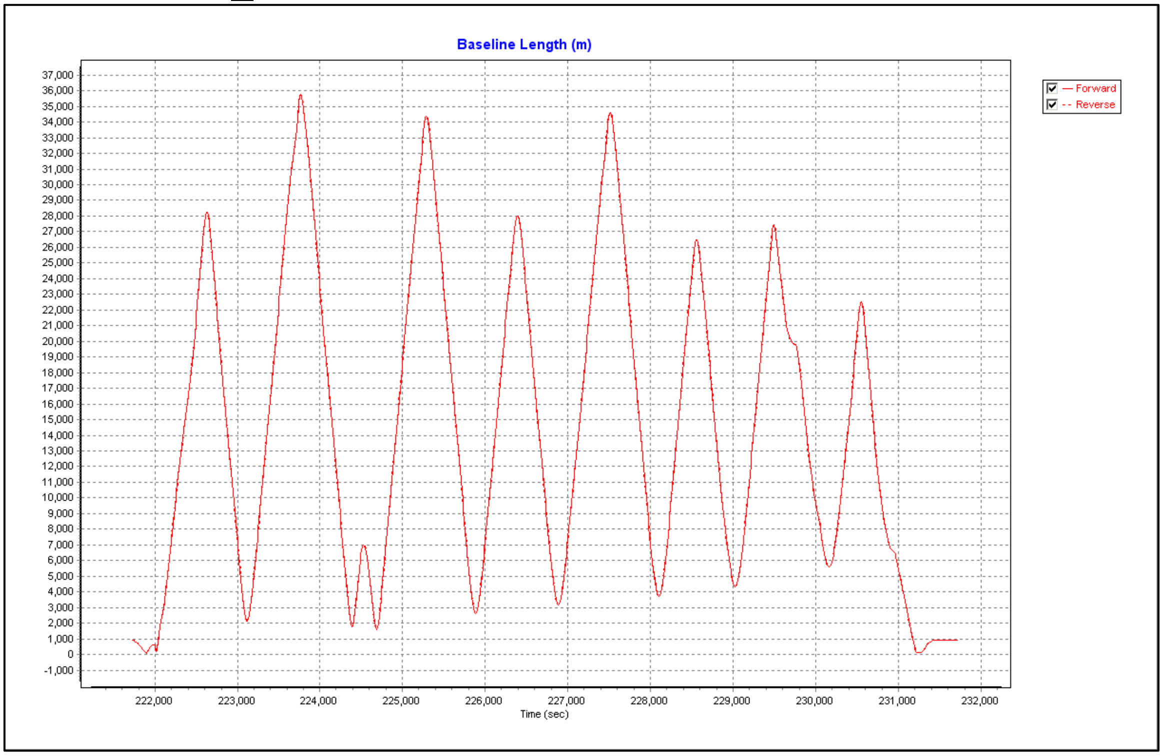
101207A-247_PROCESSMODE



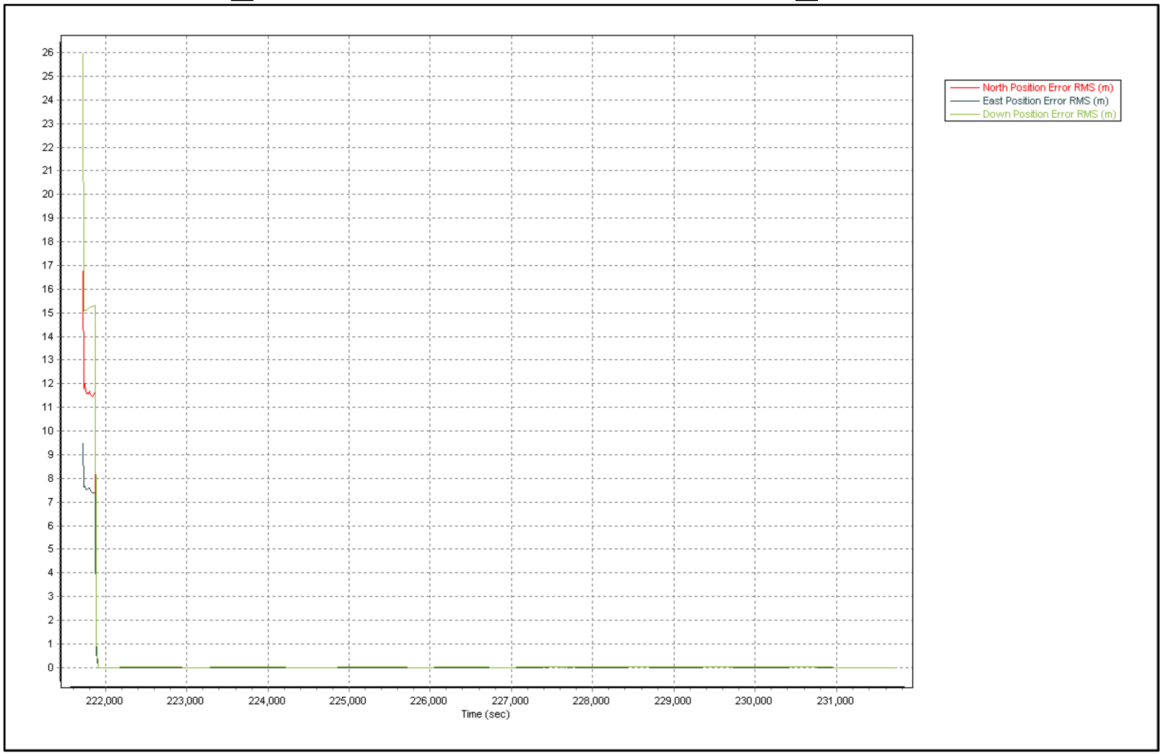
101207A-247_SCREENSHOT



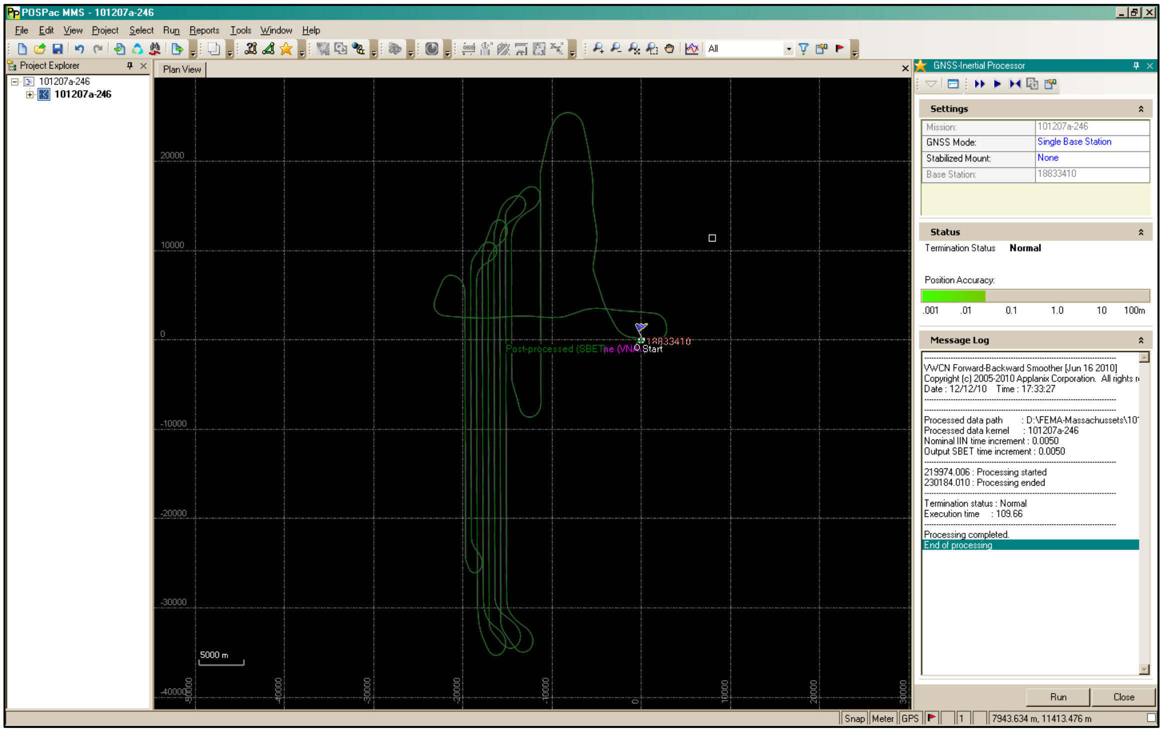
101207A-247_BASELINE



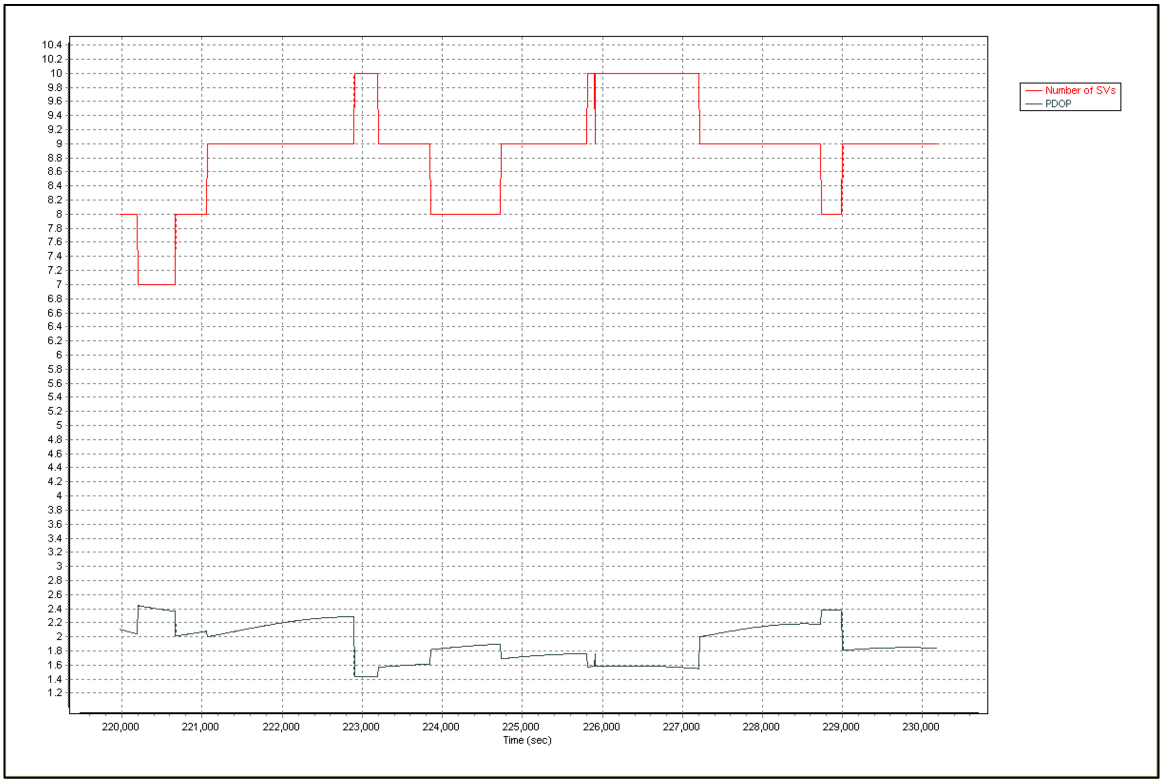
101207A-247_FORWARDPROCPERFMETRIC_NED



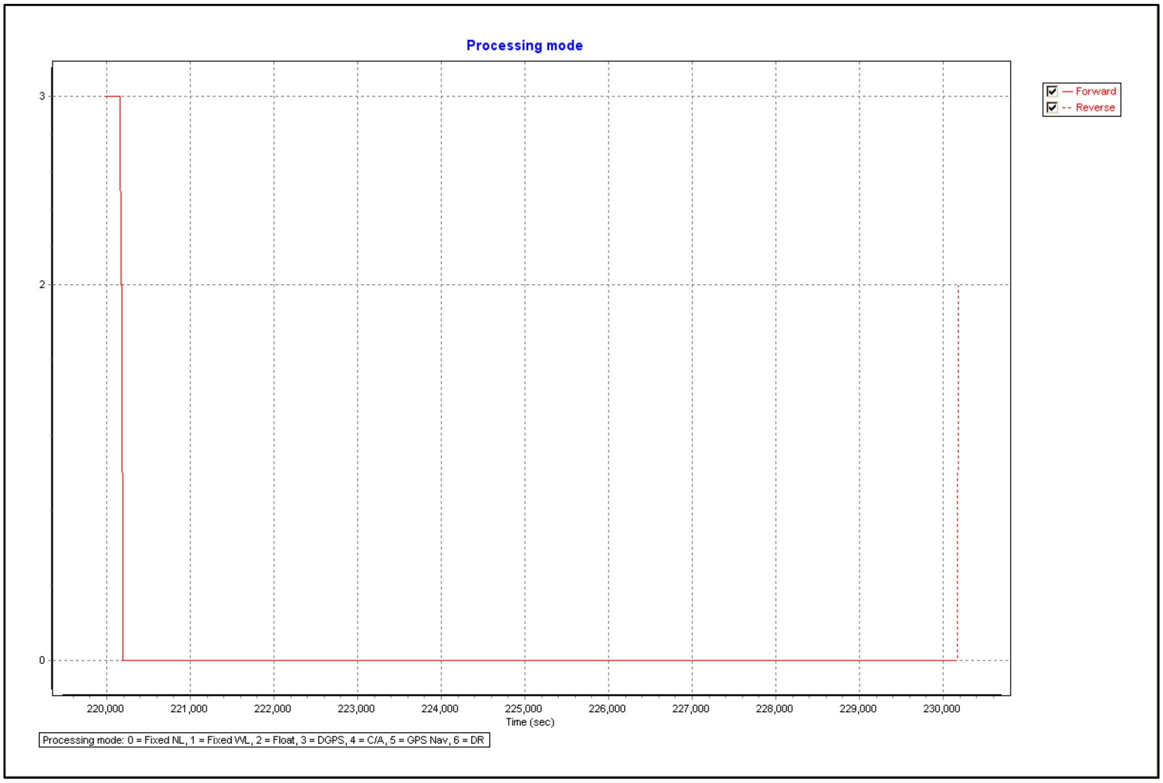
101207A-246-TRAJECTORY



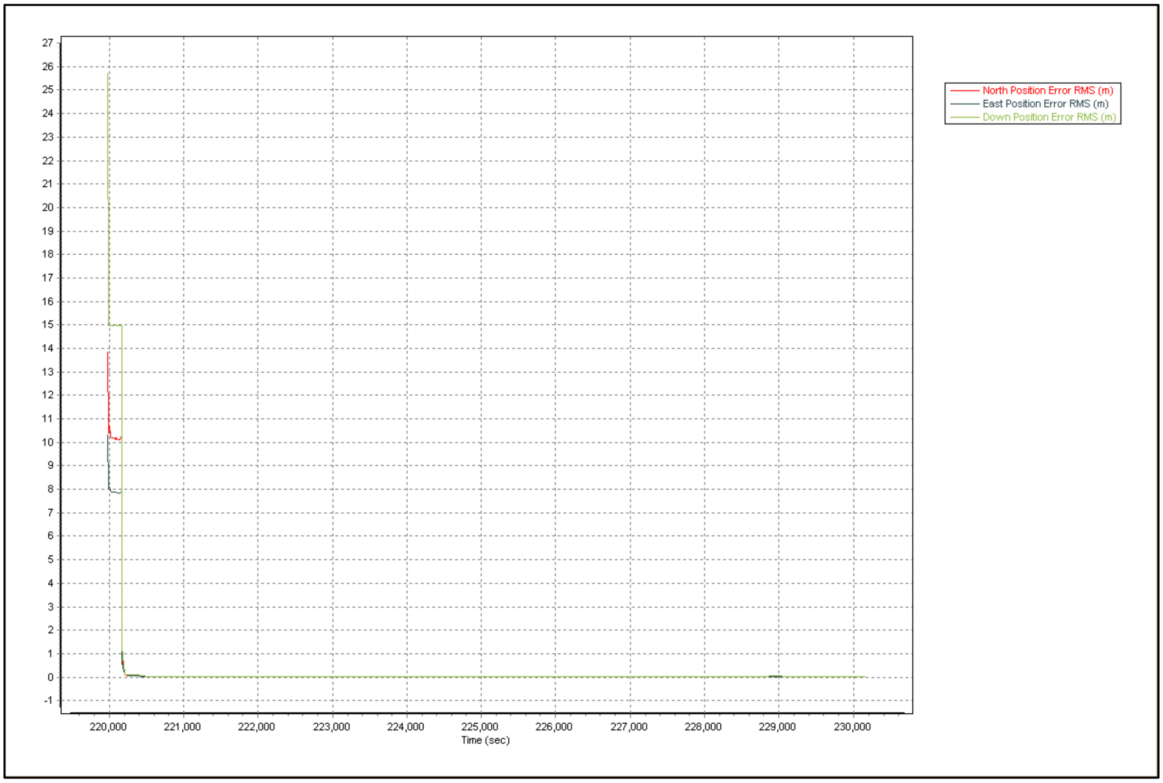
101207A-246-PDOP&SVS



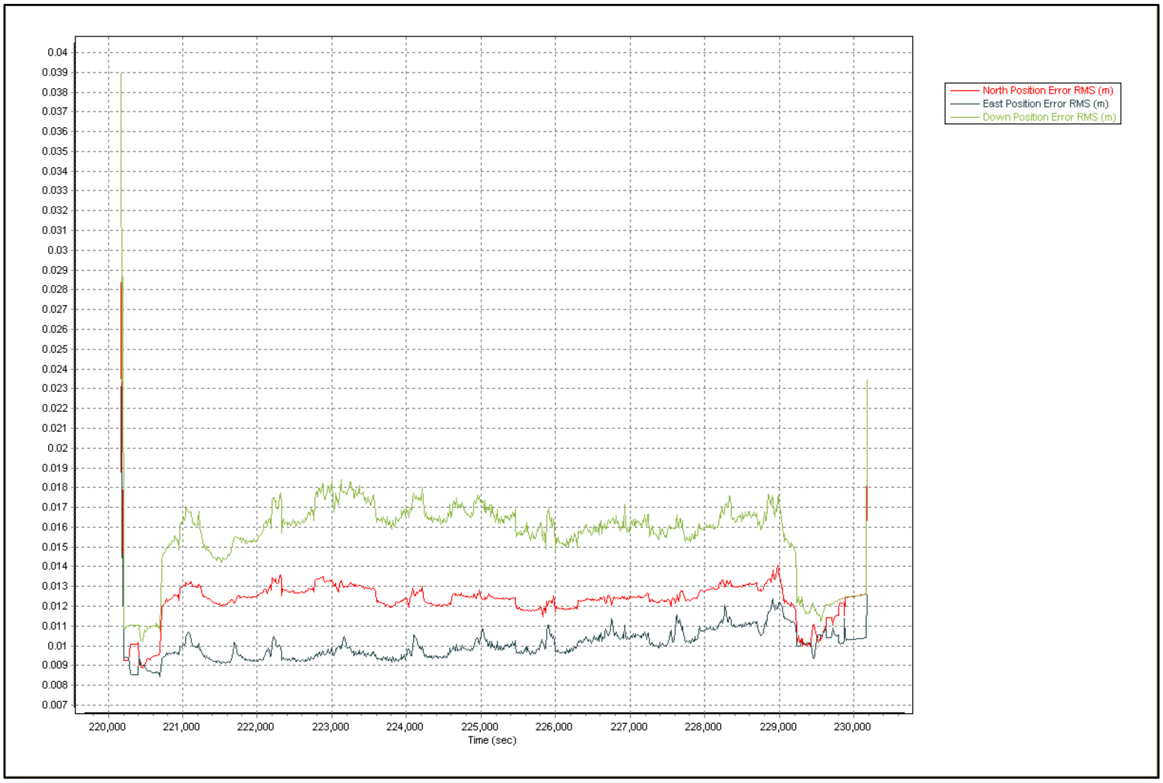
101207A-246-PROCMODE



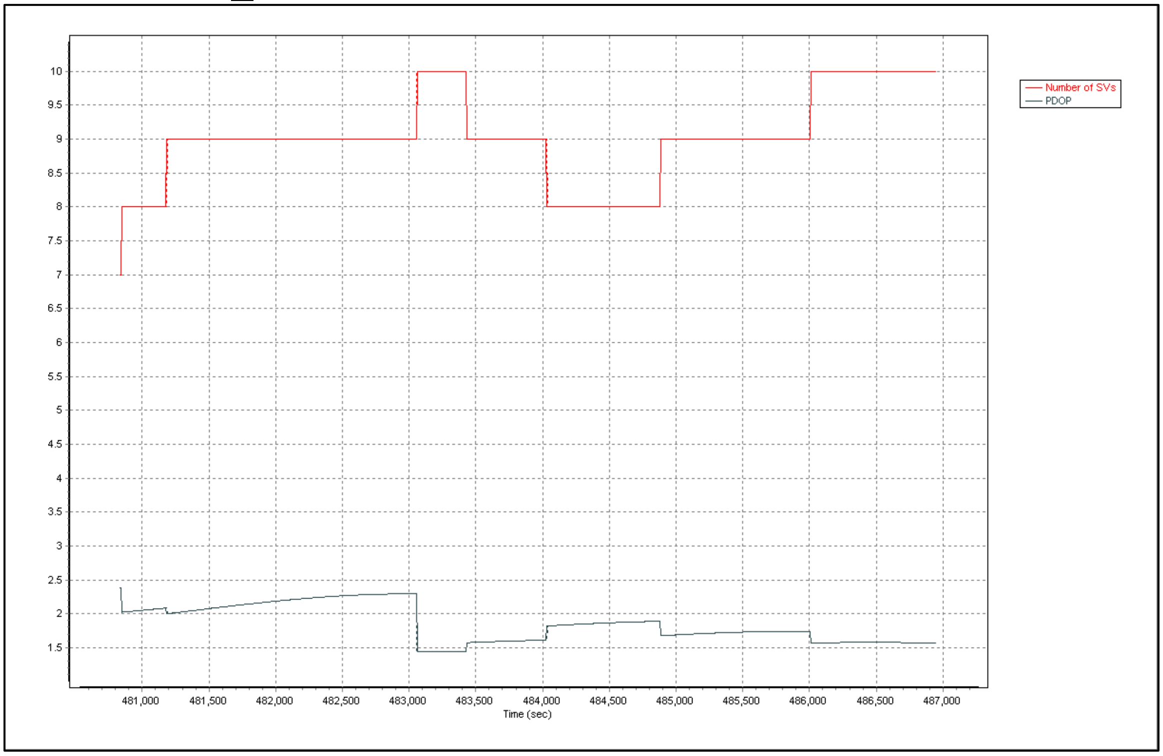
101207A-246-NEDPOSITIONERROR-FORWARD



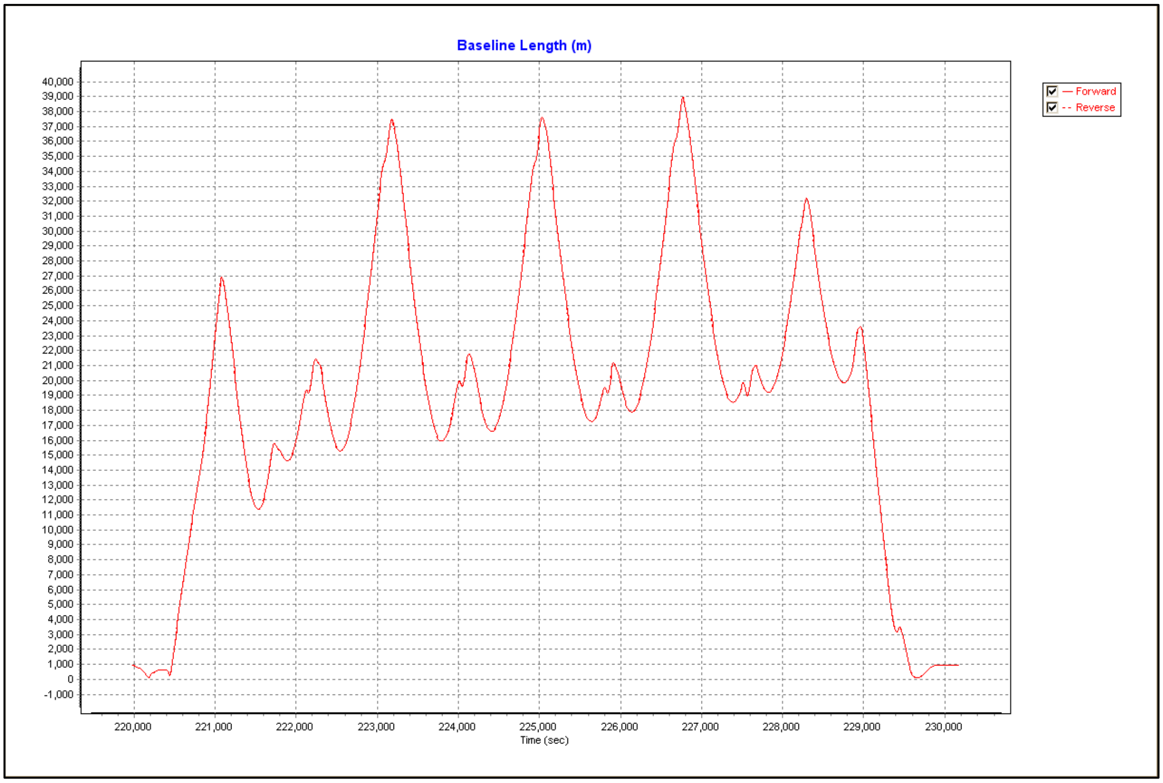
101207A-246-NEDPOSITIONERROR-SMOOTHED



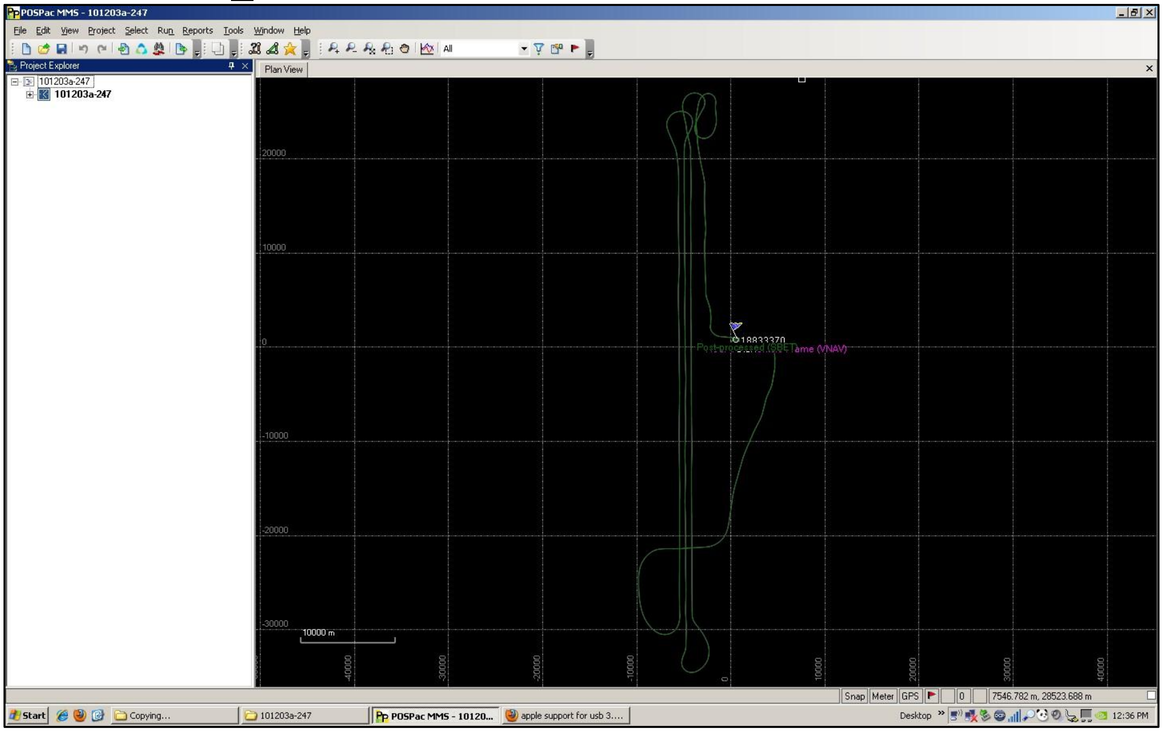
101203A-247_SVS&PDOP



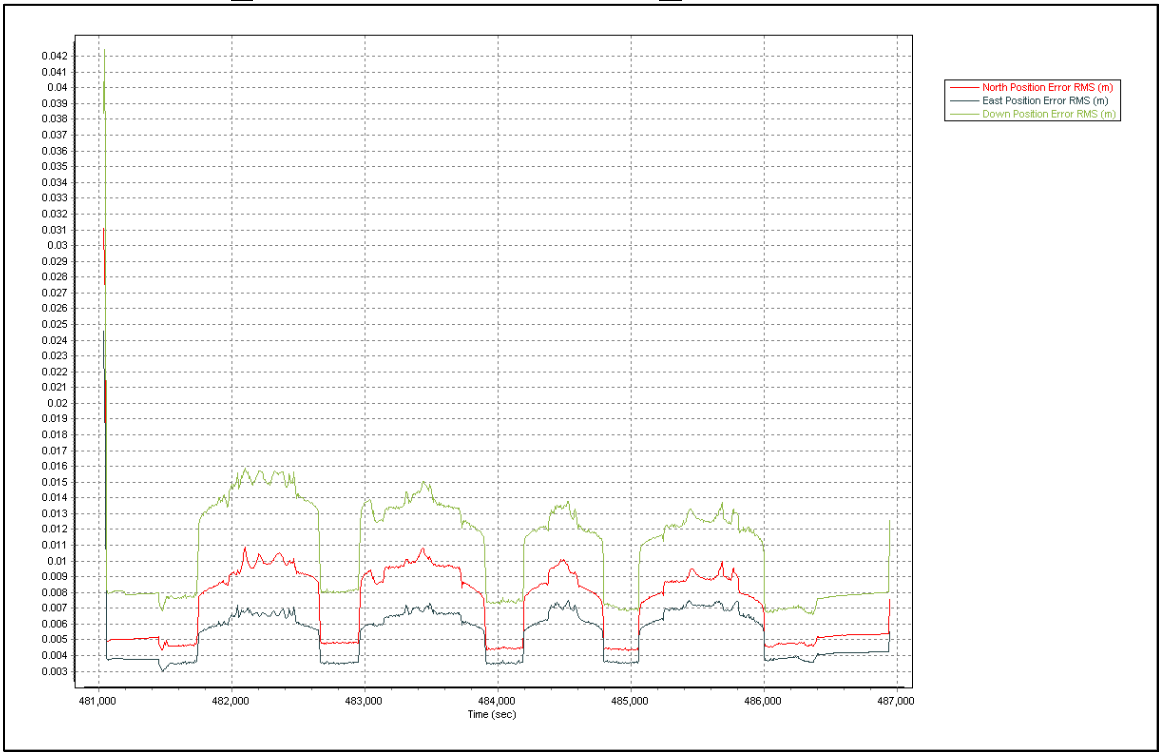
101207A-246-BASELINELENGTH



101203A-247_SCREENSHOT



101203A-247_SMOOTHPERFMETRIC_NED



101203A-247_PROCESSMODE

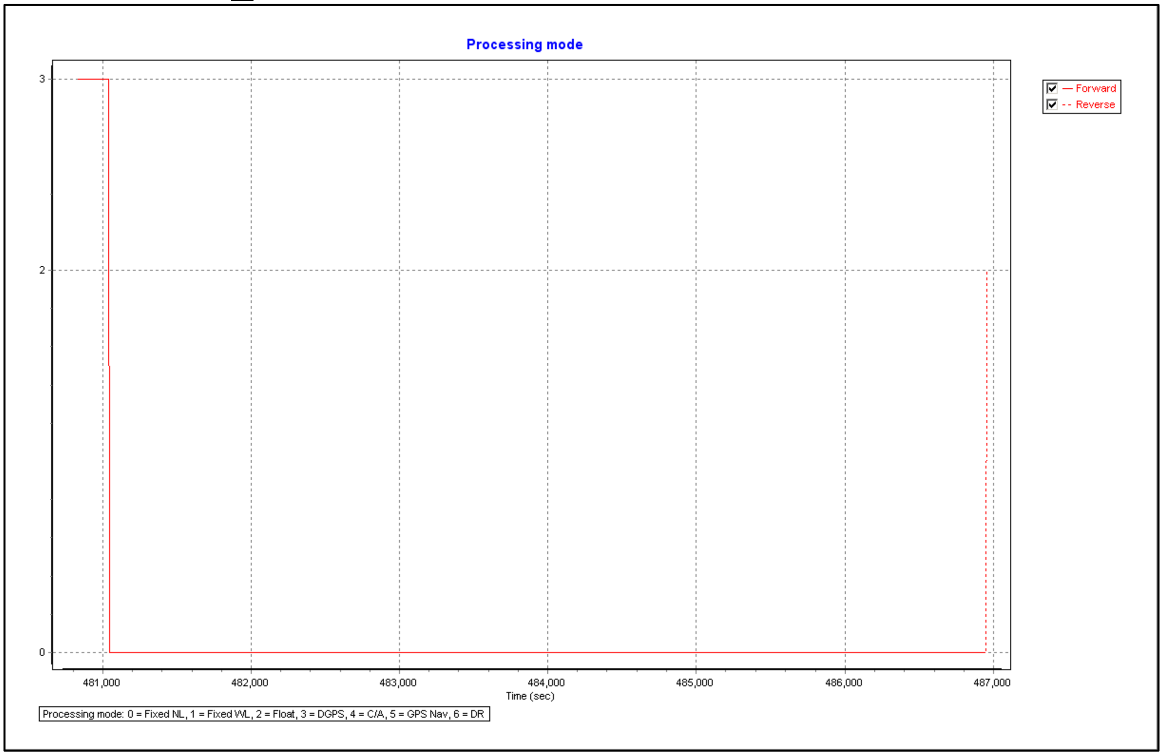


PHOTO SCIENCE
Geospatial Solutions

2670 WILHITE DRIVE
LEXINGTON, KENTUCKY 40503
PHONE 859-277-8700 + FAX 859-277-8901
WWW.PHOTOSCIENCE.COM

March 29, 2011

Post Flight Report
PSI Project 7556-005
ORH Charles, MA LiDAR

CONTRACT: ______________________
Client: ____________________________
Project Name: ORH Charles Sub Area
Attached Reference file: *7556-005_ORH-Charles_MA_Background.ZIP*

General Specifications: 1-meter nominal spacing LiDAR Acquisition and processing with a 24.5 cm vertical accuracy at 95% confidence level.

Acquisition Dates: LiDAR data for the ORH-Charles data was acquired on the dates of 12/11/2010 over 3 lifts by two different Aircraft.

Equipment Used: The data was collected with Optech Gemini LiDAR systems, Serial Numbers 246 and 247, Base GPS Receiver used was a Trimble 5700 collecting data at half second intervals. The aircraft used were Cessna 206 models, tail numbers N2448G and N7266Z. The pilots were Mark Young and Nick Greenwell and the Operators were Jeremy Berry and Nathan Galieti. The Base Station was set on the monument "ORH A, AI5600" at the Worcester Municipal Airport (ORH) set by the crews.

Project: The project consisted of 61 flight lines of 456.00 miles. The project was flown at an altitude of 5,000 feet above ground and at a planned average speed of 116 knots with a field of view of 36 degrees. The scan rates used was 30.1 Hz with a Laser Pulse Rate of 71,429 Hz with Multi-Pulse enabled. The full swath width was 989.18 meters with a planned sidelap of 30%. The point spacing was <1 meter with a NADIR point density of 1.2 points per square meter and an average point density of 3.03 points per square meter. The planned vertical accuracy was 0.13 meters.

GPS Base Station / Monument:. The Base Station was set on the monument "ORH A, AI5600" at the Worcester Municipal Airport (ORH) set by the crews. Information on this monument is included in the attached .ZIP file under "Base Station Data".

Control: Control points were collected as part of the project and used to calibrate the project data, remove any bias and verify accuracy. This data is compared to the collected model and results indicated below. This control data in included in the attached .ZIP file under "Control".

Flight Files: The planned flight files are included as reference in the attached .ZIP file under "Flight Files".

Flight Logs: Flight Logs used by the crew are included in the attached .ZIP file under "Flight Logs" and include the following type information:

- job #/name
- block or AOI
- date (s) flown
- aircraft tail #
- lines - #
- lines - direction
- lines – altitude
- lines – speed
- conditions
- comments
- pilot name
- operator name
- AGC switch
- GPS base station used

Processing Summary: Data is included in the attached .ZIP file under "Processing Summary" which includes GPS / IMU processing summary data including at a minimum:

- Processing Logs
- Message Logs
- Extract Logs
- Laser configuration files for each lift
- Max Horizontal GPS Variance (cm)
- Max Vertical GPS Variance (cm)
- Notes on GPS quality (High, Good, etc.)
- GPS separation plot
- GPS altitude plot
- PDOP plot
- Plot of GPS distance from base station/s

Project Coverage: within the attached .ZIP file in the "Project Coverage" directory is the overall boundary Shape File and the as flown trajectory Shape Files which include the project calibration flight lines (cross flights).

Accuracy: The LiDAR data was tested against the Control check points indicated above and the results are included in the "Accuracy Results" directory in the attached .ZIP file.

The LiDAR data as collected tested at 0.095 (meters) fundamental vertical accuracy at 95% confidence level. Within the accuracies indicated in the specifications, as provided.

Sincerely,

Forrest Godby
Senior Project Manager / Flight Operations Manager

ORH Concord FEMA Base Station Monument

See file dsdata.txt for more information about the datasheet.

```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1        National Geodetic Survey,   Retrieval Date = OCTOBER 29, 2010
 AI5600 ***********************************************************************
 AI5600  PACS        -  This is a Primary Airport Control Station.
 AI5600  DESIGNATION -  ORH A
 AI5600  PID         -  AI5600
 AI5600  STATE/COUNTY-  MA/WORCESTER
 AI5600  USGS QUAD   -  WEBSTER (1979)
 AI5600
 AI5600                         *CURRENT SURVEY CONTROL
 AI5600  ___________________________________________________________________
 AI5600* NAD 83(2007)-  42 16 08.44724(N)    071 52 36.42870(W)     ADJUSTED
 AI5600* NAVD 88     -       309.46   (meters)    1015.3    (feet)  GPS OBS
 AI5600  ___________________________________________________________________
 AI5600  EPOCH DATE  -        2002.00
 AI5600  X           -   1,470,437.757 (meters)                     COMP
 AI5600  Y           -  -4,492,645.101 (meters)                     COMP
 AI5600  Z           -   4,267,951.584 (meters)                     COMP
 AI5600  LAPLACE CORR-          -2.78  (seconds)                    DEFLEC09
 AI5600  ELLIP HEIGHT-         280.922 (meters)           (02/10/07) ADJUSTED
 AI5600  GEOID HEIGHT-         -28.57  (meters)                     GEOID09
 AI5600
 AI5600  ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
 AI5600  Type    PID    Designation                      North   East  Ellip
 AI5600  -------------------------------------------------------------------
 AI5600  NETWORK AI5600 ORH A                             0.92   0.80   2.04
 AI5600  -------------------------------------------------------------------
 AI5600
 AI5600.This mark is at Worcester Municipal Airport (ORH)
 AI5600
 AI5600.The horizontal coordinates were established by GPS observations
 AI5600.and adjusted by the National Geodetic Survey in February 2007.
 AI5600
 AI5600.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
 AI5600.See National Readjustment for more information.
 AI5600.The horizontal coordinates are valid at the epoch date displayed above.
 AI5600.The epoch date for horizontal control is a decimal equivalence
 AI5600.of Year/Month/Day.
 AI5600
 AI5600.The orthometric height was determined by GPS observations and a
 AI5600.high-resolution geoid model.
 AI5600
 AI5600.GPS derived orthometric heights for airport stations designated as
 AI5600.PACS or SACS are published to 2 decimal places.  This maintains
 AI5600.centimeter relative accuracy between the PACS and SACS.  It does
 AI5600.not indicate centimeter accuracy relative to other marks which are
 AI5600.part of the NAVD 88 network.
 AI5600
 AI5600.Photographs are available for this station.
 AI5600
 AI5600.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 AI5600
```

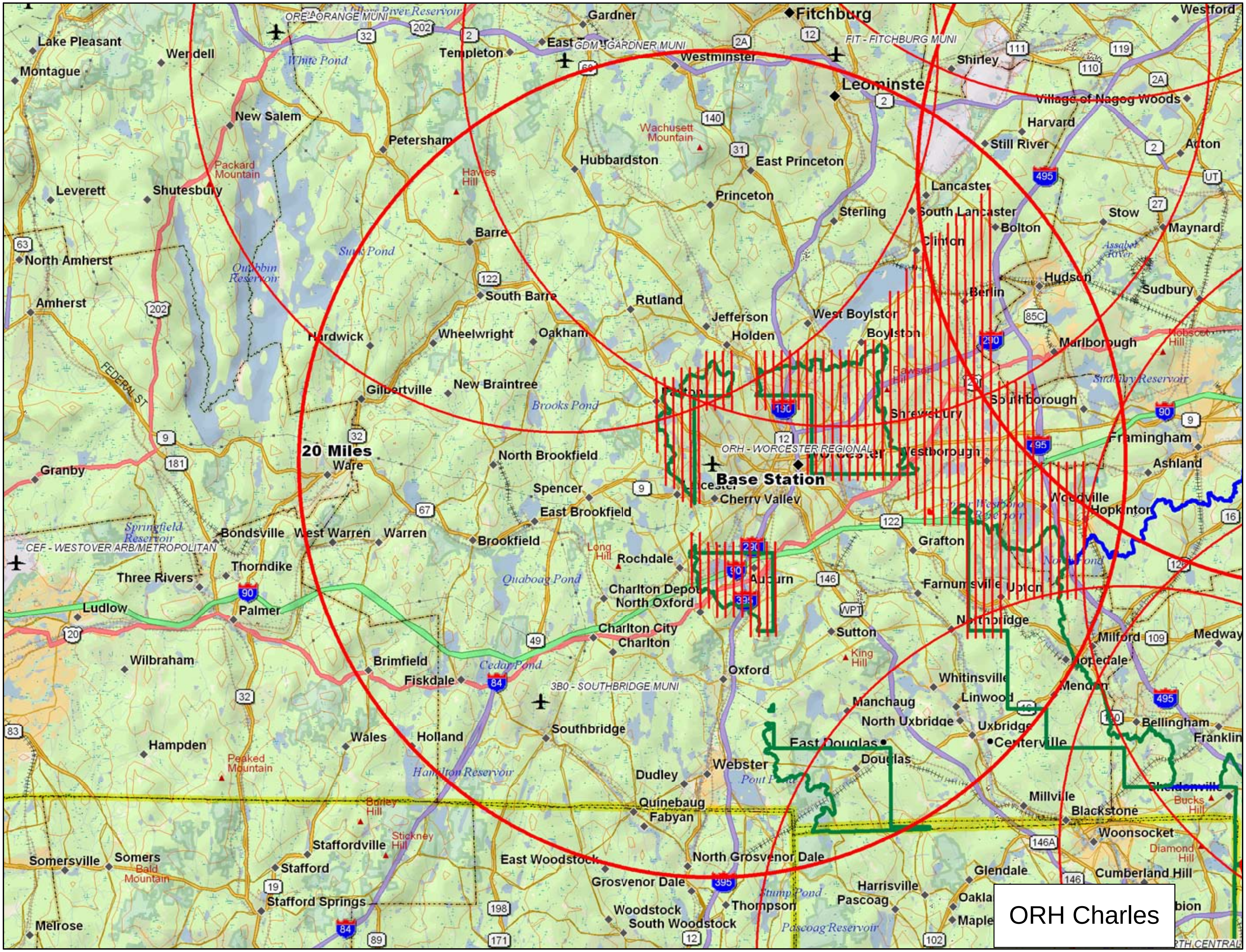
```
AI5600.The Laplace correction was computed from DEFLEC09 derived deflections.
AI5600
AI5600.The ellipsoidal height was determined by GPS observations
AI5600.and is referenced to NAD 83.
AI5600
AI5600.The geoid height was determined by GEOID09.
AI5600
AI5600;                    North         East     Units Scale Factor Converg.
AI5600;SPC MA M     -   891,017.799   168,916.022   MT  0.99996526   -0 15 11.2
AI5600;SPC MA M     - 2,923,280.90    554,185.32   sFT  0.99996526   -0 15 11.2
AI5600;UTM  19      - 4,683,653.096   262,747.901   MT  1.00029264   -1 56 09.1
AI5600
AI5600!             -  Elev Factor  x  Scale Factor =   Combined Factor
AI5600!SPC MA M     -   0.99995594  x   0.99996526  =   0.99992120
AI5600!UTM  19      -   0.99995594  x   1.00029264  =   1.00024857
AI5600
AI5600                          SUPERSEDED SURVEY CONTROL
AI5600
AI5600  ELLIP H (06/04/02)  280.920  (m)                       GP(        ) 4 1
AI5600  NAD 83(1996)-  42 16 08.44728(N)    071 52 36.42911(W) AD(        ) B
AI5600  ELLIP H (05/22/00)  280.927  (m)                       GP(        ) 4 1
AI5600
AI5600.Superseded values are not recommended for survey control.
AI5600.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AI5600.See file dsdata.txt to determine how the superseded data were derived.
AI5600
AI5600_U.S. NATIONAL GRID SPATIAL ADDRESS: 19TBG6274783653(NAD 83)
AI5600_MARKER: DH = HORIZONTAL CONTROL DISK
AI5600_SETTING: 66 = SET IN ROCK OUTCROP
AI5600_STAMPING: ORH A 1999
AI5600_MARK LOGO: NOS
AI5600_MAGNETIC: N = NO MAGNETIC MATERIAL
AI5600_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
AI5600+STABILITY: POSITION/ELEVATION WELL
AI5600_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AI5600+SATELLITE: SATELLITE OBSERVATIONS - 1999
AI5600
AI5600  HISTORY     - Date     Condition        Report By
AI5600  HISTORY     - 1999     MONUMENTED       WOOLPT
AI5600
AI5600                          STATION DESCRIPTION
AI5600
AI5600'DESCRIBED BY WOOLPERT CONSULTANTS 1999 (ARL)
AI5600'THE STATION IS LOCATED APPROXIMATELY 9.0 KM (5.60 MI) SOUTH OF HOLDEN,
AI5600'4.7 KM (2.90 MI) WEST-SOUTHWEST OF WORCESTER, 3.6 KM (2.25 MI)
AI5600'NORTHWEST OF LEICESTER, AT THE WORCESTER MUNICIPAL AIRPORT.
AI5600'OWNERSHIP-- WORCESTER MUNICIPAL AIRPORT, C/O ERIC WALDRON AIRPORT
AI5600'MANAGER, WORCESTER MUNICIPAL AIRPORT, 375 AIRPORT DRIVE, WORCESTER MA
AI5600'01602, PHONE NUMBER 508-799.1350, FAX NUMBER 508-799-1866.  THIS
AI5600'STATION REQUIRES 24 HOUR NOTICE TO AIRPORT CONTACT FOR ACCESS.
AI5600'TO REACH THE STATION FROM THE JUNCTION OF STATE ROUTES 122 AND 9 GO
AI5600'WESTERLY APPROXIMATELY 2.0 MI (3.2 KM) TO AIRPORT DRIVE ON THE LEFT,
AI5600'TURN LEFT ON AIRPORT DRIVE AND GO APPROXIMATELY 0.9 MI (1.4 KM) TO THE
AI5600'CONTINUTATION OF AIRPORT DRIVE ON THE RIGHT, TURN RIGHT TO STAY ON
AI5600'AIRPORT DRIVE AND GO APPROXIMATELY 0.5 MI (0.8 KM) TO THE AIRPORT ON
AI5600'THE LEFT.  THE STATION IS LOCATED AT THE TOP OF THE ROCK OUTCROP AND
AI5600'VIRTUALLY AT THE TOP OF THE HILL.
```

```
AI5600'THE STATION IS A STANDARD NOS DISK STAMPED--ORH A 1999-- DRIVEN INTO
AI5600'AN EXPOSED PORTION OF A ROCK OUTCROP.  THE STATION IS LOCATED 119 M
AI5600'(390.4 FT) FROM THE EDGE OF PAVEMENT OF TAXIWAY D ON AN AZIMUTH OF 350
AI5600'DEGREES, 2.04 M (6.69 FT) FROM A BRONZE DISK STAMPED-- V 8-- ON AN
AI5600'AZIMUTH OF 115 DEGREES.  THIS STATION IS DESIGNATED AS THE PRIMARY
AI5600'AIRPORT CONTROL STATION.

*** retrieval complete.
Elapsed Time = 00:00:00
```


Marshall St
Bailey St
Prouty Ln
Glen Ellen Rd
Brewster Rd
Rockrimmon Rd
Joppa Rd
Pleasant St
Robertson Rd
Benjamin Rd
Andy Rd
Airport Dr
Mill St
ORH A
Mulberry St
Mannville St
Sylvester St
Coppage Dr
Goddard Memorial Dr
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Google
© 2011 Europa Technologies
©2008
Google
42°16'08.53" N 71°52'36.54" W
elev 1013 ft
Sep 21, 2010
Eye alt 11262 ft

DELORME

XMap® 4.5



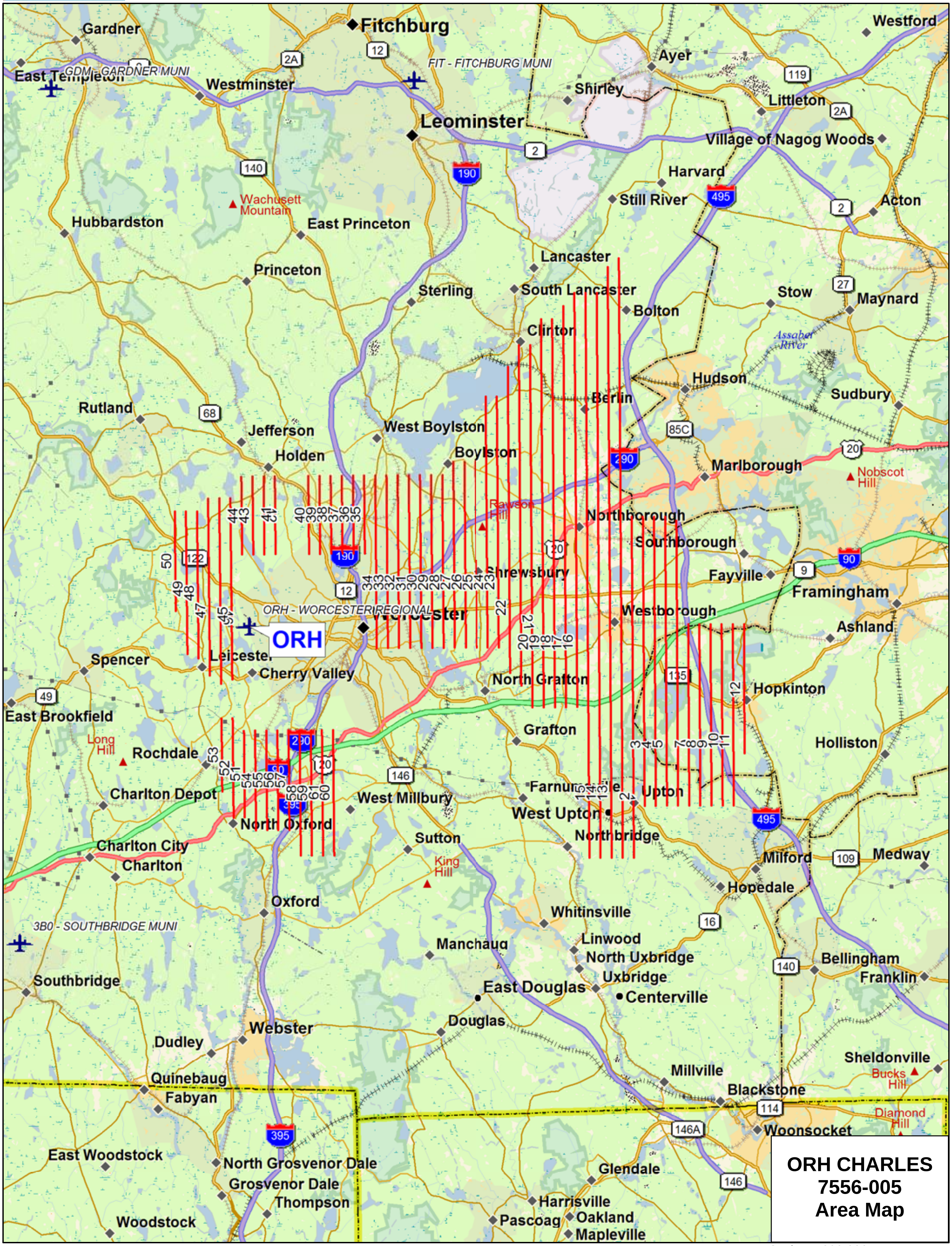
Scale 1 : 400,000

1" = 6.31 mi

Data Zoom 9-0

TN

MN (14.6°W)

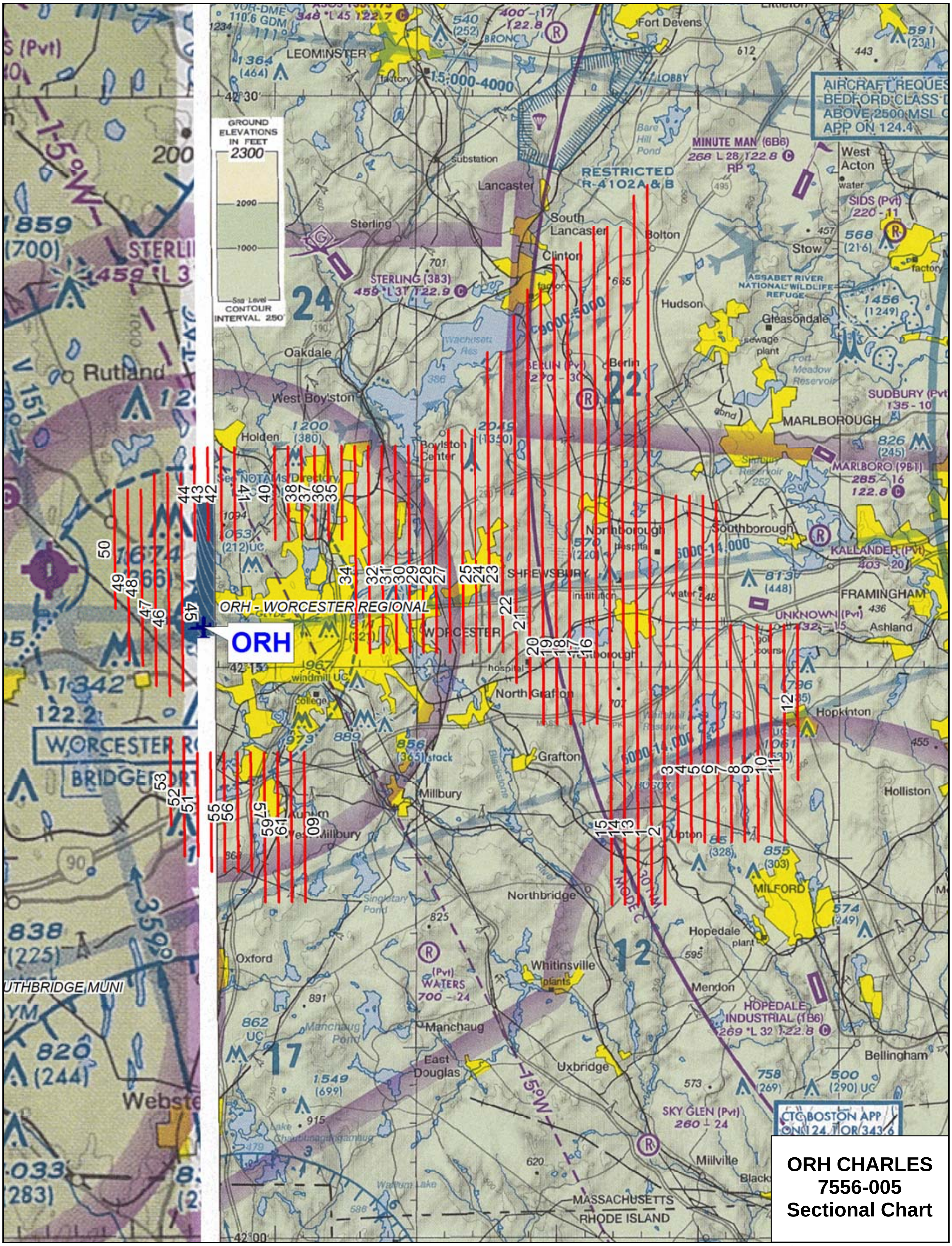


TN
MN (14.8°W)

Scale 1 : 300,000

1" = 4.73 mi

Data Zoom 9-2



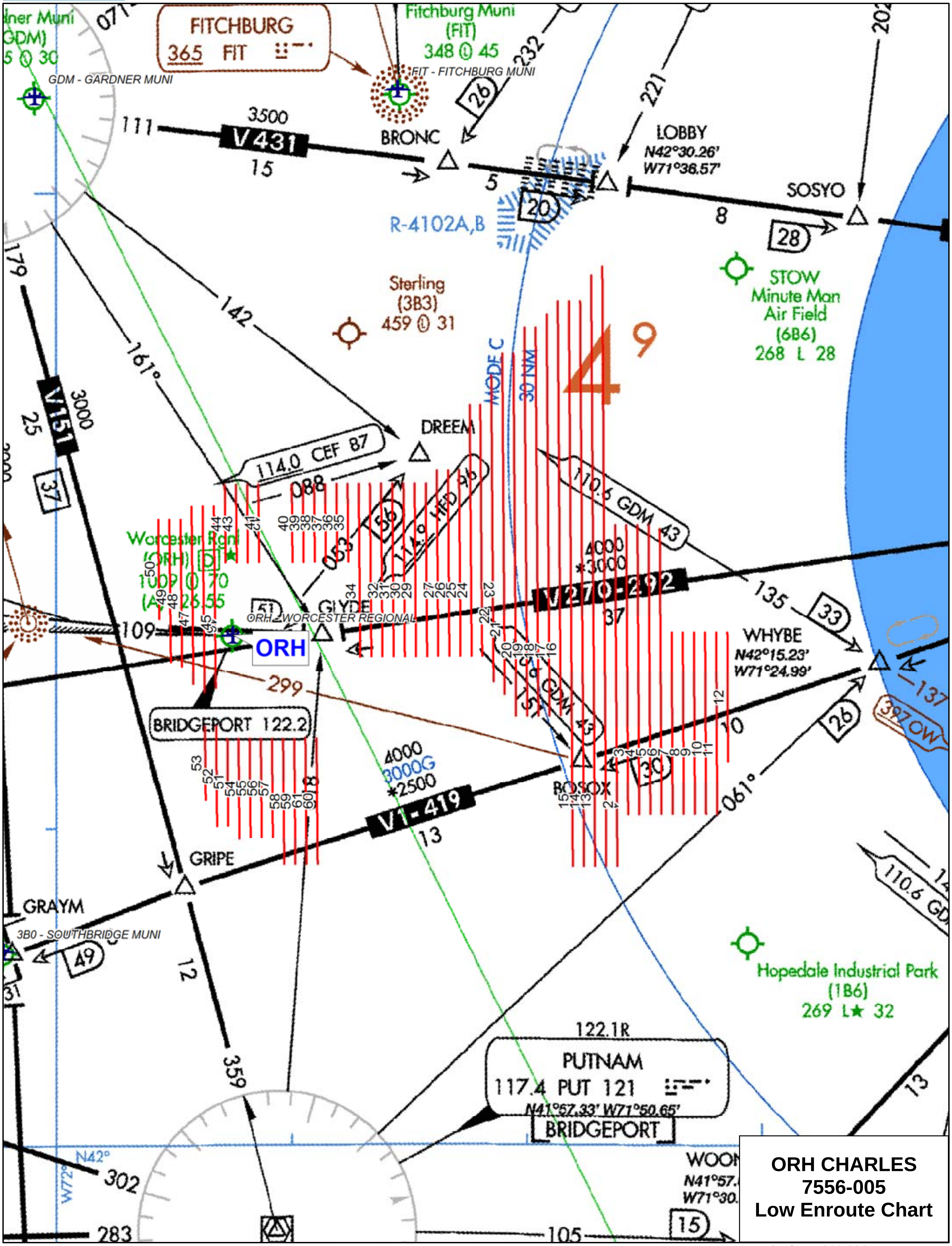
Scale 1 : 250,000

1" = 3.95 mi

Data Zoom 9-2

TN

MN (14.8°W)



ORH CHARLES
7556-005
Low Enroute Chart

Scale 1 : 300,000

1" = 4.73 mi   Data Zoom 9-2

STATE(s): MASSACHUSETTS

Project Numbers 7556-005 A004

AREA ID: ORH_CHARLES

AREA NAME: CHARLES / BLACKSTONE / CONCORD

FILE TYPES/NAMES: ☒ OPTECH: ORH_CHARLES ☒ LEICA: ORH_CHARLES

Lines: 61 FL Miles: 455 Square Miles: ____ Flight Altitudes: 5000' Tide Coord: Yes *See Notes* NO

AIRPORT ID: ORH Name: WORCESTER REGIONAL

Services: FULL ☒ Self ☒ None ☐ *See Notes* RUNWAY Length: 7000 Ft

Contact Name(s): Andrew Davis / Munger

Phone(s): (508) 799-1350 (___) ___-____ e-mail: ____________

Hotels: All Major

Rentals: All Major

EXIST BASE Station: A15600 Name: ORH A

TYPE: PACS ☒ SACS ☐ Other ☐ *Data Sheet Attached* ☒

SET BASE STATION Name: ____________ Date Set: ____________

What was Set: Re-Bar ☐ or: ____________ CAP: ____________

Who Set: ____________ Where Set: ____________ *Attach Data Sheet*

Logs ☑ Sectional ☑ Lo En-route ☑ Database ☑ OPTECH ☒ LEICA ☒

by: LR by: LR by: LR by: LR by: PB by: PB

Accuracy: Vert; 24.5 Horiz; ____cm Post Spacing: 1 Points Sq Meter: ____

NOTES: TOWERED AIRPORT

CALL AHEAD FOR PERMISSION TO SET

BASE STATION

ORH

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: Fema - Mass

Location: KORH (Worcester, MA)

Project Number: 7556-005

Completed by: Berry / Young

Date: December 11, 2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr Geodetic

Station ID: ~~ORHA~~ Marked "V8"

Start -- H.I. (m): 1.491 1.491

End -- H.I. (m): 1.491

H.I. (ft): 4.89 4.89

Start Time: 1000 AM

End Time: 4:12 PM

Time Zone: EST

Operator: Berry/Young

Comments

101211ab-246

101211b-247

Reference Mark near ORHA called V8 Was Setup on!

Opus height: 1.437 for OPUS Submission

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	FEMA-MASS
Project Number	7556-005
ALTM-NAV plnFile	ORH.Charles.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 11, 2010				
Takeoff Time (Z):	1528Z	Local:	1028AMEST	Airport	ORH
Landing Time (Z)	1846Z	Local:	140 PMEST	Airport	ORH

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30.1 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	1000
		Range	300

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246HD1
POS File Name	101211a
from, to	000 → 026

	Ground	Airport
Begin Temp	0°c	ORH
Begin Dewpoint	-4°c	
Begin Pressure	3021	
End Temp	04°c	ORH
End Dewpoint	-03°c	
End Pressure	3018	

GPS Base Location(s)	V8 ORHA	
PDOP Avoidance	Good all day	
Static or Flyover?	Static	--> if flyovers, times: –

101211a-246
1/2

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
38	1540	1542	5750'	S	116	100%	13	smooth; some snow on ground; just a dusting
60	1544	1546	5630	S	116	100%	13	
61	1550	1552	5630'	N	116	100%	-13	
39	1555	1556	5750'	N	116	100%	-14	
40	1600	1602	5750'	S	116	100%	12	
59	1605	1607	5600'	S	116	100%	12	
58	1611	1614	5600'	N	116	100%	-14	
57	1617	1619	5630'	S	116	100%	11	
56	1622	1624	5670'	N	116	100%	-13	
41	1626	1628	5870'	N	116	100%	-14	
42	1631	1632	5910'	S	116	100%	12	
55	1635	1637	5680'	S	116	100%	12	
54	1640	1642	5700'	N	116	100%	-13	
43	1645	1646	5910'	N	116	100%	-14	
44	1650	1651	5850	S	116	100%	12	
51	1654	1655	5700'	S	116	100%	14	
52	1659	1700	5730'	N	116	100%	-13	
45	1701	1704	6000'	N	116	100%	-16	
46	1707	1710	6000'	S	114	100%	13	
53	1710	1712	5770	S	116	100%	13	

Sheet 1 of 2

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema Mass
Project Number	7556-005
ALTM-NAV .pln File	ORH_Charles.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 11, 2010		
Takeoff Time (Z): 1528Z	Local: 1028 AMEST	Airport ORH	
Landing Time (Z) 1840Z	Local: 140 PMEST	Airport ORH	

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30.10 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	1000
		Range	300

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246H01
POS File Name	101211a
from, to	000 → 026

	Ground	Airport
Begin Temp	0°C	ORH
Begin Dewpoint	-4°C	
Begin Pressure	30.21	
End Temp	4	ORH
End Dewpoint	-3	
End Pressure	30.16	

GPS Base Location(s)	1/8 ORHA
PDOP Avoidance	Good allday
Static or Flyover?	Static --> if flyovers, times: –

101211a-246
2/2

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
47	1715	1719	6050	N	116	100%	-12	
48	1722	1724	6100	S	116	100%	13	
49	1727	1730	6070	N	116	100%	-13	
50	1733	1735	6130	S	116	100%	12	
Improv	1739	1741	5900	E	116	100%	-14	
23	1744	1748	5550	N	116	100%	-13	
24	1751	1756	5550	S	116	100%	12	
25	1759	1802	5600	N	116	100%	-13	
26	1804	1808	5575	S	116	100%	11	
27	1810	1813	5530	N	116	100%	-13	
28	1816	1819	5550	S	116	100%	13	
29	1822	1825	5420	N	116	100%	-13	
30	1827	1831	5400	S	116	100%	11	

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema-mass
Project Number	7556-005
ALTM-NAV-plnFile	ORH-charles.ph

Pilot	Young
Operator	BERRY
Aircraft	N7266Z

Date Flown:	December 11 2010				
Takeoff Time (Z):	1926Z	Local:	226pm EST	Airport	ORH
Landing Time (Z)	2059Z	Local:	359pm EST	Airport	ORH

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	321 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	–
		Range	–

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101211b
from, to	000 → 014

	Ground	Airport
Begin Temp	4°c	ORH
Begin Dewpoint	-04°c	
Begin Pressure	30.17	
End Temp	04°c	ORH
End Dewpoint	-04°c	
End Pressure	30.18	

GPS Base Location(s)	ORHA
PDOP Avoidance	Good all day
Static or Flyover?	Static --> if flyovers, times: –

101211b-246

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
31	1936	1939	5500'	N	116	100%	-11	Smooth alt. Snow mostly gone except for lakes
32	1943	1946	5550'	S	116	100%	10	
33	1949	1953	5600'	N	116	100%	-11	
34	1956	1959	5700'	S	116	100%	10	
35	2002	2004	5650	N	116	100%	-10	
36	2006	2008	5700	S	116	100%	10	
37	2010	2012	5730'	N	116	100%	-10	
20	2020	2026	5420'	S	116	100%	10	
21	2030	2035	5450'	N	116	100%	-10	
22	2040	2046	5500	S	116	100%	8	
Impro	2048	2049	5500	W	116	100%	-2	

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	ORH_Charles
Project Number	7556-005
ALTM-NAV .pln File	ORH_Charles.pln

Pilot	Greenwell
Operator	Galicfi
Aircraft	N2448G

Date Flown: 12/11/10 #2					
Takeoff Time (Z): 1637	Local: 1137	Airport KORH			
Landing Time (Z): 2100Z	Local: 4:00	Airport KORH			

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	—
		Range	—

Data Information

LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	101211b
from, to	0 → 33

270@6

	Ground	Airport
Begin Temp	2 C	KORH
Begin Dewpoint	-3 C	
Begin Pressure	30.20	
End Temp		
End Dewpoint		
End Pressure		

GPS Base Location(s)	ORH	
PDOP Avoidance	Good all day	
Static or Flyover?	Static	--> if flyovers, times: —

101211b-247

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
12	1707	1709	5386	179	120	100	12	
11	1713	1717	5420	359	120	100	10	
10	1722	1725	5400	179	120	100	12	
9	1731	1734	5370	359	121	100	11	
8	1739	1743	5400	179	113	100	13	
7	1749	1752	5400	359	118	100	12	
6	1758	1803	5400	179	118	100	13	
5	1808	1813	5370	359	114	100	12	
4	1818	1823	5360	179	118	100	11	
3	1828	1834	5350	359	115	100	12	
2	1839	1845	5390	179	117	100	11	
1	1850	1900	5380	359	117	100	10	
13	1904	1914	5360	179	121	100	13	
14	1919	1929	5380	359	117	100	9	
15	1933	1943	5380	179	117	100	12	
16	1947	1955	5370	359	115	100	10	
17	2011	2018	5410	179	115	100	12	
18	2023	2030	5450	359	110	100	10	
19	2034	2041	5430	179	112	100	12	
Cross line	2043	2046	5430	090	130	100	1	

extra line missed start.

Mass Area: ORH-Charles Project No 7556-005 Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	21.7	5370	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
2	12.3	5360	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
3	10.5	5350	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
4	10.5	5360	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
5	10.5	5370	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
6	10.3	5380	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
7	6.6	5380	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
8	6.6	5370	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
9	6.6	5380	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
10	6.6	5390	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
11	6.6	5400	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247		
12	4.7	5400	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247	✓	
13	21.4	5380	ORH A	ORH_Charles. ORH_CHARL	12/11/10	247	✓	

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galieti

Pilot: Greenwell

AIRCRAFT Tail Number: N2448G

Sensor Serial Number: 247

Date: 12/11/10

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	20.5	5380	ORH A	ORH_Charles. ORH_CHARL	12/11/10			
15	20.5	5390	ORH A	ORH_Charles. ORH_CHARL	12/11/10			
16	15.0	5370	ORH A	ORH_Charles. ORH_CHARL	12/11/10			
17	14.5	5360	ORH A	ORH_Charles. ORH_CHARL	12/11/10			
18	14.1	5380	ORH A	ORH_Charles. ORH_CHARL	12/11/10			
19	14.1	5420	ORH A	ORH_Charles. ORH_CHARL	12/11/10			
20	13.1	5440	ORH A	ORH_Charles. ORH_CHARL				
21	12.3	5460	ORH A	ORH_Charles. ORH_CHARL				
22	11.1	5490	ORH A	ORH_Charles. ORH_CHARL				
23	9.1	5550	ORH A	ORH_Charles. ORH_CHARL				
24	9.1	5560	ORH A	ORH_Charles. ORH_CHARL				
25	6.7	5590	ORH A	ORH_Charles. ORH_CHARL				
26	6.7	5570	ORH A	ORH_Charles. ORH_CHARL				
27	6.7	5510	ORH A	ORH_Charles. ORH_CHARL				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galieti

Pilot: Greenwell

AIRCRAFT Tail Number: N24486

Sensor Serial Number: 247

Date: 12/11/10

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	20.5	5380	ORH A	ORH_Charles. ORH_CHARL	12-11-2010	247	NG	
15	20.5	5390	ORH A	ORH_Charles. ORH_CHARL				
16	15.0	5370	ORH A	ORH_Charles. ORH_CHARL				
17	14.5	5360	ORH A	ORH_Charles. ORH_CHARL				
18	14.1	5380	ORH A	ORH_Charles. ORH_CHARL				
19	14.1	5420	ORH A	ORH_Charles. ORH_CHARL				
20	13.1	5440	ORH A	ORH_Charles. ORH_CHARL	12-11-2010	246	JB	
21	12.3	5460	ORH A	ORH_Charles. ORH_CHARL				
22	11.1	5490	ORH A	ORH_Charles. ORH_CHARL				
23	9.1	5550	ORH A	ORH_Charles. ORH_CHARL				
24	9.1	5560	ORH A	ORH_Charles. ORH_CHARL				
25	6.7	5590	ORH A	ORH_Charles. ORH_CHARL				
26	6.7	5570	ORH A	ORH_Charles. ORH_CHARL				
27	6.7	5510	ORH A	ORH_Charles. ORH_CHARL				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young
AIRCRAFT Tail Number: N726QZ
Sensor Serial Number: 246

Date: 12-11-2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	6.3	5450	ORH A	ORH_Charles. ORH_CHARL	12-11-2010	246	JB	
29	6.3	5430	ORH A	ORH_Charles. ORH_CHARL				
30	6.3	5420	ORH A	ORH_Charles. ORH_CHARL				
31	6.3	5500	ORH A	ORH_Charles. ORH_CHARL				
32	6.3	5550	ORH A	ORH_Charles. ORH_CHARL				
33	6.3	5600	ORH A	ORH_Charles. ORH_CHARL				
34	6.3	5630	ORH A	ORH_Charles. ORH_CHARL				
35	2.8	5650	ORH A	ORH_Charles. ORH_CHARL				
36	2.8	5660	ORH A	ORH_Charles. ORH_CHARL				
37	2.8	5730	ORH A	ORH_Charles. ORH_CHARL				
38 ✓	2.8	5750	ORH A	ORH_Charles. ORH_CHARL				
39 ✓	2.8	5750	ORH A	ORH_Charles. ORH_CHARL				
40 ✓	2.8	5750	ORH A	ORH_Charles. ORH_CHARL				
41 ✓	2.8	5860	ORH A	ORH_Charles. ORH_CHARL				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young

AIRCRAFT Tail Number: N2266Z
Sensor Serial Number: 246

Date: 12-11-2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
42 ✓	2.8	5910	ORH A	ORH_Charles. ORH_CHARL	12-11-2010	246	JB	
43 ✓	2.8	5900	ORH A	ORH_Charles. ORH_CHARL				
44 ✓	2.8	5860	ORH A	ORH_Charles. ORH_CHARL				
45 ✓	6.6	5950	ORH A	ORH_Charles. ORH_CHARL				
46 ✓	6.7	6020	ORH A	ORH_Charles. ORH_CHARL				
47 ✓	6.4	6080	ORH A	ORH_Charles. ORH_CHARL				
48 ✓	5.3	6090	ORH A	ORH_Charles. ORH_CHARL				
49 ✓	5.1	6090	ORH A	ORH_Charles. ORH_CHARL				
50 ✓	3.6	6100	ORH A	ORH_Charles. ORH_CHARL				
51 ✓	3.1	5710	ORH A	ORH_Charles. ORH_CHARL				
52 ✓	3.6	5750	ORH A	ORH_Charles. ORH_CHARL				
53 ✓	2.7	5780	ORH A	ORH_Charles. ORH_CHARL				
54 ✓	3.6	5700	ORH A	ORH_Charles. ORH_CHARL				
55 ✓	3.6	5680	ORH A	ORH_Charles. ORH_CHARL				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young

AIRCRAFT Tail Number: N72662
Sensor Serial Number: 246

Date: 12-12-2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
56 ✓	3.6	5660	ORH A	ORH_Charles. ORH_CHARL	12-11-2010	246	JB	
57 ✓	3.6	5600	ORH A	ORH_Charles. ORH_CHARL				
58 ✓	4.5	5600	ORH A	ORH_Charles. ORH_CHARL				
59 ✓	4.5	5610	ORH A	ORH_Charles. ORH_CHARL				
60 ✓	4.5	5640	ORH A	ORH_Charles. ORH_CHARL				
61 ✓	4.5	5630	ORH A	ORH_Charles. ORH_CHARL				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young
AIRCRAFT Tail Number: N7266Z
Sensor Serial Number: 246
Date: 12-11-2010

```
           Flight Log
------------------------------
Project Number: 7556-005
S/N            : 246
Operator       : BERRY
Pilot(s)       : YOUNG
Aircraft       : N7266Z
Airport        : KORH
Mission        : 101211A
Wheels Up      : 1528Z
Flight Length :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 11, 2010
Julian Day     : 345
Temperature    : 0C
Visibility     : HAZY
Clouds         : NONE
Precipitation : NONE
Wind Dir       : CALM
Wind Speed     : CALM
Pressure       : 30.21
           Statistics
------------------------------
Laser Time     : 01:21:25

=======================================
10:45:03.486 GMT : 00:00:02 (212) GPS 1PPS Lost
10:45:03.486 GMT : 00:00:03 (166) Divergence Error
10:45:03.486 GMT : 00:00:03 (107) Rx Shutter Closed
10:45:03.486 GMT : 00:00:03 (109) Tx Shutter Closed
10:45:03.486 GMT : 00:00:04 (164) Beam Wide
10:45:03.486 GMT : 00:00:09 (120) Laser PS Comm Ok
10:45:03.486 GMT : 00:00:09 (112) Laser Emission Off
10:45:03.486 GMT : 00:00:11 (213) GPS 1PPS Ok
10:45:03.486 GMT : 00:00:12 (204) POSAV Connected
10:45:03.486 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
10:45:03.486 GMT : 00:00:12 (211) POSAV new status
10:45:03.486 GMT : 00:00:24 (208) POSAV Rate Is 50 Hz
10:45:03.486 GMT : 00:00:24 (211) POSAV new status
10:45:03.486 GMT : 00:00:26 (211) POSAV new status
10:45:03.486 GMT : 00:00:26 (215) Nav Data Ok
10:45:03.486 GMT : 00:02:05 (211) POSAV new status
15:19:01.948 GMT : 00:03:51 (307) Format Disk
15:20:00.349 GMT : 00:04:49 (211) POSAV new status
15:23:07.952 GMT : 15:23:07 (153) Eyesafety Disabled
15:23:08.652 GMT : 15:23:07 (162) Roll Comp On
15:23:08.852 GMT : 15:23:08 (164) Beam Wide
15:23:11.952 GMT : 15:23:11 (165) Beam Narrow
15:23:16.552 GMT : 15:23:15 (211) POSAV new status
```

15:23:27.152 GMT : 15:23:26 (144) MultiPulse Mode Varies
15:35:23.264 GMT : 15:35:22 (106) Rx Shutter Open
15:35:23.264 GMT : 15:35:22 (108) Tx Shutter Open
15:40:14.369 GMT : 15:40:13 (113) Laser Emission On
15:42:01.57 GMT : 15:42:00 (112) Laser Emission Off
15:44:19.473 GMT : 15:44:19 (113) Laser Emission On
15:46:53.876 GMT : 15:46:52 (112) Laser Emission Off
15:50:23.08 GMT : 15:50:22 (113) Laser Emission On
15:52:51.682 GMT : 15:52:50 (112) Laser Emission Off
15:55:14.185 GMT : 15:55:13 (113) Laser Emission On
15:56:58.287 GMT : 15:56:57 (112) Laser Emission Off
16:00:50.892 GMT : 16:00:49 (113) Laser Emission On
16:02:30.194 GMT : 16:02:29 (112) Laser Emission Off
16:05:14.897 GMT : 16:05:14 (113) Laser Emission On
16:07:39.2 GMT : 16:07:38 (112) Laser Emission Off
16:11:42.005 GMT : 16:11:41 (113) Laser Emission On
16:14:07.509 GMT : 16:14:06 (112) Laser Emission Off
16:17:21.713 GMT : 16:17:21 (113) Laser Emission On
16:19:25.015 GMT : 16:19:24 (112) Laser Emission Off
16:22:03.219 GMT : 16:22:02 (113) Laser Emission On
16:24:10.821 GMT : 16:24:09 (112) Laser Emission Off
16:26:32.925 GMT : 16:26:32 (113) Laser Emission On
16:28:13.927 GMT : 16:28:13 (112) Laser Emission Off
16:31:17.931 GMT : 16:31:17 (113) Laser Emission On
16:32:56.633 GMT : 16:32:55 (112) Laser Emission Off
16:35:28.236 GMT : 16:35:27 (113) Laser Emission On
16:37:30.939 GMT : 16:37:30 (112) Laser Emission Off
16:40:46.043 GMT : 16:40:45 (113) Laser Emission On
16:42:46.446 GMT : 16:42:45 (112) Laser Emission Off
16:45:11.249 GMT : 16:45:10 (113) Laser Emission On
16:46:53.952 GMT : 16:46:52 (112) Laser Emission Off
16:50:03.056 GMT : 16:50:02 (113) Laser Emission On
16:51:40.158 GMT : 16:51:39 (112) Laser Emission Off
16:54:10.061 GMT : 16:54:09 (113) Laser Emission On
16:56:00.564 GMT : 16:55:59 (112) Laser Emission Off
16:58:48.068 GMT : 16:58:47 (113) Laser Emission On
17:00:45.271 GMT : 17:00:44 (112) Laser Emission Off
17:01:03.771 GMT : 17:01:03 (113) Laser Emission On
17:04:25.376 GMT : 17:04:24 (112) Laser Emission Off
17:07:04.28 GMT : 17:07:03 (113) Laser Emission On
17:10:27.284 GMT : 17:10:26 (112) Laser Emission Off
17:10:46.985 GMT : 17:10:46 (113) Laser Emission On
17:12:14.187 GMT : 17:12:13 (112) Laser Emission Off
17:15:44.392 GMT : 17:15:43 (113) Laser Emission On
17:19:01.897 GMT : 17:19:01 (112) Laser Emission Off
17:22:17.802 GMT : 17:22:17 (113) Laser Emission On
17:24:59.606 GMT : 17:24:59 (112) Laser Emission Off
17:27:57.31 GMT : 17:27:56 (113) Laser Emission On
17:30:34.614 GMT : 17:30:34 (112) Laser Emission Off
17:33:27.418 GMT : 17:33:27 (113) Laser Emission On
17:35:30.821 GMT : 17:35:30 (112) Laser Emission Off
17:39:07.827 GMT : 17:39:07 (113) Laser Emission On
17:41:05.029 GMT : 17:41:04 (112) Laser Emission Off
17:44:19.634 GMT : 17:44:19 (113) Laser Emission On

```
17:48:53.741 GMT : 17:48:52 (112) Laser Emission Off
17:51:42.345 GMT : 17:51:41 (113) Laser Emission On
17:56:12.352 GMT : 17:56:11 (112) Laser Emission Off
17:59:08.857 GMT : 17:59:08 (113) Laser Emission On
18:02:34.962 GMT : 18:02:33 (112) Laser Emission Off
18:04:59.465 GMT : 18:04:58 (113) Laser Emission On
18:08:14.17 GMT : 18:08:13 (112) Laser Emission Off
18:10:15.474 GMT : 18:10:15 (113) Laser Emission On
18:13:37.279 GMT : 18:13:36 (112) Laser Emission Off
18:16:30.783 GMT : 18:16:30 (113) Laser Emission On
18:19:44.388 GMT : 18:19:43 (112) Laser Emission Off
18:22:22.692 GMT : 18:22:22 (113) Laser Emission On
18:25:33.997 GMT : 18:25:33 (112) Laser Emission Off
18:27:57.301 GMT : 18:27:56 (113) Laser Emission On
18:31:08.706 GMT : 18:31:08 (112) Laser Emission Off
18:34:22.811 GMT : 18:34:22 (107) Rx Shutter Closed
18:34:23.111 GMT : 18:34:22 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KORH
Mission       : 101211A
Wheels Up     : 1528Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 11, 2010
Julian Day    : 345
Temperature   : 0C
Visibility    : HAZY
Clouds        : NONE
Precipitation : NONE
Wind Dir      : CALM
Wind Speed    : CALM
Pressure      : 30.21
           Statistics
------------------------------
Laser Time    : 01:21:25

=======================================

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
```

Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : KORH
Mission : 101211A
Wheels Up : 1528Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 11, 2010
Julian Day : 345
Temperature : 0C
Visibility : HAZY
Clouds : NONE
Precipitation : NONE
Wind Dir : CALM
Wind Speed : CALM
Pressure : 30.21

Statistics

Laser Time : 01:21:25

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
15:40:14.769	15:42:02.77	60	1758	70	30.10	18.00	ON	NAR	ON	0.00	179.48
15:44:20.273	15:46:48.476	61	1714	70	30.10	18.00	ON	NAR	ON	0.00	179.47
15:50:23.88	15:52:52.982	39	1715	70	30.10	18.00	ON	NAR	ON	0.00	359.44
15:55:14.985	15:56:58.987	40	1749	70	30.10	18.00	ON	NAR	ON	0.00	359.44
16:00:51.192	16:02:30.394	59	1755	70	30.10	18.00	ON	NAR	ON	0.00	179.48
16:05:15.697	16:07:41	59	1707	70	30.10	18.00	ON	NAR	ON	0.00	179.48
16:11:42.406	16:14:08.009	57	1710	70	30.10	18.00	ON	NAR	ON	0.00	179.47
16:17:22.613	16:19:26.715	56	1704	70	30.10	18.00	ON	NAR	ON	0.00	179.46
16:22:03.719	16:24:11.722	56	1725	70	30.10	18.00	ON	NAR	ON	0.00	359.46
16:26:33.325	16:28:14.727	41	1789	70	30.10	18.00	ON	NAR	ON	0.00	359.42
16:31:18.631	16:32:58.233	42	1801	70	30.10	18.00	ON	NAR	ON	0.00	179.42
16:35:28.636	16:37:28.139	55	1734	70	30.10	18.00	ON	NAR	ON	0.00	179.45

16:40:46.543	16:42:48.046	43	1736	70	30.10	18.00	ON	NAR	ON	0.00	359.41
16:45:11.649	16:46:54.952	44	1799	70	30.10	18.00	ON	NAR	ON	0.00	359.42
16:50:04.156	16:51:42.258	51	1783	70	30.10	18.00	ON	NAR	ON	0.00	179.47
16:54:10.661	16:56:00.964	52	1744	70	30.10	18.00	ON	NAR	ON	0.00	179.43
16:58:48.868	17:00:46.571	45	1766	70	30.10	18.00	ON	NAR	ON	0.00	359.4
17:01:04.271	17:04:26.576	46	1811	70	30.10	18.00	ON	NAR	ON	0.00	359.4
17:07:04.08	17:10:28.084	53	1838	70	30.10	18.00	ON	NAR	ON	0.00	179.43
17:10:47.685	17:12:15.287	47	1764	70	30.10	18.00	ON	NAR	ON	0.00	359.39
17:15:44.192	17:19:02.697	47	1848	70	30.10	18.00	ON	NAR	ON	0.00	359.39
17:22:18.402	17:25:00.306	48	1861	70	30.10	18.00	ON	NAR	ON	0.00	179.38
17:27:57.51	17:30:35.614	50	1857	70	30.10	18.00	ON	NAR	ON	0.00	359.38
17:33:28.118	17:35:31.321	53	1862	70	30.10	18.00	ON	NAR	ON	0.00	179.43
17:39:08.327	17:41:06.13	53	1807	70	30.10	18.00	ON	NAR	ON	0.00	179.43
17:44:20.534	17:48:55.041	24	1706	70	30.10	18.00	ON	NAR	ON	0.00	359.56
17:51:42.345	17:56:13.052	25	1694	70	30.10	18.00	ON	NAR	ON	0.00	179.56
17:59:09.657	18:02:35.862	26	1714	70	30.10	18.00	ON	NAR	ON	0.00	179.55
18:05:00.166	18:08:15.57	27	1699	70	30.10	18.00	ON	NAR	ON	0.00	359.55
18:10:16.374	18:13:38.679	28	1680	70	30.10	18.00	ON	NAR	ON	0.00	359.55
18:16:31.483	18:19:45.888	28	1693	70	30.10	18.00	ON	NAR	ON	0.00	179.55
18:22:23.592	18:25:35.297	30	1657	70	30.10	18.00	ON	NAR	ON	0.00	359.54
18:27:58.101	18:31:09.306	30	1650	70	30.10	18.00	ON	NAR	ON	0.00	179.54

Flight Log

Project Number: 7556-005
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : KORH
Mission : 101211B
Wheels Up : 1925Z
Flight Length :

```
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 11, 2010
Julian Day    : 345
Temperature   : 4
Visibility    : GOOD
Clouds        : NONE
Precipitation : NONE
Wind Dir      : 240
Wind Speed    : 4
Pressure      : 30.17
           Statistics
------------------------------
Laser Time    : 00:36:23

=======================================
14:43:08.678 GMT : 00:00:02 (212) GPS 1PPS Lost
14:43:08.678 GMT : 00:00:03 (166) Divergence Error
14:43:08.678 GMT : 00:00:03 (107) Rx Shutter Closed
14:43:08.678 GMT : 00:00:03 (109) Tx Shutter Closed
14:43:08.678 GMT : 00:00:04 (164) Beam Wide
14:43:08.678 GMT : 00:00:05 (213) GPS 1PPS Ok
14:43:08.678 GMT : 00:00:09 (120) Laser PS Comm Ok
14:43:08.678 GMT : 00:00:09 (112) Laser Emission Off
14:43:08.678 GMT : 00:00:12 (204) POSAV Connected
14:43:08.678 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
14:43:08.678 GMT : 00:00:13 (211) POSAV new status
14:43:08.678 GMT : 00:00:22 (208) POSAV Rate Is 50 Hz
14:43:08.678 GMT : 00:00:22 (215) Nav Data Ok
14:43:08.678 GMT : 00:00:23 (211) POSAV new status
14:43:08.678 GMT : 00:00:24 (211) POSAV new status
14:43:08.678 GMT : 00:01:51 (211) POSAV new status
14:43:08.678 GMT : 00:04:33 (211) POSAV new status
19:18:43.088 GMT : 19:18:42 (153) Eyesafety Disabled
19:18:43.788 GMT : 19:18:42 (162) Roll Comp On
19:18:43.988 GMT : 19:18:43 (164) Beam Wide
19:18:49.688 GMT : 19:18:48 (165) Beam Narrow
19:19:01.089 GMT : 19:19:00 (144) MultiPulse Mode Varies
19:23:07.994 GMT : 19:23:06 (211) POSAV new status
19:24:14.095 GMT : 19:24:13 (106) Rx Shutter Open
19:24:14.295 GMT : 19:24:13 (108) Tx Shutter Open
19:36:23.212 GMT : 19:36:22 (113) Laser Emission On
19:39:37.117 GMT : 19:39:36 (112) Laser Emission Off
19:43:04.121 GMT : 19:43:03 (113) Laser Emission On
19:46:26.726 GMT : 19:46:26 (112) Laser Emission Off
19:49:52.931 GMT : 19:49:52 (113) Laser Emission On
19:53:05.036 GMT : 19:53:04 (112) Laser Emission Off
19:56:06.14 GMT : 19:56:05 (113) Laser Emission On
19:59:19.444 GMT : 19:59:18 (112) Laser Emission Off
20:02:04.748 GMT : 20:02:04 (113) Laser Emission On
20:04:05.551 GMT : 20:04:04 (112) Laser Emission Off
```

```
20:06:44.455 GMT : 20:06:43 (113) Laser Emission On
20:08:27.457 GMT : 20:08:26 (112) Laser Emission Off
20:10:56.061 GMT : 20:10:55 (113) Laser Emission On
20:12:39.064 GMT : 20:12:38 (112) Laser Emission Off
20:20:45.175 GMT : 20:20:44 (113) Laser Emission On
20:27:00.184 GMT : 20:26:59 (112) Laser Emission Off
20:30:00.989 GMT : 20:30:00 (113) Laser Emission On
20:35:54.597 GMT : 20:35:53 (112) Laser Emission Off
20:40:50.505 GMT : 20:40:50 (113) Laser Emission On
20:46:17.013 GMT : 20:46:16 (112) Laser Emission Off
20:48:12.815 GMT : 20:48:12 (113) Laser Emission On
20:49:10.317 GMT : 20:49:09 (112) Laser Emission Off
20:49:21.617 GMT : 20:49:20 (107) Rx Shutter Closed
20:49:21.817 GMT : 20:49:20 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KORH
Mission       : 101211B
Wheels Up     : 1925Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 11, 2010
Julian Day    : 345
Temperature   : 4
Visibility    : GOOD
Clouds        : NONE
Precipitation : NONE
Wind Dir      : 240
Wind Speed    : 4
Pressure      : 30.17
           Statistics
------------------------------
Laser Time    : 00:36:23

=======================================

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KORH
```

Mission : 101211B
Wheels Up : 1925Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 11, 2010
Julian Day : 345
Temperature : 4
Visibility : GOOD
Clouds : NONE
Precipitation : NONE
Wind Dir : 240
Wind Speed : 4
Pressure : 30.17

Statistics

Laser Time : 00:36:23

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
19:36:23.812	19:39:38.217	32	1671	70	30.10	18.00	ON	NAR	ON	0.00	179.51
19:43:04.821	19:46:28.426	33	1688	70	30.10	18.00	ON	NAR	ON	0.00	359.51
19:49:53.431	19:53:05.736	34	1701	70	30.10	18.00	ON	NAR	ON	0.00	359.5
19:56:06.54	19:59:20.544	35	1719	70	30.10	18.00	ON	NAR	ON	0.00	179.51
20:02:05.948	20:04:06.151	36	1724	70	30.10	18.00	ON	NAR	ON	0.00	179.5
20:06:44.955	20:08:27.257	36	1722	70	30.10	18.00	ON	NAR	ON	0.00	179.5
20:10:57.061	20:12:40.064	37	1745	70	30.10	18.00	ON	NAR	ON	0.00	359.49
20:20:44.975	20:27:01.084	21	1654	70	30.10	18.00	ON	NAR	ON	0.00	179.59
20:30:01.889	20:35:54.797	22	1659	70	30.10	18.00	ON	NAR	ON	0.00	359.57
20:40:51.205	20:46:18.613	22	1674	70	30.10	18.00	ON	NAR	ON	0.00	179.57
20:48:13.615	20:49:11.217	21	1701	70	30.10	18.00	ON	NAR	ON	0.00	179.59

Flight Log

Project Number: ORH_Charles
S/N : 247
Operator : Galieti

```
Pilot(s)       : Greenwell
Aircraft       : N2448G
Airport        : KORH
Mission        : 2
Wheels Up      :
Flight Length  :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 11, 2010
Julian Day     : 345
Temperature    : 2
Visibility     : Clear
Clouds         : None
Precipitation  : None HZ
Wind Dir       : 270
Wind Speed     : 6
Pressure       : 30.20 HG
           Statistics
------------------------------
Laser Time     : 01:55:18

=======================================
16:51:51.407 GMT : 00:00:02 (212) GPS 1PPS Lost
16:51:51.407 GMT : 00:00:03 (166) Divergence Error
16:51:51.407 GMT : 00:00:03 (107) Rx Shutter Closed
16:51:51.407 GMT : 00:00:03 (109) Tx Shutter Closed
16:51:51.407 GMT : 00:00:04 (164) Beam Wide
16:51:51.407 GMT : 00:00:05 (213) GPS 1PPS Ok
16:51:51.407 GMT : 00:00:12 (204) POSAV Connected
16:51:51.407 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
16:51:51.407 GMT : 00:00:12 (211) POSAV new status
16:51:51.407 GMT : 00:00:18 (120) Laser PS Comm Ok
16:51:51.407 GMT : 00:00:18 (112) Laser Emission Off
16:51:51.407 GMT : 00:00:26 (208) POSAV Rate Is 50 Hz
16:51:51.407 GMT : 00:00:26 (211) POSAV new status
16:51:51.407 GMT : 00:00:26 (215) Nav Data Ok
16:51:51.407 GMT : 00:00:28 (211) POSAV new status
16:51:51.407 GMT : 00:02:01 (211) POSAV new status
16:51:51.407 GMT : 00:02:54 (211) POSAV new status
16:43:56.257 GMT : 16:43:55 (153) Eyesafety Disabled
16:43:56.357 GMT : 16:43:55 (162) Roll Comp On
16:43:56.857 GMT : 16:43:56 (164) Beam Wide
16:43:57.057 GMT : 16:43:56 (144) MultiPulse Mode Varies
16:44:02.057 GMT : 16:44:01 (166) Divergence Error
16:44:02.757 GMT : 16:44:02 (165) Beam Narrow
16:44:11.957 GMT : 16:44:11 (157) Safe Unaided Profile
16:44:12.057 GMT : 16:44:11 (157) Safe Unaided Profile
16:50:20.761 GMT : 16:50:19 (211) POSAV new status
16:59:10.268 GMT : 16:59:09 (157) Safe Unaided Profile
16:59:23.368 GMT : 16:59:22 (157) Safe Unaided Profile
16:59:29.368 GMT : 16:59:28 (106) Rx Shutter Open
```

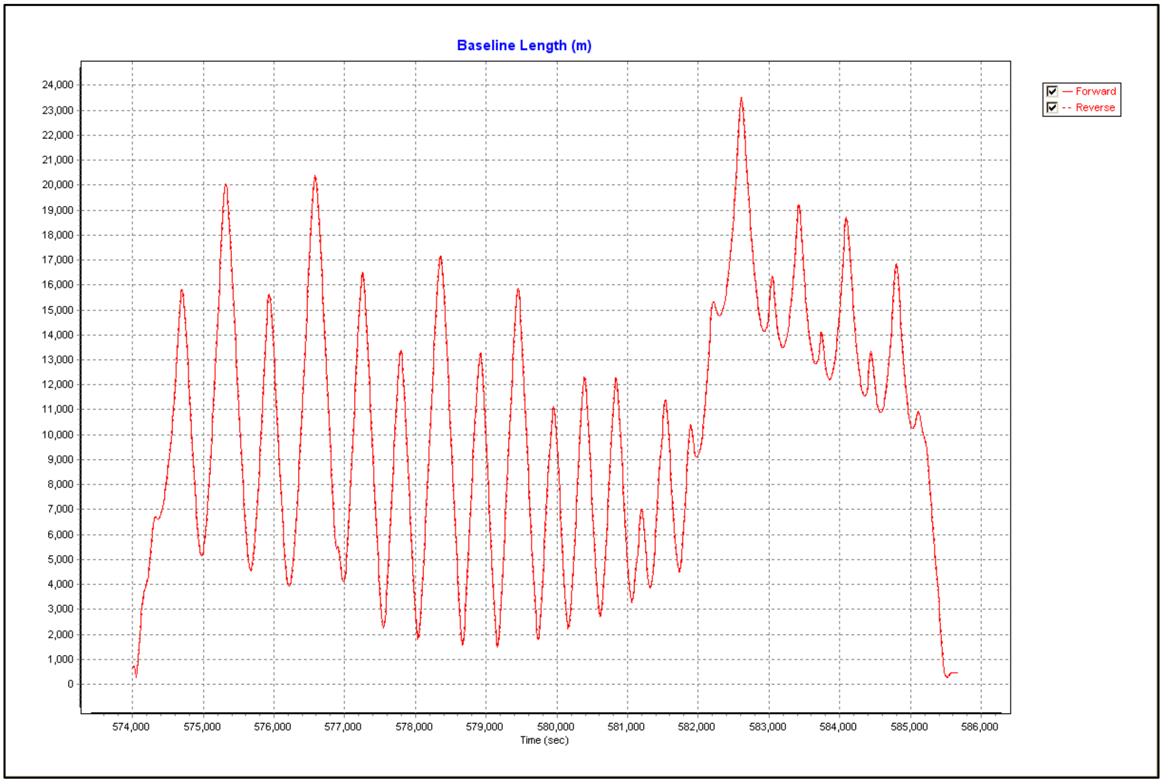
```
16:59:29.468 GMT : 16:59:28 (108) Tx Shutter Open
17:07:14.174 GMT : 17:07:13 (113) Laser Emission On
17:09:44.976 GMT : 17:09:43 (112) Laser Emission Off
17:13:53.18 GMT : 17:13:52 (113) Laser Emission On
17:17:15.582 GMT : 17:17:14 (112) Laser Emission Off
17:22:38.787 GMT : 17:22:38 (113) Laser Emission On
17:26:00.79 GMT : 17:25:59 (112) Laser Emission Off
17:31:23.994 GMT : 17:31:23 (113) Laser Emission On
17:34:43.097 GMT : 17:34:42 (112) Laser Emission Off
17:39:50.101 GMT : 17:39:49 (113) Laser Emission On
17:43:14.104 GMT : 17:43:13 (112) Laser Emission Off
17:49:13.709 GMT : 17:49:12 (113) Laser Emission On
17:52:32.212 GMT : 17:52:31 (112) Laser Emission Off
17:58:08.117 GMT : 17:58:07 (113) Laser Emission On
18:03:11.222 GMT : 18:03:10 (112) Laser Emission Off
18:08:10.926 GMT : 18:08:10 (113) Laser Emission On
18:13:25.031 GMT : 18:13:24 (112) Laser Emission Off
18:18:17.536 GMT : 18:18:16 (113) Laser Emission On
18:23:21.44 GMT : 18:23:20 (112) Laser Emission Off
18:28:50.445 GMT : 18:28:49 (113) Laser Emission On
18:34:11.45 GMT : 18:34:10 (112) Laser Emission Off
18:39:19.655 GMT : 18:39:18 (113) Laser Emission On
18:45:21.261 GMT : 18:45:19 (112) Laser Emission Off
18:50:18.766 GMT : 18:50:18 (113) Laser Emission On
19:00:22.476 GMT : 19:00:21 (112) Laser Emission Off
19:04:47.08 GMT : 19:04:45 (113) Laser Emission On
19:14:24.389 GMT : 19:14:23 (112) Laser Emission Off
19:19:31.694 GMT : 19:19:30 (113) Laser Emission On
19:29:05.104 GMT : 19:29:04 (112) Laser Emission Off
19:33:46.308 GMT : 19:33:45 (113) Laser Emission On
19:43:13.518 GMT : 19:43:12 (112) Laser Emission Off
19:47:58.522 GMT : 19:47:57 (113) Laser Emission On
19:55:07.53 GMT : 19:55:06 (112) Laser Emission Off
20:04:42.439 GMT : 20:04:41 (113) Laser Emission On
20:05:11.14 GMT : 20:05:09 (112) Laser Emission Off
20:11:19.446 GMT : 20:11:18 (113) Laser Emission On
20:18:28.653 GMT : 20:18:28 (112) Laser Emission Off
20:23:11.058 GMT : 20:23:10 (113) Laser Emission On
20:30:04.564 GMT : 20:30:02 (112) Laser Emission Off
20:34:48.369 GMT : 20:34:47 (113) Laser Emission On
20:41:36.276 GMT : 20:41:35 (112) Laser Emission Off
20:43:44.578 GMT : 20:43:43 (113) Laser Emission On
20:46:59.681 GMT : 20:46:59 (112) Laser Emission Off
20:50:07.784 GMT : 20:50:07 (157) Safe Unaided Profile
20:50:12.084 GMT : 20:50:11 (107) Rx Shutter Closed
20:50:12.284 GMT : 20:50:11 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: ORH_Charles
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
```

```
Airport        : KORH
Mission        : 2
Wheels Up      :
Flight Length  :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 11, 2010
Julian Day     : 345
Temperature    : 2
Visibility     : Clear
Clouds         : None
Precipitation  : None HZ
Wind Dir       : 270
Wind Speed     : 6
Pressure       : 30.20 HG
           Statistics
------------------------------
Laser Time     : 01:55:18

=======================================

           Flight Log
------------------------------
Project Number: ORH_Charles
S/N            : 247
Operator       : Galieti
Pilot(s)       : Greenwell
Aircraft       : N2448G
Airport        : KORH
Mission        : 2
Wheels Up      :
Flight Length  :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 11, 2010
Julian Day     : 345
Temperature    : 2
Visibility     : Clear
Clouds         : None
Precipitation  : None HZ
Wind Dir       : 270
Wind Speed     : 6
Pressure       : 30.20 HG
           Statistics
------------------------------
Laser Time     : 01:55:18
```

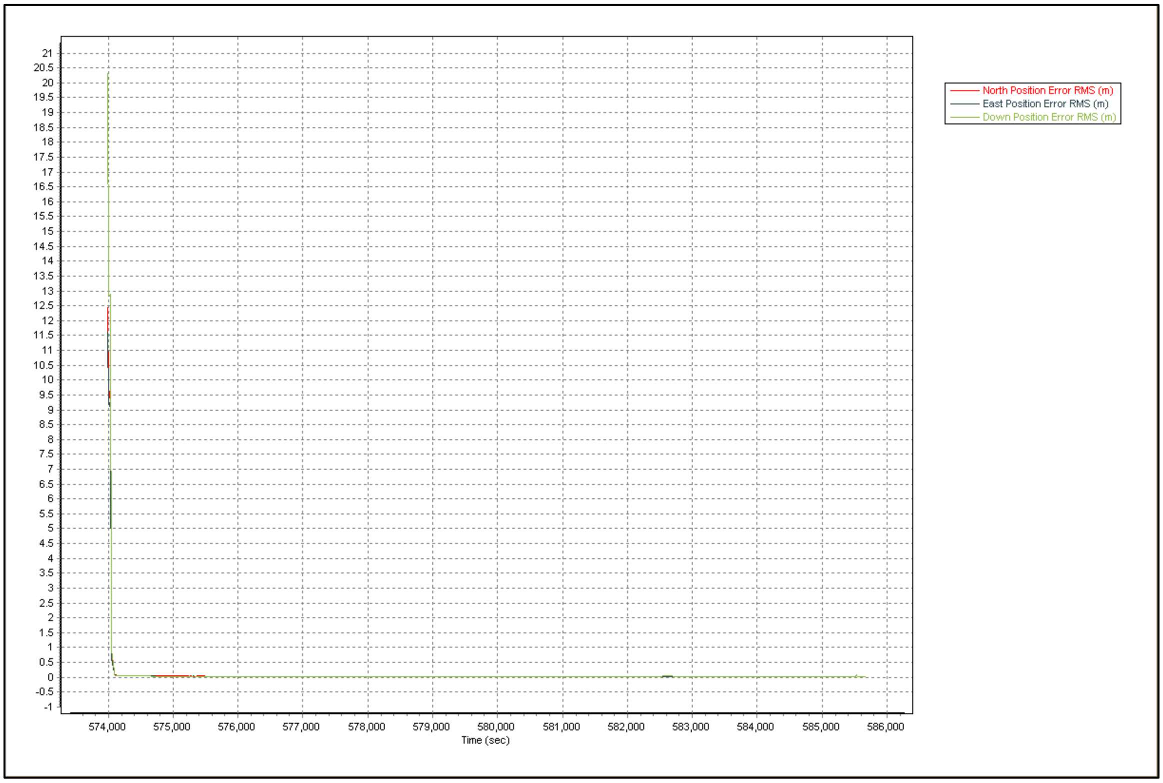
START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
17:07:15.374	17:09:45.676	12	1644	70	30.10	18.00	ON	NAR	ON	0.00	179.73
17:13:54.18	17:17:16.282	11	1644	70	30.10	18.00	ON	NAR	ON	0.00	359.7
17:22:39.387	17:26:01.69	10	1645	70	30.10	18.00	ON	NAR	ON	0.00	179.69
17:31:24.694	17:34:43.597	9	1639	70	30.10	18.00	ON	NAR	ON	0.00	359.69
17:39:50.901	17:43:15.504	8	1645	70	30.10	18.00	ON	NAR	ON	0.00	179.68
17:39:50.901	17:43:15.504	8	1645	70	30.10	18.00	ON	NAR	ON	0.00	179.68
17:49:14.209	17:52:33.612	7	1641	70	30.10	18.00	ON	NAR	ON	0.00	359.67
17:49:14.209	17:52:33.612	7	1641	70	30.10	18.00	ON	NAR	ON	0.00	359.67
17:58:08.817	18:03:12.122	6	1645	70	30.10	18.00	ON	NAR	ON	0.00	179.65
17:58:08.817	18:03:12.122	6	1645	70	30.10	18.00	ON	NAR	ON	0.00	179.65
18:08:11.826	18:13:25.631	5	1638	70	30.10	18.00	ON	NAR	ON	0.00	359.65
18:18:17.836	18:23:22.74	4	1635	70	30.10	18.00	ON	NAR	ON	0.00	179.64
18:28:50.945	18:34:13.551	3	1630	70	30.10	18.00	ON	NAR	ON	0.00	359.63
18:39:19.855	18:45:22.461	1	1644	70	30.10	18.00	ON	NAR	ON	0.00	179.62
18:50:19.866	19:00:19.576	1	1638	70	30.10	18.00	ON	NAR	ON	0.00	359.62
19:04:47.68	19:14:26.689	13	1637	70	30.10	18.00	ON	NAR	ON	0.00	179.62
19:19:31.494	19:29:05.804	14	1637	70	30.10	18.00	ON	NAR	ON	0.00	359.61
19:33:46.108	19:43:15.118	15	1636	70	30.10	18.00	ON	NAR	ON	0.00	179.6
19:33:46.108	19:43:15.118	15	1636	70	30.10	18.00	ON	NAR	ON	0.00	179.6
19:47:59.322	19:55:07.73	17	1637	70	30.10	18.00	ON	NAR	ON	0.00	359.59
19:47:59.322	19:55:07.73	17	1637	70	30.10	18.00	ON	NAR	ON	0.00	359.59
20:04:42.239	20:05:12.54	17	1643	70	30.10	18.00	ON	NAR	ON	0.00	179.59
20:11:20.246	20:18:29.653	18	1653	70	30.10	18.00	ON	NAR	ON	0.00	179.58
20:23:11.958	20:30:04.964	19	1649	70	30.10	18.00	ON	NAR	ON	0.00	359.58
20:34:49.269	20:41:37.876	19	1648	70	30.10	18.00	ON	NAR	ON	0.00	179.58

20:34:49.269	20:41:37.876	19	1648	70	30.10	18.00	ON	NAR	ON	0.00	179.58
20:43:44.578	20:47:00.281	19	1638	70	30.10	18.00	ON	NAR	ON	0.00	179.58

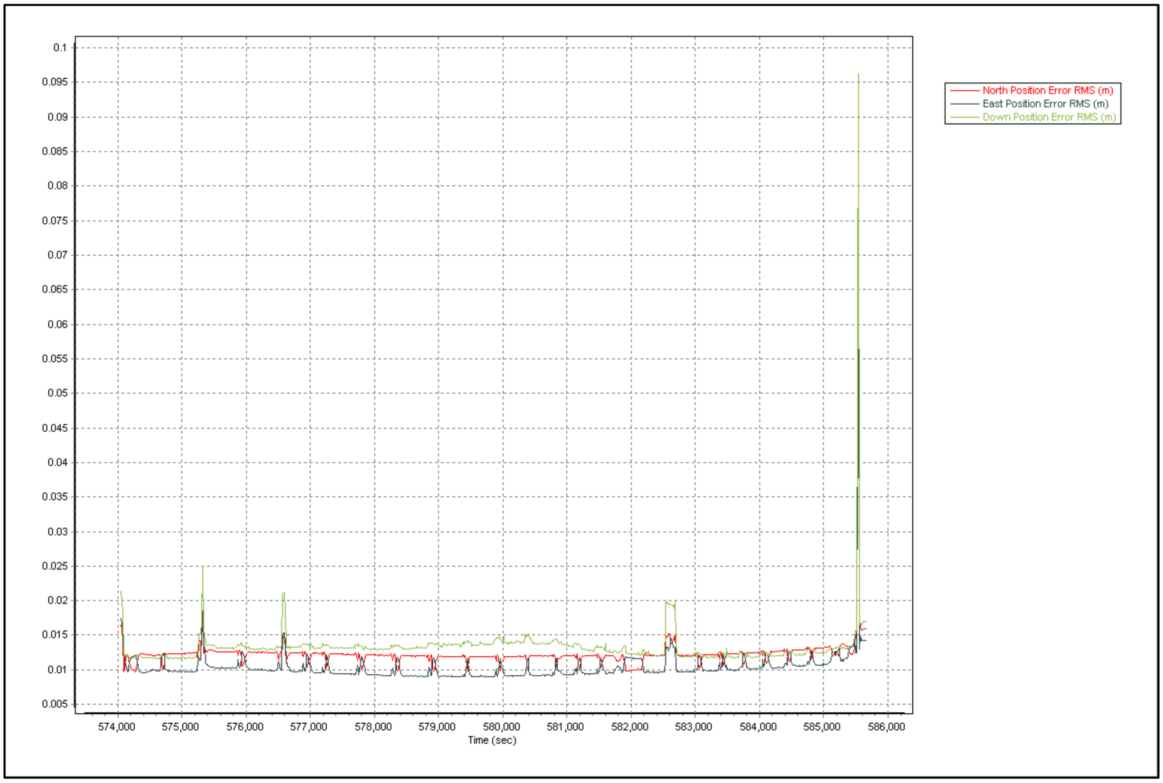
101211A-246-BASELINELENGTH



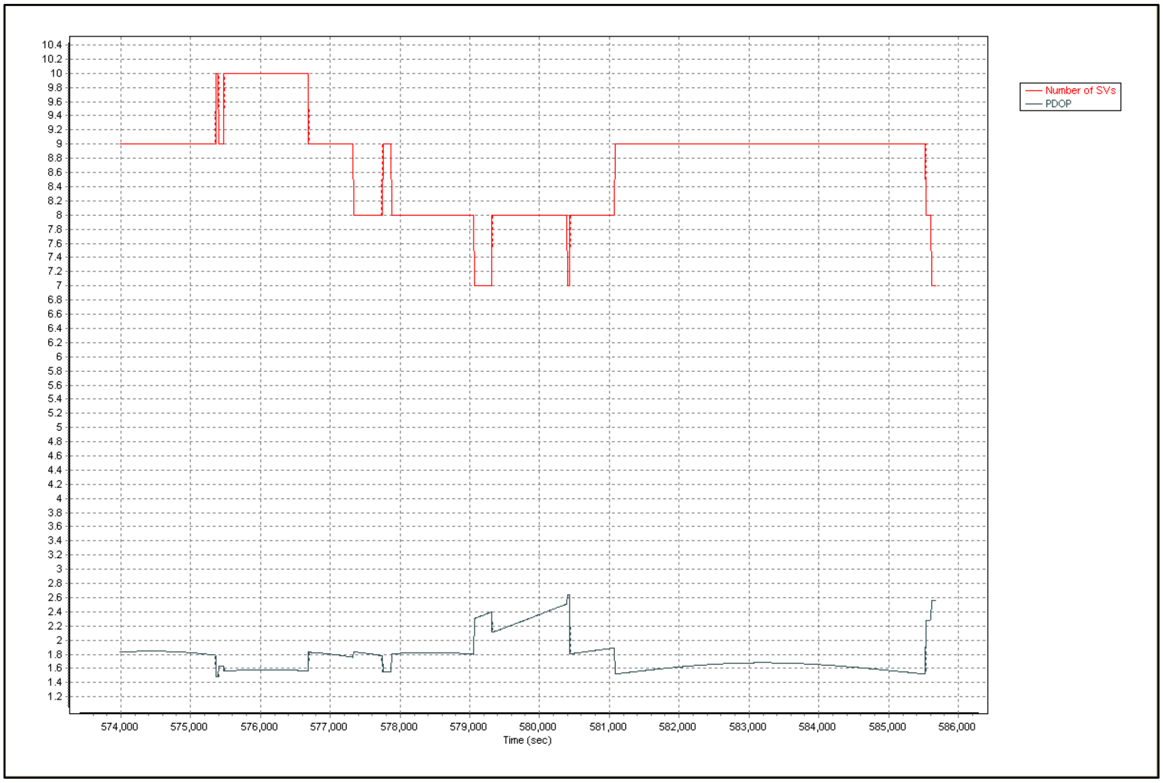
101211A-246-NEDPOSITIONERROR-FORWARD



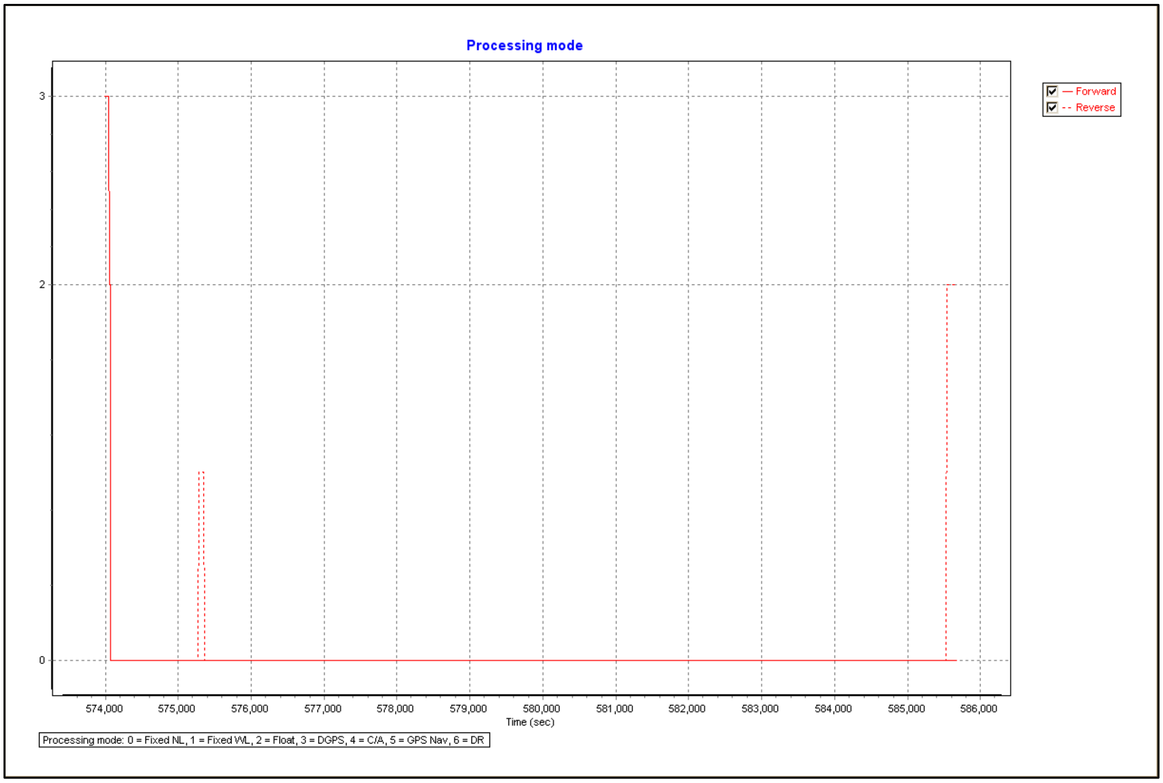
101211A-246-NEDPOSITIONERROR-SMOOTHED



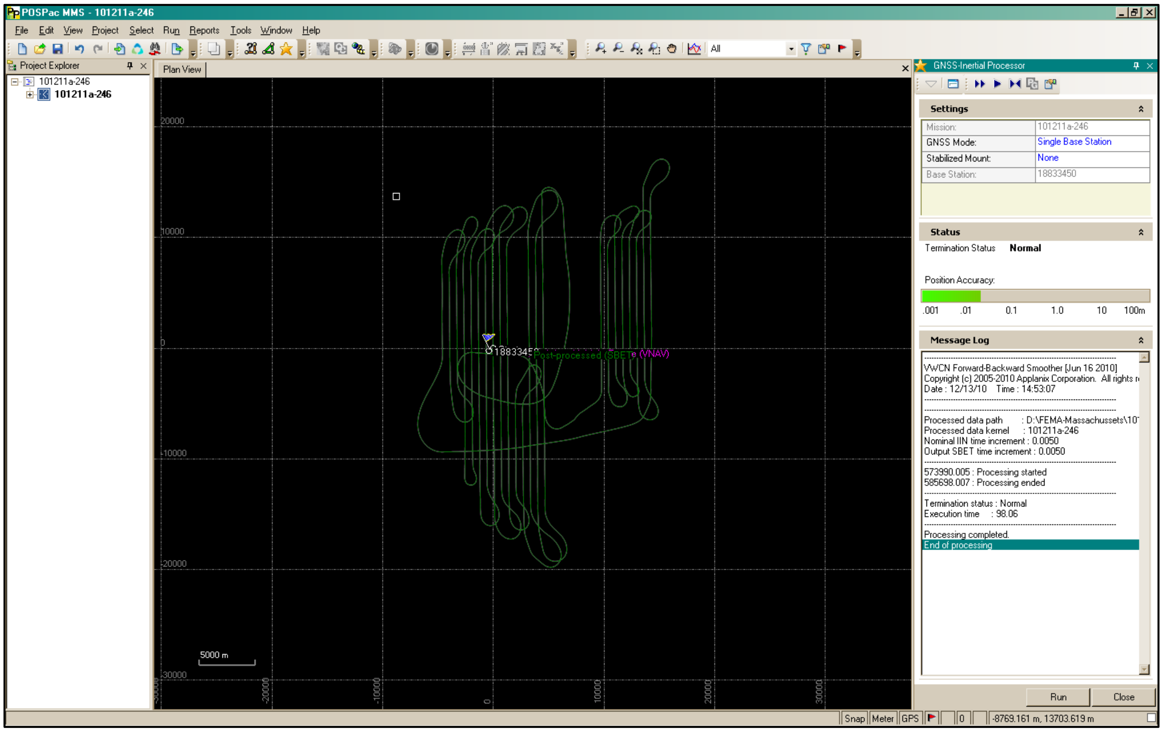
101211A-246-PDOP&SVS



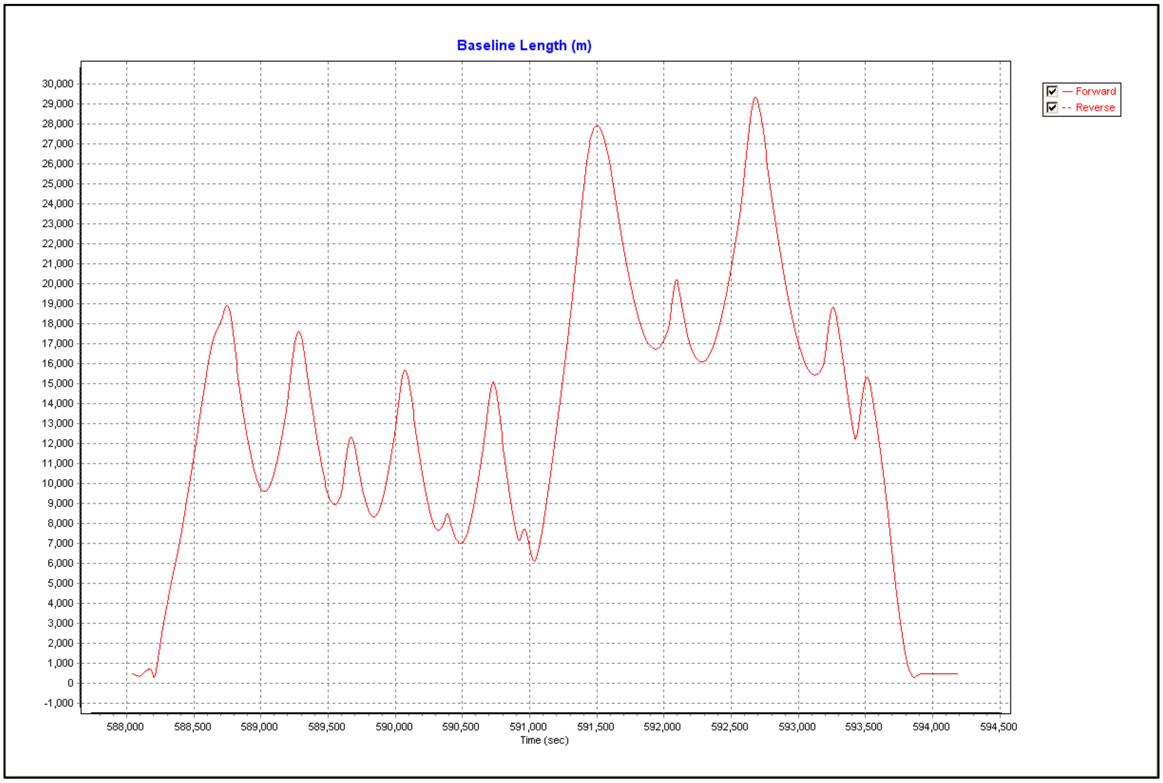
101211A-246-PROCMODE



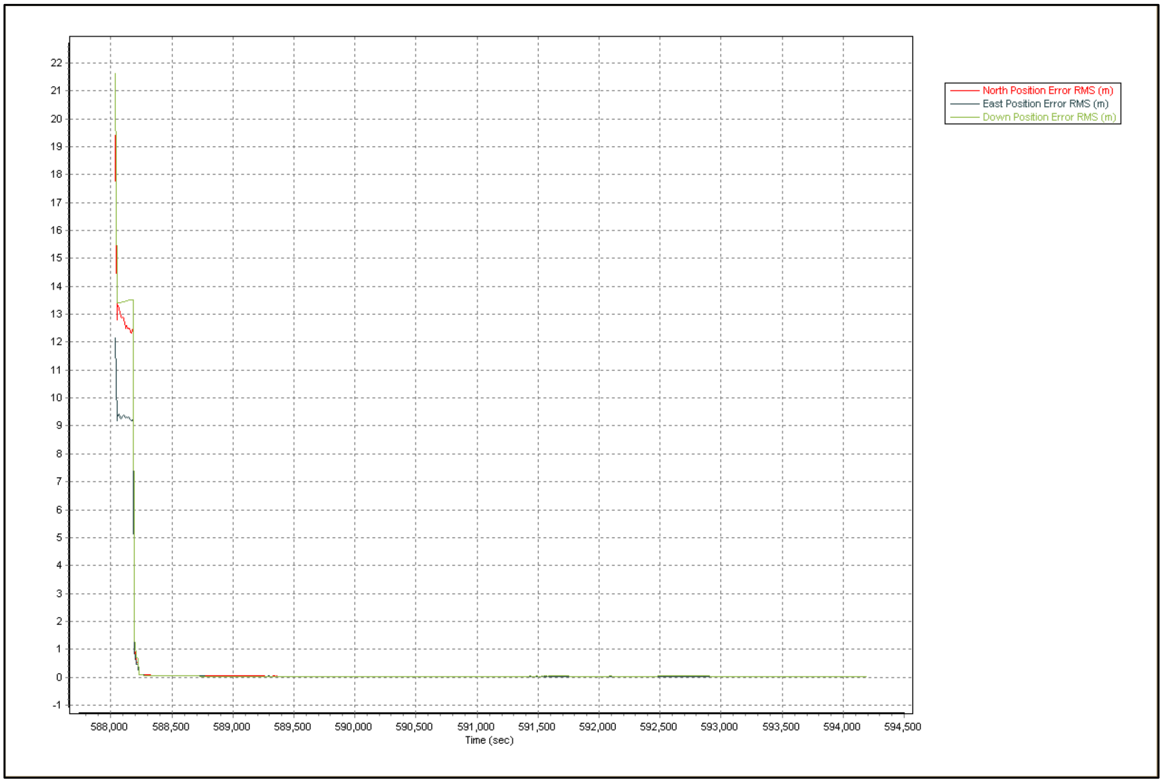
101211A-246-TRAJECTORY



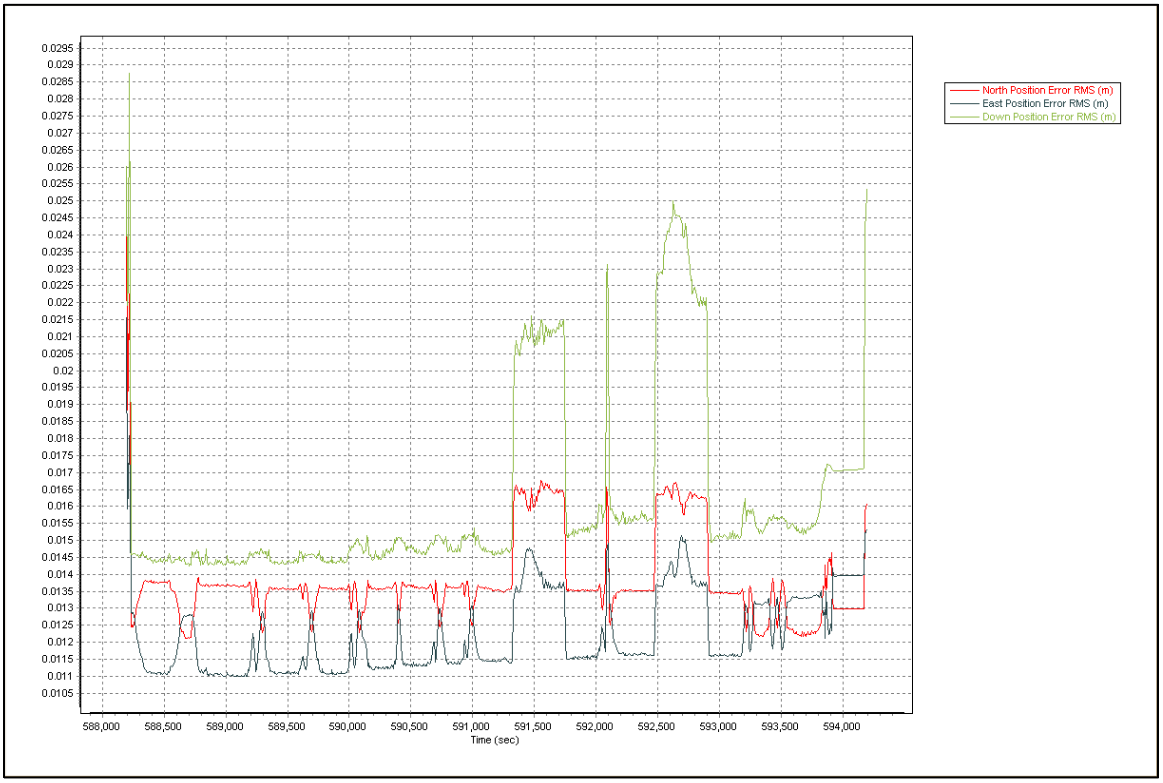
101211B-246-BASELINELENGTH



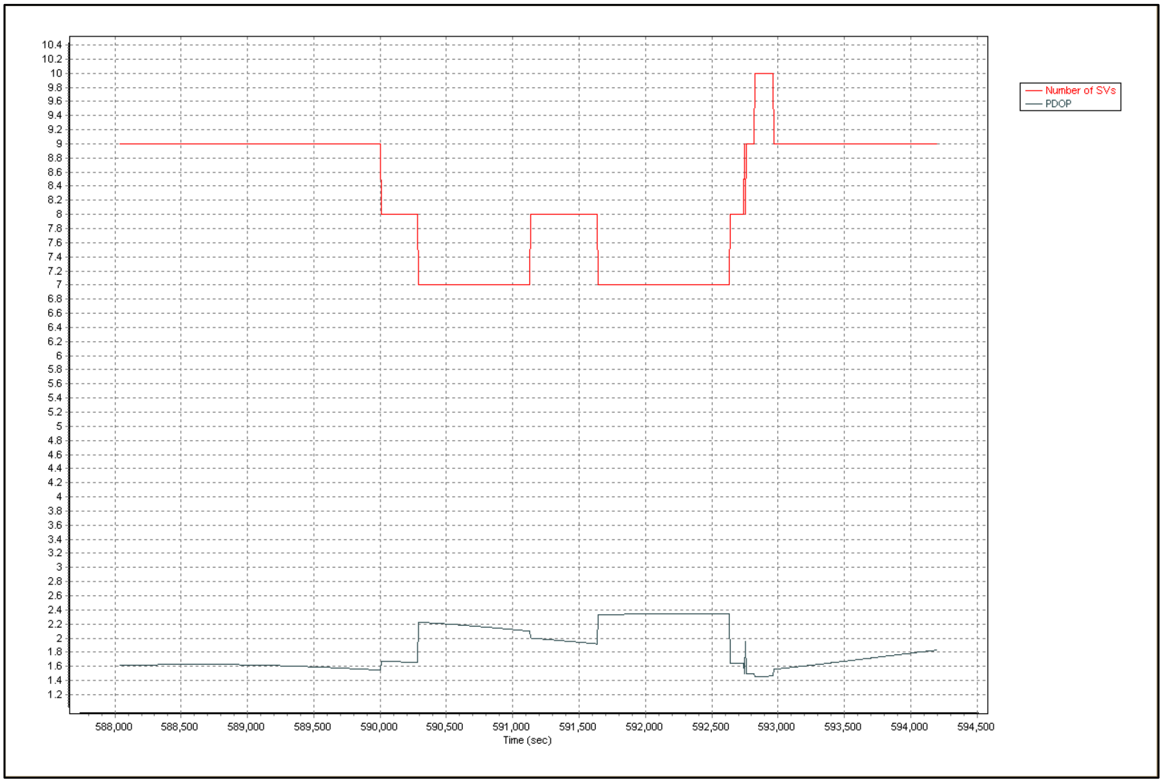
101211B-246-NEDPOSITIONERROR-FORWARD



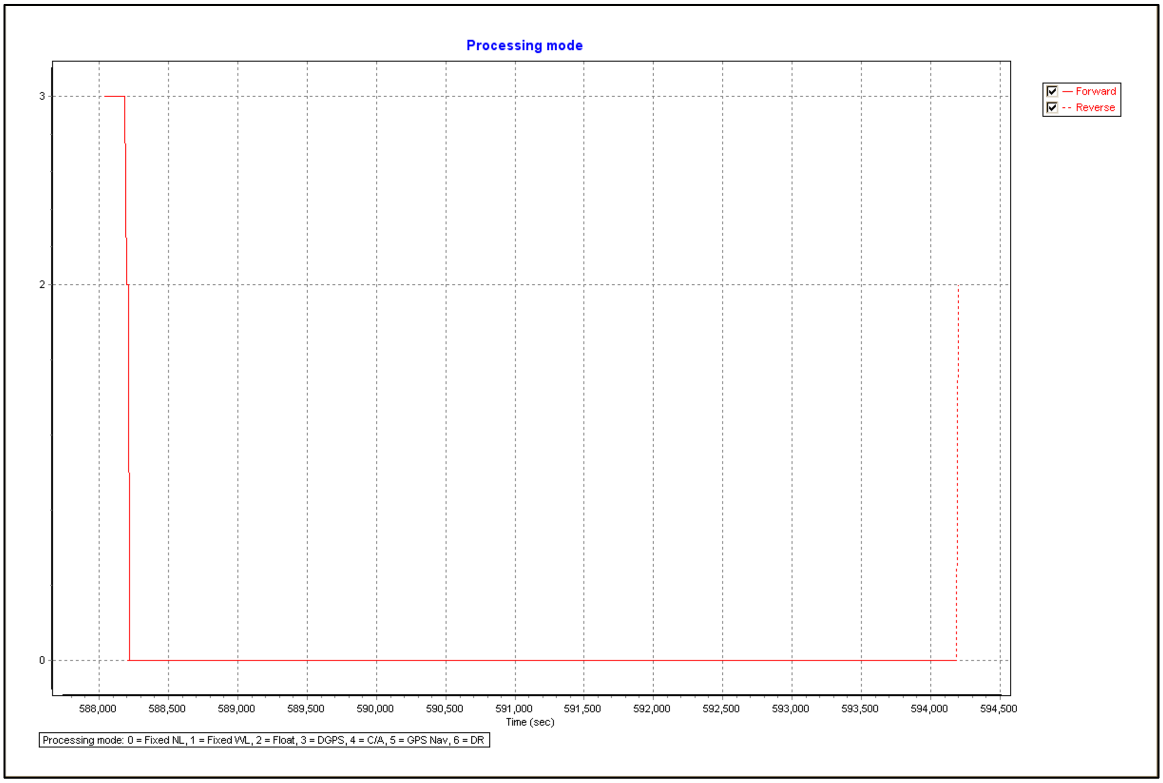
101211B-246-NEDPOSITIONERROR-SMOOTHED



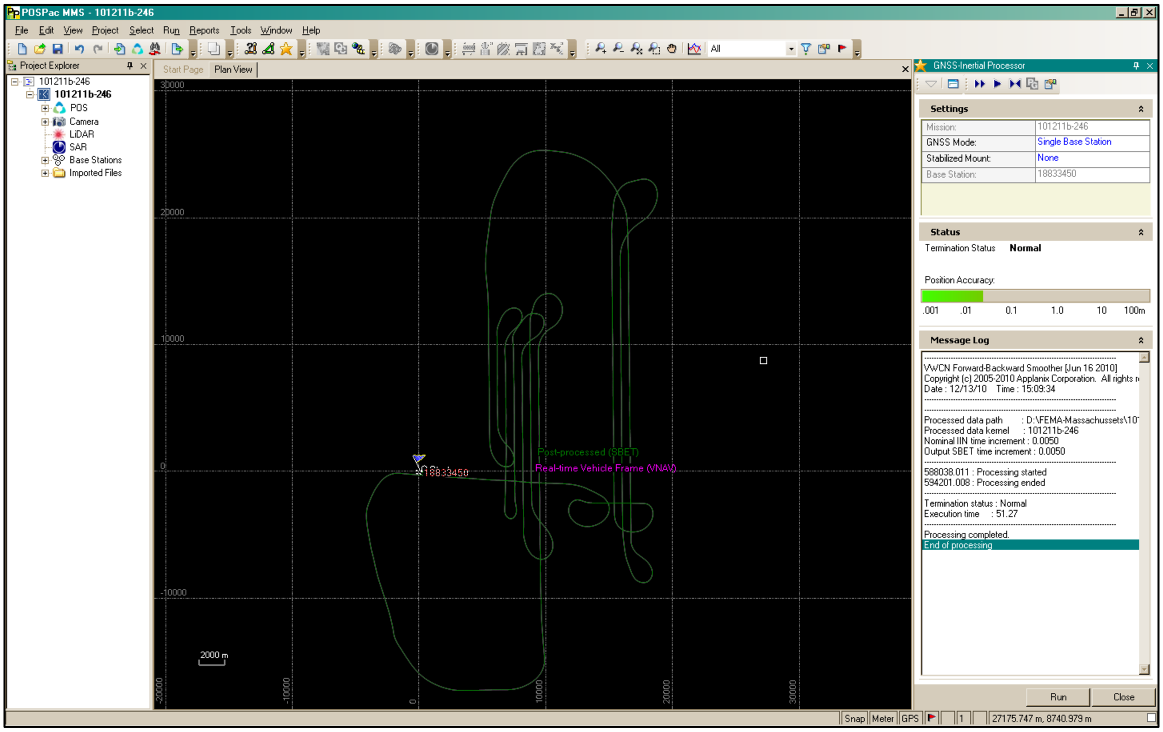
101211B-246-PDOP&SVS



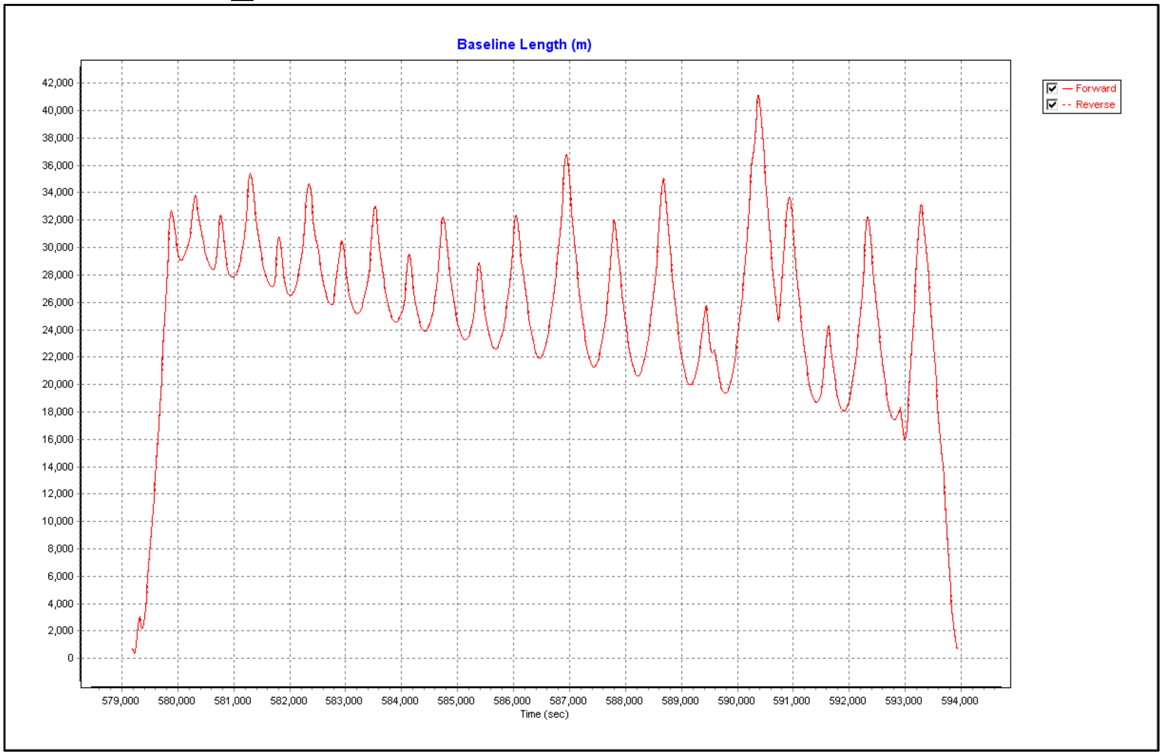
101211B-246-PROCMODE



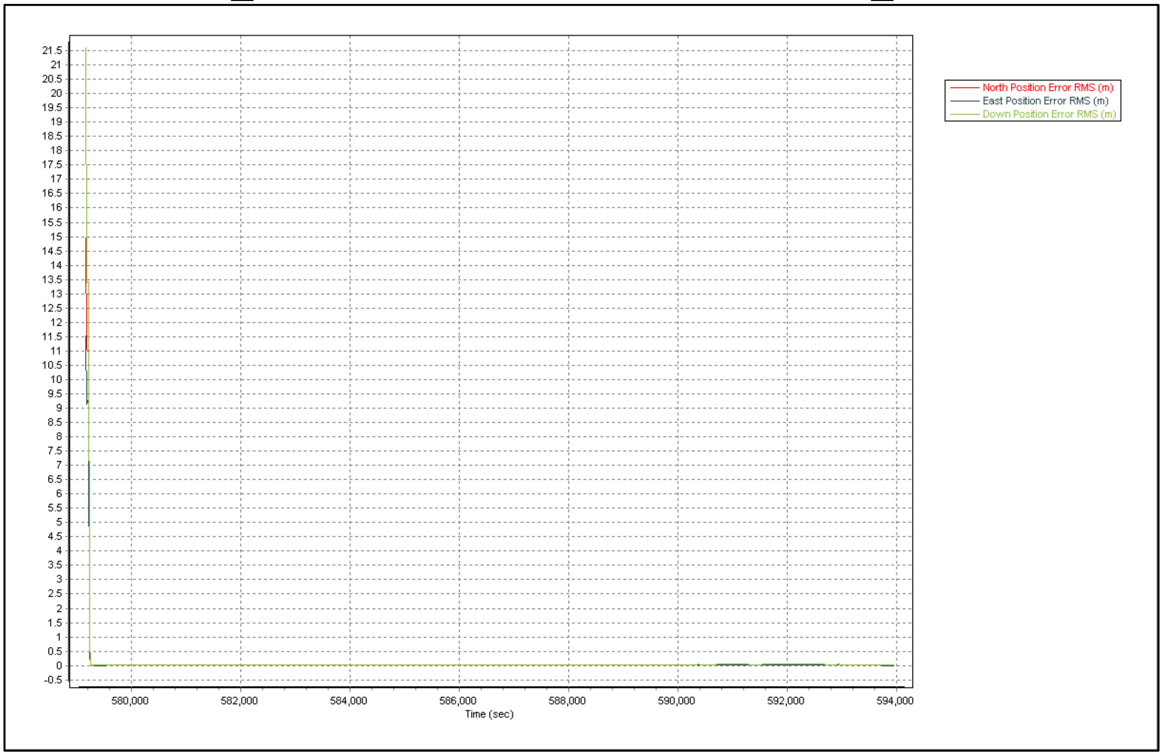
101211B-246-TRAJECTORY



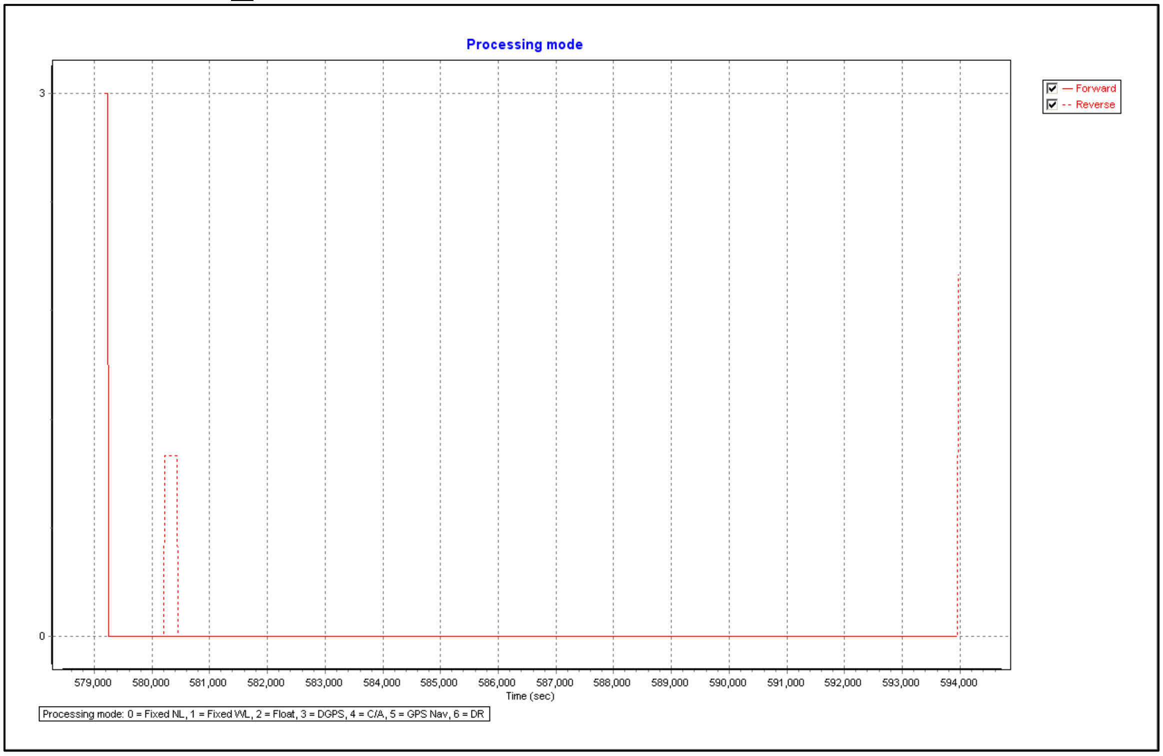
101211B-247_BASELINE



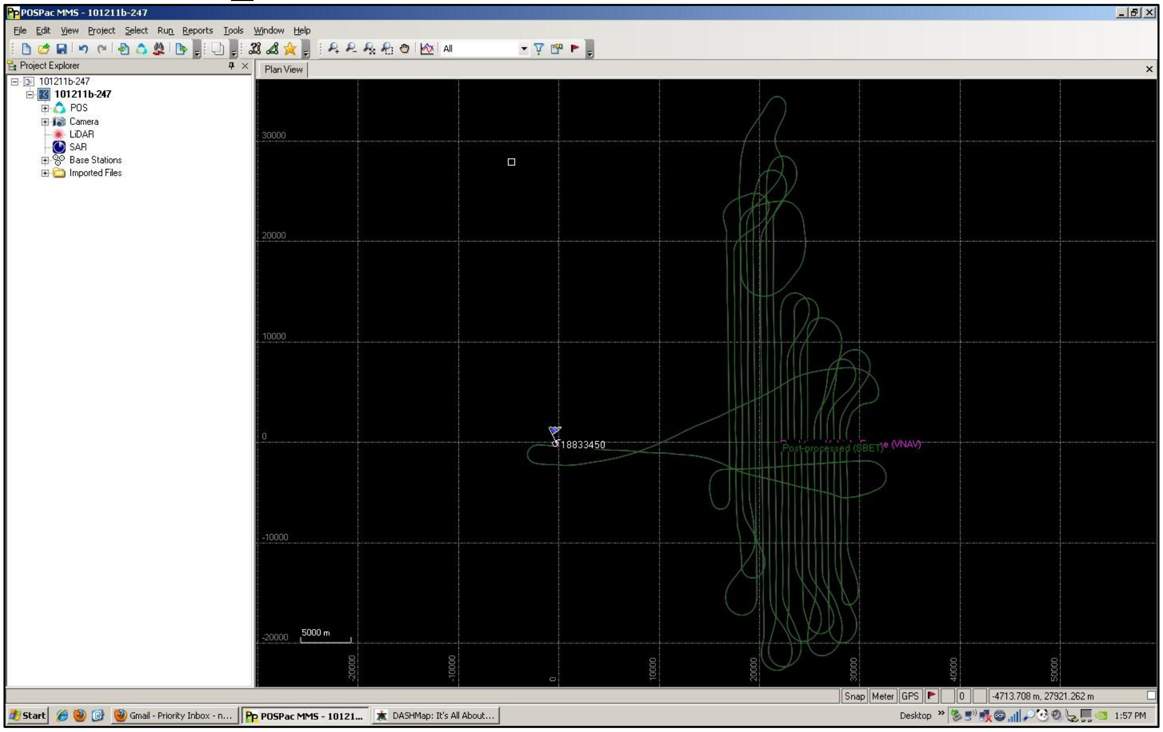
101211B-247_FORWARDPROCESSPERFMETRIC_NED



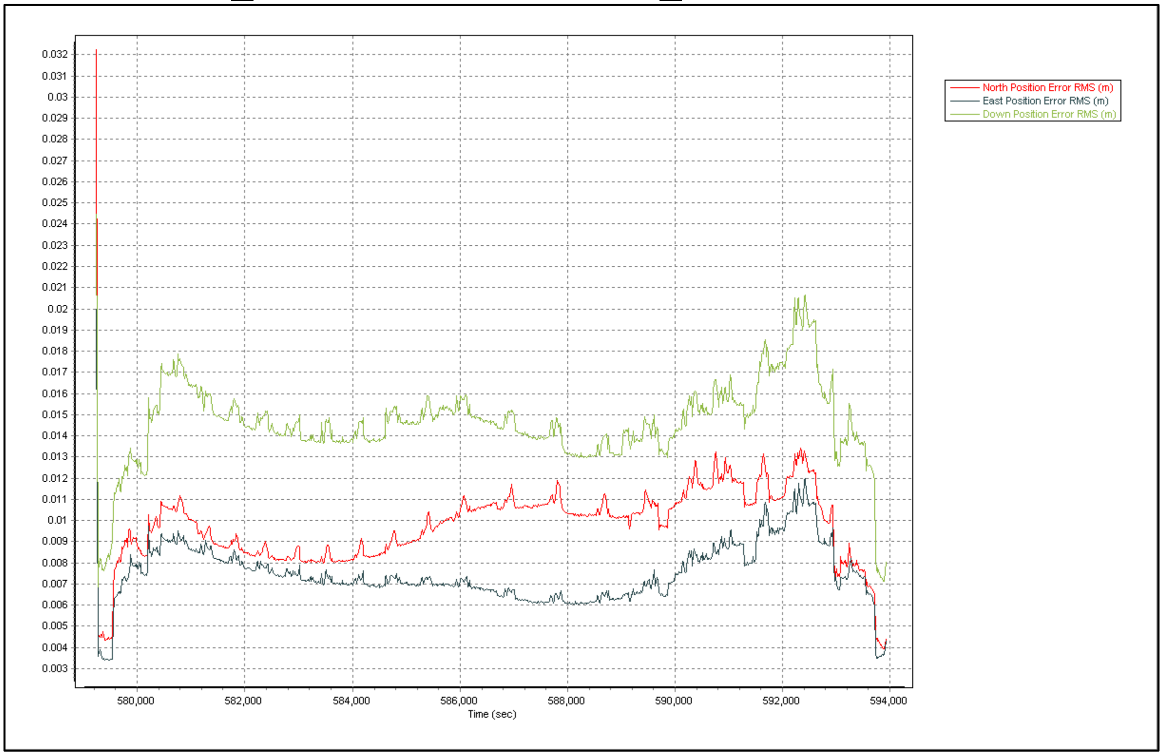
101211B-247_PROCESSMODE



101211B-247_SCREENSHOT



101211B-247_SMOOTHPERFMETRIC_NED



101211B-247_SVS&PDOP

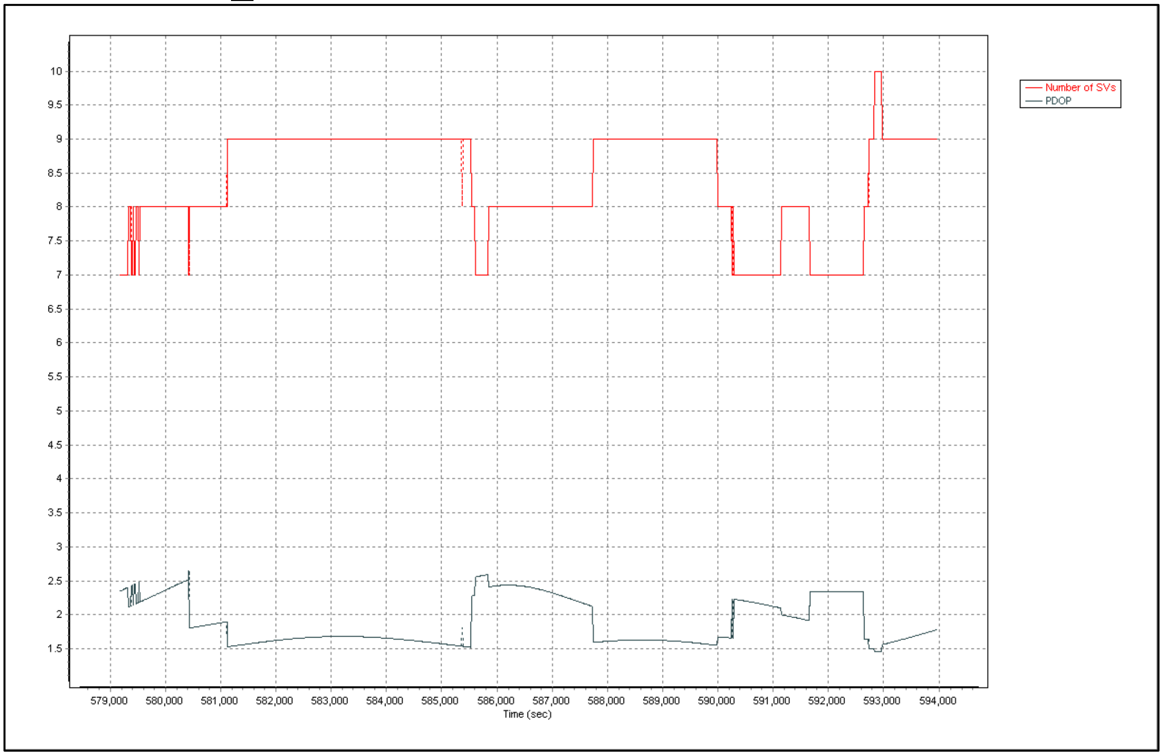


PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive
Lexington, Kentucky 40503
Phone 859-277-8700 + Fax 859-277-8901
www.photoscience.com

March 28, 2011

Post Flight Report
PSI Project 7556-005
Narragansett, MA LiDAR

CONTRACT: ____________________
Client: STARR
Project Name: Narragansett
Attached Reference file: *7556-005_Narragansett_MA_Background.ZIP*

General Specifications: 1-meter nominal spacing LiDAR Acquisition and processing with a 24.5 cm vertical accuracy at 95% confidence.

Acquisition Dates: LiDAR data for the Narragansett data was acquired on the dates of 12/08/2010, 12/10/2010, over 6 lifts by two different Aircraft.

Equipment Used: The data was collected with a Optech Gemini, Serial Numbers 246 and 247, Base GPS Receiver used was a Trimble 5700 collecting data at half second intervals. The aircraft used were Cessna 206 models, tail numbers N2448G and N7266Z. The pilots were Mark Young and Nick Greenwell and the Operators were Jeremy Berry and Nathan Galieti. The Base Station was set on the monument "Mansfield, LW5147" at the Mansfield Airport 1B9 set by the crews.

Project: The project consisted of 44 flight lines of 390.66 miles. The project was flown at an altitude of 5,000 feet above ground and at a planned average speed of 116 knots with a field of view of 36 degrees. The scan rates used was 30.1 Hz with a Laser Pulse Rate of 71.429 Hz with Multi-Pulse enabled. The full swath width was 989.18 meters with a planned sidelap of 30%. The point spacing was .912 meter with a NADIR point density of 1.2 points per square meter and an average point density of 2.93 points per square meter. The planned vertical accuracy was 0.13 meters. The area consisted of 217 square miles.

GPS Base Station / Monument: The Base Station was set on the monument "Mansfield, LW5147" at the Mansfield Airport 1B9 set by the crews. Information on this monument is included in the attached .ZIP file under "Base Station Data".

Control: 13 control points were collected as part of the project and used to calibrate the project data, remove any bias and verify accuracy. This data is compared to the collected model and results indicated below. This control data in included in the attached .ZIP file under "Control".

Flight Files: The planned flight files are included as reference in the attached .ZIP file under "Flight Files".

Flight Logs: Flight Logs used by the crew are included in the attached .ZIP file under "Flight Logs" and include the following type information:

- job #/name
- block or AOI
- date (s) flown
- aircraft tail #
- lines - #
- lines - direction
- lines – altitude
- lines – speed
- conditions
- comments
- pilot name
- operator name
- AGC switch
- GPS base station used

Processing Summary: Data is included in the attached .ZIP file under "Processing Summary" which includes GPS / IMU processing summary data including at a minimum:

- Processing Logs
- Message Logs
- Extract Logs
- Laser configuration files for each lift
- Max Horizontal GPS Variance (cm)
- Max Vertical GPS Variance (cm)
- Notes on GPS quality (High, Good, etc.)
- GPS separation plot
- GPS altitude plot
- PDOP plot
- Plot of GPS distance from base station/s

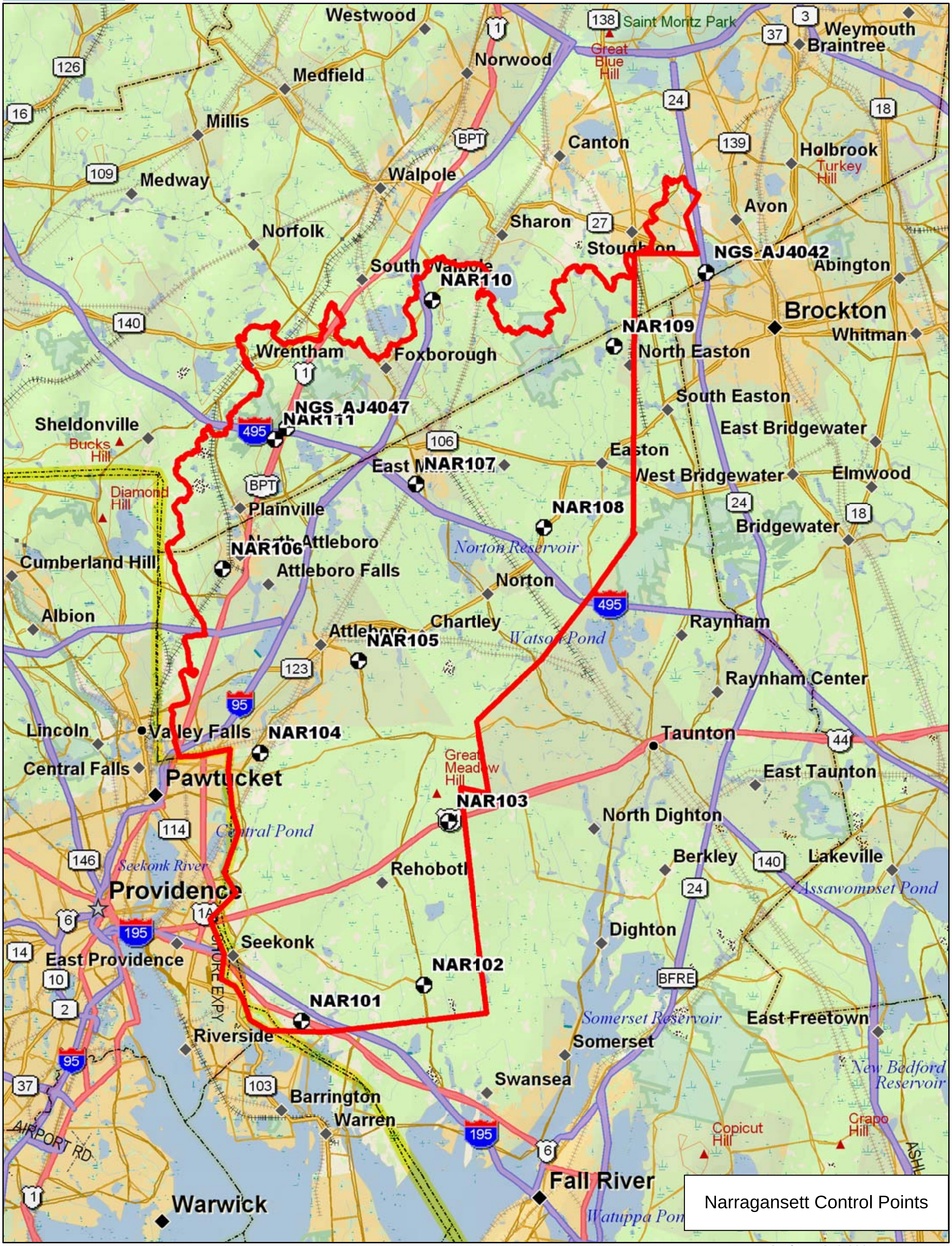
Project Coverage: within the attached .ZIP file in the "Project Coverage" directory is the overall boundary Shape File and the as flown trajectory Shape Files which include the project calibration flight lines (cross flights).

Accuracy: The LiDAR data was tested against the Control check points indicated above and the results are included in the "Accuracy Results" directory in the attached .ZIP file.

The LiDAR data as collected tested at 0.095 (meters) fundamental vertical accuracy at 95% confidence level. Within the accuracies indicated in the specifications, as provided.

Sincerely,

Forrest Godby
Senior Project Manager / Flight Operations Manager



TN
MN (14.9°W)

Scale 1 : 250,000

1" = 3.95 mi Data Zoom 9-2

```
309124.28,4627858.76,NAR101
315137.56,4629447.78,NAR102
316540.02,4637360.83,NAR103
307444.56,4640935.41,NAR104
312364.10,4645307.56,NAR105
305881.82,4649935.23,NAR106
315387.71,4653817.28,NAR107
321582.88,4651547.08,NAR108
325222.77,4660253.86,NAR109
316403.93,4662726.09,NAR110
308587.34,4656165.11,NAR111
329772.47,4663745.59,NGS_AJ4042
309178.59,4656697.39,NGS_AJ4047
```

Statistical Analysis	
Average Dz	0.08
Minimum Dz	-0.029
Maximum Dz	0.15
RMSE	0.095
Standard Deviation	0.054

Coordinate System
Horizontal Projection
NAD83 - UTM Zone 19N, Meters
Vertical Datum
NAVD88 - Geoid09, Meters

Point	Easting	Northing	Known Z	LIDAR Z	Dz
NAR101	309124.28	4627858.76	4.18	4.29	0.11
NAR102	315137.56	4629447.78	30.45	30.51	0.06
NAR103	316540.02	4637360.83	37.43	37.56	0.13
NAR104	307444.56	4640935.41	28.97	29.04	0.07
NAR105	312364.10	4645307.56	41.21	41.31	0.10
NAR106	305881.82	4649935.23	81.73	81.81	0.08
NAR107	315387.71	4653817.28	46.45	46.60	0.15
NAR108	321582.88	4651547.08	29.84	29.91	0.07
NAR109	325222.77	4660253.86	53.10	53.21	0.11
NAR110	316403.93	4662726.09	78.04	78.16	0.12
NAR111	308587.34	4656165.11	71.09	71.17	0.08
NGS_AJ4042	329772.47	4663745.59	74.83	74.81	-0.02
NGS_AJ4047	309178.59	4656697.39	61.37	61.34	-0.03

Base Monument for NARR_1B9

```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1         National Geodetic Survey,   Retrieval Date = NOVEMBER 28, 2010
 LW5147 ***********************************************************************
 LW5147  PACS         -  This is a Primary Airport Control Station.
 LW5147  DESIGNATION -  MANSFIELD
 LW5147  PID         -  LW5147
 LW5147  STATE/COUNTY-  MA/BRISTOL
 LW5147  USGS QUAD   -
 LW5147
 LW5147                        *CURRENT SURVEY CONTROL
 LW5147  ___________________________________________________________________
 LW5147* NAD 83(2007)-  41 59 51.83741(N)    071 11 32.63915(W)     ADJUSTED
 LW5147* NAVD 88     -        35.61   (meters)     116.8    (feet)  GPS OBS
 LW5147  ___________________________________________________________________
 LW5147  EPOCH DATE  -        2002.00
 LW5147  X           -   1,530,446.961 (meters)                     COMP
 LW5147  Y           -  -4,493,704.408 (meters)                     COMP
 LW5147  Z           -   4,245,421.236 (meters)                     COMP
 LW5147  LAPLACE CORR-           2.37  (seconds)                    DEFLEC09
 LW5147  ELLIP HEIGHT-           6.817 (meters)          (02/10/07) ADJUSTED
 LW5147  GEOID HEIGHT-         -28.78  (meters)                     GEOID09
 LW5147
 LW5147  ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
 LW5147  Type    PID    Designation                      North   East  Ellip
 LW5147  -------------------------------------------------------------------
 LW5147  NETWORK LW5147 MANSFIELD                          0.29   0.24   0.69
 LW5147  -------------------------------------------------------------------
 LW5147
 LW5147.This mark is at Mansfield Airport (1B9)
 LW5147
 LW5147.The horizontal coordinates were established by GPS observations
 LW5147.and adjusted by the National Geodetic Survey in February 2007.
 LW5147
 LW5147.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
 LW5147.See National Readjustment for more information.
 LW5147.The horizontal coordinates are valid at the epoch date displayed above.
 LW5147.The epoch date for horizontal control is a decimal equivalence
 LW5147.of Year/Month/Day.
 LW5147
 LW5147.The orthometric height was determined by GPS observations and a
 LW5147.high-resolution geoid model.
 LW5147
 LW5147.GPS derived orthometric heights for airport stations designated as
 LW5147.PACS or SACS are published to 2 decimal places.  This maintains
 LW5147.centimeter relative accuracy between the PACS and SACS.  It does
 LW5147.not indicate centimeter accuracy relative to other marks which are
 LW5147.part of the NAVD 88 network.
 LW5147
 LW5147.Photographs are available for this station.
 LW5147
 LW5147.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 LW5147
 LW5147.The Laplace correction was computed from DEFLEC09 derived deflections.
 LW5147
```

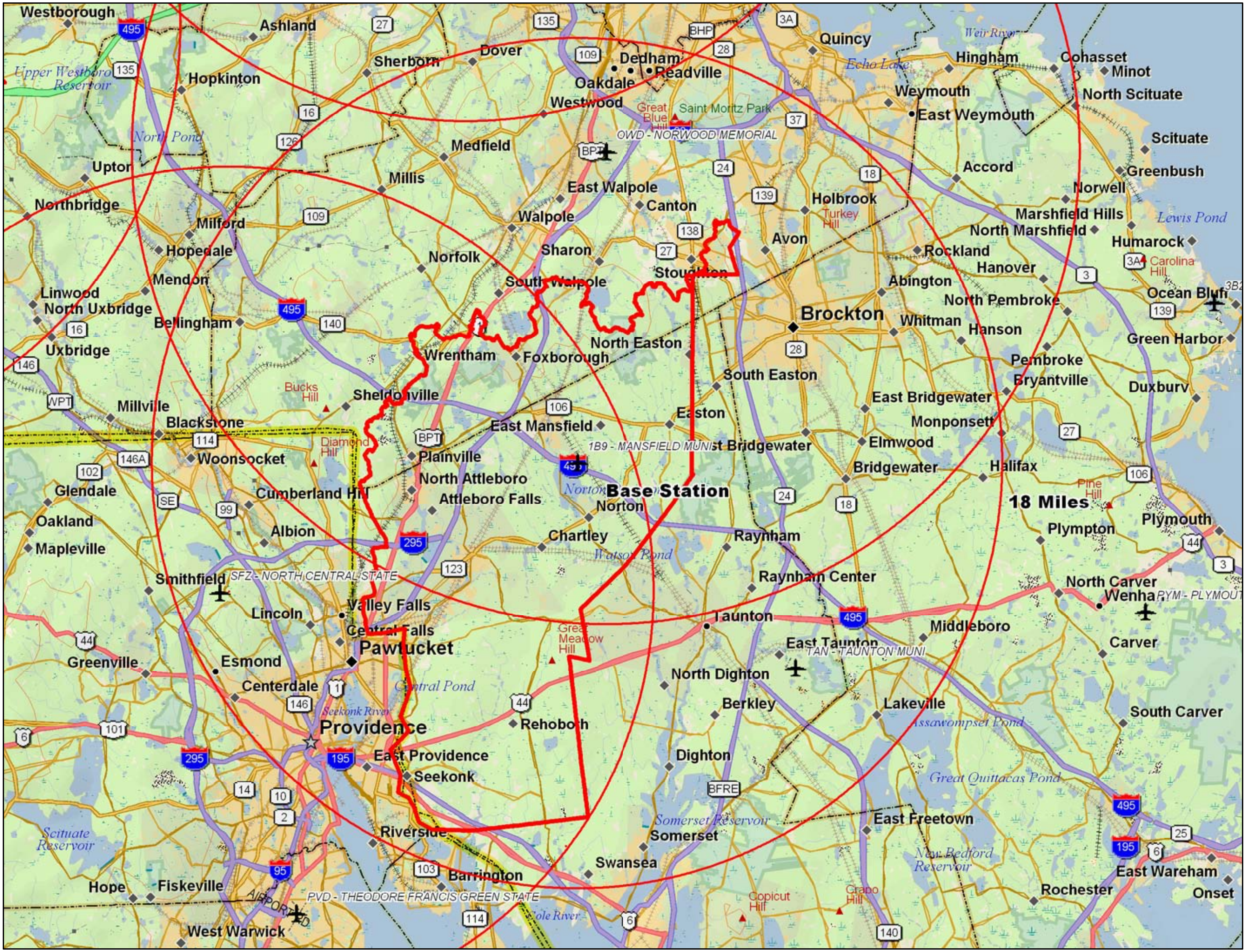
```
LW5147.The ellipsoidal height was determined by GPS observations
LW5147.and is referenced to NAD 83.
LW5147
LW5147.The geoid height was determined by GEOID09.
LW5147
LW5147;                      North         East     Units Scale Factor Converg.
LW5147;SPC MA M     -   860,863.397   225,485.019   MT  0.99997079   +0 12 23.8
LW5147;SPC MA M     - 2,824,349.33    739,778.77   sFT  0.99997079   +0 12 23.8
LW5147;UTM  19      - 4,651,849.573   318,419.504   MT  1.00000573   -1 28 02.4
LW5147
LW5147!             -  Elev Factor  x  Scale Factor =   Combined Factor
LW5147!SPC MA M     -   0.99999893  x   0.99997079  =   0.99996972
LW5147!UTM  19      -   0.99999893  x   1.00000573  =   1.00000466
LW5147
LW5147:                Primary Azimuth Mark                          Grid Az
LW5147:SPC MA M     -  MANSFIELD AZ MK                               311 03 51.3
LW5147:UTM  19      -  MANSFIELD AZ MK                               312 44 17.5
LW5147
LW5147|---------------------------------------------------------------------|
LW5147| PID    Reference Object                     Distance      Geod. Az  |
LW5147|                                                           dddmmss.s |
LW5147| LW5356 419 A                               235.366 METERS 14336     |
LW5147| MY5414 MANSFIELD AZ MK                     APPROX. 0.7 KM 3111615.1 |
LW5147|---------------------------------------------------------------------|
LW5147
LW5147                         SUPERSEDED SURVEY CONTROL
LW5147
LW5147  NAD 83(1996)-  41 59 51.83745(N)    071 11 32.63956(W) AD(        ) A
LW5147  ELLIP H (06/22/01)    6.810  (m)                       GP(        ) 4 1
LW5147  NAD 83(1996)-  41 59 51.83738(N)    071 11 32.63964(W) AD(        ) 1
LW5147  ELLIP H (05/22/00)    6.809  (m)                       GP(        ) 4 1
LW5147  NAD 83(1996)-  41 59 51.83703(N)    071 11 32.63959(W) AD(        ) 1
LW5147  ELLIP H (06/29/98)    6.797  (m)                       GP(        ) 4 1
LW5147  NAD 83(1992)-  41 59 51.83556(N)    071 11 32.63872(W) AD(        ) 1
LW5147  ELLIP H (10/08/95)    6.770  (m)                       GP(        ) 4 2
LW5147  NAD 83(1986)-  41 59 51.83432(N)    071 11 32.63531(W) AD(        ) 1
LW5147  NGVD 29 (07/20/87)   35.9    (m)          118.     (f) GPS OBS
LW5147
LW5147.Superseded values are not recommended for survey control.
LW5147.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
LW5147.See file dsdata.txt to determine how the superseded data were derived.
LW5147
LW5147_U.S. NATIONAL GRID SPATIAL ADDRESS: 19TCG1841951849(NAD 83)
LW5147_MARKER: DH = HORIZONTAL CONTROL DISK
LW5147_SETTING: 66 = SET IN ROCK OUTCROP
LW5147_SP_SET: ROCK OUTCROP
LW5147_STAMPING: MANSFIELD 1985
LW5147_MARK LOGO: NGS
LW5147_MAGNETIC: N = NO MAGNETIC MATERIAL
LW5147_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
LW5147+STABILITY: POSITION/ELEVATION WELL
LW5147_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
LW5147+SATELLITE: SATELLITE OBSERVATIONS - March 17, 2010
LW5147
LW5147  HISTORY     - Date     Condition        Report By
LW5147  HISTORY     - 1985     MONUMENTED       NGS
LW5147  HISTORY     - 1985     GOOD             NGS
```

```
LW5147  HISTORY     - 19861121 GOOD             MAGS
LW5147  HISTORY     - 19880520 GOOD             NGS
LW5147  HISTORY     - 19990930 GOOD             WOOLPT
LW5147  HISTORY     - 20000608 GOOD             NGS
LW5147  HISTORY     - 20100317 GOOD             INDIV
LW5147
LW5147                          STATION DESCRIPTION
LW5147
LW5147'DESCRIBED BY NATIONAL GEODETIC SURVEY 1985 (REP)
LW5147'THE STATION IS LOCATED ABOUT 4.0 KM (2.5 MI)
LW5147'SOUTH-SOUTHEAST OF MANSFIELD, 0.4 KM (0.25 MI) EAST OF INTERSTATE
LW5147'HIGHWAY 495, AT THE MANSFIELD MUNICIPAL AIRPORT AND NEAR THE END OF
LW5147'THE NORTHWEST-SOUTHEAST RUNWAY.
LW5147'OWNERSHIP--MANSFIELD MUNICIPAL AIRPORT, DAVID AND ROY POWELL,
LW5147'AIRPORT MANAGERS, MANSFIELD MA 02048, PHONE 617-339-3624
LW5147'
LW5147'TO REACH THE STATION FROM THE POST OFFICE IN MANSFIELD, GO SOUTH ON
LW5147'MAIN STREET, FOR 2.O KM (1.25 MI) TO A CROSSROAD, WILLOW STREET ON
LW5147'THE RIGHT, FRUIT STREET ON THE LEFT, TURN LEFT AND GO EAST AND
LW5147'SOUTHEAST ON FRUIT STREET FOR 1.3 KM (0.8 MI) TO A DRIVEWAY LEADING
LW5147'TO THE AIRPORT ON THE RIGHT. TURN RIGHT AND GO SOUTH ON THE DRIVEWAY
LW5147'FOR 1.0 KM (0.05 MI) TO A GATE AT THE TERMINAL BUILDING.  PASS
LW5147'THROUGH THE GATE AND GO SOUTHEAST FOR 0.3 KM (0.2 MI) TO THE WIND
LW5147'SOCK AND THE AZIMUTH MARK.  CONTINUE SOUTHEAST FOR 0.7 KM (0.45 MI)
LW5147'TO THE STATION AS DESCRIBED.
LW5147'
LW5147'THE STATION IS A STANDARD NGS DISK
LW5147'STAMPED---MANSFIELD 1985 --,
LW5147'SET INTO A DRILL HOLE IN ROCK OUTCROP. LOCATED
LW5147'86.3 METERS (283.0 FT) WEST-NORTHWEST FROM THE EXTREME SOUTHEAST
LW5147'CORNER OF THE RUNWAY
LW5147'34.7 METERS (114.0 FT) WEST-NORTHWEST FROM THE SOUTH BLUE LIGHT OF
LW5147'FOUR BLUE LIGHTS.
LW5147'18.3 METERS (60.0 FT) SOUTHEAST FROM THE SOUTHERLY EDGE OF THE
LW5147'RUNWAY AND
LW5147'10.1 METERS (33.0 FT) NORTHEAST FROM A CARSONITE WITNESS POST SET ON
LW5147'EDGE OF A DRAINAGE DITCH.
LW5147'
LW5147'AZIMUTH MARK NO. 1 IS A STANDARD NGS DISK
LW5147'STAMPED---MANSFIELD 1985---,
LW5147'SET INTO THE TOP OF A ROUND CONCRETE MONUMENT
LW5147'30 CM IN DIAMETER FLUSH WITH GROUND.  LOCATED
LW5147'25.9 METERS (85.0 FT) SOUTHEAST FROM THE WIND SOCK AND
LW5147'16.6 METERS (54.0 FT) EAST-NORTHEAST FROM THE EAST EDGE OF THE
LW5147'TAXIWAY.
LW5147'TO REACH THE AZIMUTH FROM THE STATION,
LW5147'GO NORTHWEST FOR 0.7 KM (0.45 MI) TO THE WIND SOCK AND THE
LW5147'AZIMUTH MARK AS DESCRIBED.
LW5147'THE UNDERGROUND MARK IS A STANDARD NGS DISK
LW5147'STAMPED---MANSFIELD 1985---,
LW5147'SET INTO AN IRREGULAR MASS OF CONCRETE 1.1 METERS BELOW THE SURFACE.
LW5147'
LW5147'AN EDM TIE WAS MADE TO MANSFIELD AZ MK
LW5147'
LW5147'DESCRIBED BY R. T. WOODRUFF
LW5147
LW5147                          STATION RECOVERY (1985)
```

LW5147
LW5147'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1985
LW5147'RECOVERED IN GOOD CONDITION.
LW5147
LW5147 STATION RECOVERY (1986)
LW5147
LW5147'RECOVERY NOTE BY MASSACHUSETTS GEODETIC SURVEY 1986
LW5147'RECOVERED IN GOOD CONDITION.
LW5147
LW5147 STATION RECOVERY (1988)
LW5147
LW5147'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1988
LW5147'THE STATION WAS RECOVERED IN GOOD CONDITION AS DESCRIBED IN THE 1985
LW5147'AIRPORT SURVEY PROJECT. A NEW DESCRIPTION FOLLOWS.
LW5147'THE STATION IS LOCATED ABPIT 2.9 KM (1.80 MI) SOUTHEAST FROM THE
LW5147'CENTER OF MANSFIELD, 0.5 KM (0.30 MI) NORTH OF INTERSTATE HIGHWAY 495,
LW5147'AT THE MANSFIELD MUNICIPAL AIRPORT, NEAR THE SOUTH CORNER OF THE
LW5147'SINGLE RUNWAY.
LW5147'OWNERSHIP--CITY OF MANSFIELD, C/O PRESIDENT RAYMOND G. POWELL, FRUIT
LW5147'STREET, MANSFILED MA 02048. PHONE 617 339-3624.
LW5147'TO REACH THE STATION FROM THE POST OFFICE IN MANSFIELD, GO SOUTH FOR
LW5147'1.9 KM (1.20 MI) ON SOUTH MAIN STREET TO A PAVED CROSS ROAD, FRUIT
LW5147'STREET ON THE LEFT AND WILLOW STREET ON THE RIGHT. THIS POINT MAY
LW5147'ALSO BE REACHED BY GOING NORTH FOR 1.2 KM (0.75 MI) ON SOUTH MAIN
LW5147'STREET FROM THE OVERPASS BRIDGE OVER INTERSTATE HIGHWAY 495 AT EXIT
LW5147'11. TURN LEFT AND GO SOUTHEAST FOR 1.1 KM (0.70 MI) ON FRUIT STREET
LW5147'TO A PAVED DRIVE ON THE RIGHT, LEADING TO THE WEST END OF THE HANGARS.
LW5147'TURN RIGHT AND GO SOUTHWEST THEN SOUTHEAST FOR 0.4 KM (0.25 MI) ON
LW5147'THE PAVED DRIVE BETWEEN THE HANGARS, ACROSS THE PARKING RAMP THEN
LW5147'SOUTHWEST ON THE TAXIWAY TO THE SOUTHEAST END OF THE RUNWAY. CROSS
LW5147'THE RUNWAY THEN GO NORTHWEST FOR 86 M (282.2 FT) TO THE STATION ON THE
LW5147'SOUTHWEST SIDE OF THE RUNWAY.
LW5147'THE STATION IS A STANDARD NGS DISK SET INTO A DRILL HOLE IN THE TOP OF
LW5147'A 0.6 BY 0.8 METER EXPOSURE OF OUTCROP FLUSH WITH THE GROUND. LOCATED
LW5147'86.3 M (283.1 FT) WEST-NORTHWEST FROM THE SOUTH CORNER OF THE ASPHALT
LW5147'RUNWAY, 34.8 M (114.2 FT) WEST-NORTHWEST FROM THE SOUTHWEST ONE OF
LW5147'FOUR LANDING LIGHTS AT THE DISPLACED THRESHOLD, 29.7 M (97.4 FT)
LW5147'SOUTHWEST FROM THE CENTER OF THE RUNWAY, 18.1 M (59.4 FT) SOUTHWEST
LW5147'FROM THE SOUTHWEST EDGE OF THE ASPHALT RUNWAY, AND 10.0 M (32.8 FT)
LW5147'NORTHEAST FROM A FIBERGLASS WITNESS POST ON THE NORTHEAST EDGE OF A
LW5147'DRAINAGE DITCH.
LW5147'DESCRIBED BY C.L. SMITH, TYPED BY R.L. ZURFLUH.
LW5147
LW5147 STATION RECOVERY (1999)
LW5147
LW5147'RECOVERY NOTE BY WOOLPERT CONSULTANTS 1999 (ARL)
LW5147'RECOVERED AS DESCRIBED. THIS STATION IS DESIGNATED AS THE PRIMARY
LW5147'AIRPORT CONTROL STATION.
LW5147
LW5147 STATION RECOVERY (2000)
LW5147
LW5147'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 2000 (CSM)
LW5147'THE STATION IS LOCATED ON THE SOUTHEAST SIDE OF MANSFIELD, AT THE
LW5147'MANSFIELD MUNICIPAL AIRPORT ON THE SOUTHWEST SIDE OF RUNWAY 36,
LW5147'IN THE GRASS FIELD ABOUT 35.05 M (114.99 FT) NORTHWEST OF THE
LW5147'DISPLACED THRESHOLD BAR FOR RUNWAY 36. OWNERSHIP--CITY OF
LW5147'MANSFIELD. NOTE--CONTACT MR. DAVID DINNEN, (AIRPORT MANAGER) ONE

```
LW5147'DAY IN ADVANCE BEFORE OCCUPYING THE STATION, PHONE 508-339-3624.
LW5147'TO REACH THE STATION FROM THE INTERSECTION OF NORTH-SOUTH MAIN
LW5147'STREET AND EAST-WEST STREETS AT THE CITY PARK IN THE CENTER OF
LW5147'MANSFIELD, GO SOUTH ON SOUTH MAIN STREET FOR 1.61 KM (1.00 MI) TO
LW5147'THE JUNCTION OF FRUIT STREET ON THE LEFT, TURN LEFT, EASTERLY ON
LW5147'FRUIT STREET FOR 0.72 KM (0.45 MI) TO THE JUNCTION OF HALL STREET ON
LW5147'THE LEFT (AT A STOP SIGN), TURN LEFT, SOUTHEASTERLY AND CONTINUE
LW5147'AHEAD ON FRUIT STREET FOR 0.56 KM (0.35 MI) TO THE AIRPORT ENTRANCE
LW5147'DRIVE ON THE RIGHT, TURN RIGHT, SOUTHWEST ON THE DRIVE AND BEAR
LW5147'RIGHT ACROSS THE PARKING LOT TO THE SECURITY GATE, PASS THROUGH
LW5147'THE GATE AND BEAR LEFT BETWEEN THE HANGARS AND ONTO THE APRON,
LW5147'GO SOUTHEAST ACROSS THE APRON PASSING THE AIRPORT OFFICE
LW5147'BUILDING TO THE SOUTHEAST SIDE OF THE APRON TO A TAXIWAY, TURN
LW5147'LEFT, SOUTHEAST ON THE TAXIWAY AND BEAR RIGHT, NORTHWEST FOR
LW5147'ABOUT 0.05 KM (0.05 MI) TO THE JUNCTION OF THE PARALLEL TAXIWAY AND
LW5147'WIND SOCK ON THE LEFT, TURN LEFT, SOUTHEAST ON THE TAXIWAY FOR
LW5147'0.72 KM (0.45 MI) TO THE END OF RUNWAY 36, TURN RIGHT, SOUTHWEST
LW5147'CROSSING THE END OF RUNWAY 36 AND ONTO THE GRASS, TURN RIGHT,
LW5147'NORTHWEST FOR ABOUT 76.2 M (250.0 FT) TO THE DISPLACED THRESHOLD
LW5147'AND THRESHOLD LIGHTS ON THE RIGHT, CONTINUE AHEAD, NORTHWEST
LW5147'FOR ABOUT 30.48 M (100.00 FT) TO THE STATION IN A SMALL AREA OF
LW5147'EXPOSED ROCK OUTCROP FLUSH WITH THE GROUND.  THE STATION IS AN
LW5147'NGS HORIZONTAL DISK SET IN A DRILL HOLE IN ROCK OUTCROP.  LOCATED
LW5147'18.14 M (59.51 FT) SOUTHWEST OF THE SOUTHWEST EDGE OF RUNWAY 36,
LW5147'34.81 M (114.21 FT) WEST-NORTHWEST OF THE SOUTHWEST ONE OF FOUR
LW5147'THRESHOLD LIGHTS, AND 10.06 M (33.01 FT) NORTHEAST OF AN NGS
LW5147'FIBERGLASS WITNESS POST SET ALONG THE TREE LINE.
LW5147'
LW5147
LW5147                          STATION RECOVERY (2010)
LW5147
LW5147'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2010 (KK)
LW5147'RECOVERED IN GOOD CONDITION.
```


Hall St
Stillbrook Ln
Hemlock Ln
Fruit St
Tracy Cir
Heather Ln
Short St
Longwood Cir
Jefferson Rd
Emerson Cir
Access Rd
MANSFIELD AZ MK
Shea Cir
Nathan Rd
Harding Ln
Essex St
S Main St
Blue Star Memorial Hwy
495
MANSFIELD
Reservoir St
Columbine Rd
Thornton Rd
Barberry Rd
Azalea Rd
Hickory Rd
Hillton
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Europa Technologies
© 2011 Google
Google
42°00'06.74" N 71°11'49.64" W
elev 113 ft
Jun 19, 2010
Eye alt 6623 ft



Data use subject to license.

www.delorme.com

TN

MN (14.9°W)

Scale 1 : 350,000

0 2 4 6 8 10 mi

0 3 6 9 12 15 km

1" = 5.52 mi

Data Zoom 9-0

STATE(s): MASSACHUSETTS

Project Numbers 7556-005 A003

AREA ID: ~~FE~~ NARR_1B9

STARR-FEMA

AREA NAME: NARRAGANSETT - FEMA

FILE TYPES/NAMES: ☒ OPTECH: NARR_1B9_OP ☒ LEICA: 1B9_NARRA_MA

Lines: 44 FL Miles: 945 Square Miles: ______ Flight Altitudes: 5,000 Tide Coord: Yes See Notes NO

AIRPORT ID: 1B9 Name: MANSFIELD MUNICIPAL

Services: FULL ☒ Self ☒ None ☐ See Notes RUNWAY Length: 3500 Ft

Contact Name(s): David Dinneen / Mrurzger

Phone(s): (____) ____-_____ (____) ____-_____ e-mail: __________

Hotels: ALL MAJOR

Rentals: ENTERPRISE

EXIST BASE Station: LW5147 Name: MANSFIELD

TYPE: PACS ☒ SACS ☐ Other ☐ *Data Sheet Attached* ☒

SET BASE STATION Name: __________ Date Set: __________

What was Set: Re-Bar ☐ or: __________ CAP: __________

Who Set: __________ Where Set: __________ *Attach Data Sheet*

Logs ☐ by: ____ Sectional ☐ by: ____ Lo En-route ☐ by: ____ Database ☐ by: ____ OPTECH ☒ by: FB LEICA ☒ by: FB

Accuracy: Vert; 24.5 Horiz; ____ cm Post Spacing: 1.0 m Points Sq Meter: _______

NOTES:

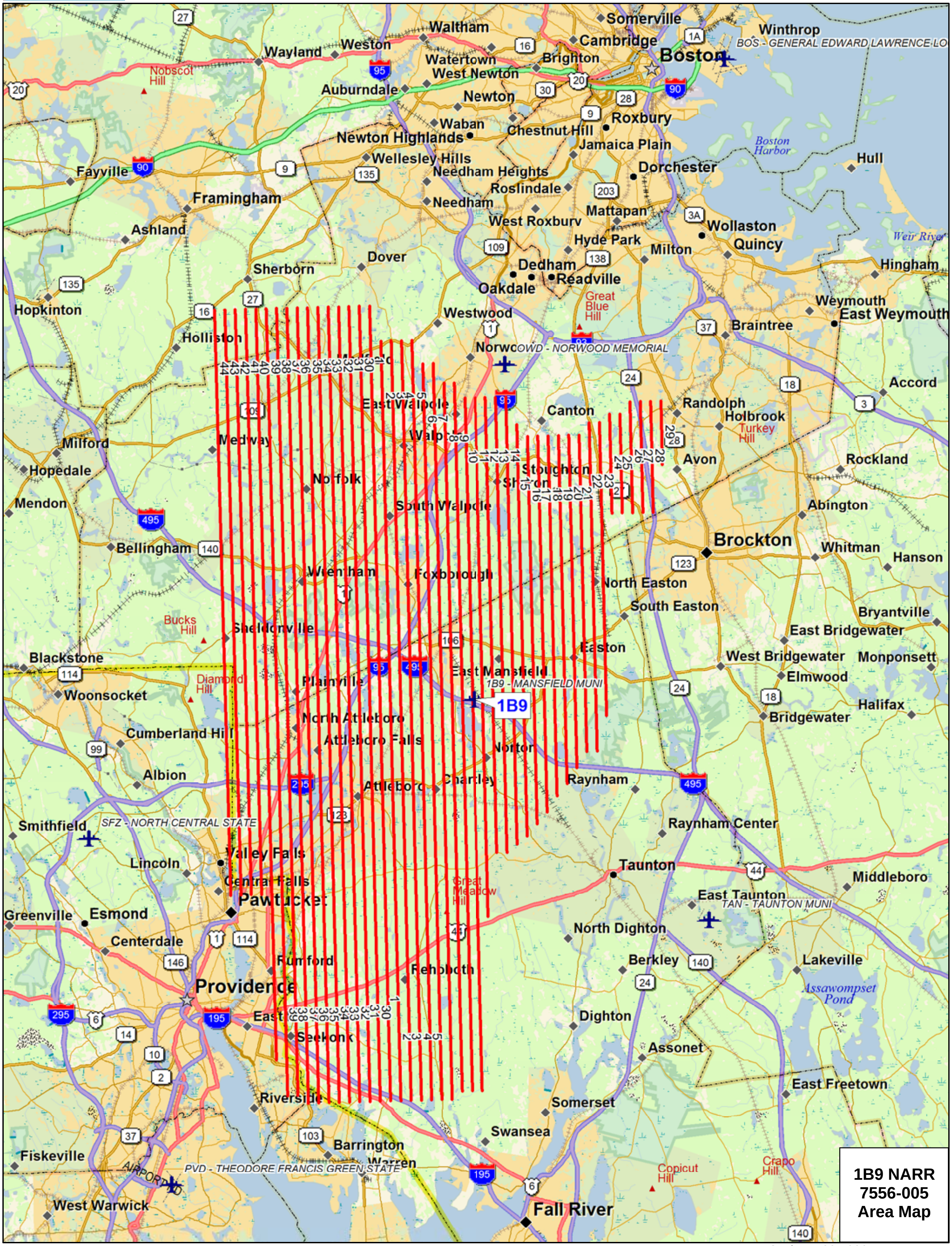
HIGH PRIORITY

42 0 0 71 11 48

14.3 SQ

DELORME

XMap® 4.5



Data use subject to license.

www.delorme.com

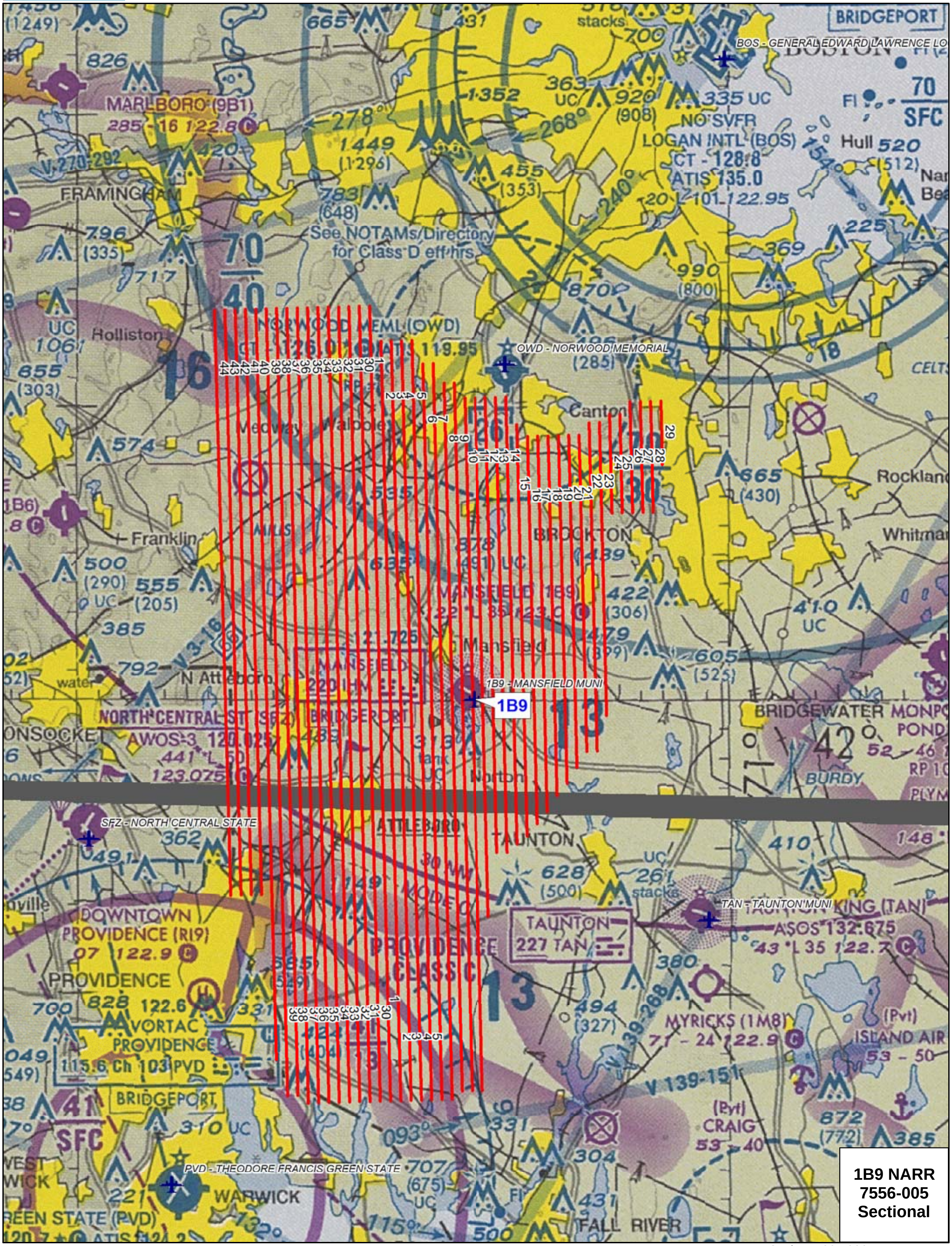
TN
MN (14.9°W)

Scale 1 : 325,000

1" = 5.13 mi

Data Zoom 9-2

DELORME



Data use subject to license.

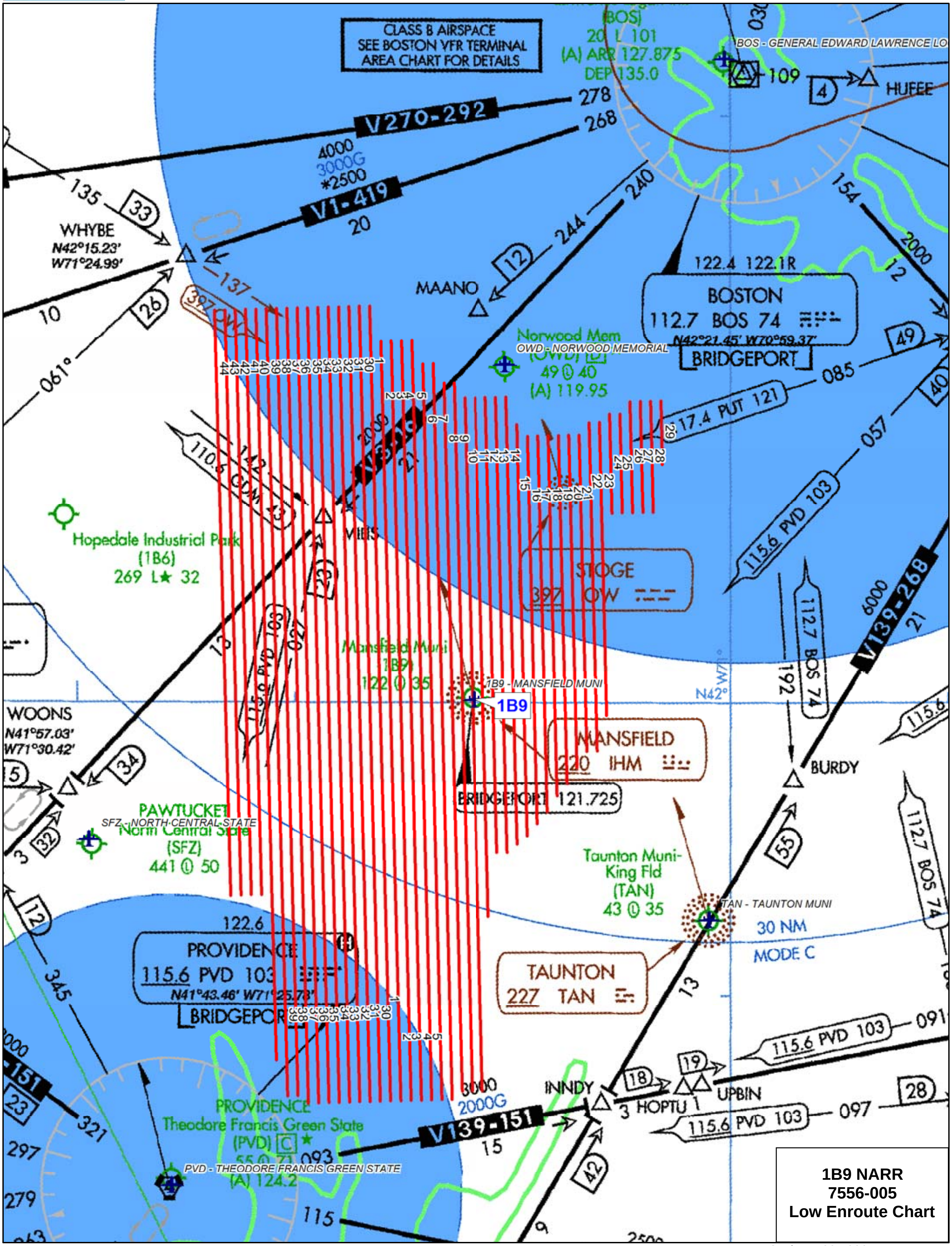
www.delorme.com

TN
MN (14.9°W)

Scale 1 : 325,000
1" = 5.13 mi
Data Zoom 9-2

DELORME

XMap® 4.5



1B9 NARR
7556-005
Low Enroute Chart

TN
MN (14.9°W)

Scale 1 : 325,000
1" = 5.13 mi
Data Zoom 9-2

Mass Area: 1B9 NARR Project No 7556-005

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

Flight Logs

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
2	29.8	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
3	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
4	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
5	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
6	28.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
7	28.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
8	27.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
9	27.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
10	27.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
11	20.3	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
12	17.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
13	17.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________________ *AIRCRAFT Tail Number:* ____________________

Pilot: ____________________ *Sensor Serial Number:* ____________________ **Date:** ____________________

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	17.5	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
15	16.1	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
16	15.2	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
17	14.8	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
18	14.1	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
19	13.6	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
20	13.0	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
21	12.4	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
22	12.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
23	11.5	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
24	3.9	5240	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
25	3.9	5240	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
26	4.3	5230	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
27	4.3	5230	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________ *AIRCRAFT Tail Number:* ____________

Pilot: ____________ *Sensor Serial Number:* ____________ **Date:** ____________

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	4.3	5220	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
29	2.5	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
30	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
31	31.2	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
32	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
33	31.2	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
34	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
35	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
36	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
37	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
38	30.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
39	30.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
40	29.5	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
41	22.9	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________________ *AIRCRAFT Tail Number:* ____________________

Pilot: ____________________ *Sensor Serial Number:* ____________________ **Date:** ____________________

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
42	22.9	5220	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
43	22.9	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
44	22.9	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________ AIRCRAFT Tail Number: ____________

Pilot: ____________ Sensor Serial Number: ____________ **Date:** ____________

1Bq

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report For Airborne GPS

Project:	Narr - 1B9
Location:	1B9
Project Number:	7556-005
Completed by:	Nathan Galieti
Date:	12/8/10
Receiver:	2 S/N 1073
Receiver Type:	Trimble 5700
Antenna Type:	Zephyr Geodetic
Station ID:	Narr-1B9
Start -- H.I. (m):	1.511 (m)
End -- H.I. (m):	1.511 (m)
H.I. (ft):	4.96 (ft)
Start Time:	9:28 AM EST
End Time:	3:29 PM EST
Time Zone:	EST
Operator:	Nathan Galieti

Comments

Station used for N2448G & 66Z
101208a+b-246
101208a+b-247

PSI\FORMS\Station Occupation Report June 10, 2010

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions
2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	FEMA MASS
Project Number	7556-005
ALTM-NAV .pln File	NARR 189 OP.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 8, 2010		
Takeoff Time (Z): 1445Z	Local: 945 EST	Airport 1B9	
Landing Time (Z) 1740Z	Local: 1240 EST	Airport 1B9	

Project's Scanning Requirements

FOV (half-degrees):	± 18.0 °	Altitude AGL (ft):
Scan Rate:	30.1 Hz	MPiA or SPiA
Pulse Rate:	71 kHz	Fixed or Auto
Ground Speed:	116 kts	A.R.F.: Samples 1000, Range 300

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101208a
from, to	000 → 025

	Ground	Airport
Begin Temp	-2°c	SFZ
Begin Dewpoint	-13°c	
Begin Pressure	2973	
End Temp	+1°c	SFZ
End Dewpoint	-13°c	
End Pressure	2978	

30 n

GPS Base Location(s)	Mansfield
PDOP Avoidance	Good all day
Static or Flyover?	Static --> if flyovers, times: -

101208a-246

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
4	1507	1521	5160'	S	116	100%	14	Clouds above man, turbulence
3	1524	1538	5150'	N	116	100%	-11	
2	1542	1556	4690'	S	116	100%	15	
1	1559	1614	4600'	N	116	100%	-13	
30	1618	1632	4600'	S	116	100%	15	
31	1635	1649	4606'	N	116	100%	-9	
32	1652	1707	4600'	S	116	100%	14	Refly last 3 miles
33	1710	1724	4600'	N	116	100%	-11	Refly last 3 miles
Improv	1728	1736	4600'	E	116	100%	-9	

Sheet 1 of __

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema-Mass
Project Number	7556-005
ALTM-NAV.pln File	NARR 1B8-90.ph

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 8, 2010		
Takeoff Time (Z): 1820Z	Local: 120PM EST	Airport 1B9	
Landing Time (Z) 2200Z	Local: 500PM EST	Airport 1B9	

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000'
Scan Rate:	30.1 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples - Range -

Data Information

LIDAR Unit	Optech Gemini sn246
HD #	246HD1
POS File Name	101208b
from, to	000 → 080

	Ground	Airport
Begin Temp	-1°c	SFZ
Begin Dewpoint	-15°c	
Begin Pressure	2973	
End Temp	-3°c	SFZ
End Dewpoint	-16°c	
End Pressure	2981	

340
15

GPS Base Location(s)	Mansfield
PDOP Avoidance	Good all day
Static or Flyover?	Static --> if flyovers, times: -

101208b-246

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
34	1833	1848	4800'	S	116	100%	9	Clouds above, turbulence Refly S end Smiles ✓
33	1852	1854	4750	N	116	100%	-11	Patch
32	1859	1902	4800'	S	116	100%	7	Patch
35	1905	1920	4750'	N	116	100%	-10	Refly N 1/5th ✓
36	1923	1937	4800'	S	116	100%	6	Refly N 1/3rd ✓
37	1940	1955	4750'	N	116	100%	-9	Refly N 1/3rd ✓
38	1959	2013	4750'	S	116	100%	8	Refly N 1/3rd ✓
39	2016	2031	4800'	N	116	100%	-7	Refly N half ✓
40	2034	2047	4800'	S	116	100%	8	Refly N 1/3rd ✓
41	2051	2103	4800	N	116	100%	-9	Refly N half ✓
42	2107	2117	4800	S	116	100%	6	Refly N 1/3rd
43	2120	2131	4800	N	116	100%	-12	Refly N 1/2
44	2134	2145	4800'	S	116	100%	8	All good
Improv ov	2148	2157	4850	E	116	100%	-8	

flight #1

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Narr_1B9
Project Number	7556-005
ALTM-NAV .pln File	NARR_1B9_OP.pln

Pilot	Greenwell
Operator	Galieti
Aircraft	N2448G

Date Flown:	12/8/10				
Takeoff Time (Z):	1438	Local:	938	Airport	1B9
Landing Time (Z):	1825	Local:	1:25	Airport	1B9

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples / Range

Data Information

LiDAR Unit	Optech Gemini sn247
HD #	2
POS File Name	101208a
from, to	D →

	Ground	Airport
Begin Temp	-4	KBED
Begin Dewpoint	-12	
Begin Pressure	29.64	
End Temp		—
End Dewpoint		
End Pressure		

GPS Base Location(s)	Narr_1B9 @ (1B9)	
PDOP Avoidance	none till 1920Z	
Static or Flyover?	static	--> if flyovers, times:

Occas| CLDS @ ALT very light in area not on line

* CLDS @ prj altitude

101208a-247

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
29	1507	1509	5218	178	116	100	13	
28	1513	1516	5282	358	114	100	9	
27	1520	1523	5215	178	123	100	13	all clear reg TB occ. light cld @ alt
26	1528	1531	5182	358	119	100	8	around line.
25	1535	1537	5232	178	116	100	13	
24	1542	1544	5153	358	111	99	9	possible high drops @ N end
23	1549	1554	5259	178	122	100	11	2-3 mi from S end light TB
22	1559	1605	5128	358	110	100	9	
descent due to clds → 21	1610	1616	5183	178	118	100	12	
20	1620	1627	5167	358	109	100	10	CLDS @ AH around line CLR @ line
19	1632	1638	4892 *	178	113	100	14	OCL LGT TB @ S End
18	1643	1650	4744 *	358	117	100	9	OCL LGT TB @ S End ~5.6 mi
17	1654	1702	4815 *	178	113	100	16	OCL LGT TB & LGT wing rocking
16	1706	1714	4457 *	358	116	100	9	LGT TB through line
15	1719	1727	4822 *	178	106	100	12	LGT wing rocking through line
14	1731	1740	4825 *	358	109	100	9	LGT wing rocking through line
5mi from 13	1744	1752	4814 *	178	108	100	14	
12	1757	1806	4814 *	358	116	100	9	
with check overlap cross line	1811	1814	4760 *	090	131	100	5	

Sheet 1 of 1

flight #2

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Narr_1B9
Project Number	7556-005
ALTM-NAV .pln File	NARR_1B9_OP.pln

Pilot	Greenwell
Operator	Gedieli
Aircraft	N2448G

Date Flown:	12/8/16				
Takeoff Time (Z):	1914	Local:	214	Airport	1B9
Landing Time (Z):	2200	Local:	5:00	Airport	1B9

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA (circled) or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto (circled)	
Ground Speed:	116 kts	A.R.F.:	Samples / Range

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	1012086
from, to	0 → /

	Ground	Airport
Begin Temp	/	—
Begin Dewpoint	/	
Begin Pressure	29.74	
End Temp	/	—
End Dewpoint	/	
End Pressure	29.74	

GPS Base Location(s)	1B9 A (PAC)	
PDOP Avoidance	none till 1920 local	
Static or Flyover?	static	--> if flyovers, times:

1012086-247

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
11	1927	1936	5193	178	110	~100	8	
10	1943	1956	5100	358	113	~100	7	
9	2001	2014	5160	178	119	~100	10	halfway down line lost nav data.
8	2019	2032	5128	358	120	~100	8	N end of line starting to look HZ
7	2037	2050	5179	178	119	~100	10	Sun setting looking HZ, little [illegible] @ 5 from N
6	2055	2109	5174	358	126	~100	8	
5	2113	2127	5155	178	110	~100	12	
cross line	2134	2135	5000	090	132	~100	6	

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: Fema - Mass

Location: K1B9 (mansfield municipal)

Project Number: 7556-005

Completed by: Berry

Date: 12-10-2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr

Station ID: Mansfield

Start -- H.I. (m): 1.578

End -- H.I. (m): 1.578

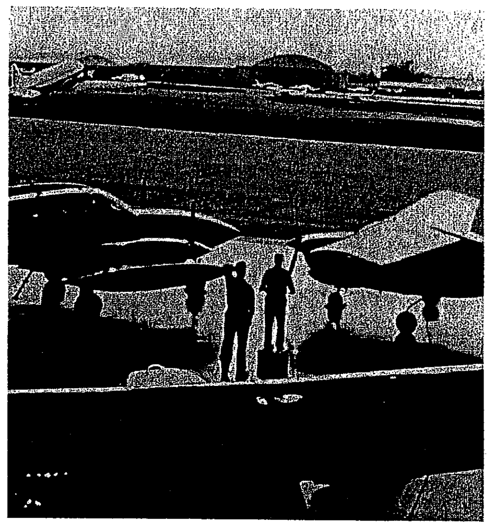
H.I. (ft): 5.18

Start Time: 7:52 Am EST

End Time: 10:49 Am EST

Time Zone: Est

Operator: Berry



Comments
1012 10a-246
1012100a-247

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema_mass
Project Number	7556-005
ALTM-NAV pln File	NARR_1B9_OP.ph

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 10, 2010				
Takeoff Time (Z):	1305Z	Local:	805 Am EST	Airport	1B9
Landing Time (Z)	1505Z	Local:	1005 PM EST	Airport	1B9

Project's Scanning Requirements

FOV (half-degrees):	± 18.0 °	Altitude AGL (ft): 5000'
Scan Rate:	36.10 Hz	MPiA or SPiA
Pulse Rate:	71 kHz	Fixed or Auto
Ground Speed:	116 kts	A.R.F.: Samples 1000 Range 300

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD2
POS File Name	101210a
from, to	000 → 017

	Ground	Airport
Begin Temp	-11°c	SFZ
Begin Dewpoint	-15c	
Begin Pressure	30.39	
End Temp	-9°c	SFZ
End Dewpoint	-14c	
End Pressure	30.38	

Chm

GPS Base Location(s)	Mansfield	
PDOP Avoidance	Good all day	
Static or Flyover?	Static	--> if flyovers, times: –

101210a-246

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
34	1313	1319	5200	S	116	100%	5	Clear Smooth @ altitude
35	1328	1335	5200'	N	116	100%	-4	All Imsare patches for this area
36	1338	1344	5200'	S	116	100%	3	"
37	1347	1354	5200'	N	116	100%	-6	" plane 7 miles
38	1358	1404	5200'	S	116	100%	3	"
39	1408	1415	5200	N	116	100%	-5	"
40	1419	1425	5200'	S	116	100%	5	"
41	1429	1435	5200'	N	116	100%	-4	"
42	1438	1444	5200'	S	116	100%	4	"
43	1447	1453	5200	N	116	100%	-5	"
Improv	1455	1458	5200	E	116	100%	-2	"

Sheet 1 of 1

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions
2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	1B9 NARR
Project Number	7556_005
ALTM-NAV .pln File	NARR_1B9_OP.pln

Pilot	Greenwell
Operator	Galick
Aircraft	N2448G

Date Flown:	12/10/10 #1				
Takeoff Time (Z):	1210	Local:	7:10	Airport	BED
Landing Time (Z):	1530	Local:	10:30	Airport	1B9

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or AUTO	
Ground Speed:	116 kts	A.R.F.: Samples / Range	

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	2
POS File Name	101210a
from, to	0 → 20

	Ground	Airport
Begin Temp	-14 C	KBED
Begin Dewpoint	-16 C	
Begin Pressure	30.43Hg	
End Temp	~~-3~~ C -7	KBED.
End Dewpoint	-14 ~~-22~~ C	
End Pressure	~~30.45~~ Hg 30.48	

101210a-247

GPS Base Location(s)	1B9 (NARR_1B9)(PAC)
PDOP Avoidance	none during day
Static or Flyover?	static --> if flyovers, times:

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
11	1319	1327	4931	178	113	100	4	
10	1331	1340	5090	358	120	100	4	
9	1345	1353	5160	178	119	100	5	
8	1359	1407	5150	358	120	100	3	
7	1413	1426	5180	178	116	100	4	4-5 mi from N plane flew under
6	1432	1445	5125	358	117	100	4	~~poss.~~ plane 3mi from N end
5	1450	1504	5150	178	120	100	5	
crossline	1511	1513	5090	090	122	100	1	

Mass Area: 1B9 NARR Project No 7556-005 Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12-8-10	246	JB	Some Clusters
2	29.8	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				of Atmospheric
3	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				returns
4	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
5	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_		247	NG	
6	28.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
7	28.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
8	27.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
9	27.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
10	27.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
11	20.3	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
12	17.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
13	17.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Bry

Pilot: Jon

AIRCRAFT Tail Number: 726c

Sensor Serial Number: 246

Date: 12-8-10

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	17.5	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12-8-10	247	NG	
15	16.1	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
16	15.2	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
17	14.8	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
18	14.1	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
19	13.6	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
20	13.0	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
21	12.4	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
22	12.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
23	11.5	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
24	3.9	5240	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
25	3.9	5240	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
26	4.3	5230	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
27	4.3	5230	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Jason

AIRCRAFT Tail Number: N2226Z
Sensor Serial Number: 246

Date: 12-8-10

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	4.3	5220	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12-8-10	247	NG	
29	2.5	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
30	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12-8-10	246	JB	
31	31.2	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
32	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
33	31.2	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				Reflight Needed Reflight 10-12
34	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
35	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
36	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
37	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
38	30.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
39	30.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
40	29.5	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
41	22.9	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young

AIRCRAFT Tail Number: N720067
Sensor Serial Number: 246

Date: 12-8-2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
42	22.9	5220	1B9_NAR	NARR_1B9_O 1B9_NARRA_				Refight Needed Reflight 10-12
43	22.9	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
44	22.9	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry

Pilot: Youn

AIRCRAFT Tail Number: 72667

Sensor Serial Number: 246

Date: 12-8-10

Mass Area: 1B9 NARR — Project No 7556-005 — Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
2	29.8	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
3	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
4	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
5	29.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247b		
6	28.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247b		
7	28.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247b		
8	27.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247b		
9	27.8	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247b		
10	27.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247b		
11	20.3	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247b		
12	17.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247a		
13	17.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247a		

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galiefi **AIRCRAFT Tail Number:** N24486

Pilot: Greenwell **Sensor Serial Number:** 247 **Date:** 12/8/10

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	17.5	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247a		
15	16.1	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
16	15.2	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
17	14.8	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
18	14.1	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
19	13.6	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
20	13.0	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
21	12.4	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
22	12.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
23	11.5	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
24	3.9	5240	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
25	3.9	5240	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
26	4.3	5230	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			
27	4.3	5230	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10			

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galieti
Pilot: Greenwell
AIRCRAFT Tail Number: N2448G
Sensor Serial Number: 247

Date: 12/8/10

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	4.3	5220	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247a		
29	2.5	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_	12/8/10	247a		
30	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
31	31.2	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
32	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
33	31.2	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
34	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
35	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
36	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
37	31.2	5160	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
38	30.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
39	30.9	5150	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
40	29.5	5170	1B9_NAR	NARR_1B9_O 1B9_NARRA_				
41	22.9	5210	1B9_NAR	NARR_1B9_O 1B9_NARRA_				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galieti **AIRCRAFT Tail Number:** N2 448G

Pilot: Greenwell **Sensor Serial Number:** 247 **Date:** 12/8/10

```
Plan Type : Fixed Survey

******************Survey Totals*********************************
Total Passes      : 44
Total Length      : 1522.498 km
Total Flight Time : 11:35:33
Total Laser Time  : 07:02:55
Total Swath Area  : 1054.223 km^2
Total AOI Area    : 1428.98 km^2


Number of Sub-Areas : 1

******************Area 1*********************************

Area Flight Profile
-----------------------------
Total Length  : 1522.498 km
Flight Time   : 11:35:33
Laser Time    : 07:02:55
Swath Area    : 346.962 km^2
AOI Area      : 1428.98 km^2
Altitude      : 5000 ft AGL
Speed         : 116.6 kts
Flight Lines  : 44
Pass Heading  : 178.49
Pass Spacing  : 227.89 m
Overlap       : 30% = 761.29 m
Turn Time     : 5 min

Area LIDAR Settings
-----------------------------
Desired Res     : 0.912 m
Density         : 1.2 ppm^2
Cross Track Res : 0.835 m
Down Track Res  : 0.997 m
Scan Frequency  : 30.1 Hz
Scan Angle      :  18 deg
Scan Cutoff     :  0.02 deg
Scan Offset     : 0 deg
System PRF      : 71.429 kHz
Swath Width     : 989.18 m
DEM Estimates
-----------------------------
DEM Min Z       : -1
DEM Max Z       : 483

Cost Estimates
-----------------------------
Area Cost       : $0
Time Cost       : $0
```

```
           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED & 1B9
Mission       : 1
Wheels Up     : 1300 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -14 C
Visibility    : clear
Clouds        : High OVC
Precipitation : none
Wind Dir      :
Wind Speed    :
Pressure      : 30.43 HG
           Statistics
------------------------------
Laser Time    : 01:14:32

=======================================
13:01:35.751 GMT : 00:00:02 (212) GPS 1PPS Lost
13:01:35.751 GMT : 00:00:03 (166) Divergence Error
13:01:35.751 GMT : 00:00:03 (107) Rx Shutter Closed
13:01:35.751 GMT : 00:00:03 (109) Tx Shutter Closed
13:01:35.751 GMT : 00:00:04 (164) Beam Wide
13:01:35.751 GMT : 00:00:12 (204) POSAV Connected
13:01:35.751 GMT : 00:00:13 (207) POSAV Rate Not 50 Hz
13:01:35.751 GMT : 00:00:13 (211) POSAV new status
13:01:35.751 GMT : 00:00:14 (213) GPS 1PPS Ok
13:01:35.751 GMT : 00:00:23 (120) Laser PS Comm Ok
13:01:35.751 GMT : 00:00:23 (112) Laser Emission Off
13:01:35.751 GMT : 00:00:45 (208) POSAV Rate Is 50 Hz
13:01:35.751 GMT : 00:00:45 (211) POSAV new status
13:01:35.751 GMT : 00:00:46 (215) Nav Data Ok
13:01:35.751 GMT : 00:00:47 (211) POSAV new status
13:01:35.751 GMT : 00:01:33 (211) POSAV new status
13:01:35.751 GMT : 00:01:45 (211) POSAV new status
13:01:35.751 GMT : 12:23:55 (211) POSAV new status
12:58:37.175 GMT : 12:58:35 (153) Eyesafety Disabled
12:58:37.275 GMT : 12:58:35 (162) Roll Comp On
12:58:37.875 GMT : 12:58:36 (164) Beam Wide
12:58:37.875 GMT : 12:58:36 (144) MultiPulse Mode Varies
12:58:41.475 GMT : 12:58:40 (165) Beam Narrow
```

```
12:59:34.076 GMT : 12:59:32 (157) Safe Unaided Profile
12:59:34.076 GMT : 12:59:32 (157) Safe Unaided Profile
13:05:13.78 GMT : 13:05:12 (157) Safe Unaided Profile
13:05:13.98 GMT : 13:05:12 (157) Safe Unaided Profile
13:05:19.48 GMT : 13:05:17 (106) Rx Shutter Open
13:05:19.48 GMT : 13:05:17 (108) Tx Shutter Open
13:19:45.49 GMT : 13:19:44 (113) Laser Emission On
13:27:52.396 GMT : 13:27:50 (112) Laser Emission Off
13:31:56.099 GMT : 13:31:55 (113) Laser Emission On
13:40:11.905 GMT : 13:40:09 (112) Laser Emission Off
13:45:23.408 GMT : 13:45:22 (113) Laser Emission On
13:53:50.615 GMT : 13:53:49 (112) Laser Emission Off
13:59:24.419 GMT : 13:59:23 (113) Laser Emission On
14:07:56.425 GMT : 14:07:55 (112) Laser Emission Off
14:13:34.23 GMT : 14:13:33 (113) Laser Emission On
14:26:46.44 GMT : 14:26:45 (112) Laser Emission Off
14:32:07.544 GMT : 14:32:06 (113) Laser Emission On
14:45:16.755 GMT : 14:45:15 (112) Laser Emission Off
14:50:39.959 GMT : 14:50:39 (113) Laser Emission On
15:04:08.37 GMT : 15:04:07 (112) Laser Emission Off
15:11:56.777 GMT : 15:11:55 (113) Laser Emission On
15:13:46.778 GMT : 15:13:45 (112) Laser Emission Off
15:15:22.28 GMT : 15:15:21 (157) Safe Unaided Profile
15:15:27.18 GMT : 15:15:25 (107) Rx Shutter Closed
15:15:27.28 GMT : 15:15:25 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED & 1B9
Mission       : 1
Wheels Up     : 1300 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -14 C
Visibility    : clear
Clouds        : High OVC
Precipitation : none
Wind Dir      :
Wind Speed    :
Pressure      : 30.43 HG
           Statistics
------------------------------
Laser Time    : 01:14:32
```

==

Flight Log

Project Number: 7556-005
S/N : 247
Operator : Galieti
Pilot(s) : Greenwell
Aircraft : N2448G
Airport : KBED & 1B9
Mission : 1
Wheels Up : 1300 Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 10, 2010
Julian Day : 344
Temperature : -14 C
Visibility : clear
Clouds : High OVC
Precipitation : none
Wind Dir :
Wind Speed :
Pressure : 30.43 HG

Statistics

Laser Time : 01:14:32

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
13:19:46.19	13:27:52.696	11	1521	70	30.10	18.00	ON	NAR	ON	0.00	178.54
13:31:57.199	13:40:11.705	10	1585	70	30.10	18.00	ON	NAR	ON	0.00	358.54
13:45:24.008	13:53:51.515	9	1577	70	30.10	18.00	ON	NAR	ON	0.00	178.53
13:59:25.419	14:07:57.725	8	1570	70	30.10	18.00	ON	NAR	ON	0.00	358.53
14:13:35.23	14:26:48.44	7	1583	70	30.10	18.00	ON	NAR	ON	0.00	178.52
14:32:08.144	14:45:17.555	6	1572	70	30.10	18.00	ON	NAR	ON	0.00	358.51
14:50:40.759	15:04:10.07	5	1580	70	30.10	18.00	ON	NAR	ON	0.00	178.51
15:11:57.677	15:13:48.178	5	1585	70	30.10	18.00	ON	NAR	ON	0.00	178.51

```
           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : K1B9
Mission       : 101210A
Wheels Up     : 1305Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -11C
Visibility    : >10
Clouds        : 11000FT
Precipitation : NO
Wind Dir      : CLM
Wind Speed    : CLM
Pressure      : 30.39
           Statistics
------------------------------
Laser Time    : 01:03:09

=======================================
08:33:06.953 GMT : 00:00:02 (212) GPS 1PPS Lost
08:33:06.953 GMT : 00:00:03 (166) Divergence Error
08:33:06.953 GMT : 00:00:03 (107) Rx Shutter Closed
08:33:06.953 GMT : 00:00:03 (109) Tx Shutter Closed
08:33:06.953 GMT : 00:00:04 (164) Beam Wide
08:33:06.953 GMT : 00:00:09 (120) Laser PS Comm Ok
08:33:06.953 GMT : 00:00:09 (112) Laser Emission Off
08:33:06.953 GMT : 00:00:11 (213) GPS 1PPS Ok
08:33:06.953 GMT : 00:00:12 (204) POSAV Connected
08:33:06.953 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
08:33:06.953 GMT : 00:00:13 (211) POSAV new status
08:33:06.953 GMT : 00:00:25 (208) POSAV Rate Is 50 Hz
08:33:06.953 GMT : 00:00:26 (211) POSAV new status
08:33:06.953 GMT : 00:00:26 (215) Nav Data Ok
08:33:06.953 GMT : 00:00:27 (211) POSAV new status
08:33:06.953 GMT : 00:01:56 (211) POSAV new status
13:00:14.809 GMT : 00:04:39 (211) POSAV new status
13:04:33.813 GMT : 13:04:32 (211) POSAV new status
13:05:20.114 GMT : 13:05:19 (153) Eyesafety Disabled
13:05:20.314 GMT : 13:05:19 (162) Roll Comp On
13:05:20.714 GMT : 13:05:20 (164) Beam Wide
13:05:20.914 GMT : 13:05:20 (144) MultiPulse Mode Varies
13:05:25.514 GMT : 13:05:25 (165) Beam Narrow
13:05:37.214 GMT : 13:05:36 (106) Rx Shutter Open
```

```
13:05:37.314 GMT : 13:05:36 (108) Tx Shutter Open
13:13:21.622 GMT : 13:13:20 (113) Laser Emission On
13:19:12.827 GMT : 13:19:11 (112) Laser Emission Off
13:28:28.036 GMT : 13:28:27 (113) Laser Emission On
13:35:28.343 GMT : 13:35:27 (112) Laser Emission Off
13:38:17.346 GMT : 13:38:16 (113) Laser Emission On
13:44:23.952 GMT : 13:44:23 (112) Laser Emission Off
13:47:43.055 GMT : 13:47:42 (113) Laser Emission On
13:54:02.362 GMT : 13:54:00 (112) Laser Emission Off
13:58:11.267 GMT : 13:58:10 (113) Laser Emission On
14:04:21.874 GMT : 14:04:21 (112) Laser Emission Off
14:08:43.979 GMT : 14:08:43 (113) Laser Emission On
14:15:57.888 GMT : 14:15:56 (112) Laser Emission Off
14:19:41.093 GMT : 14:19:40 (113) Laser Emission On
14:25:34.4 GMT : 14:25:33 (112) Laser Emission Off
14:29:08.604 GMT : 14:29:08 (113) Laser Emission On
14:35:14.512 GMT : 14:35:13 (112) Laser Emission Off
14:38:53.217 GMT : 14:38:52 (113) Laser Emission On
14:44:13.523 GMT : 14:44:11 (112) Laser Emission Off
14:47:29.428 GMT : 14:47:28 (113) Laser Emission On
14:53:02.735 GMT : 14:53:02 (112) Laser Emission Off
14:55:54.238 GMT : 14:55:53 (113) Laser Emission On
14:58:05.541 GMT : 14:58:04 (112) Laser Emission Off
14:58:20.342 GMT : 14:58:19 (107) Rx Shutter Closed
14:58:20.442 GMT : 14:58:19 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : K1B9
Mission       : 101210A
Wheels Up     : 1305Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 10, 2010
Julian Day    : 344
Temperature   : -11C
Visibility    : >10
Clouds        : 11000FT
Precipitation : NO
Wind Dir      : CLM
Wind Speed    : CLM
Pressure      : 30.39
           Statistics
------------------------------
Laser Time    : 01:03:09
```

===

Flight Log

Project Number: 7556-005
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : K1B9
Mission : 101210A
Wheels Up : 1305Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 10, 2010
Julian Day : 344
Temperature : -11C
Visibility : >10
Clouds : 11000FT
Precipitation : NO
Wind Dir : CLM
Wind Speed : CLM
Pressure : 30.39

Statistics

Laser Time : 01:03:09

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
13:13:21.422	13:19:14.227	35	1576	70	30.10	18.00	ON	NAR	ON	0.00	178.46
13:28:28.536	13:35:29.543	36	1577	70	30.10	18.00	ON	NAR	ON	0.00	178.45
13:38:17.446	13:44:24.752	37	1574	70	30.10	18.00	ON	NAR	ON	0.00	358.45
13:47:43.555	13:54:03.762	37	1569	70	30.10	18.00	ON	NAR	ON	0.00	358.45
13:58:11.967	14:04:22.774	39	1571	70	30.10	18.00	ON	NAR	ON	0.00	178.43
14:08:44.679	14:15:58.388	40	1570	70	30.10	18.00	ON	NAR	ON	0.00	178.43
14:19:41.593	14:25:34.6	41	1576	70	30.10	18.00	ON	NAR	ON	0.00	178.42
14:29:09.604	14:35:15.712	42	1587	70	30.10	18.00	ON	NAR	ON	0.00	358.41

```
 14:38:54.017  14:44:13.223    43   1592   70    30.10    18.00   ON  NAR
ON       0.00       358.41
 14:47:29.528  14:53:03.435    43   1587   70    30.10    18.00   ON  NAR
ON       0.00       358.41
 14:55:54.939  14:58:06.241    43   1583   70    30.10    18.00   ON  NAR
ON       0.00       358.41

           Flight Log
------------------------------
Project Number: 0
S/N           : 0
Operator      : ???
Pilot(s)      : ???
Aircraft      : ???
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :
           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 0

========================================

           Flight Log
------------------------------
Project Number: 0
S/N           : 0
Operator      : ???
Pilot(s)      : ???
Aircraft      : ???
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :
           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
```

```
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 0

=======================================

           Flight Log
------------------------------
Project Number: 0
S/N           : 0
Operator      : ???
Pilot(s)      : ???
Aircraft      : ???
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :
           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 0



        START          STOP LINE#    ALT  PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
=======================================

           Flight Log
------------------------------
Project Number: 0
S/N           : 0
Operator      : ???
Pilot(s)      : ???
Aircraft      : ???
```

```
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 01:56:27

=======================================
10:25:56.168 GMT : 14:59:40 (106) Rx Shutter Open
10:25:56.168 GMT : 14:59:41 (108) Tx Shutter Open
10:25:56.168 GMT : 15:00:29 (109) Tx Shutter Closed
10:25:56.168 GMT : 15:00:30 (107) Rx Shutter Closed
10:25:56.168 GMT : 15:00:49 (108) Tx Shutter Open
10:25:56.168 GMT : 15:00:52 (106) Rx Shutter Open
10:25:56.168 GMT : 15:00:53 (107) Rx Shutter Closed
10:25:56.168 GMT : 15:00:57 (106) Rx Shutter Open
15:02:52.437 GMT : 15:02:51 (107) Rx Shutter Closed
15:02:52.637 GMT : 15:02:51 (109) Tx Shutter Closed
15:03:00.337 GMT : 15:02:59 (106) Rx Shutter Open
15:03:00.337 GMT : 15:02:59 (108) Tx Shutter Open
15:07:15.34 GMT : 15:07:14 (113) Laser Emission On
15:21:11.153 GMT : 15:21:10 (112) Laser Emission Off
15:24:24.756 GMT : 15:24:24 (113) Laser Emission On
15:38:51.47 GMT : 15:38:50 (112) Laser Emission Off
15:42:26.974 GMT : 15:42:26 (113) Laser Emission On
15:56:21.288 GMT : 15:56:20 (112) Laser Emission Off
15:59:30.992 GMT : 15:59:30 (113) Laser Emission On
16:14:25.108 GMT : 16:14:24 (112) Laser Emission Off
16:18:22.113 GMT : 16:18:21 (113) Laser Emission On
16:32:42.529 GMT : 16:32:41 (112) Laser Emission Off
16:35:10.432 GMT : 16:35:09 (113) Laser Emission On
16:49:53.45 GMT : 16:49:51 (112) Laser Emission Off
16:52:53.454 GMT : 16:52:52 (113) Laser Emission On
17:07:18.672 GMT : 17:07:17 (112) Laser Emission Off
17:10:06.575 GMT : 17:10:06 (113) Laser Emission On
17:24:50.994 GMT : 17:24:49 (112) Laser Emission Off
17:28:31.998 GMT : 17:28:31 (113) Laser Emission On
17:30:07 GMT : 17:30:06 (112) Laser Emission Off
17:31:34.402 GMT : 17:31:33 (107) Rx Shutter Closed
```

```
17:31:34.402 GMT : 17:31:33 (109) Tx Shutter Closed

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

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 01:56:27

=======================================

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

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
```

Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 01:56:27

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
15:07:16.24	15:21:12.453	4	1571	70	30.10	18.00	ON	NAR	ON	0.00	178.5
15:24:25.656	15:38:51.57	2	1450	70	30.10	18.00	ON	NAR	ON	0.00	178.49
15:42:27.574	15:56:17.888	1	1414	70	30.10	18.00	ON	NAR	ON	0.00	358.49
15:59:31.492	16:14:25.708	1	1381	70	30.10	18.00	ON	NAR	ON	0.00	358.49
16:18:22.613	16:32:42.829	30	1391	70	30.10	18.00	ON	NAR	ON	0.00	178.48
16:35:10.532	16:49:54.65	32	1393	70	30.10	18.00	ON	NAR	ON	0.00	358.47
16:52:54.254	17:07:18.972	33	1398	70	30.10	18.00	ON	NAR	ON	0.00	178.47
17:10:07.175	17:24:51.694	33	1387	70	30.10	18.00	ON	NAR	ON	0.00	358.47
17:28:32.798	17:30:07.7	33	1397	70	30.10	18.00	ON	NAR	ON	0.00	358.47

Flight Log

Project Number: 7556-005
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : 1B9
Mission : 101208B
Wheels Up : 120 PM EST
Flight Length : -
HOBBS Start : -
HOBBS End : -

Weather

Date : December 08, 2010
Julian Day : 342
Temperature : -1C
Visibility : CLOUDS AT 5700'
Clouds : CLOUDS AT 5700'
Precipitation : NEGATIVE GHOST RIDER

```
Wind Dir       : 340
Wind Speed     : BLOWING AT 15 KTS
Pressure       : 2973
           Statistics
------------------------------
Laser Time     : 02:33:39

=======================================
13:40:23.615 GMT : 00:00:02 (212) GPS 1PPS Lost
13:40:23.615 GMT : 00:00:03 (166) Divergence Error
13:40:23.615 GMT : 00:00:03 (107) Rx Shutter Closed
13:40:23.615 GMT : 00:00:03 (109) Tx Shutter Closed
13:40:23.615 GMT : 00:00:04 (164) Beam Wide
13:40:23.615 GMT : 00:00:05 (213) GPS 1PPS Ok
13:40:23.615 GMT : 00:00:09 (120) Laser PS Comm Ok
13:40:23.615 GMT : 00:00:09 (112) Laser Emission Off
13:40:23.615 GMT : 00:00:12 (204) POSAV Connected
13:40:23.615 GMT : 00:00:13 (207) POSAV Rate Not 50 Hz
13:40:23.615 GMT : 00:00:14 (211) POSAV new status
13:40:23.615 GMT : 00:00:22 (215) Nav Data Ok
13:40:23.615 GMT : 00:00:23 (208) POSAV Rate Is 50 Hz
13:40:23.615 GMT : 00:00:24 (211) POSAV new status
13:40:23.615 GMT : 00:00:25 (211) POSAV new status
13:40:23.615 GMT : 00:01:52 (211) POSAV new status
13:40:23.615 GMT : 00:03:00 (211) POSAV new status
18:09:05.496 GMT : 18:09:04 (211) POSAV new status
18:13:51.001 GMT : 18:13:49 (153) Eyesafety Disabled
18:13:51.201 GMT : 18:13:49 (162) Roll Comp On
18:13:51.901 GMT : 18:13:50 (164) Beam Wide
18:13:52.001 GMT : 18:13:50 (144) MultiPulse Mode Varies
18:13:53.101 GMT : 18:13:52 (165) Beam Narrow
18:26:09.516 GMT : 18:26:08 (106) Rx Shutter Open
18:26:09.516 GMT : 18:26:08 (108) Tx Shutter Open
18:33:52.326 GMT : 18:33:51 (113) Laser Emission On
18:48:38.444 GMT : 18:48:36 (112) Laser Emission Off
18:52:29.049 GMT : 18:52:27 (113) Laser Emission On
18:55:00.252 GMT : 18:54:58 (112) Laser Emission Off
18:59:40.958 GMT : 18:59:39 (113) Laser Emission On
19:02:38.362 GMT : 19:02:37 (112) Laser Emission Off
19:05:31.865 GMT : 19:05:30 (113) Laser Emission On
19:20:15.884 GMT : 19:20:14 (112) Laser Emission Off
19:23:18.788 GMT : 19:23:17 (113) Laser Emission On
19:37:58.706 GMT : 19:37:57 (112) Laser Emission Off
19:40:40.609 GMT : 19:40:39 (113) Laser Emission On
19:55:37.328 GMT : 19:55:35 (112) Laser Emission Off
19:59:01.332 GMT : 19:59:00 (113) Laser Emission On
20:13:22.85 GMT : 20:13:21 (112) Laser Emission Off
20:17:01.055 GMT : 20:16:59 (113) Laser Emission On
20:31:25.073 GMT : 20:31:23 (112) Laser Emission Off
20:34:10.876 GMT : 20:34:09 (113) Laser Emission On
20:47:50.694 GMT : 20:47:49 (112) Laser Emission Off
20:51:50.499 GMT : 20:51:49 (113) Laser Emission On
21:04:01.114 GMT : 21:03:59 (112) Laser Emission Off
21:07:08.618 GMT : 21:07:07 (113) Laser Emission On
```

```
21:17:58.632 GMT : 21:17:57 (112) Laser Emission Off
21:20:44.735 GMT : 21:20:43 (113) Laser Emission On
21:31:44.749 GMT : 21:31:43 (112) Laser Emission Off
21:34:24.252 GMT : 21:34:22 (113) Laser Emission On
21:45:15.866 GMT : 21:45:14 (112) Laser Emission Off
21:48:57.47 GMT : 21:48:56 (113) Laser Emission On
21:51:28.673 GMT : 21:51:26 (112) Laser Emission Off
21:51:44.374 GMT : 21:51:42 (107) Rx Shutter Closed
21:51:44.374 GMT : 21:51:42 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : 1B9
Mission       : 101208B
Wheels Up     : 120 PM EST
Flight Length : -
HOBBS Start   : -
HOBBS End     : -

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : -1C
Visibility    : CLOUDS AT 5700'
Clouds        : CLOUDS AT 5700'
Precipitation : NEGATIVE GHOST RIDER
Wind Dir      : 340
Wind Speed    : BLOWING AT 15 KTS
Pressure      : 2973
           Statistics
------------------------------
Laser Time    : 02:33:39

=======================================

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : 1B9
Mission       : 101208B
Wheels Up     : 120 PM EST
Flight Length : -
HOBBS Start   : -
HOBBS End     : -
```

Weather

Date : December 08, 2010
Julian Day : 342
Temperature : -1C
Visibility : CLOUDS AT 5700'
Clouds : CLOUDS AT 5700'
Precipitation : NEGATIVE GHOST RIDER
Wind Dir : 340
Wind Speed : BLOWING AT 15 KTS
Pressure : 2973

Statistics

Laser Time : 02:33:39

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
18:33:53.226	18:48:38.244	34	1426	70	30.10	18.00	ON	NAR	ON	0.00	178.46
18:52:29.049	18:55:01.052	33	1435	70	30.10	18.00	ON	NAR	ON	0.00	358.47
18:59:41.958	19:02:39.262	35	1447	70	30.10	18.00	ON	NAR	ON	0.00	178.46
19:05:32.466	19:20:16.684	36	1454	70	30.10	18.00	ON	NAR	ON	0.00	178.45
19:23:19.488	19:37:59.206	36	1446	70	30.10	18.00	ON	NAR	ON	0.00	178.45
19:40:41.309	19:55:37.028	38	1445	70	30.10	18.00	ON	NAR	ON	0.00	178.44
19:59:02.332	20:13:24.65	38	1456	70	30.10	18.00	ON	NAR	ON	0.00	178.44
20:17:01.855	20:31:26.173	40	1445	70	30.10	18.00	ON	NAR	ON	0.00	178.43
20:34:11.476	20:47:51.494	41	1464	70	30.10	18.00	ON	NAR	ON	0.00	178.42
20:51:51.099	21:04:02.614	42	1459	70	30.10	18.00	ON	NAR	ON	0.00	178.41
21:07:09.218	21:17:59.132	43	1460	70	30.10	18.00	ON	NAR	ON	0.00	358.41
21:20:45.335	21:31:46.749	44	1454	70	30.10	18.00	ON	NAR	ON	0.00	358.4
21:34:25.052	21:45:16.866	44	1475	70	30.10	18.00	ON	NAR	ON	0.00	178.4
21:48:58.17	21:51:29.173	44	1479	70	30.10	18.00	ON	NAR	ON	0.00	178.4

Flight Log

Project Number: 0
S/N : 0

```
Operator      : ???
Pilot(s)      : ???
Aircraft      : ???
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :
           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 0

=======================================
15:12:35.543 GMT : 00:00:02 (212) GPS 1PPS Lost
15:12:35.543 GMT : 00:00:03 (166) Divergence Error
15:12:35.543 GMT : 00:00:03 (107) Rx Shutter Closed
15:12:35.543 GMT : 00:00:03 (109) Tx Shutter Closed
15:12:35.543 GMT : 00:00:04 (164) Beam Wide
15:12:35.543 GMT : 00:00:08 (213) GPS 1PPS Ok
15:12:35.543 GMT : 00:00:12 (204) POSAV Connected
15:12:35.543 GMT : 00:00:13 (207) POSAV Rate Not 50 Hz
15:12:35.543 GMT : 00:00:13 (211) POSAV new status
15:12:35.543 GMT : 00:00:18 (120) Laser PS Comm Ok
15:12:35.543 GMT : 00:00:18 (112) Laser Emission Off
15:12:35.543 GMT : 00:00:20 (208) POSAV Rate Is 50 Hz
15:12:35.543 GMT : 00:00:20 (211) POSAV new status
15:12:35.543 GMT : 00:00:22 (211) POSAV new status
15:12:35.543 GMT : 00:00:22 (215) Nav Data Ok
15:12:35.543 GMT : 00:01:57 (211) POSAV new status
14:44:05.275 GMT : 00:03:20 (307) Format Disk

           Flight Log
------------------------------
Project Number: 0
S/N           : 0
Operator      : ???
Pilot(s)      : ???
Aircraft      : ???
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
```

```
HOBBS Start   :
HOBBS End     :
           Weather
-----------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
-----------------------------
Laser Time    : 0

======================================

           Flight Log
-----------------------------
Project Number: 0
S/N           : 0
Operator      : ???
Pilot(s)      : ???
Aircraft      : ???
Airport       : ???
Mission       : ???
Wheels Up     : ???
Flight Length :
HOBBS Start   :
HOBBS End     :
           Weather
-----------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
-----------------------------
Laser Time    : 0


        START          STOP LINE#    ALT  PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
======================================

           Flight Log
```

```
------------------------------
Project Number: NARR_1B9
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : 1B9 Mansfield, MA
Mission       : 1
Wheels Up     :
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : -4 C @KBED
Visibility    : clear
Clouds        : none
Precipitation : nill
Wind Dir      :
Wind Speed    :
Pressure      : 29.64 HG @KBED
           Statistics
------------------------------
Laser Time    : 01:42:05

=======================================
15:18:13.952 GMT : 00:04:38 (157) Safe Unaided Profile
15:18:13.952 GMT : 00:04:38 (162) Roll Comp On
15:18:13.952 GMT : 00:04:38 (157) Safe Unaided Profile
15:18:13.952 GMT : 00:04:39 (164) Beam Wide
14:45:27.775 GMT : 00:04:42 (165) Beam Narrow
14:45:29.875 GMT : 00:04:44 (211) POSAV new status
14:46:45.876 GMT : 14:46:44 (157) Safe Unaided Profile
14:47:01.876 GMT : 14:47:00 (157) Safe Unaided Profile
14:47:01.876 GMT : 14:47:01 (157) Safe Unaided Profile
14:47:13.376 GMT : 14:47:11 (152) Invalid Beam
14:47:13.576 GMT : 14:47:11 (152) Invalid Beam
14:47:28.076 GMT : 14:47:26 (157) Safe Unaided Profile
14:47:28.276 GMT : 14:47:26 (157) Safe Unaided Profile
14:48:44.577 GMT : 14:48:43 (157) Safe Unaided Profile
14:48:44.677 GMT : 14:48:43 (157) Safe Unaided Profile
14:48:45.277 GMT : 14:48:44 (144) MultiPulse Mode Varies
14:51:43.278 GMT : 14:51:42 (211) POSAV new status
15:00:24.783 GMT : 15:00:23 (157) Safe Unaided Profile
15:00:29.183 GMT : 15:00:27 (106) Rx Shutter Open
15:00:29.383 GMT : 15:00:27 (108) Tx Shutter Open
15:07:31.987 GMT : 15:07:30 (113) Laser Emission On
15:09:26.188 GMT : 15:09:24 (112) Laser Emission Off
15:13:52.591 GMT : 15:13:51 (113) Laser Emission On
15:16:21.093 GMT : 15:16:19 (112) Laser Emission Off
15:20:54.095 GMT : 15:20:53 (113) Laser Emission On
```

```
15:23:10.697 GMT : 15:23:09 (112) Laser Emission Off
15:28:35.6 GMT : 15:28:34 (113) Laser Emission On
15:31:02.102 GMT : 15:31:00 (112) Laser Emission Off
15:35:22.005 GMT : 15:35:20 (113) Laser Emission On
15:37:30.206 GMT : 15:37:29 (112) Laser Emission Off
15:42:37.11 GMT : 15:42:35 (113) Laser Emission On
15:44:53.911 GMT : 15:44:52 (112) Laser Emission Off
15:49:28.814 GMT : 15:49:27 (113) Laser Emission On
15:55:00.818 GMT : 15:54:59 (112) Laser Emission Off
15:59:09.921 GMT : 15:59:08 (113) Laser Emission On
16:05:35.525 GMT : 16:05:34 (112) Laser Emission Off
16:10:21.828 GMT : 16:10:20 (113) Laser Emission On
16:16:26.333 GMT : 16:16:24 (112) Laser Emission Off
16:20:57.836 GMT : 16:20:56 (113) Laser Emission On
16:27:35.74 GMT : 16:27:33 (112) Laser Emission Off
16:32:11.844 GMT : 16:32:10 (113) Laser Emission On
16:38:54.148 GMT : 16:38:52 (112) Laser Emission Off
16:43:19.252 GMT : 16:43:18 (113) Laser Emission On
16:50:22.757 GMT : 16:50:21 (112) Laser Emission Off
16:54:59.86 GMT : 16:54:58 (113) Laser Emission On
17:02:09.565 GMT : 17:02:08 (112) Laser Emission Off
17:06:49.968 GMT : 17:06:48 (113) Laser Emission On
17:14:38.674 GMT : 17:14:37 (112) Laser Emission Off
17:19:02.977 GMT : 17:19:02 (113) Laser Emission On
17:27:06.983 GMT : 17:27:05 (112) Laser Emission Off
17:31:45.587 GMT : 17:31:44 (113) Laser Emission On
17:40:01.293 GMT : 17:40:00 (112) Laser Emission Off
17:44:38.496 GMT : 17:44:37 (113) Laser Emission On
17:52:48.802 GMT : 17:52:46 (112) Laser Emission Off
17:57:42.006 GMT : 17:57:40 (113) Laser Emission On
18:06:25.612 GMT : 18:06:24 (112) Laser Emission Off
18:11:03.916 GMT : 18:11:02 (113) Laser Emission On
18:14:04.918 GMT : 18:14:03 (112) Laser Emission Off
18:19:06.122 GMT : 18:19:05 (157) Safe Unaided Profile
18:19:28.822 GMT : 18:19:27 (157) Safe Unaided Profile
18:19:33.122 GMT : 18:19:31 (107) Rx Shutter Closed
18:19:33.222 GMT : 18:19:31 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: NARR_1B9
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : 1B9 Mansfield, MA
Mission       : 1
Wheels Up     :
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
```

```
Date          : December 08, 2010
Julian Day    : 342
Temperature   : -4 C @KBED
Visibility    : clear
Clouds        : none
Precipitation : nill
Wind Dir      :
Wind Speed    :
Pressure      : 29.64 HG @KBED
           Statistics
------------------------------
Laser Time    : 01:42:05

=======================================

           Flight Log
------------------------------
Project Number: NARR_1B9
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : 1B9 Mansfield, MA
Mission       : 1
Wheels Up     :
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   : -4 C @KBED
Visibility    : clear
Clouds        : none
Precipitation : nill
Wind Dir      :
Wind Speed    :
Pressure      : 29.64 HG @KBED
           Statistics
------------------------------
Laser Time    : 01:42:05


        START          STOP LINE#    ALT  PRF     FREQ   ANGLE   MP  DIV
RC        HDG    Plan File
=======================================
 15:07:31.787  15:09:26.488    29   1599   70    30.10   18.00   ON  NAR
ON       0.00       178.63
 15:07:31.787  15:09:26.488    29   1599   70    30.10   18.00   ON  NAR
ON       0.00       178.63
```

15:13:53.391	15:16:22.293	28	1582	70	30.10	18.00	ON	NAR	ON	0.00	358.62
15:13:53.391	15:16:22.293	28	1583	70	30.10	18.00	ON	NAR	ON	0.00	358.62
15:20:55.095	15:23:12.597	27	1586	70	30.10	18.00	ON	NAR	ON	0.00	178.62
15:20:55.095	15:23:12.597	26	1586	70	30.10	18.00	ON	NAR	ON	0.00	178.61
15:28:36.2	15:31:03.002	26	1579	70	30.10	18.00	ON	NAR	ON	0.00	358.61
15:35:21.805	15:37:32.006	24	1597	70	30.10	18.00	ON	NAR	ON	0.00	178.6
15:42:38.31	15:44:52.111	24	1568	70	30.10	18.00	ON	NAR	ON	0.00	358.6
15:42:38.31	15:44:56.211	24	1569	70	30.10	18.00	ON	NAR	ON	0.00	358.6
15:49:29.014	15:55:01.618	23	1611	70	30.10	18.00	ON	NAR	ON	0.00	178.6
15:59:09.621	16:05:36.125	22	1570	70	30.10	18.00	ON	NAR	ON	0.00	358.59
15:59:09.621	16:05:36.125	21	1571	70	30.10	18.00	ON	NAR	ON	0.00	178.59
16:10:22.728	16:16:25.833	21	1576	70	30.10	18.00	ON	NAR	ON	0.00	178.59
16:20:57.736	16:27:37.74	20	1536	70	30.10	18.00	ON	NAR	ON	0.00	358.58
16:32:12.844	16:38:53.848	19	1463	70	30.10	18.00	ON	NAR	ON	0.00	178.58
16:43:20.452	16:50:24.157	18	1450	70	30.10	18.00	ON	NAR	ON	0.00	358.57
16:43:20.452	16:50:24.157	17	1450	70	30.10	18.00	ON	NAR	ON	0.00	358.57
16:55:00.76	17:02:11.065	17	1482	70	30.10	18.00	ON	NAR	ON	0.00	178.57
16:55:00.76	17:02:11.065	17	1483	70	30.10	18.00	ON	NAR	ON	0.00	178.57
17:06:49.968	17:14:39.674	16	1468	70	30.10	18.00	ON	NAR	ON	0.00	358.56
17:19:04.177	17:27:03.583	15	1477	70	30.10	18.00	ON	NAR	ON	0.00	178.56
17:31:46.287	17:40:01.993	14	1468	70	30.10	18.00	ON	NAR	ON	0.00	358.55
17:31:46.287	17:40:01.993	14	1466	70	30.10	18.00	ON	NAR	ON	0.00	358.55
17:44:39.096	17:52:50.302	13	1456	70	30.10	18.00	ON	NAR	ON	0.00	178.55
17:57:42.206	18:06:27.812	12	1472	70	30.10	18.00	ON	NAR	ON	0.00	358.54
18:11:04.416	18:14:06.318	12	1440	70	30.10	18.00	ON	NAR	ON	0.00	358.54
18:11:04.416	18:14:06.318	12	1438	70	30.10	18.00	ON	NAR	ON	0.00	358.54

Flight Log

```
------------------------------
Project Number: NARR_1B9
S/N            : 247
Operator       : Galieti
Pilot(s)       : Greenwell
Aircraft       : N2448G
Airport        : 1B9
Mission        : 2
Wheels Up      : 1914 Z
Flight Length  :
HOBBS Start    :
HOBBS End      :

           Weather
------------------------------
Date           : December 08, 2010
Julian Day     : 342
Temperature    :
Visibility     : +10 SM
Clouds         : SCT 060
Precipitation  : nill
Wind Dir       :
Wind Speed     :
Pressure       : 29.74 HG
           Statistics
------------------------------
Laser Time     : 01:30:36

=======================================
19:46:19.541 GMT : 19:14:34 (157) Safe Unaided Profile
19:14:58.319 GMT : 19:14:56 (157) Safe Unaided Profile
19:14:58.519 GMT : 19:14:56 (157) Safe Unaided Profile
19:16:11.22 GMT : 19:16:10 (157) Safe Unaided Profile
19:16:16.92 GMT : 19:16:15 (157) Safe Unaided Profile
19:16:20.02 GMT : 19:16:18 (106) Rx Shutter Open
19:16:20.22 GMT : 19:16:18 (108) Tx Shutter Open
19:27:11.628 GMT : 19:27:10 (113) Laser Emission On
19:36:44.835 GMT : 19:36:43 (112) Laser Emission Off
19:43:55.741 GMT : 19:43:54 (113) Laser Emission On
19:56:47.05 GMT : 19:56:45 (112) Laser Emission Off
20:01:23.853 GMT : 20:01:22 (113) Laser Emission On
20:07:17.158 GMT : 20:07:15 (214) Nav Data Lost
20:07:21.158 GMT : 20:07:19 (215) Nav Data Ok
20:14:47.963 GMT : 20:14:45 (112) Laser Emission Off
20:19:23.167 GMT : 20:19:21 (113) Laser Emission On
20:32:15.376 GMT : 20:32:14 (112) Laser Emission Off
20:37:20.98 GMT : 20:37:19 (113) Laser Emission On
20:50:36.19 GMT : 20:50:34 (112) Laser Emission Off
20:55:38.393 GMT : 20:55:36 (113) Laser Emission On
21:09:12.503 GMT : 21:09:10 (112) Laser Emission Off
21:13:28.506 GMT : 21:13:27 (113) Laser Emission On
21:27:34.217 GMT : 21:27:33 (112) Laser Emission Off
21:34:02.521 GMT : 21:34:01 (113) Laser Emission On
21:35:29.722 GMT : 21:35:28 (112) Laser Emission Off
```

```
21:37:34.224 GMT : 21:37:33 (157) Safe Unaided Profile
21:37:35.024 GMT : 21:37:33 (157) Safe Unaided Profile
21:37:38.624 GMT : 21:37:37 (107) Rx Shutter Closed
21:37:38.824 GMT : 21:37:37 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: NARR_1B9
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : 1B9
Mission       : 2
Wheels Up     : 1914 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
Temperature   :
Visibility    : +10 SM
Clouds        : SCT 060
Precipitation : nill
Wind Dir      :
Wind Speed    :
Pressure      : 29.74 HG
           Statistics
------------------------------
Laser Time    : 01:30:36

=======================================

           Flight Log
------------------------------
Project Number: NARR_1B9
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : 1B9
Mission       : 2
Wheels Up     : 1914 Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 08, 2010
Julian Day    : 342
```

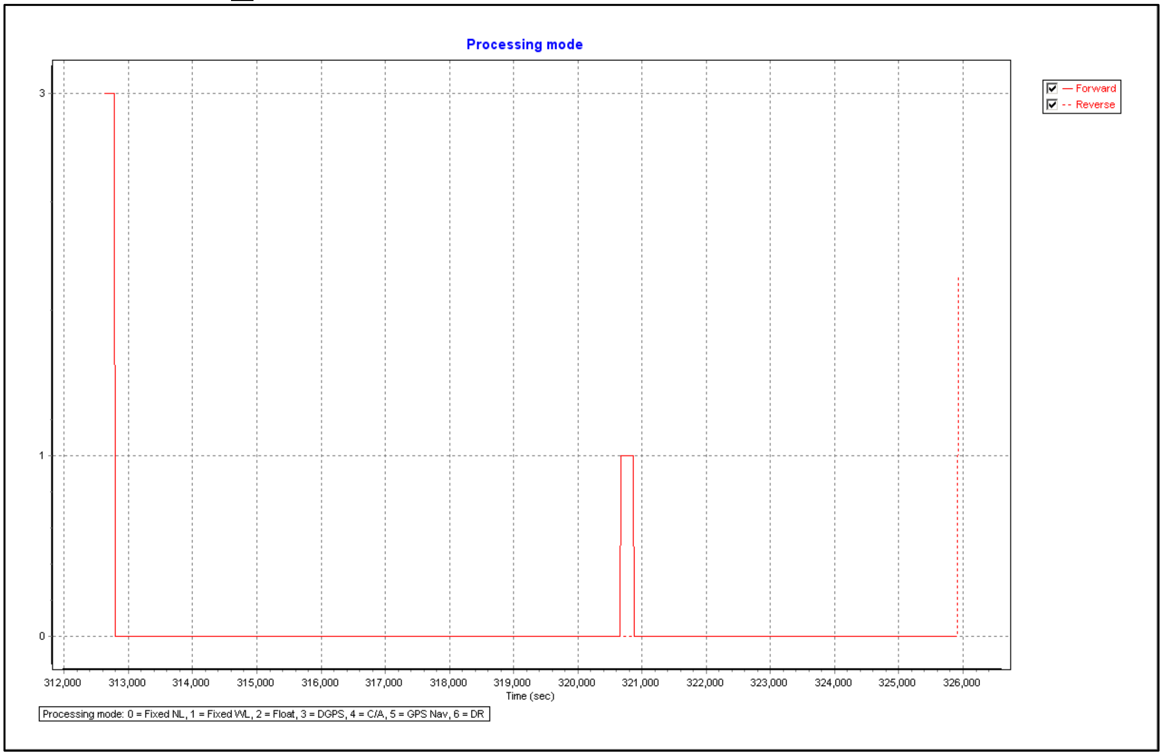
Temperature :
Visibility : +10 SM
Clouds : SCT 060
Precipitation : nill
Wind Dir :
Wind Speed :
Pressure : 29.74 HG

Statistics

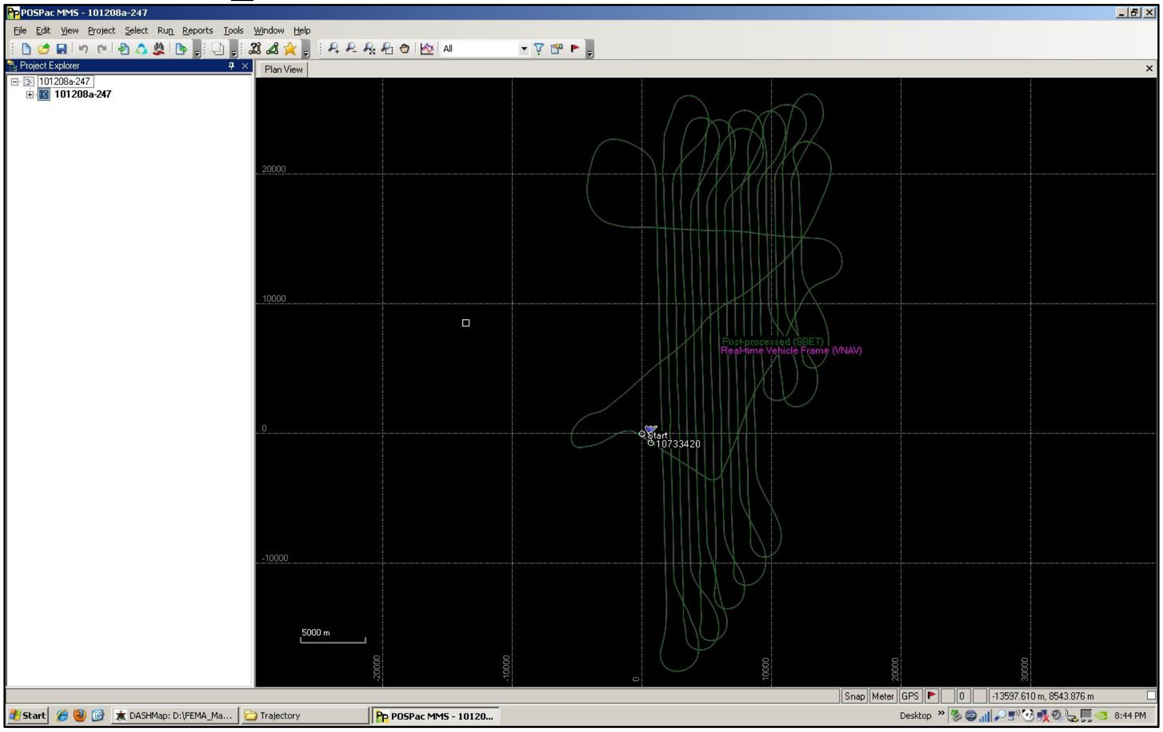
Laser Time : 01:30:36

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
19:27:12.228	19:36:46.135	11	1565	70	30.10	18.00	ON	NAR	ON	0.00	178.54
19:43:56.641	19:56:48.35	10	1560	70	30.10	18.00	ON	NAR	ON	0.00	358.54
19:43:56.641	19:56:48.35	10	1560	70	30.10	18.00	ON	NAR	ON	0.00	358.54
20:01:24.553	20:14:48.163	9	1584	70	30.10	18.00	ON	NAR	ON	0.00	178.53
20:01:24.553	20:14:48.163	9	1585	70	30.10	18.00	ON	NAR	ON	0.00	178.53
20:19:23.067	20:32:16.376	8	1559	70	30.10	18.00	ON	NAR	ON	0.00	358.53
20:37:20.98	20:50:35.99	7	1580	70	30.10	18.00	ON	NAR	ON	0.00	178.52
20:55:39.293	21:09:11.903	6	1560	70	30.10	18.00	ON	NAR	ON	0.00	358.51
21:13:29.406	21:27:36.517	5	1575	70	30.10	18.00	ON	NAR	ON	0.00	178.51
21:34:03.621	21:35:30.322	5	1519	70	30.10	18.00	ON	NAR	ON	0.00	178.51
21:34:03.621	21:35:30.322	5	1516	70	30.10	18.00	ON	NAR	ON	0.00	178.51

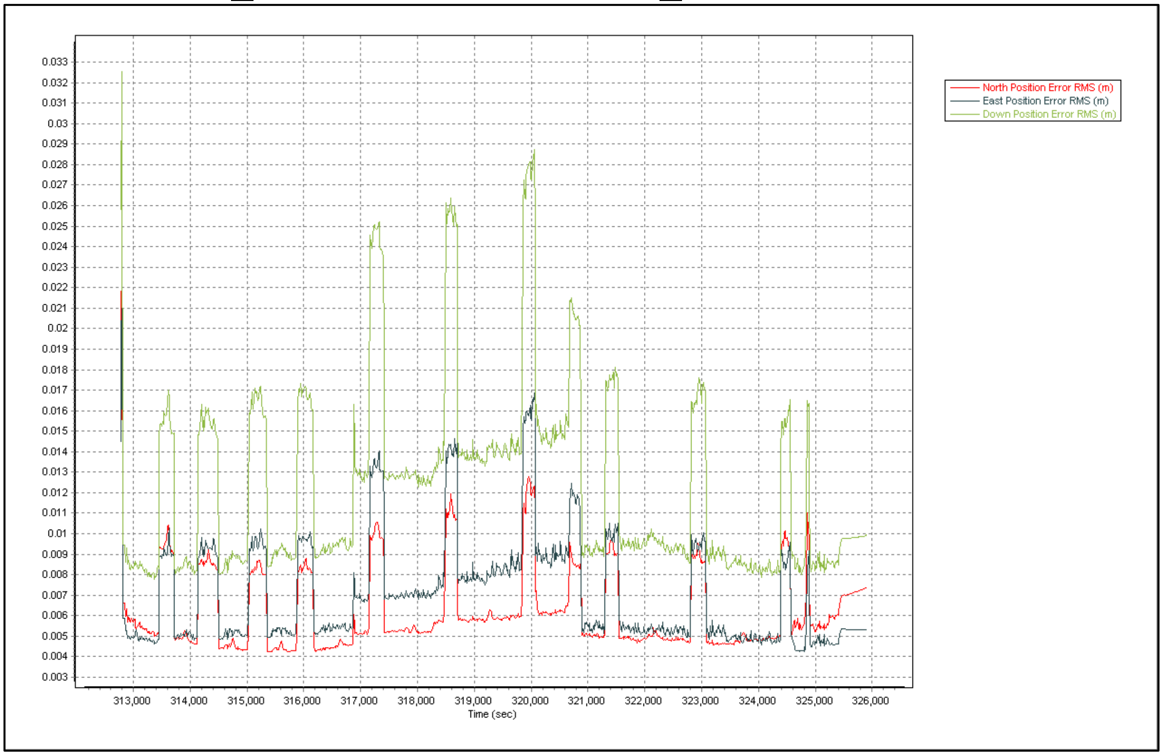
101208A-247_PROCESSMODE



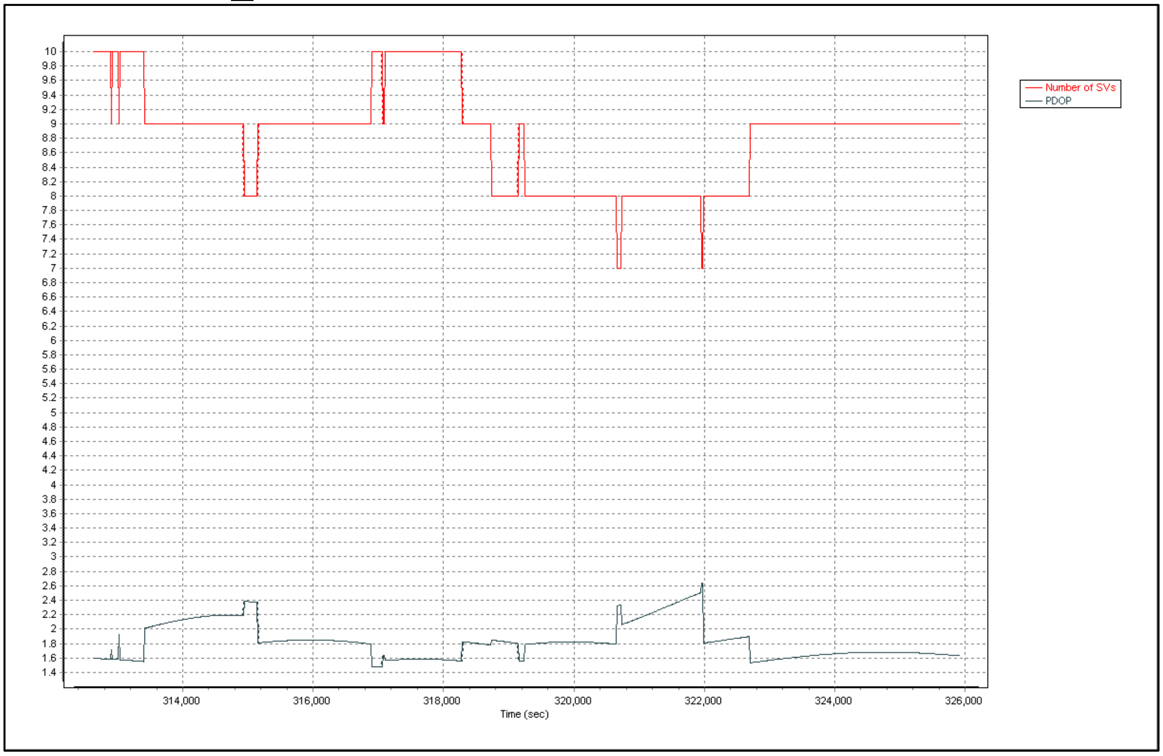
101208A-247_SCREENSHOT



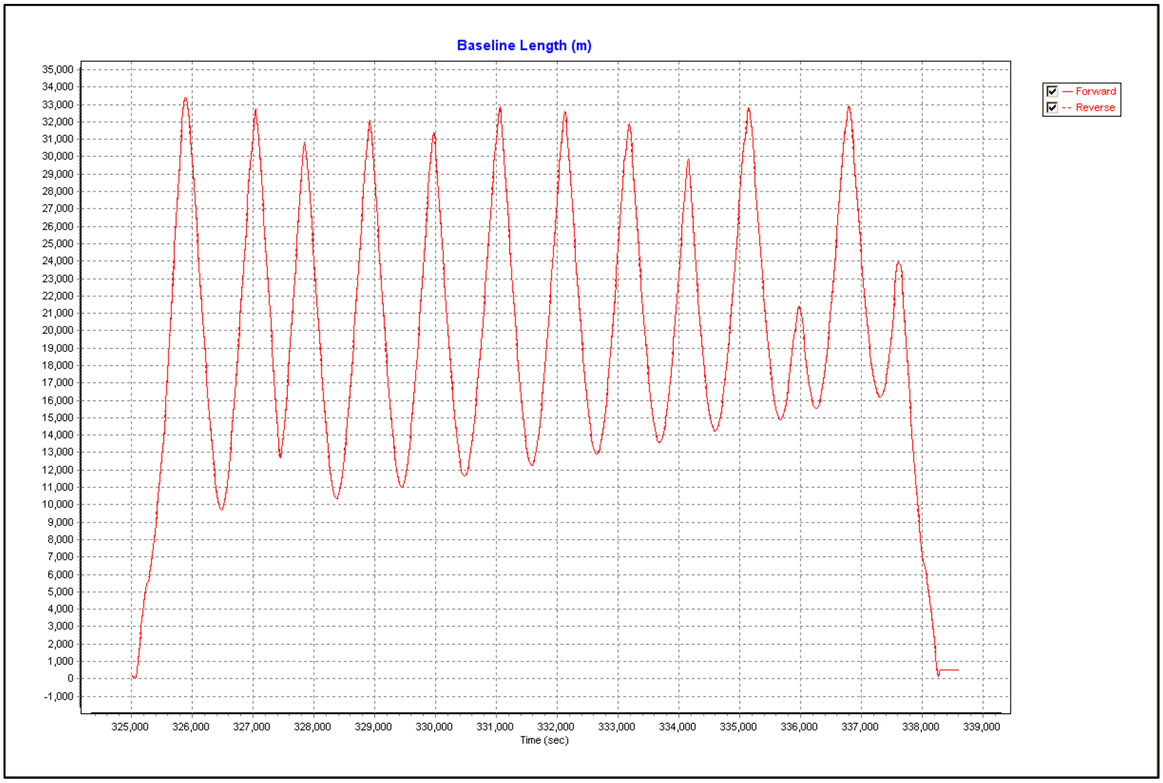
101208A-247_SMOOTHPERFMETRIC_NED



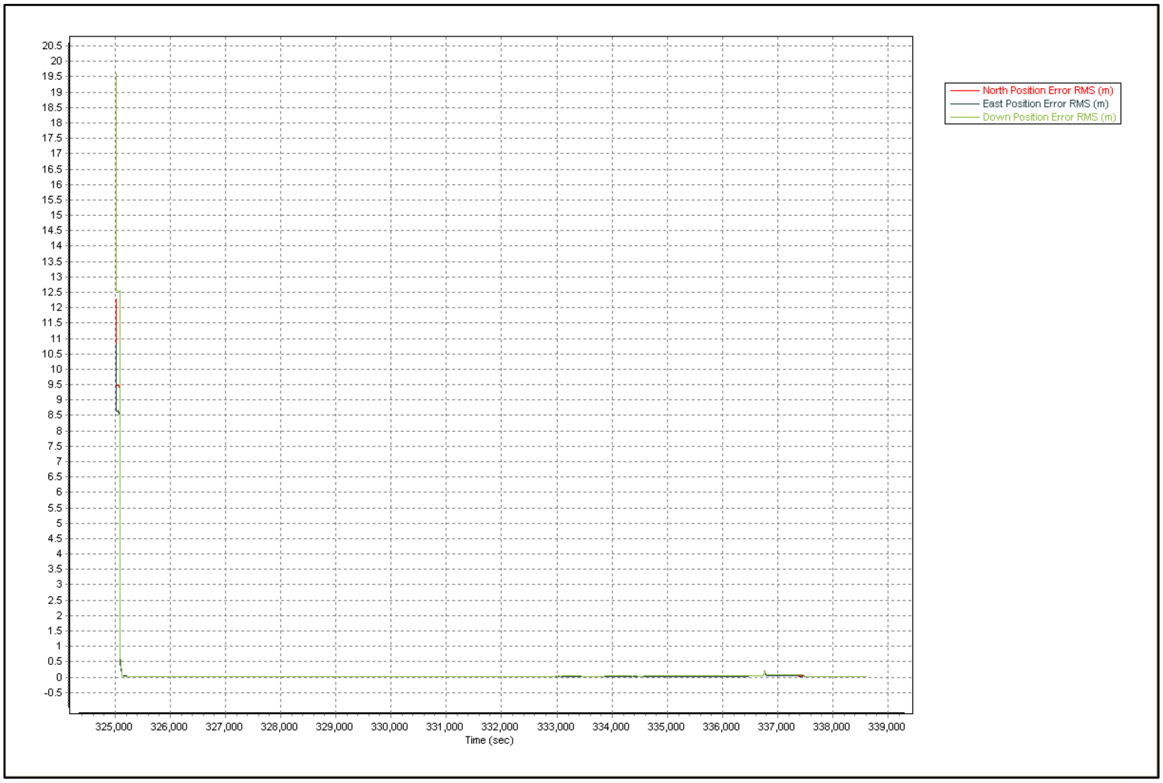
101208A-247_SVS&PDOP



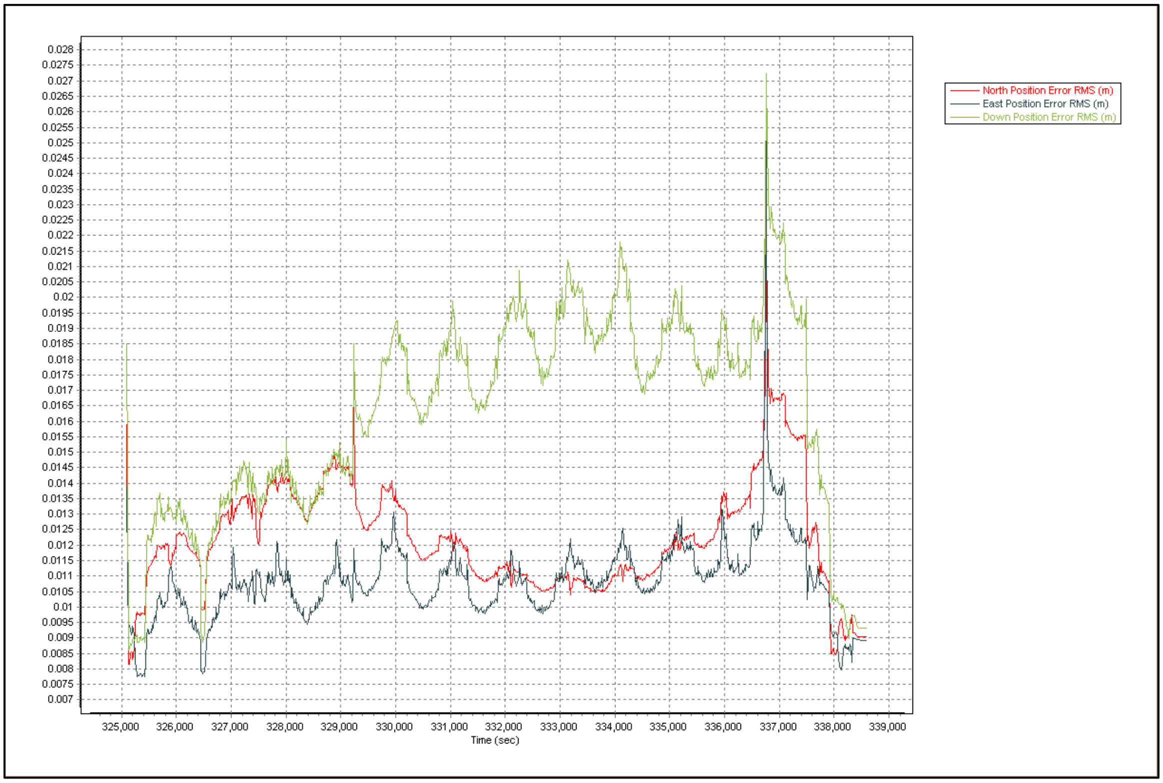
101208B-246-BASELINELENGTH



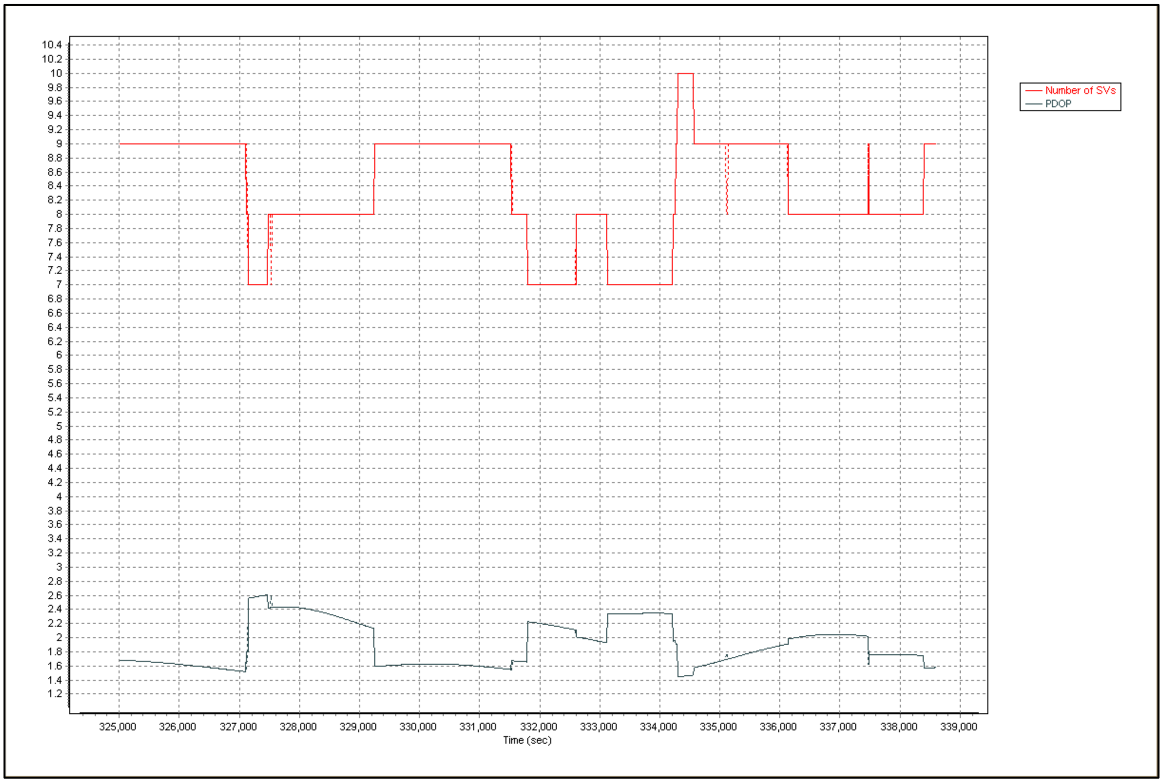
101208B-246-NEDPOSITIONERROR-FORWARD



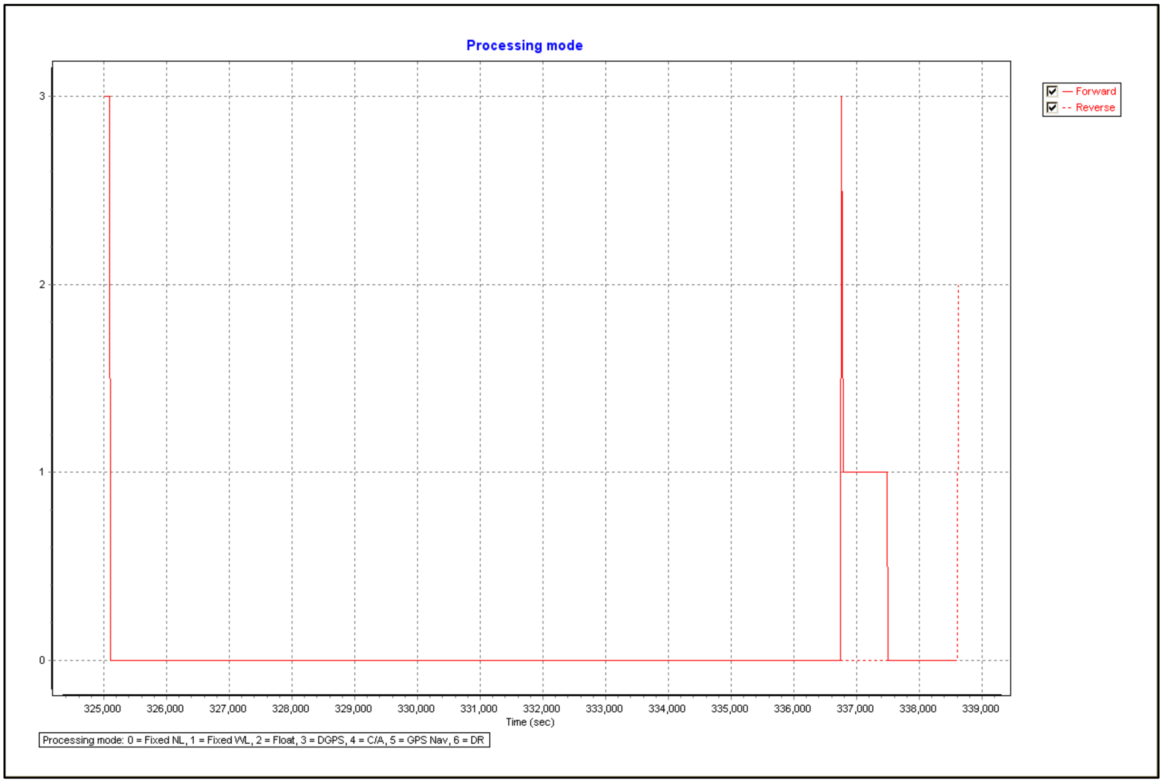
101208B-246-NEDPOSITIONERROR-SMOOTHED



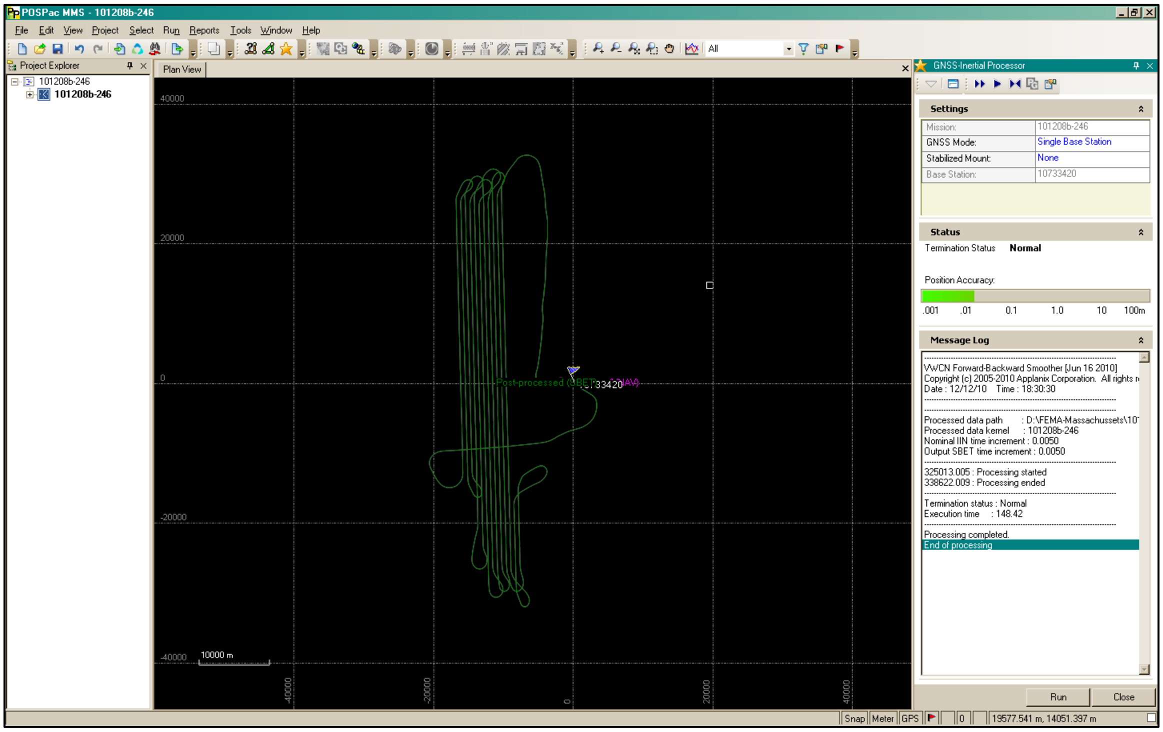
101208B-246-PDOP&SVS



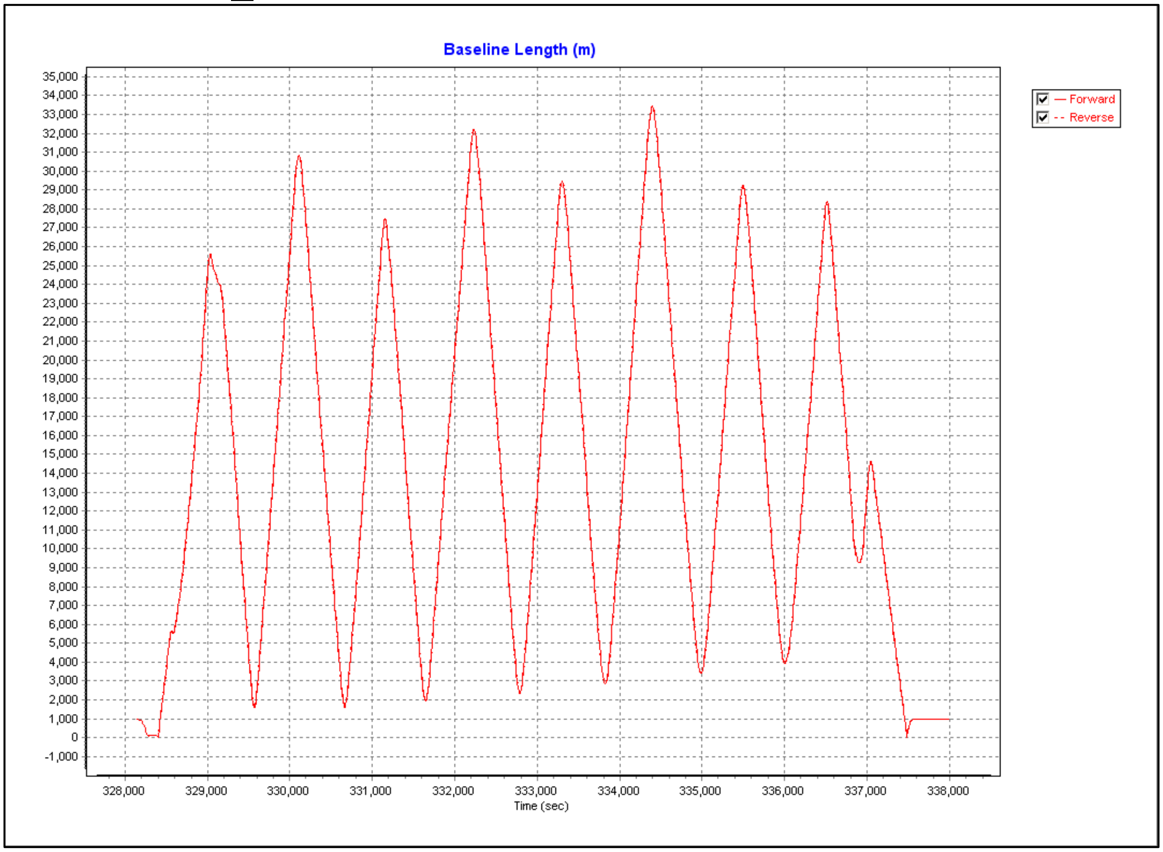
101208B-246-PROCMODE



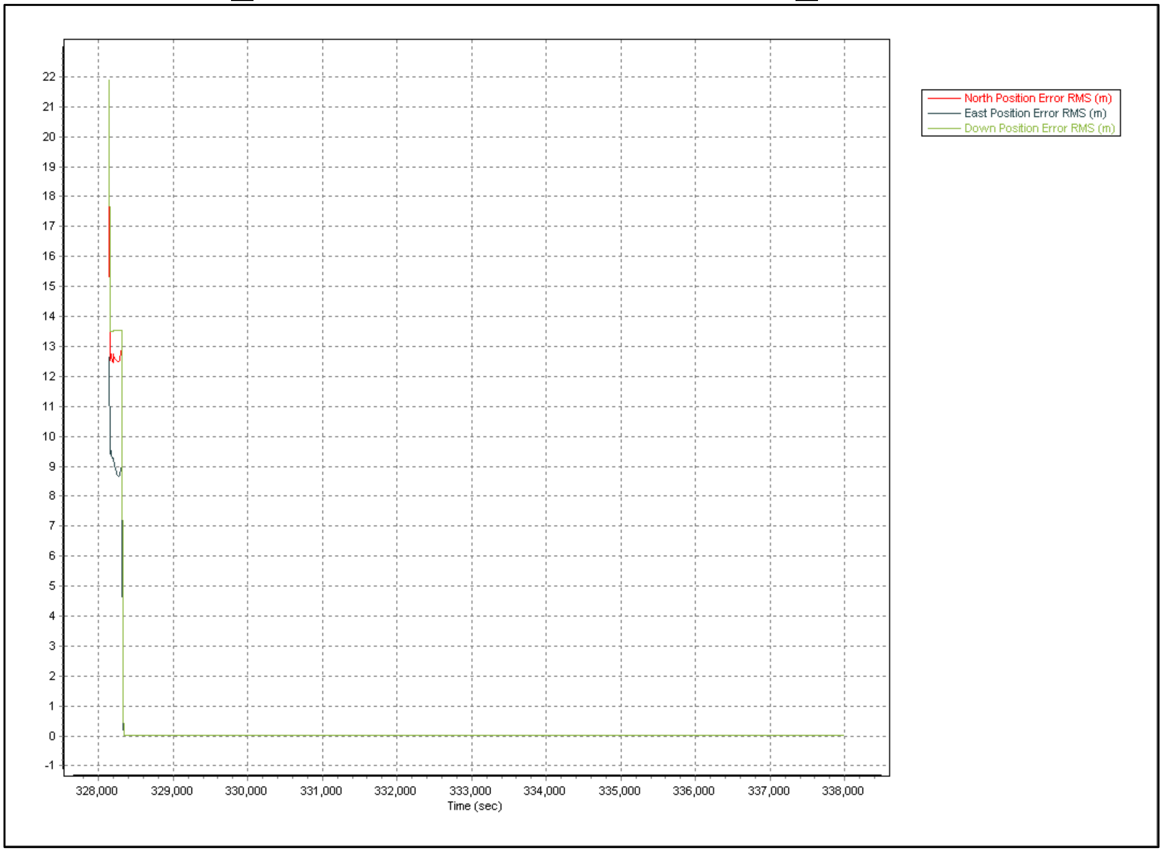
101208B-246-TRAJECTORY



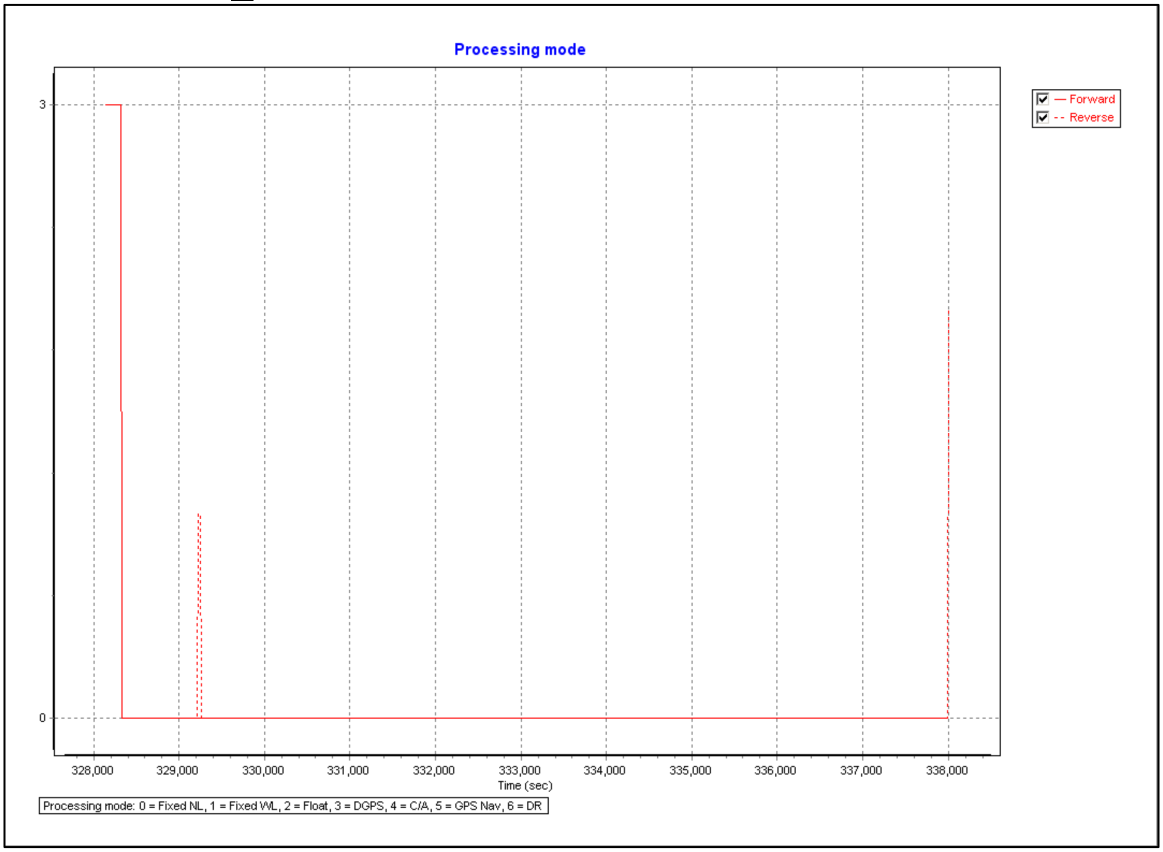
101208B-247_BASELINE



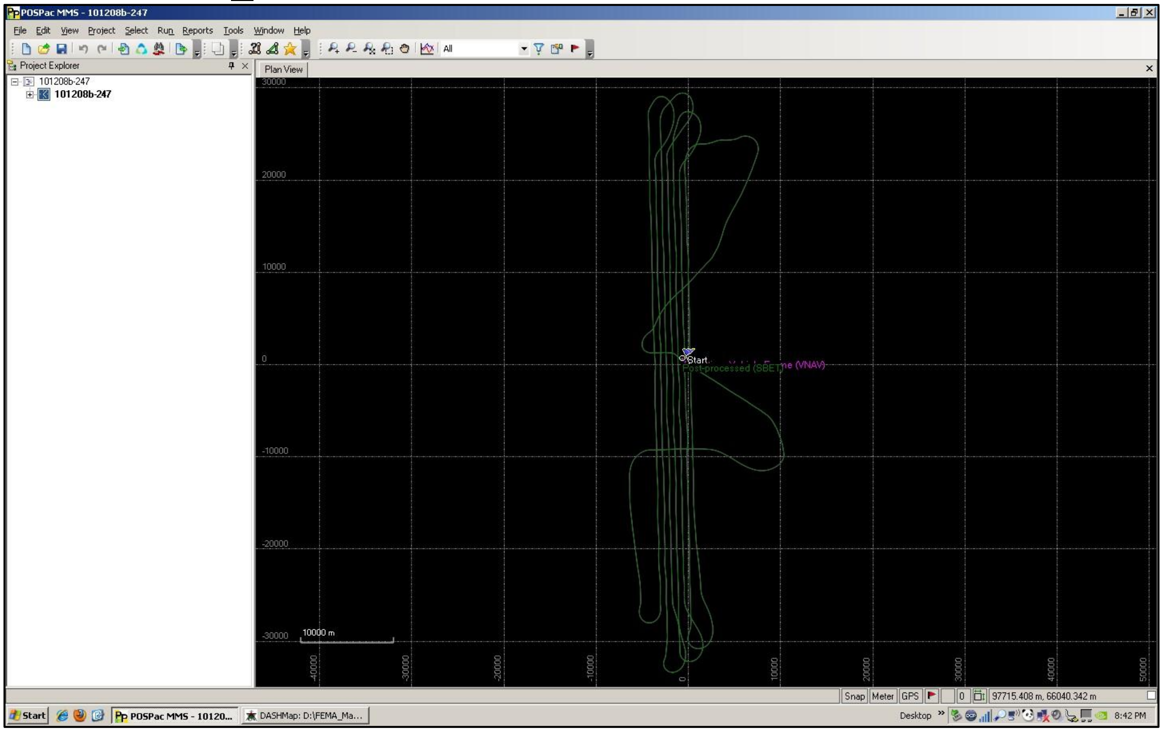
101208B-247_FORWARDPROCPERFMETRIC_NED



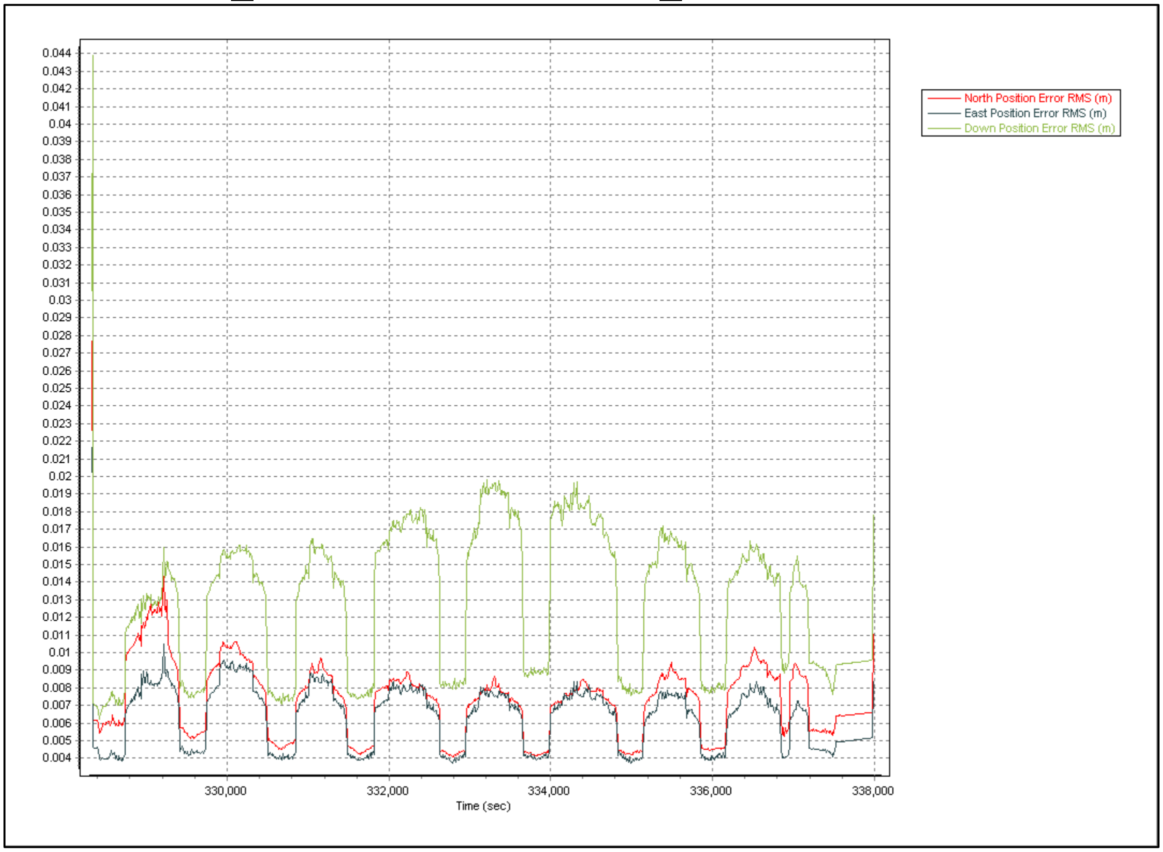
101208B-247_PROCESSMODE



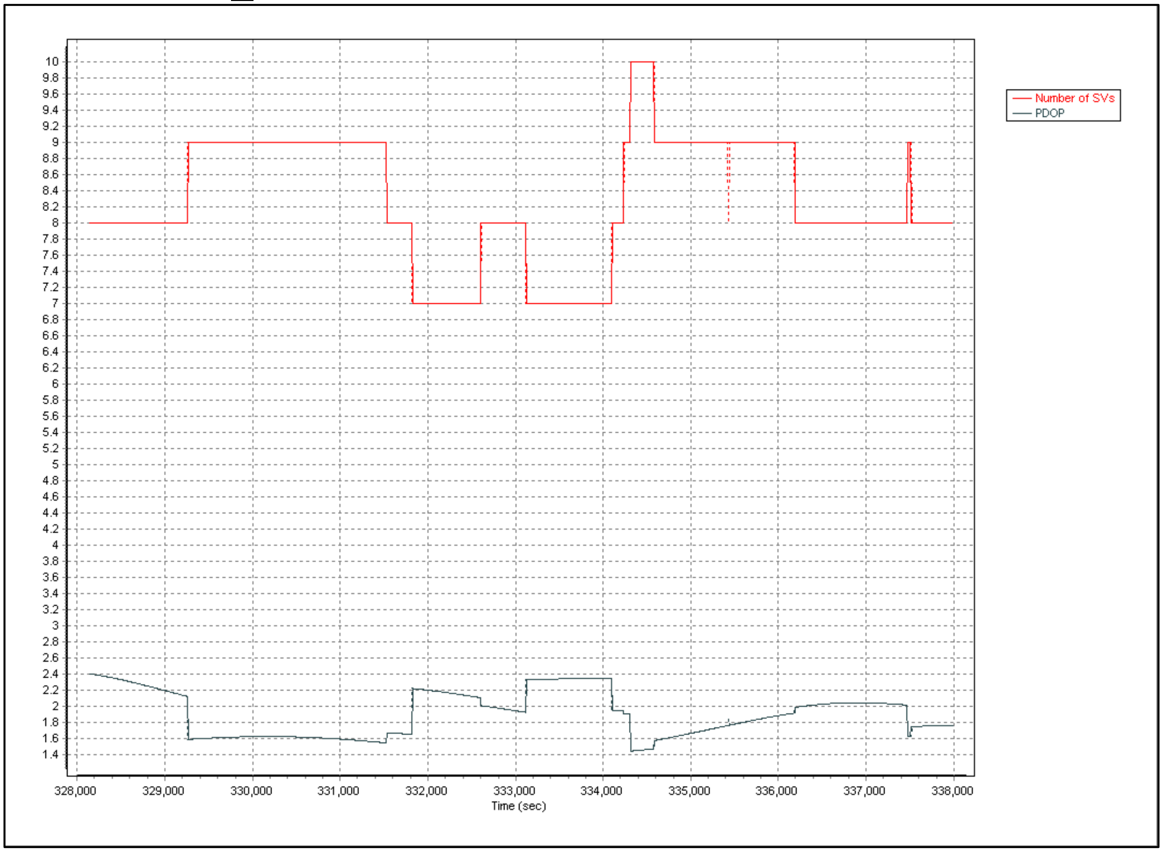
101208B-247_SCREENSHOT



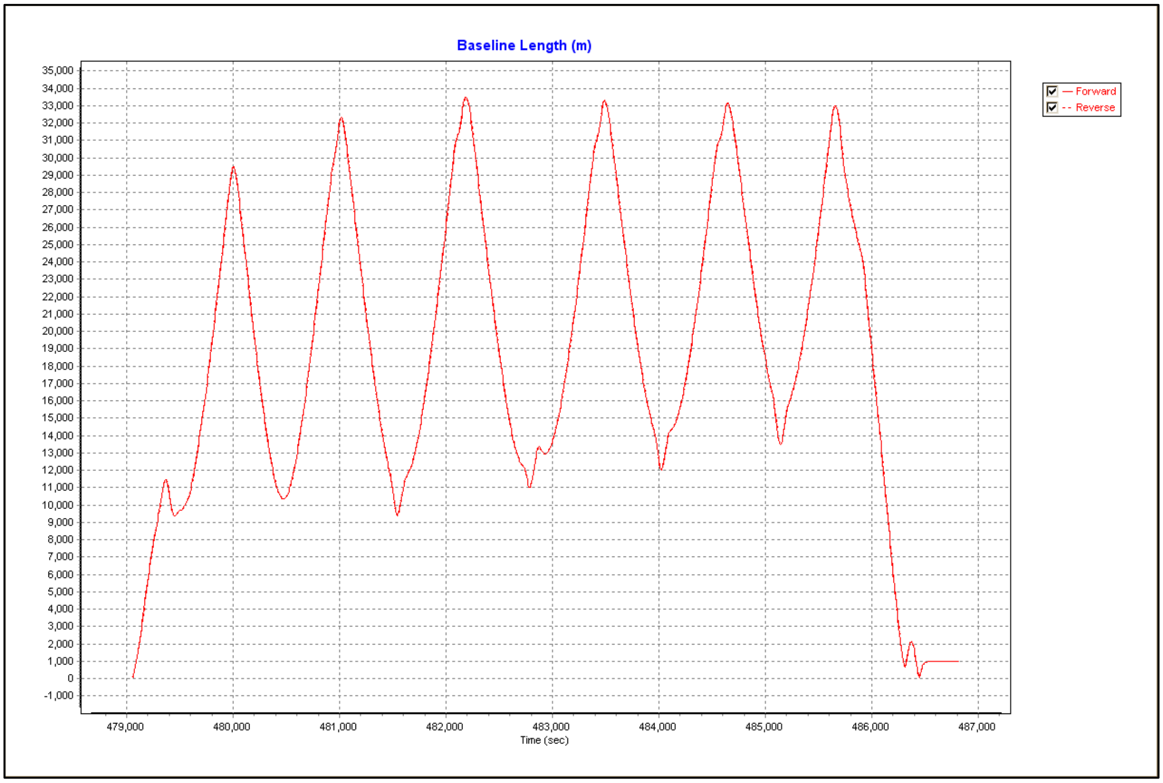
101208B-247_SMOOTHPERFMETRIC_NED



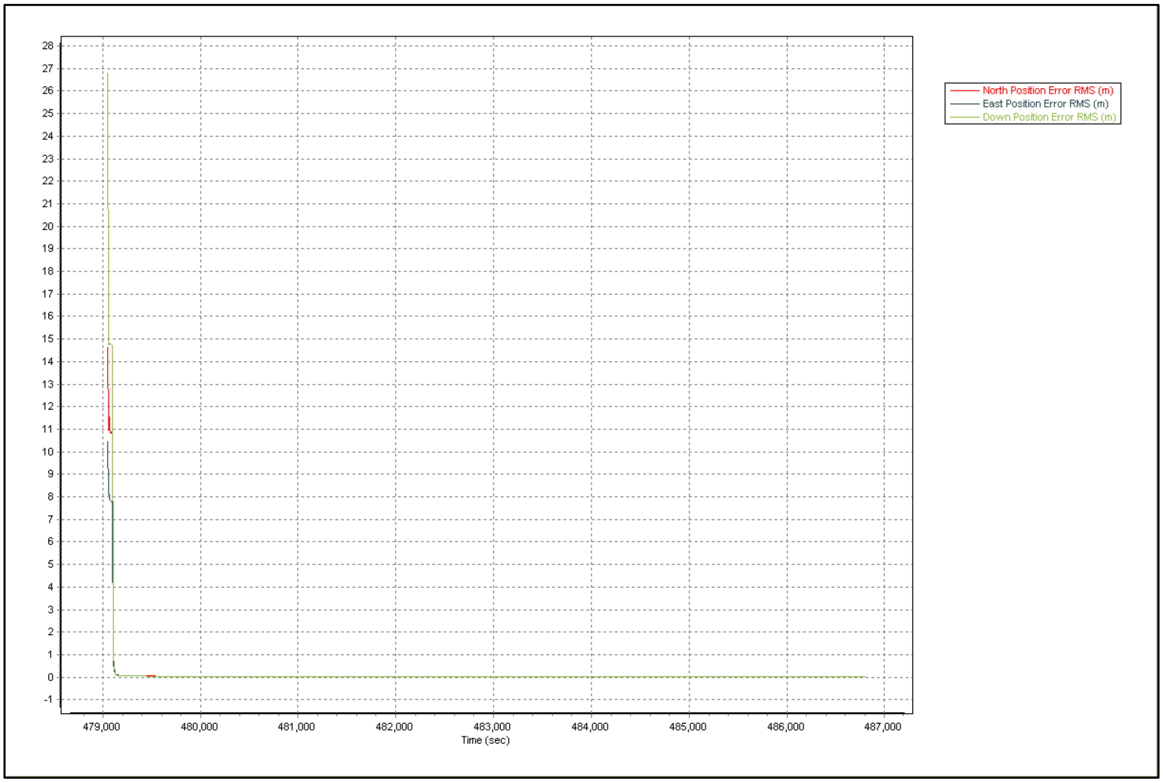
101208B-247_SVS&PDOP



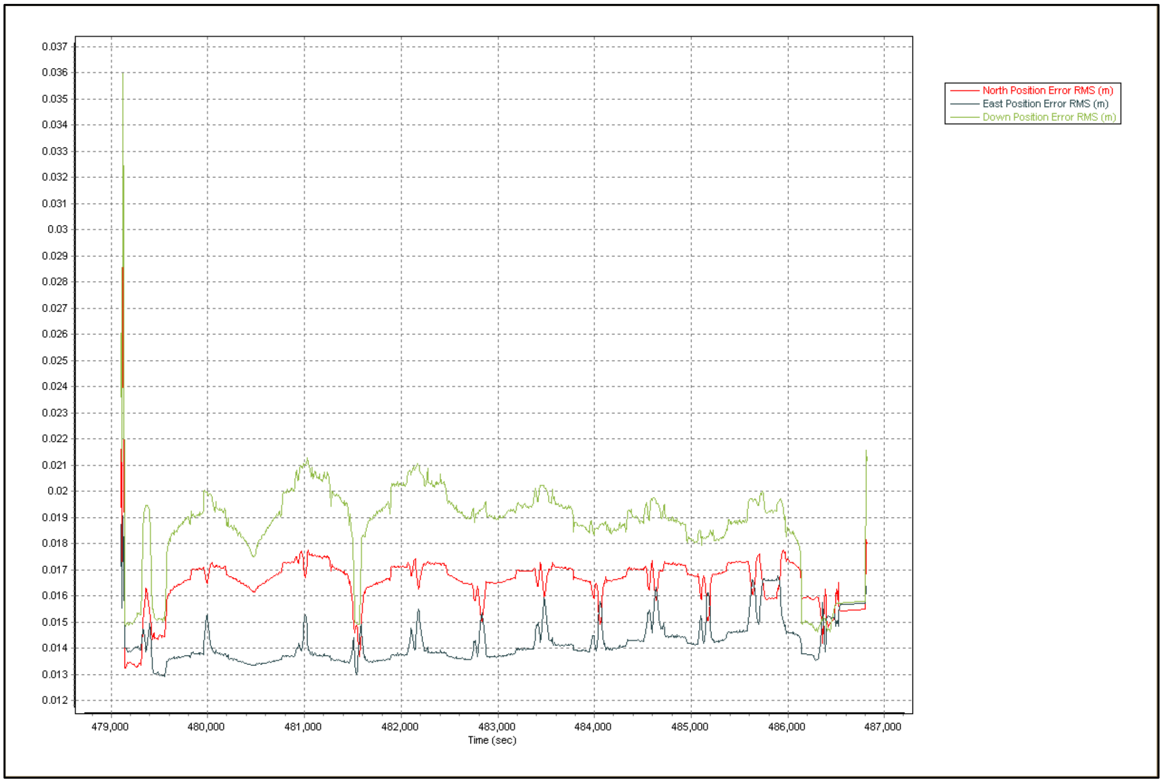
101210A-246-BASELINELENGTH



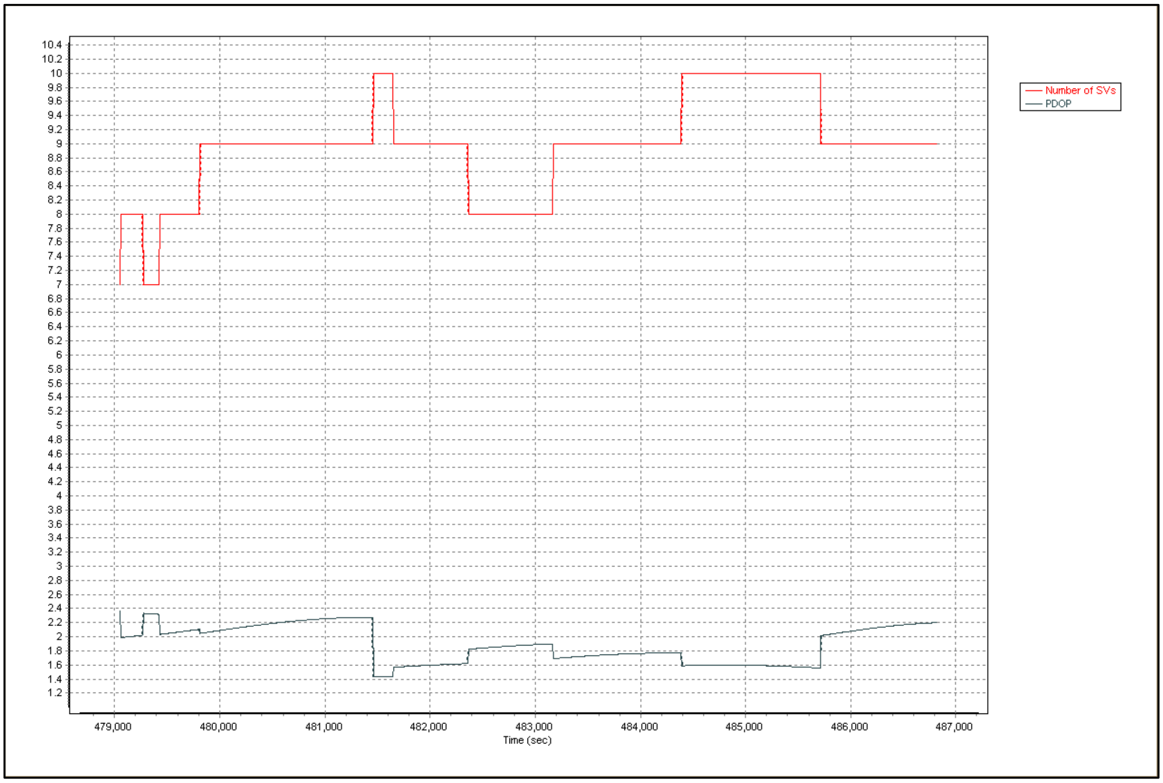
101210A-246-NEDPOSITIONERROR-FORWARD



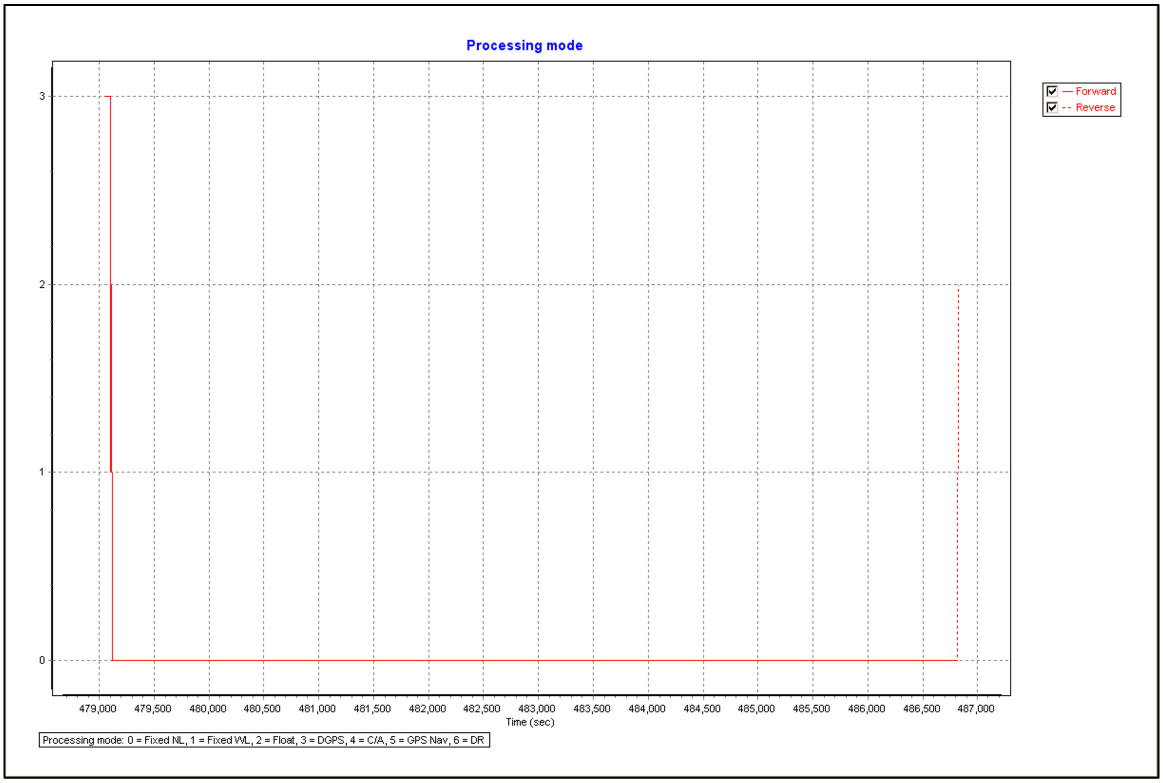
101210A-246-NEDPOSITIONERROR-SMOOTHED



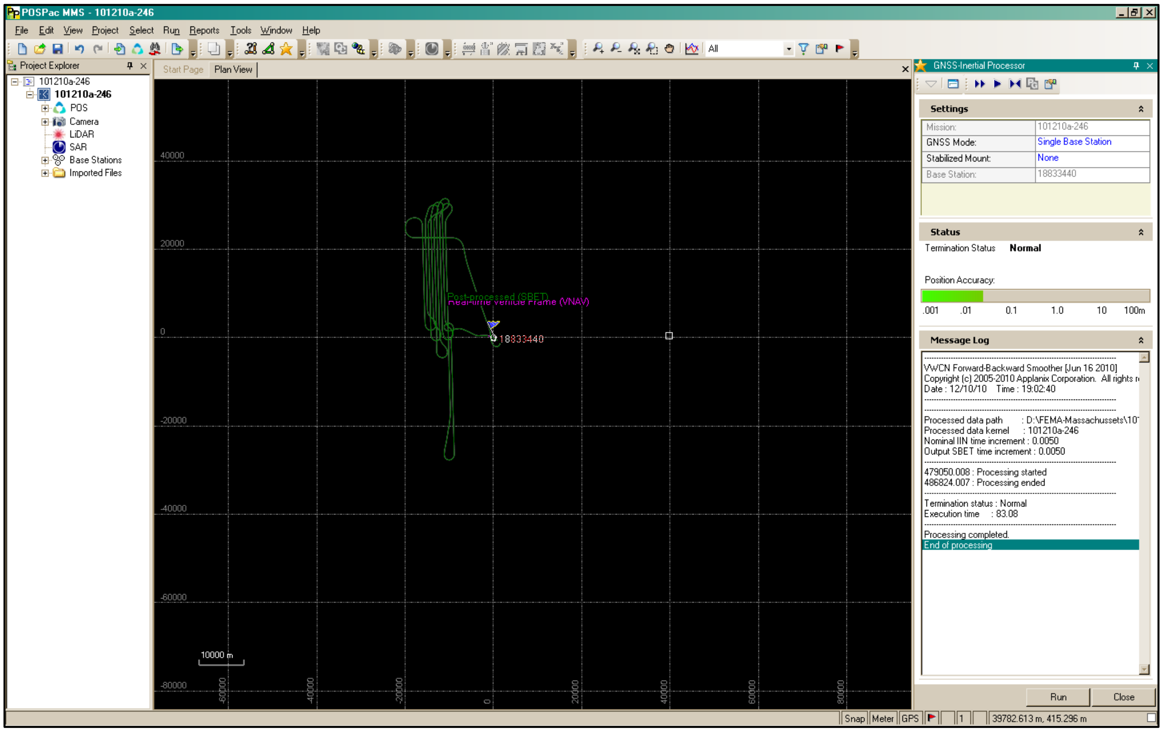
101210A-246-PDOP&SVS



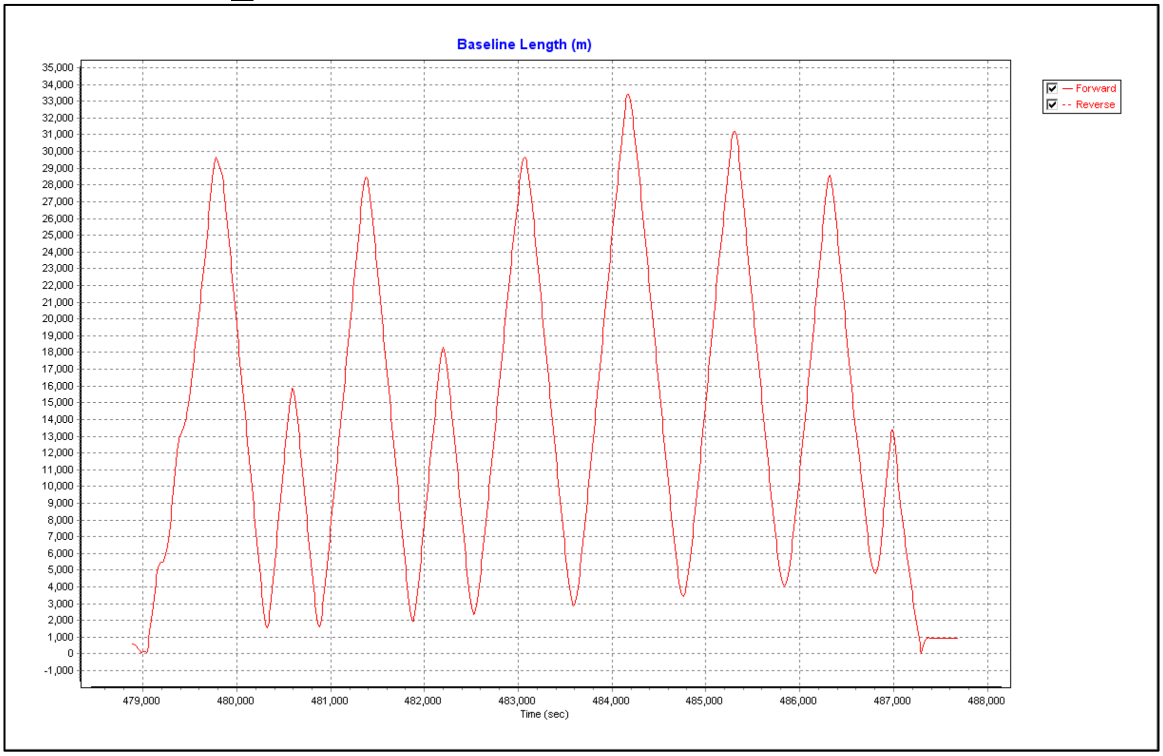
101210A-246-PROCMODE



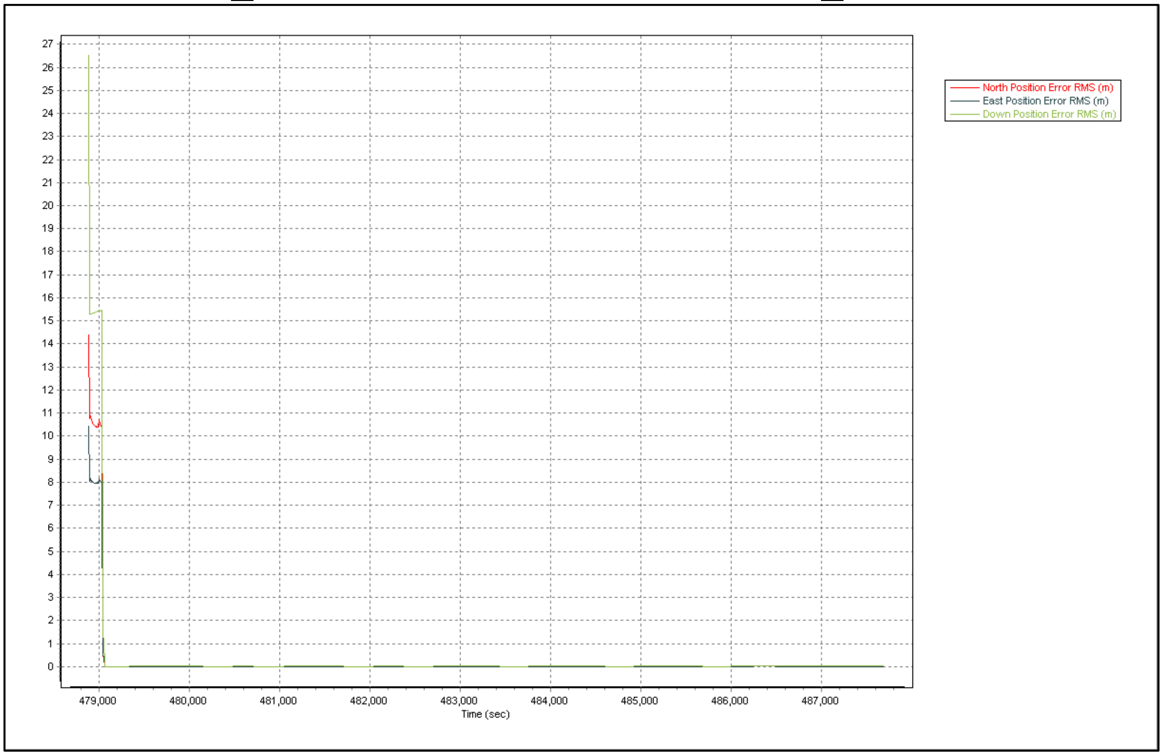
101210A-246-TRAJECTORY



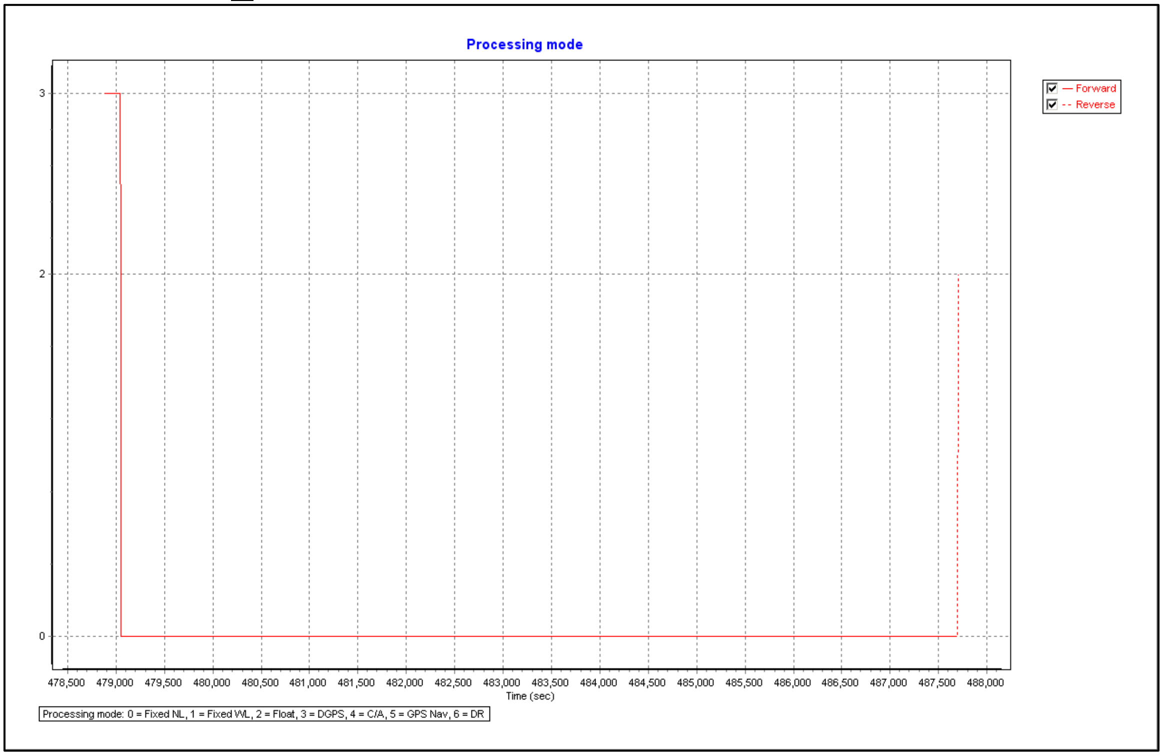
101210A-247_BASELINE



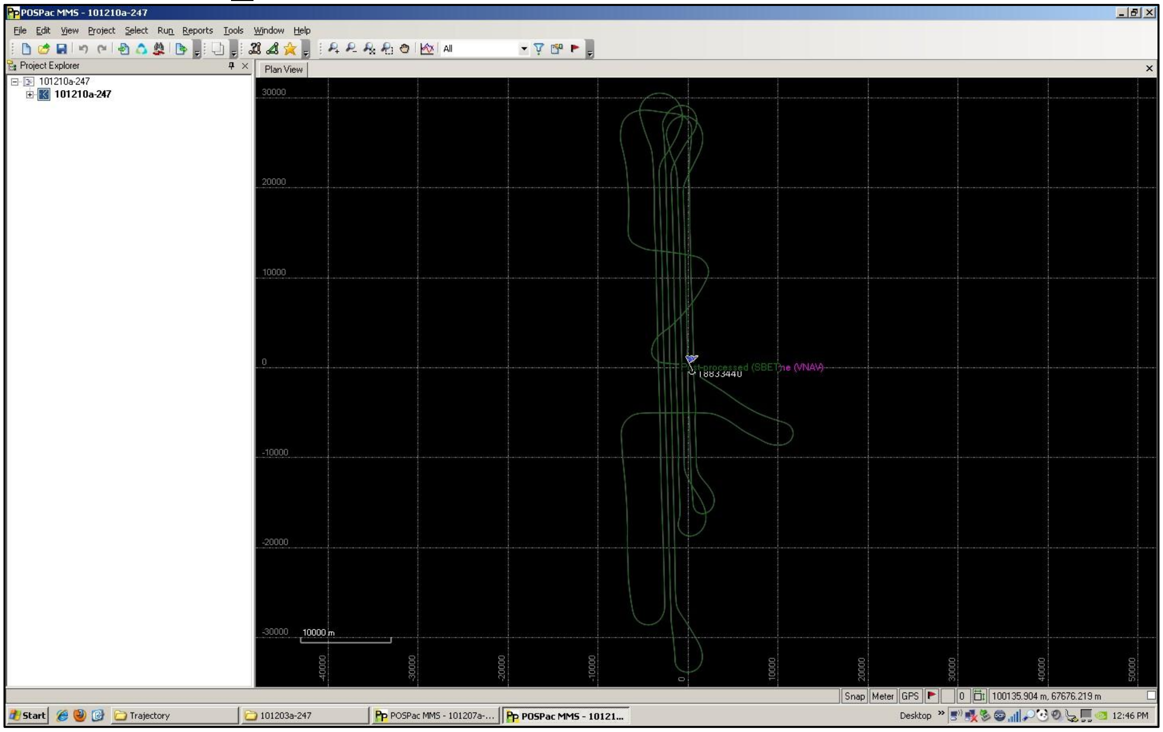
101210A-247_FORWARDPROCPERFSMETRIC_NED



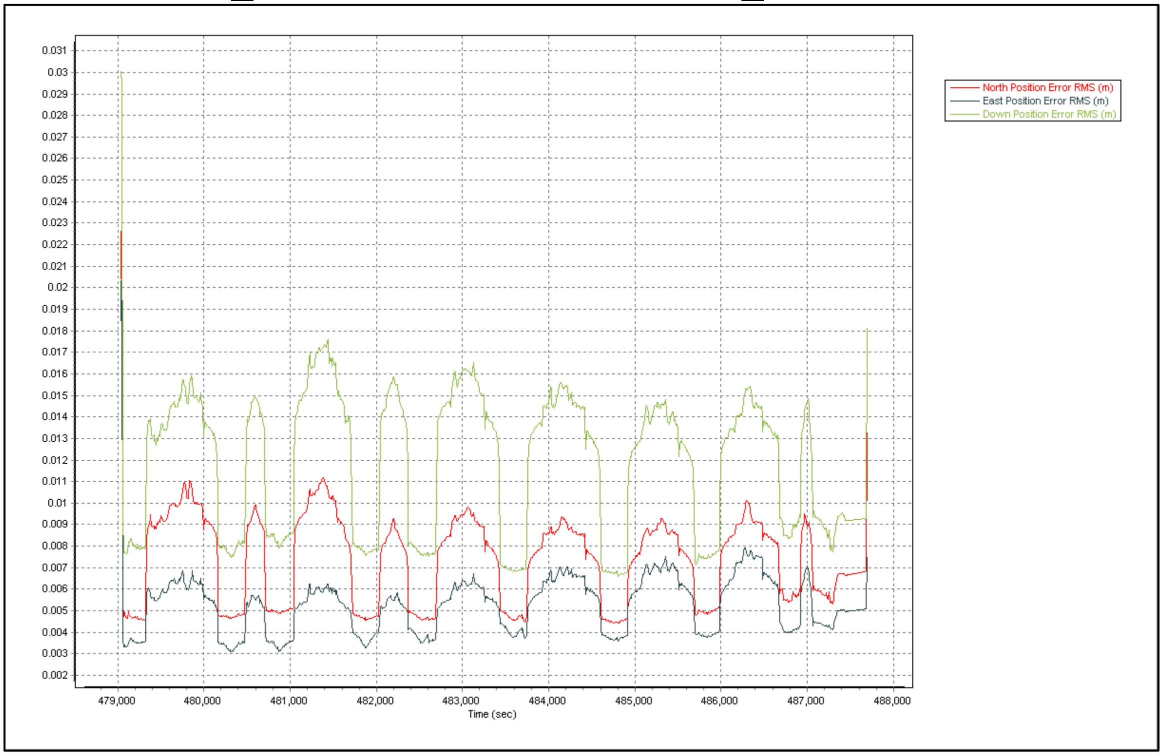
101210A-247_PROCESSMODE



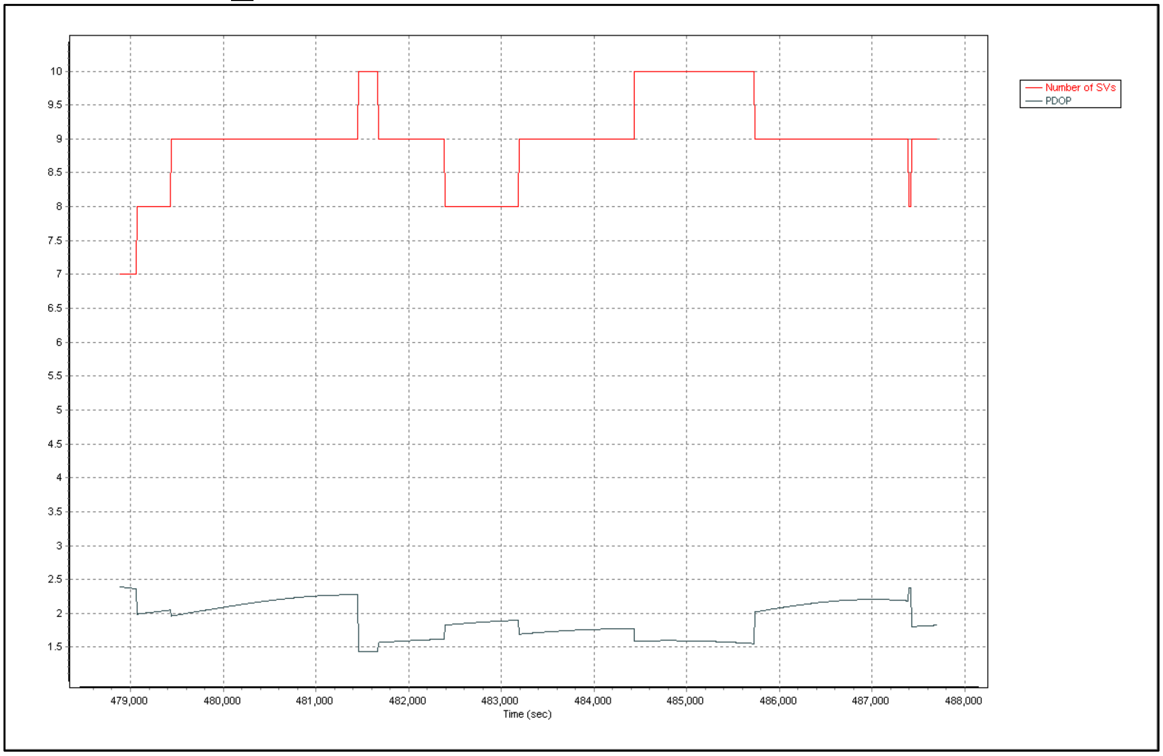
101210A-247_SCREENSHOT



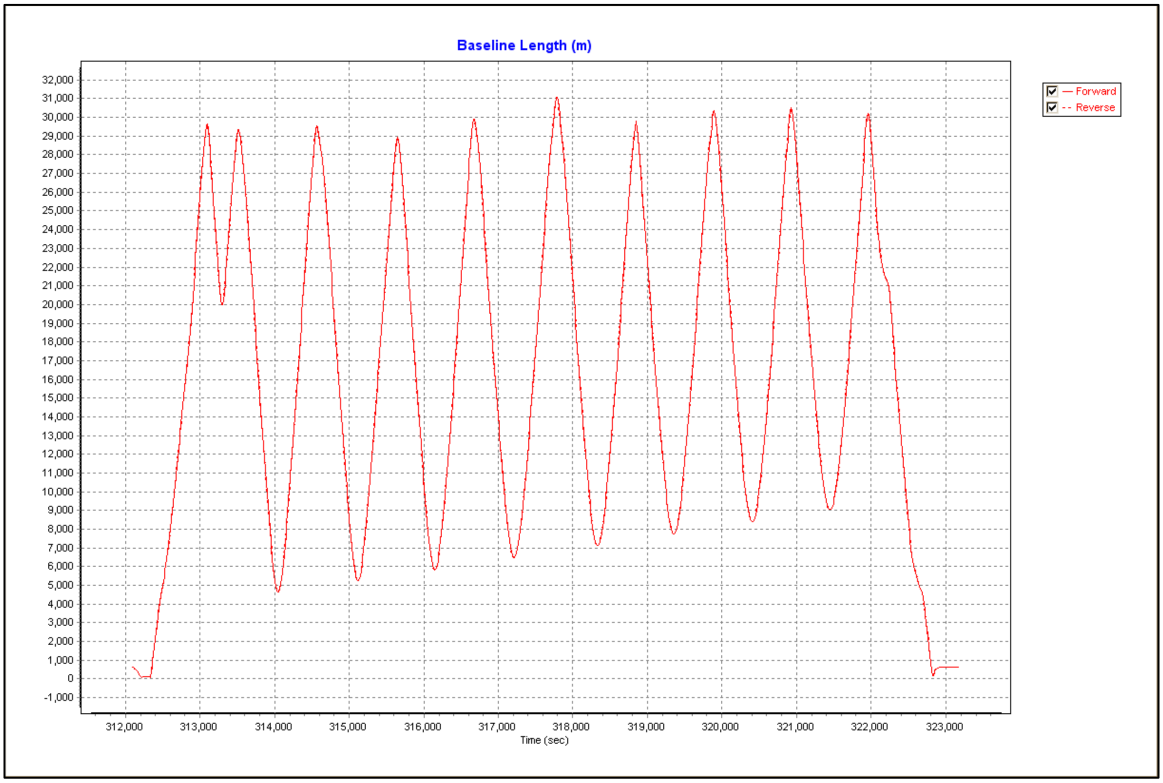
101210A-247_SMOOTHPROCESSMETRIC_NED



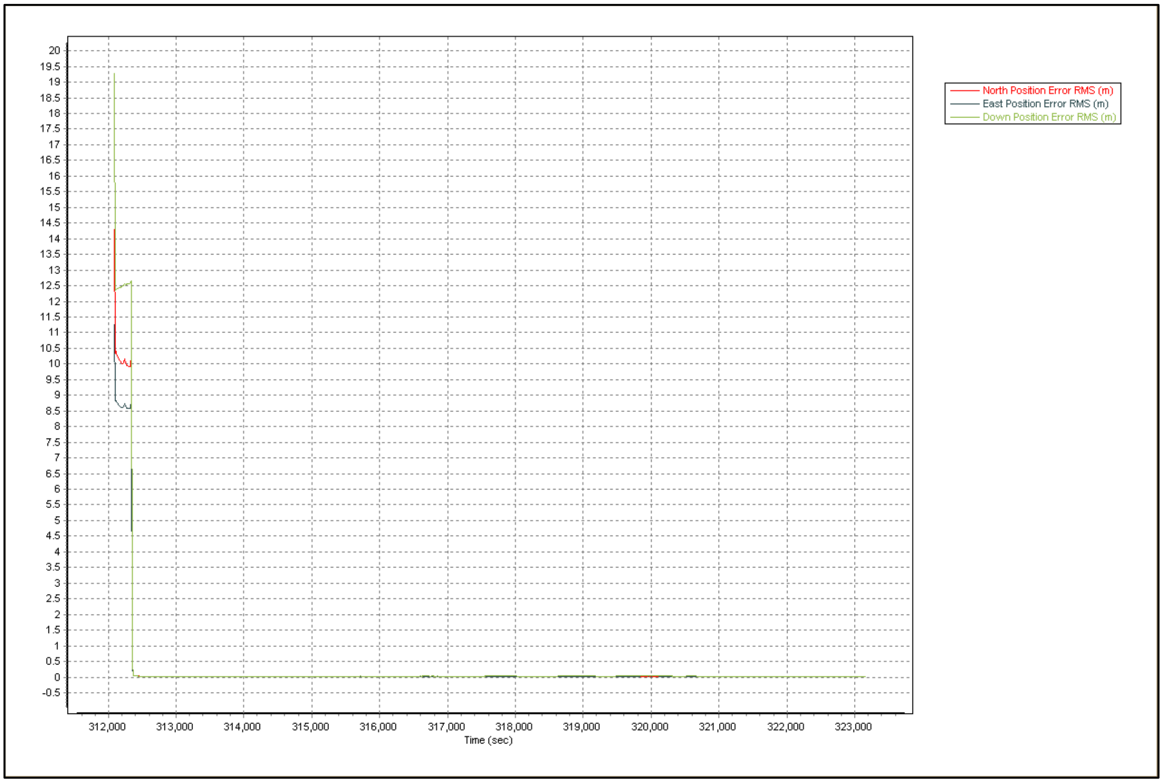
101210A-247_SVS&PDOP



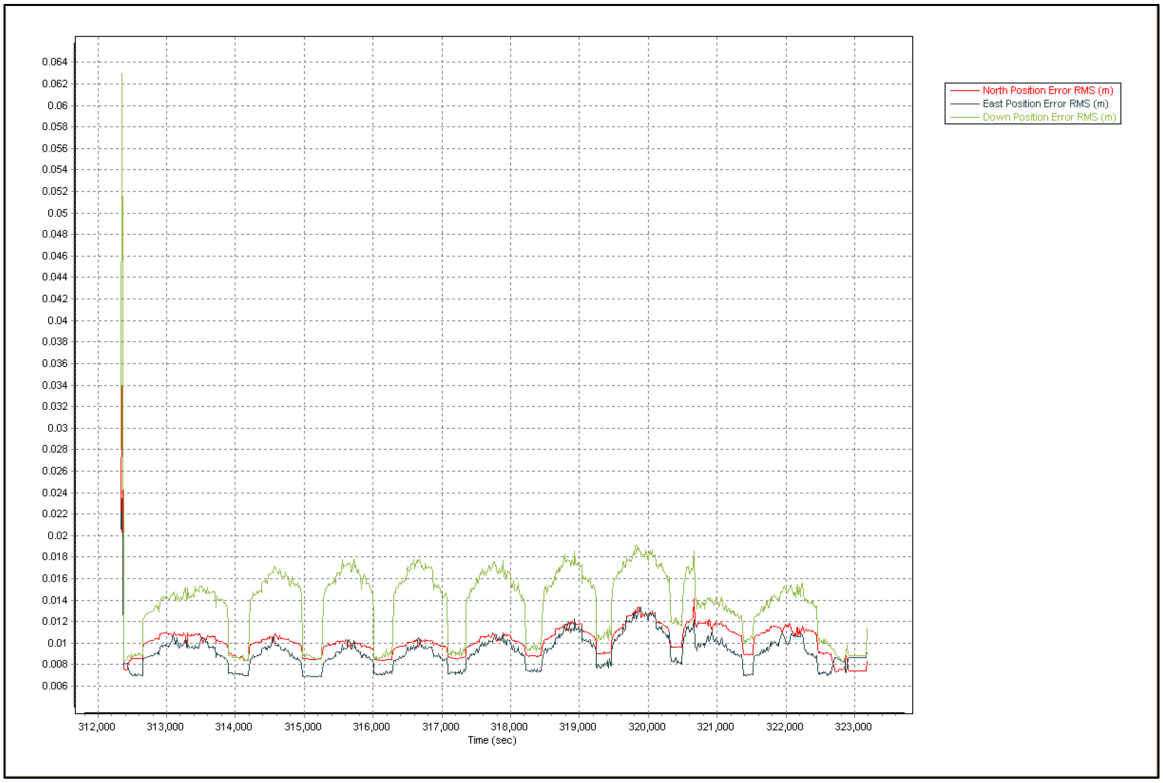
101208A-246-BASELINELENGTH



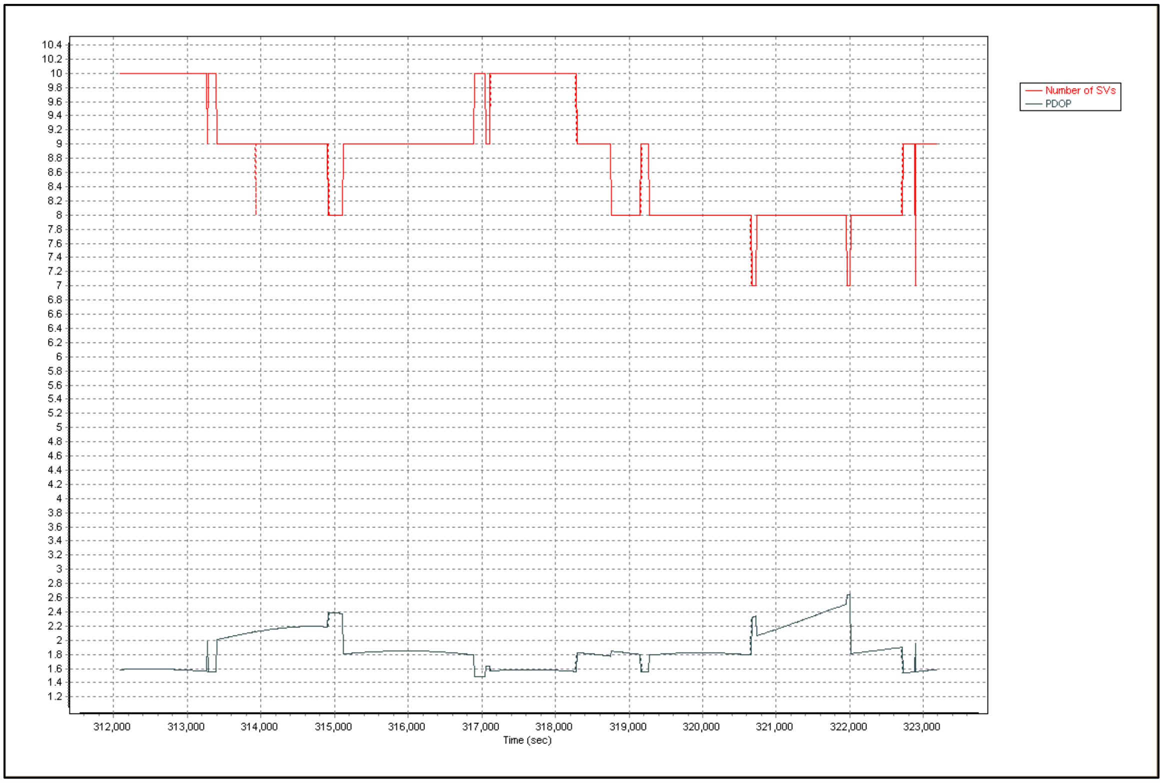
101208A-246-NEDPOSITIONERROR-FORWARD



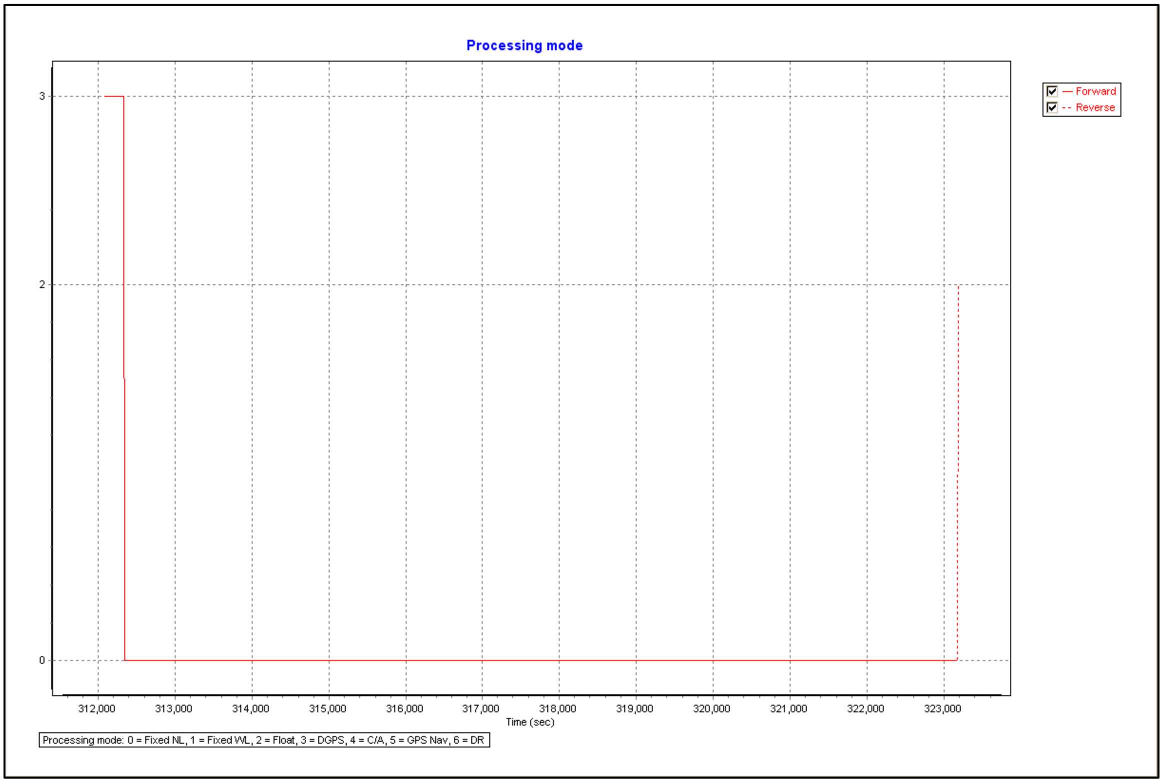
101208A-246-NEDPOSITIONERROR-SMOOTHED



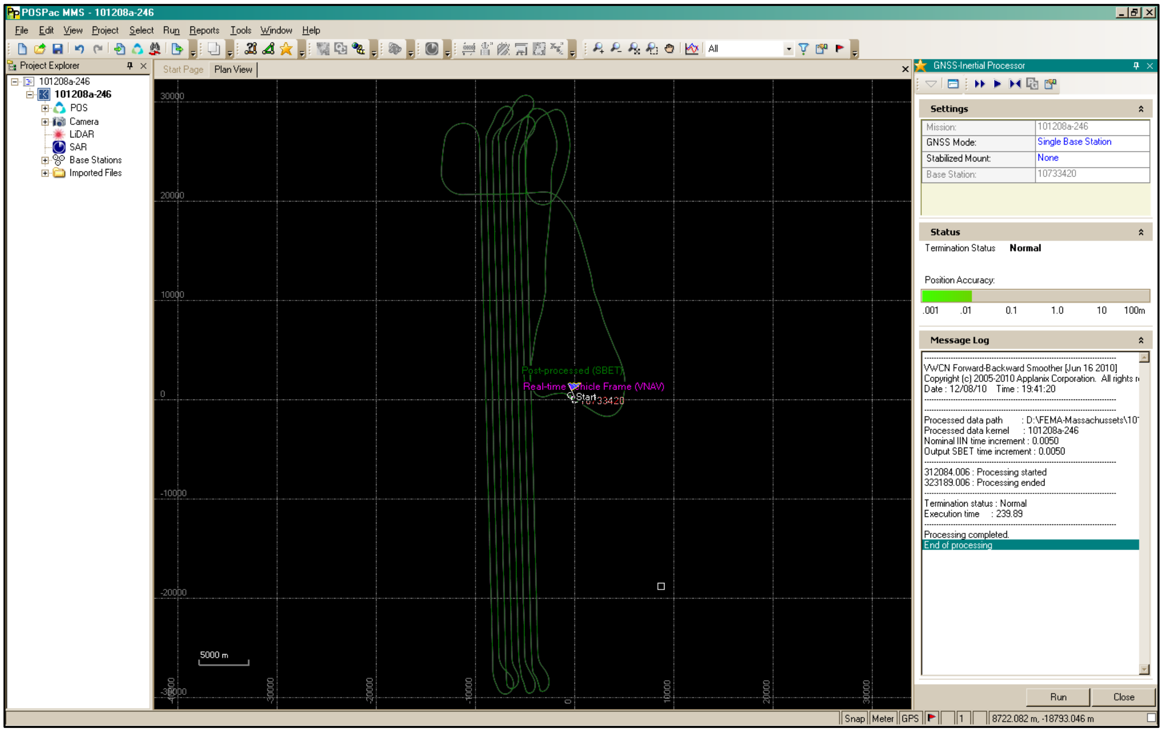
101208A-246-PDOP&SVS



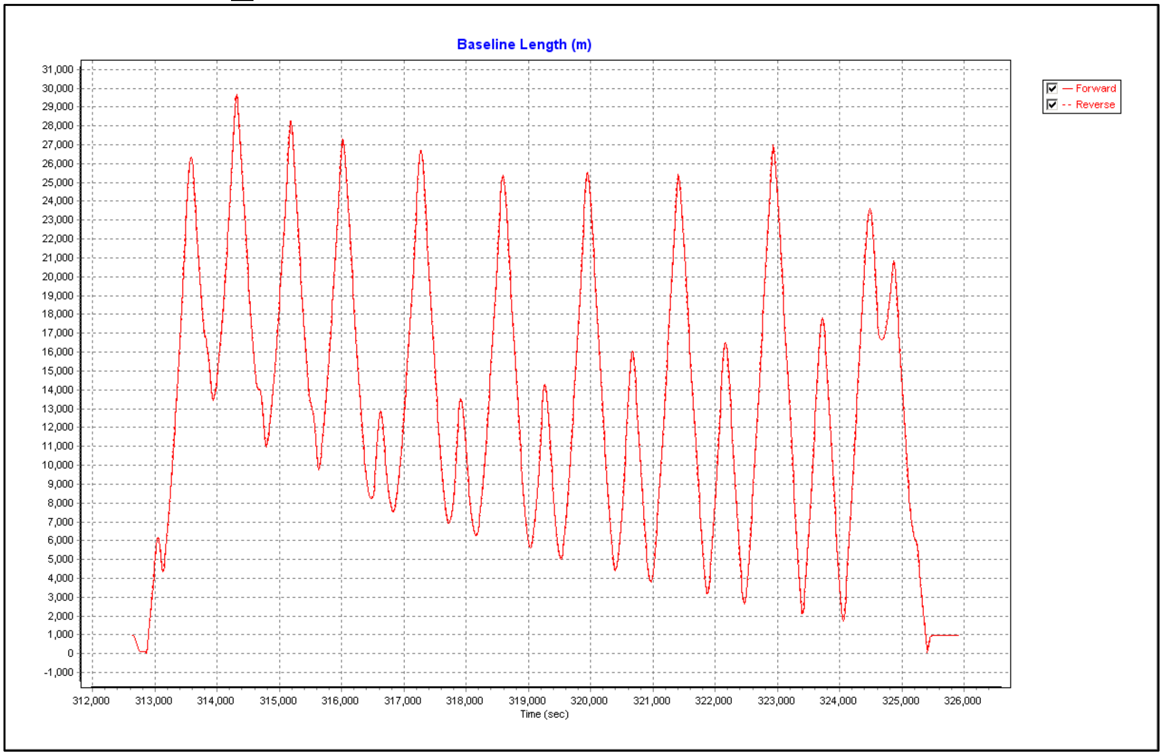
101208A-246-PROCMODE



101208A-246-TRAJECTORY



101208A-247_BASELINE



101208A-247_FORWARDPROCPERFMETRIC_NED

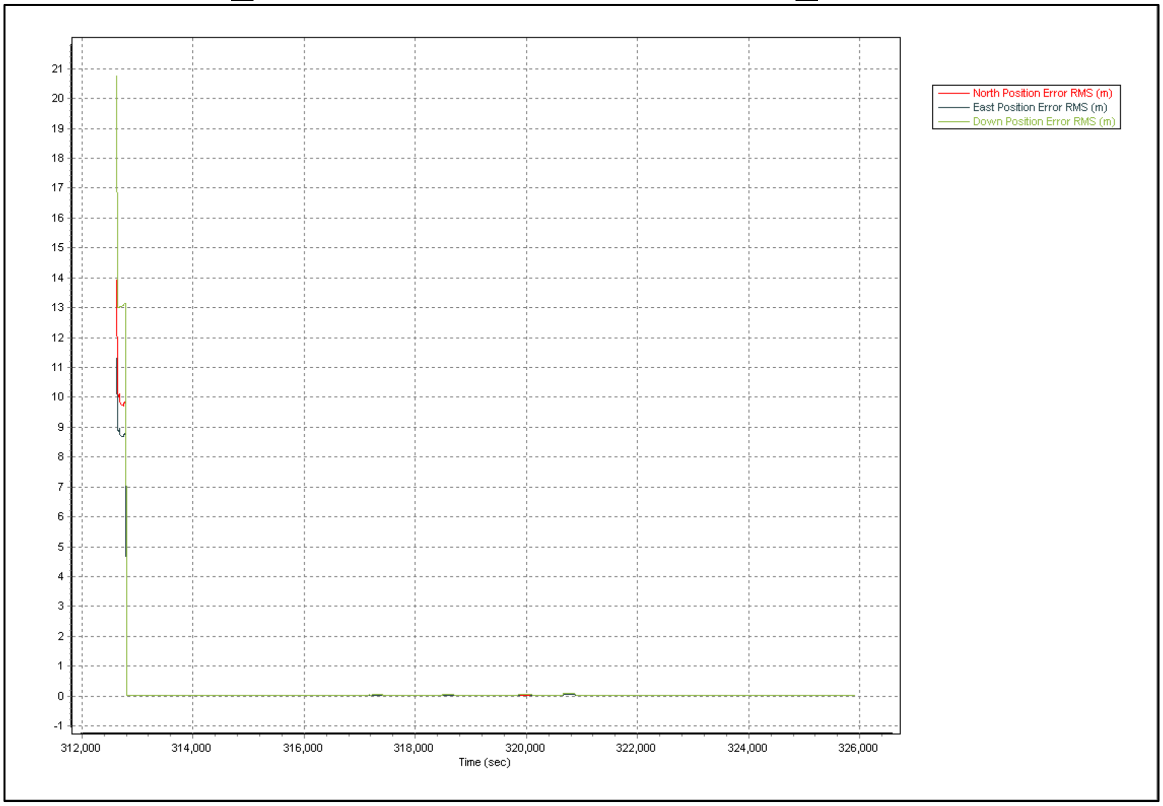


PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive
Lexington, Kentucky 40503
Phone 859-277-8700 + Fax 859-277-8901
www.photoscience.com

March 29, 2011

Post Flight Report
PSI Project 7556-005
SFZ_Blackstone LiDAR

CONTRACT: ______________________
Client: ____________________________
Project Name: SFZ Blackstone sub-block
Attached Reference file: *7556-005_SFZ-Blackstone_MA_Background.ZIP*

General Specifications: 1-meter nominal spacing LiDAR Acquisition and processing with a 24.5 cm vertical accuracy at 95% confidence level.

Acquisition Dates: LiDAR data for the SFZ_Blackstone data was acquired on the dates of 12/15, 12/16 and 12/17 2010 over 5 lifts by two different Aircraft.

Equipment Used: The data was collected with Optech Gemini LiDAR systems, Serial Numbers 246 and 247; Base GPS Receiver used was a Trimble 5700 collecting data at half second intervals. The aircraft used were Cessna 206 models, tail numbers N2448G and N7266Z. The pilots were Mark Young and Nick Greenwell and the Operators were Jeremy Berry and Nathan Galieti. The Base Station was set on the monument "Central, LW0418" at the North Central State Airport (SFZ) and was set by the flight crew.

Project: The project consisted of 40 flight lines of 355.00 miles. The project was flown at an altitude of 5,000 feet above ground and at a planned average speed of 116 knots with a field of view of 36 degrees. The scan rates used was 30.1 Hz with a Laser Pulse Rate of 71,429 Hz with Multi-Pulse enabled. The full swath width was 989.18 meters with a planned sidelap of 30%. The point spacing was <1 meter with a NADIR point density of 1.2 points per square meter and an average point density of 3.03 points per square meter. The planned vertical accuracy was 0.13 meters. The area consisted of 155 square miles.

GPS Base Station / Monument:. The Base Station was set on the monument "Central, LW0418" at the North Central State Airport (SFZ) and was set by the flight crew. Information on this monument is included in the attached .ZIP file under "Base Station Data".

Control: 17 control points were collected as part of the project and used to calibrate the project data, remove any bias and verify accuracy. This data is compared to the collected model and results indicated below. This control data in included in the attached .ZIP file under "Control".

Flight Files: The planned flight files are included as reference in the attached .ZIP file under "Flight Files".

Flight Logs: Flight Logs used by the crew are included in the attached .ZIP file under "Flight Logs" and include the following type information:

- job #/name
- block or AOI
- date (s) flown
- aircraft tail #
- lines - #
- lines - direction
- lines – altitude
- lines – speed
- conditions
- comments
- pilot name
- operator name
- AGC switch
- GPS base station used

Processing Summary: Data is included in the attached .ZIP file under "Processing Summary" which includes GPS / IMU processing summary data including at a minimum:

- Processing Logs
- Message Logs
- Extract Logs
- Laser configuration files for each lift
- Max Horizontal GPS Variance (cm)
- Max Vertical GPS Variance (cm)
- Notes on GPS quality (High, Good, etc.)
- GPS separation plot
- GPS altitude plot
- PDOP plot
- Plot of GPS distance from base station/s

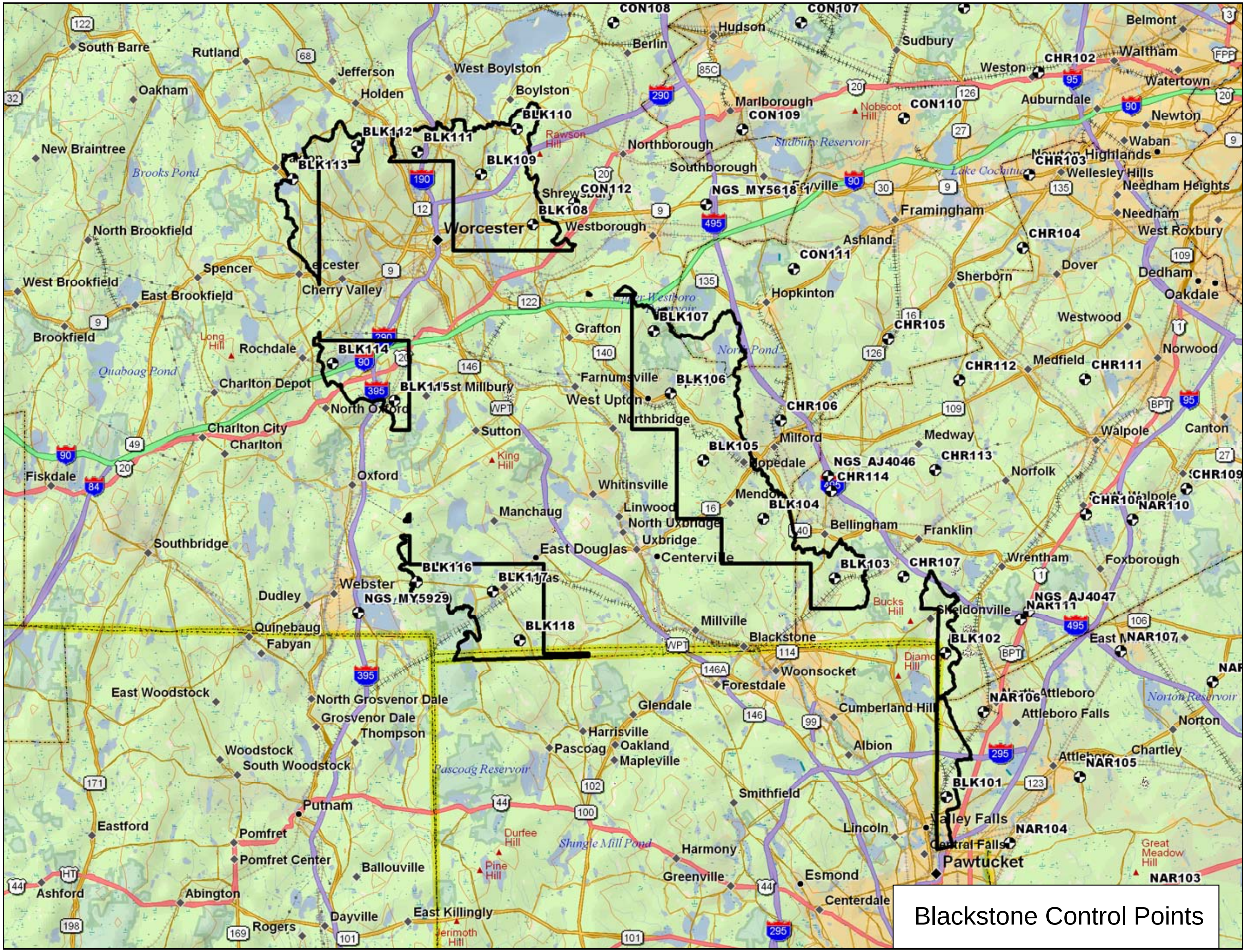
Project Coverage: within the attached .ZIP file in the "Project Coverage" directory is the overall boundary Shape File and the as flown trajectory Shape Files which include the project calibration flight lines (cross flights).

Accuracy: The LiDAR data was tested against the Control check points indicated above and the results are included in the "Accuracy Results" directory in the attached .ZIP file.

The LiDAR data as collected tested at 0.095 (meters) fundamental vertical accuracy at 95% confidence level. Within the accuracies indicated in the specifications, as provided.

Sincerely,

Forrest Godby
Senior Project Manager / Flight Operations Manager



Scale 1 : 350,000

1" = 5.52 mi

Data Zoom 9-2

SFZ_Blackstone Base Monument

See file dsdata.txt for more information about the datasheet.

```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1         National Geodetic Survey,   Retrieval Date = NOVEMBER 29, 2010
 LW0418 ***********************************************************************
 LW0418  FBN          -  This is a Federal Base Network Control Station.
 LW0418  DESIGNATION -  CENTRAL
 LW0418  PID         -  LW0418
 LW0418  STATE/COUNTY-  RI/PROVIDENCE
 LW0418  USGS QUAD   -  PAWTUCKET (1975)
 LW0418
 LW0418                         *CURRENT SURVEY CONTROL
 LW0418  ___________________________________________________________________
 LW0418* NAD 83(2007)-  41 55 08.78493(N)    071 29 16.22822(W)     ADJUSTED
 LW0418* NAVD 88     -       141.913  (meters)     465.59   (feet)  ADJUSTED
 LW0418  ___________________________________________________________________
 LW0418  EPOCH DATE  -        2002.00
 LW0418  X           -   1,509,134.136 (meters)                     COMP
 LW0418  Y           -  -4,507,147.660 (meters)                     COMP
 LW0418  Z           -   4,238,997.637 (meters)                     COMP
 LW0418  LAPLACE CORR-           4.05  (seconds)                    DEFLEC09
 LW0418  ELLIP HEIGHT-         112.555 (meters)          (02/10/07) ADJUSTED
 LW0418  GEOID HEIGHT-         -29.37  (meters)                     GEOID09
 LW0418  DYNAMIC HT  -         141.869 (meters)     465.45  (feet)  COMP
 LW0418
 LW0418  ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
 LW0418  Type    PID    Designation                     North   East  Ellip
 LW0418  -------------------------------------------------------------------
 LW0418  NETWORK LW0418 CENTRAL                          0.51   0.39   1.20
 LW0418  -------------------------------------------------------------------
 LW0418  MODELED GRAV-     980,308.1   (mgal)                      NAVD 88
 LW0418
 LW0418  VERT ORDER  -  SECOND    CLASS 0
 LW0418
 LW0418.This mark is at North Central State Airport (SFZ)
 LW0418
 LW0418.The horizontal coordinates were established by GPS observations
 LW0418.and adjusted by the National Geodetic Survey in February 2007.
 LW0418
 LW0418.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
 LW0418.See National Readjustment for more information.
 LW0418.The horizontal coordinates are valid at the epoch date displayed above.
 LW0418.The epoch date for horizontal control is a decimal equivalence
 LW0418.of Year/Month/Day.
 LW0418
 LW0418.The orthometric height was determined by differential leveling and
 LW0418.adjusted in June 1991.
 LW0418
 LW0418.Photographs are available for this station.
 LW0418
 LW0418.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 LW0418
 LW0418.The Laplace correction was computed from DEFLEC09 derived deflections.
```

```
LW0418
LW0418.The ellipsoidal height was determined by GPS observations
LW0418.and is referenced to NAD 83.
LW0418
LW0418.The geoid height was determined by GEOID09.
LW0418
LW0418.The dynamic height is computed by dividing the NAVD 88
LW0418.geopotential number by the normal gravity value computed on the
LW0418.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
LW0418.degrees latitude (g = 980.6199 gals.).
LW0418
LW0418.The modeled gravity was interpolated from observed gravity values.
LW0418
LW0418;                   North         East     Units Scale Factor Converg.
LW0418;SPC RI       -    92,823.524   101,008.637   MT  0.99999376   +0 00 29.2
LW0418;SPC RI       -   304,538.51    331,392.50   sFT  0.99999376   +0 00 29.2
LW0418;UTM  19      - 4,643,788.144   293,695.093   MT  1.00012376   -1 39 45.6
LW0418
LW0418!             -  Elev Factor  x  Scale Factor =   Combined Factor
LW0418!SPC RI       -   0.99998235  x   0.99999376  =   0.99997611
LW0418!UTM  19      -   0.99998235  x   1.00012376  =   1.00010610
LW0418
LW0418:                Primary Azimuth Mark                     Grid Az
LW0418:SPC RI       -  CENTRAL AZ MK 2                          284 02 20.3
LW0418:UTM  19      -  CENTRAL AZ MK 2                          285 42 35.1
LW0418
LW0418|---------------------------------------------------------------------|
LW0418| PID    Reference Object                     Distance      Geod. Az  |
LW0418|                                                           dddmmss.s |
LW0418| LW0417 CENTRAL RM 1                          16.942 METERS 03324     |
LW0418| CS6847 GREENVILLE WATER DIST TANK                         2434958.3 |
LW0418| LW2763 AIRPORT BCN N CENTRAL ST APT         181.893 METERS 27719     |
LW0418| LW1771 CENTRAL AZ MK 2                      APPROX. 0.7 KM 2840249.5 |
LW0418| LW0421 CENTRAL AZ MK                                      2962952.9 |
LW0418| LW0419 CENTRAL RM 2                          16.661 METERS 30524     |
LW0418| LW1769 NORTH CENTRAL CBL 900                480.129 METERS 3083751.7 |
LW0418|---------------------------------------------------------------------|
LW0418
LW0418                          SUPERSEDED SURVEY CONTROL
LW0418
LW0418  ELLIP H (06/22/01)  112.528  (m)                        GP(       ) 4 1
LW0418  NAD 83(1996)-  41 55 08.78524(N)    071 29 16.22880(W) AD(       ) B
LW0418  ELLIP H (07/24/97)  112.510  (m)                        GP(       ) 1 1
LW0418  NAD 83(1992)-  41 55 08.78369(N)    071 29 16.22790(W) AD(       ) B
LW0418  ELLIP H (04/16/93)  112.480  (m)                        GP(       ) 4 1
LW0418  NAD 83(1986)-  41 55 08.78250(N)    071 29 16.22742(W) AD(       ) 1
LW0418  NAD 27      -  41 55 08.42594(N)    071 29 18.01019(W) AD(       ) 1
LW0418  NAVD 88 (04/16/93)  141.91   (m)          465.6    (f) LEVELING    3
LW0418  NGVD 29 (??/??/92)  142.153  (m)          466.38   (f) ADJ UNCH    2 0
LW0418
LW0418.Superseded values are not recommended for survey control.
LW0418.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
LW0418.See file dsdata.txt to determine how the superseded data were derived.
LW0418
LW0418_U.S. NATIONAL GRID SPATIAL ADDRESS: 19TBG9369543788(NAD 83)
LW0418_MARKER: DH = HORIZONTAL CONTROL DISK
LW0418_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
```

```
LW0418_SP_SET: CONCRETE POST
LW0418_STAMPING: CENTRAL 1968
LW0418_MARK LOGO: CGS
LW0418_MAGNETIC: N = NO MAGNETIC MATERIAL
LW0418_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
LW0418+STABILITY: SURFACE MOTION
LW0418_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
LW0418+SATELLITE: SATELLITE OBSERVATIONS - August 10, 2010
LW0418
LW0418  HISTORY     - Date     Condition        Report By
LW0418  HISTORY     - 1968     MONUMENTED       CGS
LW0418  HISTORY     - 1969     GOOD             NGS
LW0418  HISTORY     - 1975     GOOD             LOCENG
LW0418  HISTORY     - 1978     GOOD             NGS
LW0418  HISTORY     - 1985     GOOD             RIGS
LW0418  HISTORY     - 1985     GOOD             RIGS
LW0418  HISTORY     - 1987     GOOD             RIGS
LW0418  HISTORY     - 19880601 GOOD             NGS
LW0418  HISTORY     - 19890402 GOOD             RIGS
LW0418  HISTORY     - 19920506 GOOD             NGS
LW0418  HISTORY     - 19920630 GOOD             NGS
LW0418  HISTORY     - 19991206 GOOD             WOOLPT
LW0418  HISTORY     - 20000610 GOOD             NGS
LW0418  HISTORY     - 20030519 GOOD             INDIV
LW0418  HISTORY     - 20100810 GOOD             PB
LW0418
LW0418                          STATION DESCRIPTION
LW0418
LW0418'DESCRIBED BY COAST AND GEODETIC SURVEY 1968 (LMC)
LW0418'STATION IS LOCATED ABOUT 7-1/2 MILES NORTHWEST OF PROVIDENCE, 6 MILES
LW0418'SOUTH OF WOONSOCKET, 1-1/2 MILES WEST OF STATE HIGHWAY 146 AND 0.1
LW0418'MILE EAST OF THE NORTH CENTRAL STATE AIRPORT TERMINAL BUILDING.
LW0418'
LW0418'TO REACH FROM THE JUNCTION OF STATE HIGHWAYS 116 AND 146 ABOUT 8
LW0418'MILES NORTH OF CENTER OF PROVIDENCE, GO WEST ON HIGHWAY 116 FOR 0.8
LW0418'MILES TO THE JUNCTION OF STATE HIGHWAY 123.  TURN LEFT AND GO SOUTH
LW0418'ON HIGHWAY 123 (ALBINO ROAD) FOR 0.95 MILE TO A SIDE ROAD LEFT.
LW0418'(TO REACH THE AZIMUTH MARK FROM HERE CONTINUE AHEAD SOUTH PASSING
LW0418'THROUGH HANGAR AREA FOR 0.2 MILE TO THE TERMINAL BUILDING AND A GATE
LW0418'ON THE RIGHT.  TURN RIGHT AND GO WEST PASSING THROUGH GATE AND
LW0418'CROSSING RUNWAYS FOR 0.3 MILE TO THE EDGE OF WOODS AND MARK ON
LW0418'RIGHT AS DESCRIBED.) BEAR LEFT KEEPING WITH HIGHWAY 123 AND
LW0418'GO EAST FOR 0.15 MILE TO A SIDE ROAD RIGHT LEADING TO THE NORTH
LW0418'CENTRAL STATE AIRPORT.  TURN RIGHT AND GO SOUTH FOR 0.15
LW0418'MILE TO STATION ON LEFT AS DESCRIBED.
LW0418'
LW0418'STATION MARK, STAMPED CENTRAL 1968 IS SET IN A ROUND CONCRETE POST
LW0418'WHICH IS FLUSH WITH THE GROUND SURFACE.  IT IS 98 FEET NORTH OF A
LW0418'PAVED ROAD, 74 FEET SOUTHEAST OF A PAVED ROAD AND 66.6 FEET EAST OF
LW0418'A METAL WITNESS POST.
LW0418'
LW0418'RM 1, STAMPED CENTRAL NO 1 1968 IS SET IN A DRILL HOLE IN A BOULDER
LW0418'WHICH PROJECTS ABOUT 4 INCHES ABOVE THE GROUND SURFACE AND IS 2 BY 4
LW0418'FOOT IN SIZE.  IT IS 104 FEET EAST OF A LONE TREE AND 53 FEET
LW0418'SOUTHEAST OF A PAVED ROAD.
LW0418'
LW0418'RM 2, STAMPED CENTRAL NO 2 1968 IS SET IN A DRILL HOLE IN A BOULDER
```

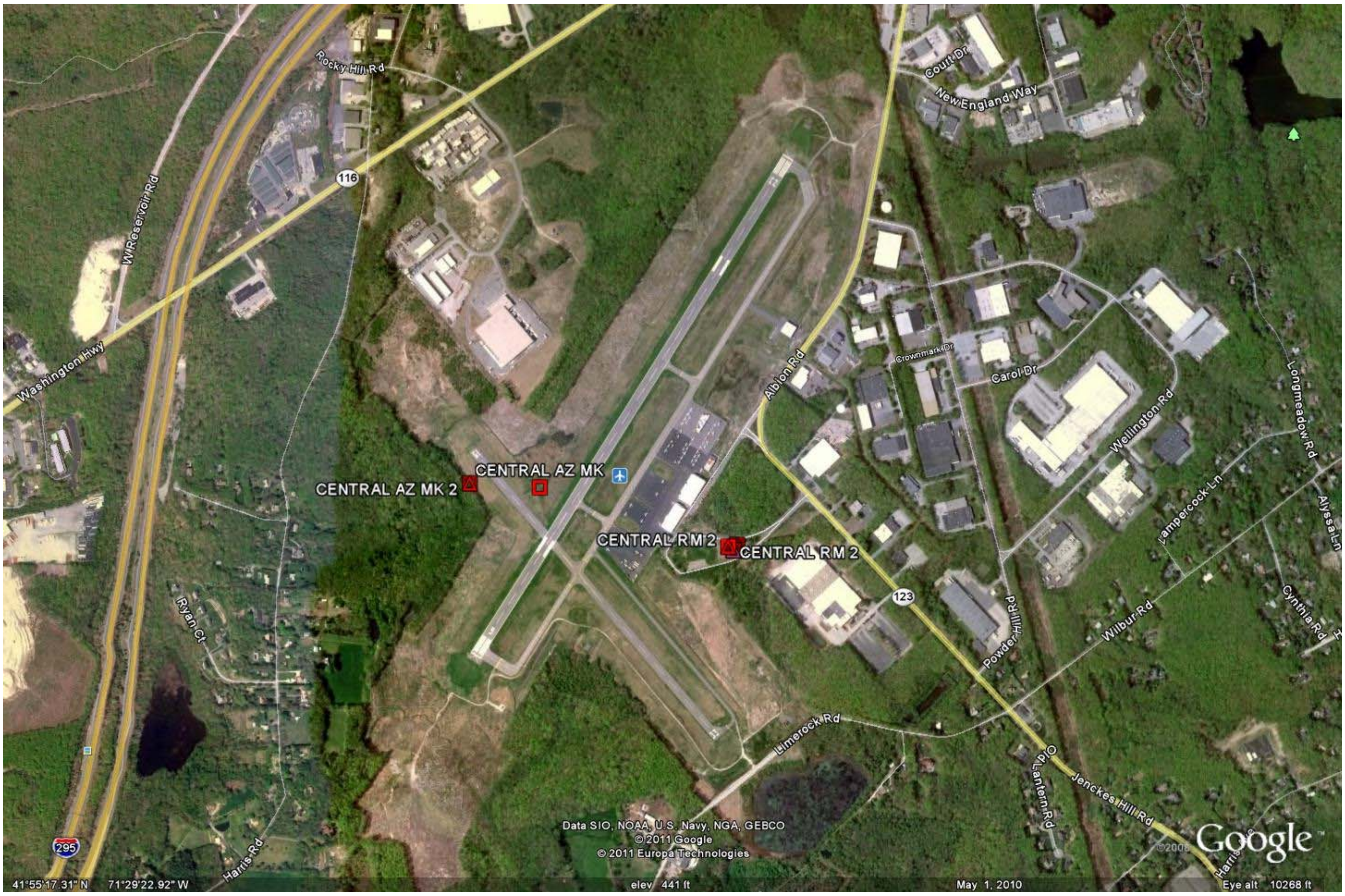
```
LW0418'WHICH PROJECTS ABOUT 4 FEET ABOVE THE GROUND SURFACE AND IS 5 BY 7
LW0418'FOOT IN SIZE.  IT IS 65 FEET SOUTHEAST OF A PAVED ROAD, 45 FEET
LW0418'EAST OF THE LONE TREE AND 13.9 FEET NORTHEAST OF A METAL WITNESS
LW0418'POST.
LW0418'
LW0418'AZ MK, STAMPED CENTRAL 1968 IS SET IN A DRILL HOLE IN A BOULDER
LW0418'WHICH PROJECTS 1 FOOT ABOVE THE GROUND SURFACE AND IS 5 BY 6 FOOT IN
LW0418'SIZE.  IT IS ABOUT 0.1 MILE WEST OF A NORTH-SOUTH RUNWAY, 0.05
LW0418'MILE NORTH OF AN EAST-WEST RUNWAY, 43 FEET SOUTHEAST OF A 12-INCH
LW0418'OAK TREE AND 3 FEET NORTHEAST OF A METAL WITNESS POST.
LW0418'
LW0418'HEIGHT OF LIGHT ABOVE STATION MARK 22 METERS.
LW0418
LW0418                          STATION RECOVERY (1969)
LW0418
LW0418'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1969
LW0418'9.4 MI NW FROM PROVIDENCE.
LW0418'ABOUT 7.4 MILES NORTH ALONG CHARLES STREET AND STATE HIGHWAY 146
LW0418'FROM THE INTERSTATE HIGHWAY 95 OVERPASS OVER CHARLES STREET,
LW0418'THENCE 0.8 MILE WEST ALONG STATE HIGHWAY 116, THENCE 1.1 MILES
LW0418'SOUTH ALONG STATE HIGHWAY 123, THENCE 0.15 MILE SOUTHWEST ALONG
LW0418'THE DRIVEWAY TO THE NORTH CENTRAL STATE AIRPORT, ABOUT 0.1
LW0418'MILE EAST OF THE ADMINISTRATION BUILDING, ON A HIGH BANK BETWEEN
LW0418'THE TWO DRIVES TO THE AIRPORT, 98.8 FEET NORTHEAST OF THE
LW0418'NORTHEAST CORNER OF A CATCH BASIN, 74 FEET NORTH OF THE CENTER
LW0418'LINE OF THE EASTBOUND LANE OF THE DRIVE, 8 FEET ABOVE THE
LW0418'LEVEL OF THE DRIVE AND SET IN THE TOP OF A CONCRETE POST
LW0418'FLUSH WITH THE GROUND.
LW0418
LW0418                          STATION RECOVERY (1975)
LW0418
LW0418'RECOVERY NOTE BY LOCAL ENGINEER (INDIVIDUAL OR FIRM) 1975
LW0418'STATION MARK WAS RECOVERED IN GOOD CONDITION.  THERE IS NO
LW0418'WITNESS POST, NONE NEEDED.
LW0418'
LW0418'RM 1 WAS RECOVERED IN GOOD CONDITION.  THERE IS NO LONE TREE.
LW0418'
LW0418'RM 2 WAS RECOVERED IN POOR CONDITION, NOT ABLE TO READ.
LW0418'
LW0418'AZIMUTH MARK WAS BLOCKED BY NEW CONSTRUCTION, STATE SETTING NEW
LW0418'ONE.
LW0418
LW0418                          STATION RECOVERY (1978)
LW0418
LW0418'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1978 (CLN)
LW0418'THE STATION MARK, REFERENCE MARKS 1 AND 2 AND THE AZIMUTH MARK WERE
LW0418'RECOVERED IN GOOD CONDITION.  A HANGAR WAS BUILT ON LINE TO THE
LW0418'AZIMUTH MARK SO AZIMUTH MARK 2 WAS ESTABLISHED AT THIS TIME WITH A
LW0418'POLARIS OBSERVATION.  THE DISTANCES AND DIRECTIONS TO THE REFERENCE
LW0418'MARKS CHECKED.  A NEW DESCRIPTION FOLLOWS.
LW0418'
LW0418'THE STATION IS LOCATED ABOUT 7.5 MILES NORTHWEST OF PROVIDENCE, 6
LW0418'MILES SOUTH OF WOONSOCKET AND 0.1 MILE EAST OF THE NORTH CENTRAL STATE
LW0418'AIRPORT TERMINAL BUILDING.
LW0418'
LW0418'TO REACH THE STATION FROM THE JUNCTION OF STATE HIGHWAYS 146 AND 116
LW0418'ABOUT 8 MILES NORTH OF PROVIDENCE, GO WEST ON HIGHWAY 116 FOR 0.8 MILE
```

```
LW0418'TO A CROSSROAD.  TURN LEFT AND GO SOUTH ON HIGHWAY 123 FOR 0.95 MILE
LW0418'TO A FORK.  TO REACH AZIMUTH MARKS FROM THIS POINT GO SOUTH ON THE
LW0418'PAVED ROAD FOR 0.2 MILE TO THE TERMINAL BUILDING.  TURN RIGHT THROUGH
LW0418'GATE AND GO WESTERLY CROSSING THE NORTHEAST-SOUTHWEST RUNWAY FOR ABOUT
LW0418'0.3 MILE TO THE AZIMUTH MARK ON THE RIGHT AND AZIMUTH MARK 2 ON THE
LW0418'LEFT.  TAKE THE LEFT FORK AND GO SOUTHEAST ON HIGHWAY 123 FOR 0.15
LW0418'MILE TO A SIDE ROAD RIGHT.  TURN RIGHT AND GO WESTERLY ON THE PAVED
LW0418'ROAD FOR 0.15 MILE TO THE MARK ON LEFT, IN MEDIAN OF ROADS.
LW0418'
LW0418'THE STATION MARK STAMPED---CENTRAL 1968---IS A STANDARD DISK SET IN
LW0418'THE TOP OF A 12-INCH CYLINDRICAL CONCRETE MONUMENT THAT IS FLUSH WITH
LW0418'THE GROUND SURFACE.  IT IS 98 FEET SOUTH OF THE CENTER OF A PAVED
LW0418'ROAD, 74 FEET NORTH OF THE CENTER OF A PAVED ROAD AND 52 FEET
LW0418'SOUTHEAST OF A METAL WITNESS POST.
LW0418'
LW0418'REFERENCE MARK 1 STAMPED---CENTRAL NO 1 1968---IS A STANDARD DISK
LW0418'CEMENTED IN A DRILL HOLE IN A BOULDER THAT PROJECTS 4 INCHES.  IT IS
LW0418'69 FEET EAST OF THE METAL WITNESS POST AND 54 FEET SOUTH OF THE
LW0418'CENTER OF THE NORTH PAVED ROAD.
LW0418'
LW0418'REFERENCE MARK 2 STAMPED---CENTRAL NO 2 1968---IS A STANDARD DISK
LW0418'CEMENTED IN A DRILL HOLE IN A BOULDER THAT PROJECTS 4 FEET.  IT IS 65
LW0418'FEET SOUTH OF THE CENTER OF THE NORTH PAVED ROAD AND 7.5 FEET
LW0418'WEST-SOUTHWEST OF THE METAL WITNESS POST.
LW0418'
LW0418'THE AZIMUTH MARK STAMPED---CENTRAL 1968---IS A STANDARD DISK CEMENTED
LW0418'IN A DRILL HOLE IN A BOULDER THAT PROJECTS 1-FOOT.  IT IS 0.05 MILE
LW0418'EAST-NORTHEAST OF THE NORTHWEST-SOUTHEAST RUNWAY, 43 FEET SOUTHWEST OF
LW0418'A 12-INCH OAK TREE AND 3 FEET SOUTHEAST OF A METAL WITNESS POST.
LW0418'
LW0418'AZIMUTH MARK 2 STAMPED---CENTRAL 1968 NO 2 1978---IS A STANDARD DISK
LW0418'CEMENTED IN A DRILL HOLE IN A BOULDER THAT PROJECTS 6 INCHES.  IT IS
LW0418'0.1 MILE NORTHWEST OF THE NORTHEAST-SOUTHWEST RUNWAY, 189 FEET
LW0418'WEST-SOUTHWEST OF THE NORTHWEST-SOUTHEAST RUNWAY EVEN WITH THE LIGHTS
LW0418'AND 4 FEET SOUTH-SOUTHEAST OF A METAL WITNESS POST.
LW0418
LW0418                          STATION RECOVERY (1985)
LW0418
LW0418'RECOVERY NOTE BY RHODE ISLAND GEODETIC SURVEY 1985 (RJP)
LW0418'THE STATION WAS RECOVERED AT THIS DATE.
LW0418'THE STATION MARK, REFERENCE MARKS 1 AND 2, AND AZIMUTH MARKS 1 AND 2,
LW0418'WERE RECOVERED AS DESCRIBED IN GOOD CONDITION. AZIMUTH MARK 1, SET IN
LW0418'1968, IS NO LONGER VISIBLE FROM GROUND.
LW0418'
LW0418'THE STATION IS A STANDARD NGS DISK
LW0418
LW0418                          STATION RECOVERY (1985)
LW0418
LW0418'RECOVERY NOTE BY RHODE ISLAND GEODETIC SURVEY 1985
LW0418'RECOVERED IN GOOD CONDITION.
LW0418
LW0418                          STATION RECOVERY (1987)
LW0418
LW0418'RECOVERY NOTE BY RHODE ISLAND GEODETIC SURVEY 1987 (GEC)
LW0418'THE DESIGNATED MARK WAS RECOVERED AS PREVIOUSLY DESCRIBED.
LW0418'
LW0418'RECOVERED BY THE RHODE ISLAND GEODETIC SURVEY.
```

```
LW0418
LW0418                          STATION RECOVERY (1988)
LW0418
LW0418'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1988
LW0418'THE STATION WAS RECOVERED IN GOOD CONDITION.  THE ORIGINAL DESCRIPTION
LW0418'WAS ADEQUATE WITH CHANGES IN A ROAD NAME, ALBION INSTEAD OF ALBINO AND
LW0418'CHANGES IN DIRECTIONS IN THE MEASUREMENTS.  A NEW DESCRIPTION FOLLOWS.
LW0418'THE STATION IS LOCATED ABOUT 12.1 KM (7.50 MI) NORTHWEST OF
LW0418'PROVIDENCE, 9.7 KM (6.05 MI) SOUTH OF WOONSOCKET, 2.4 KM (1.50 MI)
LW0418'WEST OF STATE HIGHWAY 146, AND 0.2 KM (0.10 MI) EAST OF THE NORTH
LW0418'CENTRAL STATE AIRPORT TERMINAL BUILDING.
LW0418'OWNERSHIP--STATE OF RHODE ISLAND, C/O AIRPORT MANAGER TED POLAK.
LW0418'PHONE 401-351-6800.
LW0418'TO REACH THE STATION FROM THE JUNCTION OF STATE HIGHWAYS 146 AND 116,
LW0418'ABOUT 12.9 KM (8.00 MI) NORTHWEST FROM THE CENTER OF PROVIDENCE, GO
LW0418'WEST FOR 1.3 KM (0.80 MI) ON HIGHWAY 116 TO THE JUNCTION OF STATE
LW0418'ROUTE 123, ALBION ROAD, ON THE LEFT.  TURN LEFT AND GO SOUTH FOR 1.5
LW0418'KM (0.95 MI) ON ROUTE 123 TO THE NORTH ENTRANCE ROAD TO THE AIRPORT ON
LW0418'THE RIGHT, AT A CURVE IN THE ROAD.  BEAR LEFT AND GO SOUTH FOR 0.2 KM
LW0418'(0.10 MI) ON ROUTE 123 TO THE MAIN ENTRANCE ROAD TO THE AIRPORT ON THE
LW0418'RIGHT.  TURN RIGHT AND GO WEST FOR 0.2 KM (0.10 MI) ON THE PAVED
LW0418'AIRPORT ROAD TO THE STATION ON THE LEFT, ON TOP OF A LOW, FLAT, GRASSY
LW0418'HILL IN THE CENTER OF THE CIRCULAR DRIVE.
LW0418'THE STATION IS A STANDARD CGS DISK STAMPED---CENTRAL 1968---, SET INTO
LW0418'THE TOP OF A ROUND CONCRETE MONUMENT 30 CM IN DIAMETER FLUSH WITH THE
LW0418'GROUND.  LOCATED 46.2 M (151.6 FT) WEST FROM THE SOUTHWEST CORNER OF A
LW0418'CHAIN LINK FENCE AROUND AN ANTENNA, 29.7 M (97.4 FT) SOUTH FROM THE
LW0418'CENTER OF THE ENTRANCE ROAD, AND 22.3 M (73.2 FT) NORTH FROM THE
LW0418'CENTER OF THE ROAD LEAVING THE AIRPORT.
LW0418'DESCRIBED BY C.L. SMITH, TYPED BY R.L. ZURFLUH.
LW0418
LW0418                          STATION RECOVERY (1989)
LW0418
LW0418'RECOVERY NOTE BY RHODE ISLAND GEODETIC SURVEY 1989
LW0418'RECOVERED IN GOOD CONDITION.
LW0418
LW0418                          STATION RECOVERY (1992)
LW0418
LW0418'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1992
LW0418'THE STATION AND RM1 AND RM2 WERE RECOVERED IN GOOD CONDITION.  NO
LW0418'OTHER MARKS SEARCHED FOR THIS SURVEY.  AN UPDATED DESCRIPTION
LW0418'FOLLOWS.
LW0418'STATION IS LOCATED ABOUT 12 KM (7.45 MI) NORTHWEST OF PROVIDENCE, 9.6
LW0418'KM (5.95 MI) SOUTH OF WOONSOCKET, AND 0.16 KM (0.10 MI) EAST OF THE
LW0418'NORTH CENTRAL STATE AIRPORT AND THE CHESTER M. SPOONER MEMORIAL
LW0418'TERMINAL BUILDING.  OWNERSHIP--STATE OF RHODE ISLAND, C/O AIRPORT
LW0418'MANAGER TED POLAK IN 1986, PH-401-351-6800.  NO CONTACT WAS NEEDED
LW0418'THIS SURVEY.
LW0418'TO REACH THE STATION FROM THE JUNCTION OF STATE ROUTE 146 AND 116
LW0418'LOCATED ABOUT 12.9 KM (8.00 MI) NORTH OF PROVIDENCE AND 1 KM
LW0418'(0.60 MI) SOUTH OF INTERSTATE 95 EXIT 9A, GO WEST ALONG HIGHWAY 116
LW0418'FOR 0.6 KM (0.35 MI) TO WAKE ROBIN ROAD ON THE LEFT.  CONTINUE WEST
LW0418'ALONG HIGHWAY 116 FOR 0.6 KM (0.35 MI) TO HIGHWAY 123 ON THE LEFT.
LW0418'TURN LEFT AND GO SOUTH ALONG HIGHWAY 123 FOR 1.5 KM (0.95 MI) TO A
LW0418'FORK IN THE ROAD. BEAR LEFT SOUTHEAST ALONG HIGHWAY 123 FOR 0.24 KM
LW0418'(0.15 MI) TO A SIDE ROAD RIGHT.  TURN RIGHT ON PAVED ROAD WESTERLY
LW0418'FOR 0.16 KM (0.10 MI) TO THE STATION ON THE LEFT JUST PAST A RADIO
```

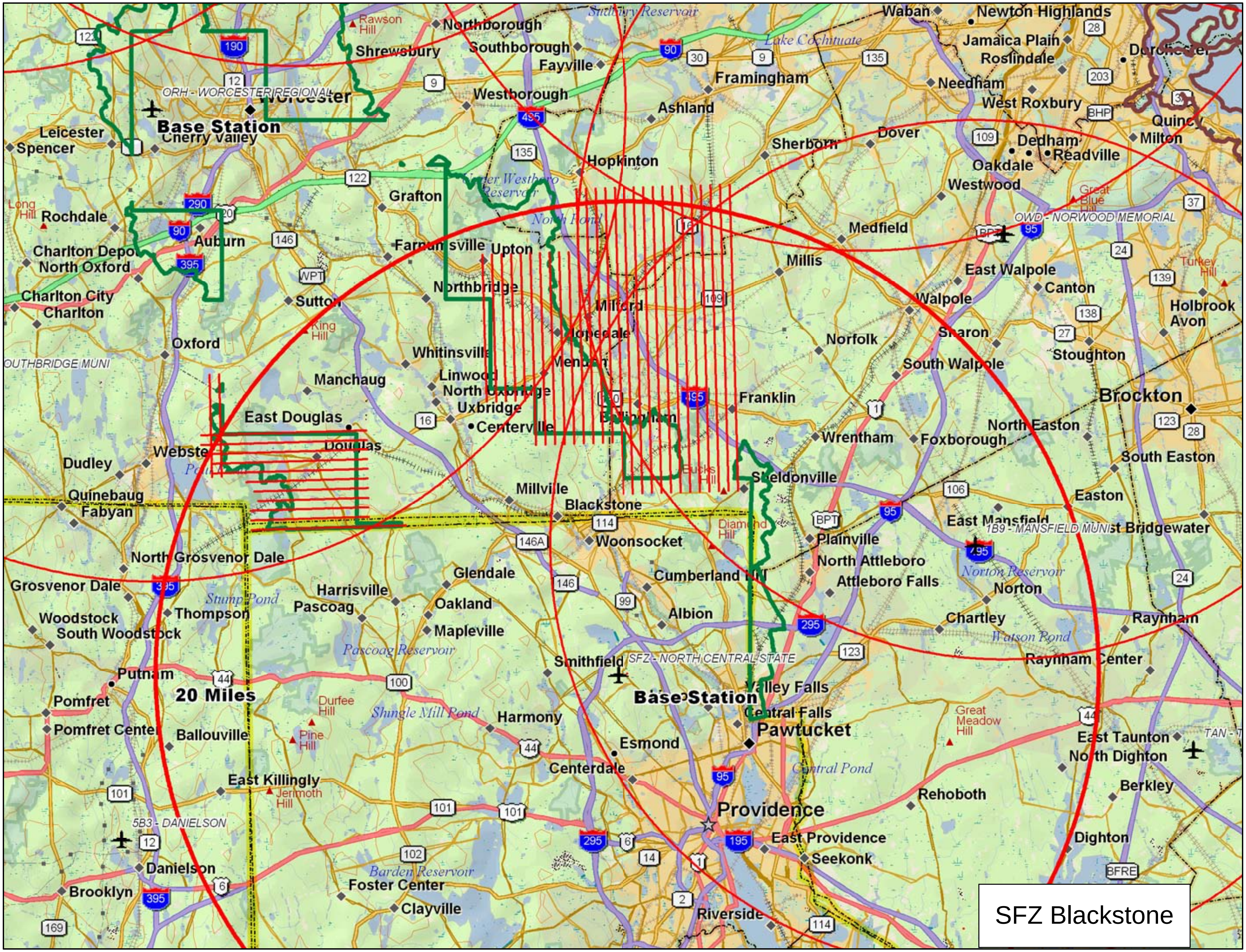
LW0418'TOWER AND ON TOP OF A MOUND IN MEDIAN OF TWO ROADS.
LW0418'STATION IS 29.8 M (97.8 FT) SOUTH OF THE CENTER OF THE PAVED ROAD,
LW0418'22.5 M (73.8 FT) NORTH OF THE CENTER OF A PAVED ROAD, 45.9 M
LW0418'(150.6 FT) WEST OF THE SOUTHWEST CORNER FENCE POST OF FENCE AROUND
LW0418'RADIO TOWER, 16.7 M (54.8 FT) SOUTHEAST OF RM2, 16.7 M (54.8 FT)
LW0418'SOUTHWEST OF RM1, 0.31 M (1.02 FT) NORTH OF A FIBERGLASS WITNESS POST,
LW0418'AND ABOUT FLUSH WITH THE GROUND SURFACE.
LW0418
LW0418   STATION RECOVERY (1992)
LW0418
LW0418'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1992
LW0418'STATION IS LOCATED ON ELEVATED GROUND EAST OF THE OPERATIONS BUILDING
LW0418'BETWEEN THE NDB AND A TALL SKELETAL STEEL TOWER, BOTH OF WHICH ARE
LW0418'WITHIN FENCED COMPOUNDS. IT IS SOUTHEAST OF THE LARGEST BOULDER ON
LW0418'THE ELEVATED GROUND, ON WHICH RM 2 IS LOCATED. THE STATION IS 55.6
LW0418'FEET (16.9 M) SW OF CENTRAL RM 1 1968 AND 54.7 FEET (16.7 M) SOUTHEAST
LW0418'OF CENTRAL RM 2 1968. THE STATION IS AN NGS DISK STAMPED CENTRAL 1968
LW0418'SET IN THE TOP OF A CONCRETE MONUMENT FLUSH WITH THE GROUND.
LW0418
LW0418   STATION RECOVERY (1999)
LW0418
LW0418'RECOVERY NOTE BY WOOLPERT CONSULTANTS 1999 (ARL)
LW0418'RECOVERED AS DESCRIBED.
LW0418
LW0418   STATION RECOVERY (2000)
LW0418
LW0418'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 2000 (CSM)
LW0418'THE STATION RM 1 AND RM 2 WERE RECOVERED IN GOOD CONDITION, NEW
LW0418'DESCRIPTION FOLLOWS. THE STATION IS LOCATED ABOUT 12.1 KM (7.50 MI)
LW0418'NORTHWEST OF PROVIDENCE, ABOUT 9.67 KM (6.00 MI) SOUTH OF
LW0418'WOONSOCKET AT THE NORTH CENTRAL STATE AIRPORT, ABOUT 0.16 KM
LW0418'(0.10 MI) EAST OF THE ENTRANCE TO THE TERMINAL BUILDING ON TOP OF
LW0418'THE SOUTH SIDE OF A MOUND IN THE MEDIAN BETWEEN THE ENTRANCE
LW0418'AND EXIT DRIVES. OWNERSHIP--STATE OF RHODE ISLAND. TO REACH THE
LW0418'STATION FROM THE JUNCTION OF STATE HIGHWAY 146 AND 116 LOCATED
LW0418'ABOUT 11.27 KM (7.00 MI) NORTHWEST OF PROVIDENCE, ABOUT 0.97 KM (0.60
LW0418'MI) SOUTHEAST OF INTERSTATE HIGHWAY 295 (EXIT 9A), FROM THE CENTER
LW0418'OF THE UNDERPASS GO WESTERLY ON HIGHWAY 116 FOR 1.21 KM (0.75 MI)
LW0418'TO THE JUNCTION OF ALBION ROAD (STATE HIGHWAY 123) ON THE LEFT,
LW0418'TURN LEFT, SOUTH ON ALBION ROAD FOR 1.53 KM (0.95 MI) TO A ROAD ON
LW0418'THE RIGHT LEADING SOUTH TO THE HANGAR-AIRPLANE ACCESS AREA,
LW0418'CONTINUE AHEAD, SOUTHEASTERLY ON ALBION ROAD FOR 0.16 KM (0.10 MI)
LW0418'TO THE MAIN ENTRANCE DRIVE TO THE AIRPORT ON THE RIGHT, TURN
LW0418'RIGHT, WEST ON THE DRIVE FOR 0.32 KM (0.20 MI) TO THE ENTRANCE TO THE
LW0418'CHESTER SPOONER MEMORIAL BUILDING (TERMINAL BUILDING) ON THE
LW0418'RIGHT, CONTINUE AHEAD, EASTERLY ON THE THE EXIT DRIVE FOR 0.16 KM
LW0418'TO THE STATION ON THE RIGHT ON TOP OF THE SOUTH SIDE OF A MOUND IN
LW0418'THE MEDIAN, ABOUT 45.72 M (150.00 FT) WEST OF THE SOUTHWEST CORNER
LW0418'OF A CHAIN LINK FENCE ENCLOSING A RADIO TOWER ANTENNA AND ON THE
LW0418'NORTH SIDE OF A WITNESS POST. THE STATION IS A CGS TRIANGULATION
LW0418'STATION DISK SET IN TOP OF A 30 CM ROUND CONCRETE POST ABOUT
LW0418'FLUSH WITH THE GROUND, LOCATED 45.88 M (150.52 FT) WEST OF THE
LW0418'SOUTHWEST CORNER OF A CHAIN LINK FENCE AROUND A RADIO TOWER
LW0418'ANTENNA, 16.77 M (55.02 FT) SOUTHEAST OF RM 2 (WHICH IS SET IN THE TOP
LW0418'OF A LARGE BOULDER ALONG THE NORTH SIDE OF THE MOUND), 22.41 M
LW0418'(73.52 FT) NORTH OF THE CENTER OF THE AIRPORT EXIT DRIVE (SLOPE),
LW0418'16.77

```
LW0418'M (55.02 FT) SOUTHWEST OF RM 1 AND 0.3 M (1.0 FT) NORTH OF A
LW0418'FIBERGLASS WITNESS POST.
LW0418'
LW0418
LW0418                          STATION RECOVERY (2003)
LW0418
LW0418'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2003 (PMC)
LW0418'RECOVERED IN GOOD CONDITION.
LW0418
LW0418                          STATION RECOVERY (2010)
LW0418
LW0418'RECOVERY NOTE BY PBS&J 2010 (MAZ)
LW0418'PHOTOS, RINEX (20MIN.) ARE AVAILABLE

*** retrieval complete.
Elapsed Time = 00:00:01
```


Rocky Hill Rd
W Reservoir Rd
116
Washington Hwy
CENTRAL AZ MK 2
CENTRAL AZ MK
CENTRAL RM 2
CENTRAL RM 2
Court Dr
New England Way
Albion Rd
Crownmark Dr
Carol Dr
Wellington Rd
Longmeadow Rd
Lampercock Ln
Alyssa Ln
123
Powder Hill Rd
Wilbur Rd
Cynthia Rd
Limerock Rd
Ryan Ct
Harris Rd
295
Old Lantern Rd
Jenckes Hill Rd
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Google
© 2011 Europa Technologies
Google
41°55'17.31" N 71°29'22.92" W
elev 441 ft
May 1, 2010
Eye alt 10268 ft

DELORME

XMap® 4.5



TN

MN (14.8°W)

Data use subject to license.

www.delorme.com

Scale 1 : 350,000

0 2 4 6 8 10 mi

0 3 6 9 12 15 km

1" = 5.52 mi

Data Zoom 9-0

Mass Area: OWD-Quincy Project No 7556-005 Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

	FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
8	1	7.9	5010	~~OWD-A~~ BEPA	OWD_QUINC / OWD_QUINC	12-17-2010	246	JB	
8	2	8.6	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
9	3	9.6	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
9	4	9.6	5000	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
9	5	10.1	5000	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
10	6	11.7	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
8	7	7.9	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
7	8	5.1	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
10	9	11.3	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
9	10	8.6	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
9	11	8.9	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				Plane Shadow in data
8	12	8.4	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				
8	13	8.2	5010	~~OWD-A~~	OWD_QUINC / OWD_QUINC				

112

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young
AIRCRAFT Tail Number: N72667
Sensor Serial Number: 246
Date: 12-17-2010

	FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
8	14	7.0	5010	~~OWD A~~	OWD_QUINC OWD_QUINC	12-17-2010	246	93	
8	15	8.1	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
8	16	8.4	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
9	17	9.6	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
7	18	6.2	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
7	19	5.8	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
7	20	5.3	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
6	21	3.6	5030	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	22	2.0	5000	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	23	2.9	5000	~~OWD A~~	OWD_QUINC OWD_QUINC				
6	24	2.9	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	25	2.7	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
6	26	2.2	5030	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	27	2.2	5030	~~OWD A~~	OWD_QUINC OWD_QUINC				

92

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

204 miles 3.5 hours.

Operator: Berry

Pilot: Young

AIRCRAFT Tail Number: N72607

Sensor Serial Number: 246

Date: 12-17-2010

Mass Area: SFZ Blackstone Project No 7556-005 Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	12.9	5250	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
2	12.9	5250	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
3	12.9	5250	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
4	12.9	5250	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
5	12.9	5240	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
6	12.9	5250	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
7	12.9	5260	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
8	12.9	5280	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
9	12.9	5270	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
10	12.9	5250	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
11	12.9	5260	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	Clouds possible @ S end
12	12.9	5280	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	
13	12.9	5290	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	3.5mi S of N end possible clouds

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galiefi

Pilot: Greenwell

AIRCRAFT Tail Number: N24486

Sensor Serial Number: 247

Date: 12/16/2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	10.7	5320	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	Clouds possible on line
15	10.7	5320	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	Clouds possible on line
16 ✓	10.7	5310	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
17	10.7	5330	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
18	8.1	5310	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
19	8.1	5340	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
20	8.1	5360	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
21	8.1	5360	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
22	8.1	5390	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
23	6.2	5430	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
24	6.2	5450	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
25	6.2	5430	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
26	6.2	5370	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
27 ✓	6.2	5290	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galiefi

Pilot: Greenwell

AIRCRAFT Tail Number: N2448G

Sensor Serial Number: 247

Date: 12/16/2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	6.5	5560	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	247	✓	
29	5.0	5580	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
30	5.0	5580	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
31	4.7	5570	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
32	4.8	5590	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
33	5.1	5650	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
34	6.5	5680	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
35	6.5	5670	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
36	6.8	5650	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
37	7.0	5640	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
38	7.0	5620	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
39	4.3	5810	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
40	4.3	5750	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galiefi
AIRCRAFT Tail Number: N2448G

Pilot: Greenwell
Sensor Serial Number: 247
Date: ________

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: Fema MASS

Location: K SFZ (N. Central State, RI)

Project Number: 7556-005

Completed by: Berry / Galieti

Date:

Receiver: Trimble "2"

Receiver Type: 5700

Antenna Type: Zephyr

Station ID: CENTRAL

Start -- H.I. (m): 1.482 / 1.481 / 1.482 m

End -- H.I. (m): 1.482

H.I. (ft): 4.86 ft

Start Time: 920 AM

End Time: 1048 AM

Time Zone: EST

Operator: Berry

Comments 10121 5a-246 (VOID)
10121 5a-247

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions
2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema MAS
Project Number	7556-005
ALTM-NAV pln File	SFZ Blackstone.ph

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 15, 2010		
Takeoff Time (Z): 1447Z	Local:	Airport SFZ	
Landing Time (Z) 1525Z	Local:	Airport SFZ	

Project's Scanning Requirements

FOV (half-degrees):	± 10.0°	Altitude AGL (ft):	5000'
Scan Rate:	30.10 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	–
		Range	–

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101215a
from, to	000→

	Ground	Airport
Begin Temp	-8°C	SFZ
Begin Dewpoint	-16°C	
Begin Pressure	29.53	
End Temp		
End Dewpoint		
End Pressure		

320
14

GPS Base Location(s)	Central @ KSFZ (Central State)	
PDOP Avoidance	Good all day	
Static or Flyover?	Static	--> if flyovers, times: –

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
28	1455	1459	5560	W	116	100%	8	Bumpy Cloudy
29	1502	1505	5590	E	116	100%	-13	possible cloud
30	1509	1511	5580	W	116	100%	9	Clouded out
31								

Void

All Lines reflown on 12/17 by Sn 247

Sheet ___ of ___

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	SFZ_Blackstone
Project Number	7556-005
ALTM-NAV .pln File	SFZ_Blackstone.pln

Pilot	Greenwell
Operator	Galieti
Aircraft	N2448G

Date Flown:	12/15/2010				
Takeoff Time (Z):	1445	Local:		Airport	KSFZ
Landing Time (Z)		Local:		Airport	

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	
		Range	

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	101215a
from, to	0 → 6

	Ground	Airport
Begin Temp	-9°C	KSFZ
Begin Dewpoint	-16°C	
Begin Pressure	29.55	
End Temp	-9 °C	KSFZ
End Dewpoint	-16°C	
End Pressure	29.55	

GPS Base Location(s)	KSFZ (PAC)	
PDOP Avoidance		
Static or Flyover?	static	--> if flyovers, times:

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
1	1457	1500	5180	358	115	~99	4	cloud interference @ N end
1	1500	1504	5160	358	109	~99	2	cloud inter. @ S end
2	1508	1514	5260	178	111	~100	8	possible cloud interf.

3:15

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: FEMA MASS

Location: KSFZ

Project Number: 7556-005

Completed by: Berry / Galiotti

Date: December 16, 2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr Geodetic

Station ID: CENTRAL

Start -- H.I. (m): 1.565 / 1.565 / 1.565 m

End -- H.I. (m): 1.565m

H.I. (ft): 5.135ft

Start Time: 9:20 Am

End Time: 2:04 Pm

Time Zone: EST

Operator: Berry

Comments
1012169-246
1012169-247

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema -Mass
Project Number	7556-005
ALTM-NAV pln File	SFZ Bladstone.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 16, 2010		
Takeoff Time (Z): 1440Z	Local: 940 AM EST	Airport SFZ	
Landing Time (Z) 1655Z	Local: 1155 AM EST	Airport SFZ	

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft): 5000'	
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples –	Range –

Data Information	
LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101216a
from, to	000→019

	Ground	Airport
Begin Temp	-3°C	SFZ
Begin Dewpoint	-10°C	
Begin Pressure	29.75	
End Temp	-1	SFZ
End Dewpoint	-10	
End Pressure	29.74	

GPS Base Location(s)	Central
PDOP Avoidance	Good allday
Static or Flyover?	Static —> if flyovers, times: –

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
29	1453	1454	5500'	W	116	100%	–	Wend refligt Atmospheric returns / Clouds
19	1502	1507	5350'	N	116	100%	-9	Smooth Clouds around
20	1510	1514	5350'	S	116	100%	10	" "
21	1517	1521	5380'	N	116	100%	-9	" "
22	1525	1528	5350'	S	116	100%	10	" "
23	1533	1536	5450'	N	116	100%	-9	" "
24	1539	1543	5400'	S	116	100%	9	" "
27	1545	1549	5310'	N	116	100%	-9	" "
26	1552	1555	5400'	S	116	100%	9	" "
25	1559	1602	5450'	N	116	100%	-10	" "
18	1605	1609	5310'	S	116	100%	10	" " Cloud last third
17	1613	1619	5320'	N	116	100%	-9	" "
16	1622	1627	5350'	S	116	100%	10	" "
Impor	1634	1637	5800	W	116	100%	3	" "

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	SFZ_Blackstone
Project Number	7556-005
ALTM-NAV .pln File	SFZ_Blackstone.pln

Pilot	Greenwell
Operator	Galleti
Aircraft	N2448G

Date Flown:	12/16/10				
Takeoff Time (Z):	1430	Local:	9:30 AM	Airport	KSFZ
Landing Time (Z):		Local:		Airport	

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples / Range

Data Information

LiDAR Unit	Optech Gemini sn247
HD #	2
POS File Name	101216a
from, to	~~0~~ 7 → 32

	Ground	Airport
Begin Temp	-7 °C	
Begin Dewpoint	-11 °C	KBED
Begin Pressure	29.75	
End Temp	6 °C	
End Dewpoint	-11 °C	
End Pressure	29.73	

GPS Base Location(s)	SFZ Blackstone (PAc)	
PDOP Avoidance		
Static or Flyover?	static	--> if flyovers, times:

light SCT clouds in area @~4K 25004

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
1	1453	1459	5270	358	101	~100	10	
2	1503	1510	5350	178	116	100	13	
3	1514	1521	5260	358	118	100	9	Bottom half.
4	1525	1531	5240	178	117	100	12	
5	1535	1541	5250	358	119	100	7	
6	1546	1552	5360	178	117	106	11	
7	1556	1603	5230	358	118	100	8	
8	1607	1613	5330	178	118	100	12	
9	1617	1624	5270	358	116	100	8	
10	1629	1635	5360	178	121	100	11	
11	1646	1646	5230	358	118	100	9	Clouds possible @ S end.
12	1650	1656	5310	178	120	100	13	
13	1701	1707	5270	359	117	100	7	3.5 mi S of N end possible clouds
14	1712	1717	5380	178	120	~100	12	clouds very possible on line
15	1720	1726	5330	358	113	~100	7	
cross line	1729	1732	5160	090	133	100	4	

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report For Airborne GPS

Project: SFZ_Blackstone

Location: SFZ_Blackstone (PAC)

Project Number: 7556-005

Completed by: Nathan Galieti

Date: 12/17/10

Receiver: Trimble 2

Receiver Type: Trimble 5700

Antenna Type: Zephyr Geodetic

Station ID: SFZ_Blackstone

Start -- H.I. (m): ~~1.54~~ 1.574 / 1.573 m

End -- H.I. (m): 1.574 m

H.I. (ft): 5.16 ft.

Start Time: 9:33 AM

End Time: 12:14 PM

Time Zone: EST

Operator: Galieti

Comments 10/217a-247

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions
2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	SFZ Blackstone
Project Number	7556-005
ALTM NAV pln File	SFZ-Blackstone.pln

Pilot	Greenwell
Operator	Gallieti
Aircraft	N2448G

Date Flown:	12/17/10				
Takeoff Time (Z):	1445	Local:	9:45 EST	Airport	KSFZ
Landing Time (Z):		Local:		Airport	

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft): 5000
Scan Rate:	30 Hz	MPiA or SPiA
Pulse Rate:	70 kHz	Fixed or Auto
Ground Speed:	116 kts	A.R.F. : Samples / Range

Data Information

LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	~~151217a~~ 161216a
from, to	0 →

note wrong date entered

	Ground	Airport
Begin Temp	-11 °C	KSFZ
Begin Dewpoint	-13 °C	
Begin Pressure	29.80	
End Temp	0 °C	KSFZ.
End Dewpoint	-9 °C	
End Pressure	29.81	

GPS Base Location(s)	SFZ_Blackstone PAC	
PDOP Avoidance		
Static or Flyover?	Static	-> if flyovers, times:

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
28	1507	1511	5530	268	115	100	6	
29	1515	1518	5580	88	118	100	6	
30	1523	1526	5540	268	113	100	6	
31	1530	1532	5590	88	109	100	8	
32	1537	1540	5540	268	115	100	6	
33	1546	1548	5590	88	114	100	8	
34	1553	1556	5540	268	113	100	6	
35	1601	1604	5580	88	116	100	7	
36	1609	1613	5550	268	112	100	6	
37	1617	1621	5580	88	113	100	6	
38	1626	1630	5540	268	111	100	6	
39	1635	1638	5780	358	118	100	9	
40	1642	1645	5810	178	121	106	10	

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: FEMA - MASSACHUSETTS

Location: KBED @ Bedford Municipal

Project Number: 7556-005

Completed by: Berry / Galich

Date: 12-17-2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr Geodetic

Station ID: KBED (BED A)

Start -- H.I. (m): 1.499 1.496

End -- H.I. (m): 1.494

H.I. (ft): 4.92

Start Time: 7:08 AM EST

End Time: 12:11 PM EST

Time Zone: EST

Operator: Berry

Comments 101217a-246

SVN 34

1045-1215

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema_Massachussets
Project Number	7556-005
ALTM-NAV pln File	OWD_Quincy.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 17, 2010				
Takeoff Time (Z):	1245Z	Local:	745AM EST	Airport	BED
Landing Time (Z)		Local:		Airport	

Project's Scanning Requirements

FOV (half-degrees):	± 18.0°	Altitude AGL (ft):	5000
Scan Rate:	30.1 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples 1000; Range 300m

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101217a
from, to	000 → /

	Ground	Airport
Begin Temp	-12°C	BED
Begin Dewpoint	-14°C	
Begin Pressure	2979	
End Temp		
End Dewpoint		
End Pressure		

GPS Base Location(s)	BED A	
PDOP Avoidance	1045-1215am (SVN34 back online @ 921 Am)	
Static or Flyover?	Static	--> if flyovers, times: -

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
Improv	1258	1301	5000'	NE	116 Kts	100%	-8	Clear and Smooth
24	1301	1303	5000'	NE	116 Kts	100%	-8	"
23	1308	1309	5000'	SW	116 Kts	100%	7	"
22	1313	1314	5000'	NW	116 kts	100%	-6	"
21	1318	1320	5000'	SE	116 kts	100%	2	"
20	1325	1328	5000'	NW	116 kts	100%	-4	"
19	1332	1335	5000'	SE	116 kts	100%	2	"
18	1339	1342	5000'	NW	116 kts	100%	-4	"
17	1345	1350	5000'	SE	116 kts	100%	2	"
16	1353	1358	5000'	NW	116 kts	100%	-4	"
15	1401	1405	5000'	SE	116 kts	100%	3	"
14	1409	1413	5000'	NW	116 kts	100%	-7	"
13	1417	1421	5000'	SE	116 kts	100%	4	"
12	1424	1429	5000'	NW	116 kts	100%	-5	"
11	1432	1436	5000'	SE	116 kts	100%	4	"
10	1439	1443	5000'	NW	116 kts	100%	-5	"
9	1446	1448	5000'	SE	116 kts	100%	3	Need to redo (ARF not set to ON)
6	1455	1501	5000'	NW	116 kts	100%	-5	
5	1504	1510	5000'	SE	116 kts	100%	3	
4	1514	1518	5000'	NW	116 kts	100%	-5	

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions
2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	FemaMass
Project Number	7856-005
ALTM-NAV pln File	OLD_Quincy

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 17, 2010				
Takeoff Time (Z):	1245	Local:	745AMEST	Airport	BED
Landing Time (Z)	1645	Local:	1145AMES	Airport	BED

Project's Scanning Requirements

FOV (half-degrees):	± 18.6 °	Altitude AGL (ft):	5000
Scan Rate:	30.1 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	1600
		Range	460

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246HD1
POS File Name	101217a
from, to	000 → /

	Ground	Airport
Begin Temp	-2°C	BED
Begin Dewpoint	4°C	
Begin Pressure	2979	
End Temp	-1°C	BED
End Dewpoint	-9°C	
End Pressure	2983	

GPS Base Location(s)	Central		
PDOP Avoidance	See sheet 1		
Static or Flyover?	Static	--> if flyovers, times:	–

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
3	1521	1526	5000'	SE	116 kts	100%	5	
2	1530	1534	5000'	NW	116kts	100%	-5	
1	1537	1541	5000'	SE	116 kts	100%	5	
7	1545	1549	5000'	NW	116kts	100%	-5	
8	1551	1554	5000'	SE	116kts	100%	4	
25	1557	1558	5000'	NW	116kts	100%	-5	
26	1600	1604	5000'	SW	116kts	100%	6	
27	1606	1608	5000'	NE	116kts	100%	-10	
9	1614	1620	5000'	S	116kts	100%	5	Reflight of 9

Sheet 2 of 2

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

           Weather
------------------------------
Date          : December 15, 2010
Julian Day    : 349
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:08:48

=======================================
10:05:07.237 GMT : 00:00:02 (212) GPS 1PPS Lost
10:05:07.237 GMT : 00:00:03 (166) Divergence Error
10:05:07.237 GMT : 00:00:03 (107) Rx Shutter Closed
10:05:07.237 GMT : 00:00:03 (109) Tx Shutter Closed
10:05:07.237 GMT : 00:00:04 (164) Beam Wide
10:05:07.237 GMT : 00:00:08 (213) GPS 1PPS Ok
10:05:07.237 GMT : 00:00:09 (120) Laser PS Comm Ok
10:05:07.237 GMT : 00:00:09 (112) Laser Emission Off
10:05:07.237 GMT : 00:00:12 (204) POSAV Connected
10:05:07.237 GMT : 00:00:13 (207) POSAV Rate Not 50 Hz
10:05:07.237 GMT : 00:00:13 (211) POSAV new status
10:05:07.237 GMT : 00:00:21 (211) POSAV new status
10:05:07.237 GMT : 00:00:22 (208) POSAV Rate Is 50 Hz
10:05:07.237 GMT : 00:00:22 (215) Nav Data Ok
10:05:07.237 GMT : 00:00:23 (211) POSAV new status
10:05:07.237 GMT : 00:02:04 (211) POSAV new status
14:39:42.274 GMT : 00:04:27 (153) Eyesafety Disabled
14:39:42.474 GMT : 00:04:27 (162) Roll Comp On
14:39:42.674 GMT : 00:04:28 (164) Beam Wide
14:39:42.774 GMT : 00:04:28 (144) MultiPulse Mode Varies
14:39:47.674 GMT : 00:04:33 (165) Beam Narrow
14:40:04.074 GMT : 00:04:49 (211) POSAV new status
14:45:45.679 GMT : 14:45:44 (211) POSAV new status
```

```
14:53:16.586 GMT : 14:53:15 (106) Rx Shutter Open
14:53:16.586 GMT : 14:53:15 (108) Tx Shutter Open
14:55:52.588 GMT : 14:55:51 (113) Laser Emission On
14:59:13.891 GMT : 14:59:12 (112) Laser Emission Off
15:02:33.894 GMT : 15:02:32 (113) Laser Emission On
15:05:31.097 GMT : 15:05:29 (112) Laser Emission Off
15:09:21.901 GMT : 15:09:20 (113) Laser Emission On
15:12:01.103 GMT : 15:11:59 (112) Laser Emission Off
15:15:38.907 GMT : 15:15:37 (107) Rx Shutter Closed
15:15:39.107 GMT : 15:15:37 (109) Tx Shutter Closed

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

           Weather
------------------------------
Date          : December 15, 2010
Julian Day    : 349
Temperature   : ???
Visibility    : ???
Clouds        : ???
Precipitation : ???
Wind Dir      : ???
Wind Speed    : ???
Pressure      : ???
           Statistics
------------------------------
Laser Time    : 00:08:48

=======================================

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

HOBBS End :

Weather

Date : December 15, 2010
Julian Day : 349
Temperature : ???
Visibility : ???
Clouds : ???
Precipitation : ???
Wind Dir : ???
Wind Speed : ???
Pressure : ???

Statistics

Laser Time : 00:08:48

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
14:55:53.088	14:59:15.391	29	1693	70	30.10	18.00	ON	NAR	ON	0.00	88.3
15:02:33.894	15:05:30.897	30	1700	70	30.10	18.00	ON	NAR	ON	0.00	268.29
15:09:22.501	15:12:01.703	31	1697	70	30.10	18.00	ON	NAR	ON	0.00	88.29

Flight Log

Project Number: SFZ_Blackstone 7556-005
S/N : 247
Operator : Galieti
Pilot(s) : Greenwell
Aircraft : N2448G
Airport : KSFZ
Mission : 1
Wheels Up :
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 16, 2010
Julian Day : 350
Temperature : -3 C
Visibility : CLR
Clouds : Very SCT 040
Precipitation : none
Wind Dir : 250
Wind Speed : 4
Pressure : 29.43 HG

```
           Statistics
------------------------------
Laser Time    : 01:34:17

=======================================
14:39:48.569 GMT : 00:00:02 (212) GPS 1PPS Lost
14:39:48.569 GMT : 00:00:03 (166) Divergence Error
14:39:48.569 GMT : 00:00:03 (107) Rx Shutter Closed
14:39:48.569 GMT : 00:00:03 (109) Tx Shutter Closed
14:39:48.569 GMT : 00:00:04 (164) Beam Wide
14:39:48.569 GMT : 00:00:05 (213) GPS 1PPS Ok
14:39:48.569 GMT : 00:00:12 (204) POSAV Connected
14:39:48.569 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
14:39:48.569 GMT : 00:00:13 (211) POSAV new status
14:39:48.569 GMT : 00:00:19 (208) POSAV Rate Is 50 Hz
14:39:48.569 GMT : 00:00:20 (211) POSAV new status
14:39:48.569 GMT : 00:00:21 (211) POSAV new status
14:39:48.569 GMT : 00:00:22 (215) Nav Data Ok
14:39:48.569 GMT : 00:00:25 (120) Laser PS Comm Ok
14:39:48.569 GMT : 00:00:25 (112) Laser Emission Off
14:39:48.569 GMT : 00:02:00 (211) POSAV new status
14:35:51.313 GMT : 00:04:01 (307) Format Disk
14:36:30.713 GMT : 00:04:40 (153) Eyesafety Disabled
14:36:34.713 GMT : 00:04:44 (211) POSAV new status
14:36:53.513 GMT : 14:36:52 (160) Safe Aided Wide
14:36:53.713 GMT : 14:36:52 (160) Safe Aided Wide
14:37:19.713 GMT : 14:37:18 (157) Safe Unaided Profile
14:37:19.913 GMT : 14:37:18 (162) Roll Comp On
14:37:19.913 GMT : 14:37:18 (157) Safe Unaided Profile
14:37:20.513 GMT : 14:37:19 (164) Beam Wide
14:37:20.713 GMT : 14:37:19 (144) MultiPulse Mode Varies
14:37:24.513 GMT : 14:37:23 (165) Beam Narrow
14:41:54.515 GMT : 14:41:53 (211) POSAV new status
14:44:56.117 GMT : 14:44:55 (157) Safe Unaided Profile
14:45:26.917 GMT : 14:45:25 (157) Safe Unaided Profile
14:45:27.817 GMT : 14:45:26 (157) Safe Unaided Profile
14:45:32.017 GMT : 14:45:30 (106) Rx Shutter Open
14:45:32.217 GMT : 14:45:30 (108) Tx Shutter Open
14:53:08.622 GMT : 14:53:07 (113) Laser Emission On
14:59:44.825 GMT : 14:59:43 (112) Laser Emission Off
15:03:58.828 GMT : 15:03:58 (113) Laser Emission On
15:10:19.832 GMT : 15:10:18 (112) Laser Emission Off
15:14:53.835 GMT : 15:14:52 (113) Laser Emission On
15:21:11.339 GMT : 15:21:09 (112) Laser Emission Off
15:25:18.541 GMT : 15:25:17 (113) Laser Emission On
15:31:29.745 GMT : 15:31:27 (112) Laser Emission Off
15:35:34.648 GMT : 15:35:33 (113) Laser Emission On
15:41:49.852 GMT : 15:41:48 (112) Laser Emission Off
15:46:17.355 GMT : 15:46:16 (113) Laser Emission On
15:52:29.86 GMT : 15:52:28 (112) Laser Emission Off
15:56:49.062 GMT : 15:56:47 (113) Laser Emission On
16:03:02.467 GMT : 16:03:01 (112) Laser Emission Off
16:07:37.67 GMT : 16:07:36 (113) Laser Emission On
16:13:45.974 GMT : 16:13:44 (112) Laser Emission Off
```

```
16:17:58.177 GMT : 16:17:57 (113) Laser Emission On
16:24:27.682 GMT : 16:24:26 (112) Laser Emission Off
16:29:20.085 GMT : 16:29:19 (113) Laser Emission On
16:35:33.39 GMT : 16:35:32 (112) Laser Emission Off
16:40:05.093 GMT : 16:40:04 (113) Laser Emission On
16:46:25.698 GMT : 16:46:23 (112) Laser Emission Off
16:50:32.201 GMT : 16:50:31 (113) Laser Emission On
16:56:40.605 GMT : 16:56:39 (112) Laser Emission Off
17:01:32.809 GMT : 17:01:31 (113) Laser Emission On
17:07:56.713 GMT : 17:07:55 (112) Laser Emission Off
17:12:22.217 GMT : 17:12:20 (113) Laser Emission On
17:17:39.821 GMT : 17:17:38 (112) Laser Emission Off
17:20:45.723 GMT : 17:20:44 (113) Laser Emission On
17:26:07.927 GMT : 17:26:06 (112) Laser Emission Off
17:27:07.228 GMT : 17:27:05 (153) Eyesafety Disabled
17:29:47.33 GMT : 17:29:46 (113) Laser Emission On
17:32:32.132 GMT : 17:32:30 (112) Laser Emission Off
17:35:55.934 GMT : 17:35:54 (107) Rx Shutter Closed
17:35:55.934 GMT : 17:35:54 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: SFZ_Blackstone 7556-005
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KSFZ
Mission       : 1
Wheels Up     :
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 16, 2010
Julian Day    : 350
Temperature   : -3 C
Visibility    : CLR
Clouds        : Very SCT 040
Precipitation : none
Wind Dir      : 250
Wind Speed    : 4
Pressure      : 29.43 HG
           Statistics
------------------------------
Laser Time    : 01:34:17

=======================================

           Flight Log
------------------------------
Project Number: SFZ_Blackstone 7556-005
```

```
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KSFZ
Mission       : 1
Wheels Up     :
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 16, 2010
Julian Day    : 350
Temperature   : -3 C
Visibility    : CLR
Clouds        : Very SCT 040
Precipitation : none
Wind Dir      : 250
Wind Speed    : 4
Pressure      : 29.43 HG
           Statistics
------------------------------
Laser Time    : 01:34:17
```

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
14:53:08.622	14:59:46.025	1	1601	70	30.10	18.00	ON	NAR	ON	0.00	358.4
15:03:59.828	15:10:21.032	2	1617	70	30.10	18.00	ON	NAR	ON	0.00	178.39
15:14:54.035	15:21:10.939	4	1606	70	30.10	18.00	ON	NAR	ON	0.00	358.38
15:25:19.141	15:31:29.945	4	1616	70	30.10	18.00	ON	NAR	ON	0.00	178.38
15:25:19.141	15:31:29.945	5	1616	70	30.10	18.00	ON	NAR	ON	0.00	178.38
15:35:35.348	15:41:50.952	6	1603	70	30.10	18.00	ON	NAR	ON	0.00	358.37
15:46:17.855	15:52:31.16	6	1623	70	30.10	18.00	ON	NAR	ON	0.00	178.37
15:46:17.855	15:52:31.16	7	1623	70	30.10	18.00	ON	NAR	ON	0.00	178.37
15:56:49.362	16:03:04.667	7	1593	70	30.10	18.00	ON	NAR	ON	0.00	358.37
16:07:38.27	16:13:47.374	8	1619	70	30.10	18.00	ON	NAR	ON	0.00	178.36
16:07:38.27	16:13:47.374	9	1619	70	30.10	18.00	ON	NAR	ON	0.00	178.36

16:17:58.877	16:24:28.582	9	1606	70	30.10	18.00	ON	NAR	ON	0.00	358.36
16:29:20.785	16:35:33.89	10	1614	70	30.10	18.00	ON	NAR	ON	0.00	178.35
16:40:06.093	16:46:25.398	11	1593	70	30.10	18.00	ON	NAR	ON	0.00	358.35
16:50:33.101	16:56:42.605	12	1623	70	30.10	18.00	ON	NAR	ON	0.00	178.34
17:01:33.209	17:07:58.113	13	1600	70	30.10	18.00	ON	NAR	ON	0.00	358.33
17:12:22.817	17:17:40.521	15	1612	70	30.10	18.00	ON	NAR	ON	0.00	178.32
17:20:46.323	17:26:08.327	15	1602	70	30.10	18.00	ON	NAR	ON	0.00	358.32
17:29:48.13	17:32:32.632	15	1618	70	30.10	18.00	ON	NAR	ON	0.00	358.32
17:29:48.13	17:32:32.632	15	1617	70	30.10	18.00	ON	NAR	ON	0.00	358.32

Flight Log

Project Number: 7505-056
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : KSFZ
Mission : 101216A
Wheels Up : 1440Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 16, 2010
Julian Day : 350
Temperature : -1
Visibility : >10
Clouds : 4500'
Precipitation : NO
Wind Dir : -
Wind Speed : -
Pressure : 29.75

Statistics

Laser Time : 00:50:02

=======================================

09:55:52.781 GMT : 00:00:02 (212) GPS 1PPS Lost
09:55:52.781 GMT : 00:00:03 (166) Divergence Error
09:55:52.781 GMT : 00:00:03 (107) Rx Shutter Closed
09:55:52.781 GMT : 00:00:03 (109) Tx Shutter Closed
09:55:52.781 GMT : 00:00:04 (164) Beam Wide

```
09:55:52.781 GMT : 00:00:05 (213) GPS 1PPS Ok
09:55:52.781 GMT : 00:00:08 (212) GPS 1PPS Lost
09:55:52.781 GMT : 00:00:09 (120) Laser PS Comm Ok
09:55:52.781 GMT : 00:00:09 (112) Laser Emission Off
09:55:52.781 GMT : 00:00:12 (204) POSAV Connected
09:55:52.781 GMT : 00:00:13 (207) POSAV Rate Not 50 Hz
09:55:52.781 GMT : 00:00:13 (211) POSAV new status
09:55:52.781 GMT : 00:00:14 (213) GPS 1PPS Ok
09:55:52.781 GMT : 00:00:25 (211) POSAV new status
09:55:52.781 GMT : 00:00:26 (208) POSAV Rate Is 50 Hz
09:55:52.781 GMT : 00:00:26 (215) Nav Data Ok
09:55:52.781 GMT : 00:00:27 (211) POSAV new status
09:55:52.781 GMT : 00:01:57 (211) POSAV new status
14:34:43.96 GMT : 00:04:40 (211) POSAV new status
14:35:20.761 GMT : 14:35:19 (153) Eyesafety Disabled
14:35:20.961 GMT : 14:35:19 (162) Roll Comp On
14:35:21.461 GMT : 14:35:20 (164) Beam Wide
14:35:21.661 GMT : 14:35:20 (144) MultiPulse Mode Varies
14:35:25.261 GMT : 14:35:24 (165) Beam Narrow
14:40:25.764 GMT : 14:40:24 (106) Rx Shutter Open
14:40:25.964 GMT : 14:40:24 (108) Tx Shutter Open
14:41:09.465 GMT : 14:41:08 (211) POSAV new status
14:53:36.175 GMT : 14:53:34 (113) Laser Emission On
14:54:17.076 GMT : 14:54:15 (112) Laser Emission Off
15:03:00.784 GMT : 15:02:59 (113) Laser Emission On
15:07:03.088 GMT : 15:07:01 (112) Laser Emission Off
15:10:38.491 GMT : 15:10:37 (113) Laser Emission On
15:14:36.295 GMT : 15:14:35 (112) Laser Emission Off
15:17:46.698 GMT : 15:17:45 (113) Laser Emission On
15:21:55.302 GMT : 15:21:54 (112) Laser Emission Off
15:25:33.506 GMT : 15:25:32 (113) Laser Emission On
15:29:41.309 GMT : 15:29:39 (112) Laser Emission Off
15:33:36.813 GMT : 15:33:35 (113) Laser Emission On
15:36:44.916 GMT : 15:36:43 (112) Laser Emission Off
15:39:54.419 GMT : 15:39:53 (113) Laser Emission On
15:43:17.823 GMT : 15:43:16 (112) Laser Emission Off
15:45:59.325 GMT : 15:45:58 (113) Laser Emission On
15:49:15.629 GMT : 15:49:14 (112) Laser Emission Off
15:52:31.832 GMT : 15:52:30 (113) Laser Emission On
15:55:48.735 GMT : 15:55:47 (112) Laser Emission Off
15:59:36.539 GMT : 15:59:35 (113) Laser Emission On
16:02:58.443 GMT : 16:02:56 (112) Laser Emission Off
16:05:37.445 GMT : 16:05:36 (113) Laser Emission On
16:09:43.15 GMT : 16:09:42 (112) Laser Emission Off
16:13:49.454 GMT : 16:13:47 (113) Laser Emission On
16:19:04.06 GMT : 16:19:03 (112) Laser Emission Off
16:22:45.364 GMT : 16:22:43 (113) Laser Emission On
16:27:58.07 GMT : 16:27:56 (112) Laser Emission Off
16:34:34.877 GMT : 16:34:33 (113) Laser Emission On
16:37:23.981 GMT : 16:37:22 (112) Laser Emission Off
16:43:51.788 GMT : 16:43:50 (107) Rx Shutter Closed
16:43:51.888 GMT : 16:43:50 (109) Tx Shutter Closed
```

Flight Log

Project Number: 7505-056
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : KSFZ
Mission : 101216A
Wheels Up : 1440Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 16, 2010
Julian Day : 350
Temperature : -1
Visibility : >10
Clouds : 4500'
Precipitation : NO
Wind Dir : -
Wind Speed : -
Pressure : 29.75

Statistics

Laser Time : 00:50:02

=======================================

Flight Log

Project Number: 7505-056
S/N : 246
Operator : BERRY
Pilot(s) : YOUNG
Aircraft : N7266Z
Airport : KSFZ
Mission : 101216A
Wheels Up : 1440Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 16, 2010
Julian Day : 350
Temperature : -1
Visibility : >10
Clouds : 4500'
Precipitation : NO
Wind Dir : -
Wind Speed : -

Pressure   : 29.75

Statistics

Laser Time   : 00:50:02

START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
14:53:35.975	14:54:18.276	29	1692	70	30.10	18.00	ON	NAR	ON	0.00	268.3
15:03:01.284	15:07:03.288	20	1632	70	30.10	18.00	ON	NAR	ON	0.00	178.3
15:10:39.091	15:14:37.995	21	1634	70	30.10	18.00	ON	NAR	ON	0.00	178.29
15:17:47.398	15:21:52.702	22	1635	70	30.10	18.00	ON	NAR	ON	0.00	178.29
15:25:34.306	15:29:42.01	23	1640	70	30.10	18.00	ON	NAR	ON	0.00	358.28
15:33:37.513	15:36:45.716	24	1654	70	30.10	18.00	ON	NAR	ON	0.00	358.28
15:39:55.019	15:43:18.223	27	1666	70	30.10	18.00	ON	NAR	ON	0.00	178.26
15:45:59.825	15:49:16.829	26	1612	70	30.10	18.00	ON	NAR	ON	0.00	178.27
15:52:31.832	15:55:50.235	25	1640	70	30.10	18.00	ON	NAR	ON	0.00	358.27
15:59:37.439	16:02:59.143	25	1659	70	30.10	18.00	ON	NAR	ON	0.00	358.27
16:05:38.445	16:09:44.15	17	1618	70	30.10	18.00	ON	NAR	ON	0.00	178.31
16:13:50.254	16:19:05.26	16	1618	70	30.10	18.00	ON	NAR	ON	0.00	358.32
16:22:46.064	16:27:59.17	16	1623	70	30.10	18.00	ON	NAR	ON	0.00	178.32
16:34:35.877	16:37:25.481	39	1603	70	30.10	18.00	ON	NAR	ON	0.00	358.59

Flight Log

Project Number: SFZ_Blackstone
S/N   : 247
Operator   : Galieti
Pilot(s)   : Greenwell
Aircraft   : N2448G
Airport   : KBED KSFZ
Mission   : 1
Wheels Up   : 9:45 AM EST 1445Z
Flight Length :
HOBBS Start   :
HOBBS End   :

Weather

```
------------------------------
Date          : December 17, 2010
Julian Day    : 351
Temperature   : -11 C
Visibility    : -13 C
Clouds        : None
Precipitation : None
Wind Dir      : 290
Wind Speed    : 6
Pressure      : 29.81 HG
           Statistics
------------------------------
Laser Time    : 00:38:46

=======================================
14:57:15.275 GMT : 00:00:02 (212) GPS 1PPS Lost
14:57:15.275 GMT : 00:00:03 (166) Divergence Error
14:57:15.275 GMT : 00:00:03 (107) Rx Shutter Closed
14:57:15.275 GMT : 00:00:03 (109) Tx Shutter Closed
14:57:15.275 GMT : 00:00:04 (164) Beam Wide
14:57:15.275 GMT : 00:00:05 (213) GPS 1PPS Ok
14:57:15.275 GMT : 00:00:12 (204) POSAV Connected
14:57:15.275 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
14:57:15.275 GMT : 00:00:12 (211) POSAV new status
14:57:15.275 GMT : 00:00:18 (208) POSAV Rate Is 50 Hz
14:57:15.275 GMT : 00:00:18 (211) POSAV new status
14:57:15.275 GMT : 00:00:18 (215) Nav Data Ok
14:57:15.275 GMT : 00:00:20 (211) POSAV new status
14:57:15.275 GMT : 00:00:21 (120) Laser PS Comm Ok
14:57:15.275 GMT : 00:00:21 (112) Laser Emission Off
14:57:15.275 GMT : 00:01:54 (211) POSAV new status
14:47:58.544 GMT : 00:04:36 (211) POSAV new status
14:48:27.744 GMT : 14:48:27 (153) Eyesafety Disabled
14:48:27.944 GMT : 14:48:27 (162) Roll Comp On
14:48:28.544 GMT : 14:48:28 (164) Beam Wide
14:48:28.744 GMT : 14:48:28 (144) MultiPulse Mode Varies
14:48:31.944 GMT : 14:48:31 (165) Beam Narrow
14:48:48.144 GMT : 14:48:47 (157) Safe Unaided Profile
14:48:48.344 GMT : 14:48:47 (157) Safe Unaided Profile
14:53:35.646 GMT : 14:53:34 (211) POSAV new status
14:57:01.448 GMT : 14:57:01 (157) Safe Unaided Profile
14:57:02.448 GMT : 14:57:01 (157) Safe Unaided Profile
14:57:07.548 GMT : 14:57:06 (106) Rx Shutter Open
14:57:07.748 GMT : 14:57:06 (108) Tx Shutter Open
15:07:32.954 GMT : 15:07:32 (113) Laser Emission On
15:11:01.155 GMT : 15:11:00 (112) Laser Emission Off
15:15:28.458 GMT : 15:15:28 (113) Laser Emission On
15:18:09.26 GMT : 15:18:08 (112) Laser Emission Off
15:23:32.563 GMT : 15:23:32 (113) Laser Emission On
15:26:17.365 GMT : 15:26:16 (112) Laser Emission Off
15:30:08.067 GMT : 15:30:07 (113) Laser Emission On
15:32:48.469 GMT : 15:32:47 (112) Laser Emission Off
15:37:59.172 GMT : 15:37:58 (113) Laser Emission On
15:40:38.974 GMT : 15:40:37 (112) Laser Emission Off
```

```
15:45:11.777 GMT : 15:45:11 (113) Laser Emission On
15:48:03.079 GMT : 15:48:02 (112) Laser Emission Off
15:53:13.283 GMT : 15:53:12 (113) Laser Emission On
15:56:38.285 GMT : 15:56:37 (112) Laser Emission Off
16:01:02.288 GMT : 16:01:01 (113) Laser Emission On
16:04:20.99 GMT : 16:04:20 (112) Laser Emission Off
16:09:31.194 GMT : 16:09:30 (113) Laser Emission On
16:13:12.497 GMT : 16:13:12 (112) Laser Emission Off
16:17:41.6 GMT : 16:17:41 (113) Laser Emission On
16:21:20.003 GMT : 16:21:18 (112) Laser Emission Off
16:26:30.307 GMT : 16:26:29 (113) Laser Emission On
16:30:11.01 GMT : 16:30:10 (112) Laser Emission Off
16:35:43.114 GMT : 16:35:42 (113) Laser Emission On
16:38:04.916 GMT : 16:38:04 (112) Laser Emission Off
16:42:38.92 GMT : 16:42:38 (113) Laser Emission On
16:45:00.221 GMT : 16:44:59 (112) Laser Emission Off
16:46:23.223 GMT : 16:46:22 (157) Safe Unaided Profile
16:46:47.123 GMT : 16:46:46 (157) Safe Unaided Profile
16:46:51.223 GMT : 16:46:50 (107) Rx Shutter Closed
16:46:51.423 GMT : 16:46:50 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: SFZ_Blackstone
S/N           : 247
Operator      : Galieti
Pilot(s)      : Greenwell
Aircraft      : N2448G
Airport       : KBED KSFZ
Mission       : 1
Wheels Up     : 9:45 AM EST 1445Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 17, 2010
Julian Day    : 351
Temperature   : -11 C
Visibility    : -13 C
Clouds        : None
Precipitation : None
Wind Dir      : 290
Wind Speed    : 6
Pressure      : 29.81 HG
           Statistics
------------------------------
Laser Time    : 00:38:46

=======================================

           Flight Log
------------------------------
```

Project Number: SFZ_Blackstone
S/N : 247
Operator : Galieti
Pilot(s) : Greenwell
Aircraft : N2448G
Airport : KBED KSFZ
Mission : 1
Wheels Up : 9:45 AM EST 1445Z
Flight Length :
HOBBS Start :
HOBBS End :

Weather

Date : December 17, 2010
Julian Day : 351
Temperature : -11 C
Visibility : -13 C
Clouds : None
Precipitation : None
Wind Dir : 290
Wind Speed : 6
Pressure : 29.81 HG

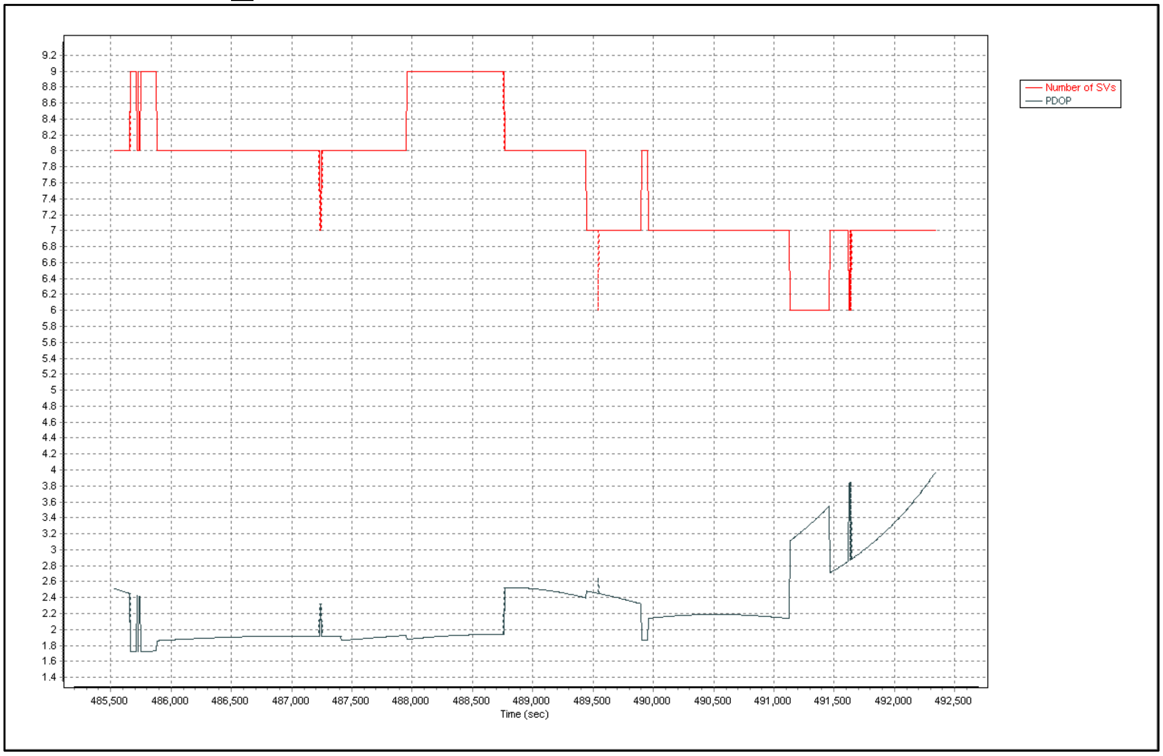
Statistics

Laser Time : 00:38:46

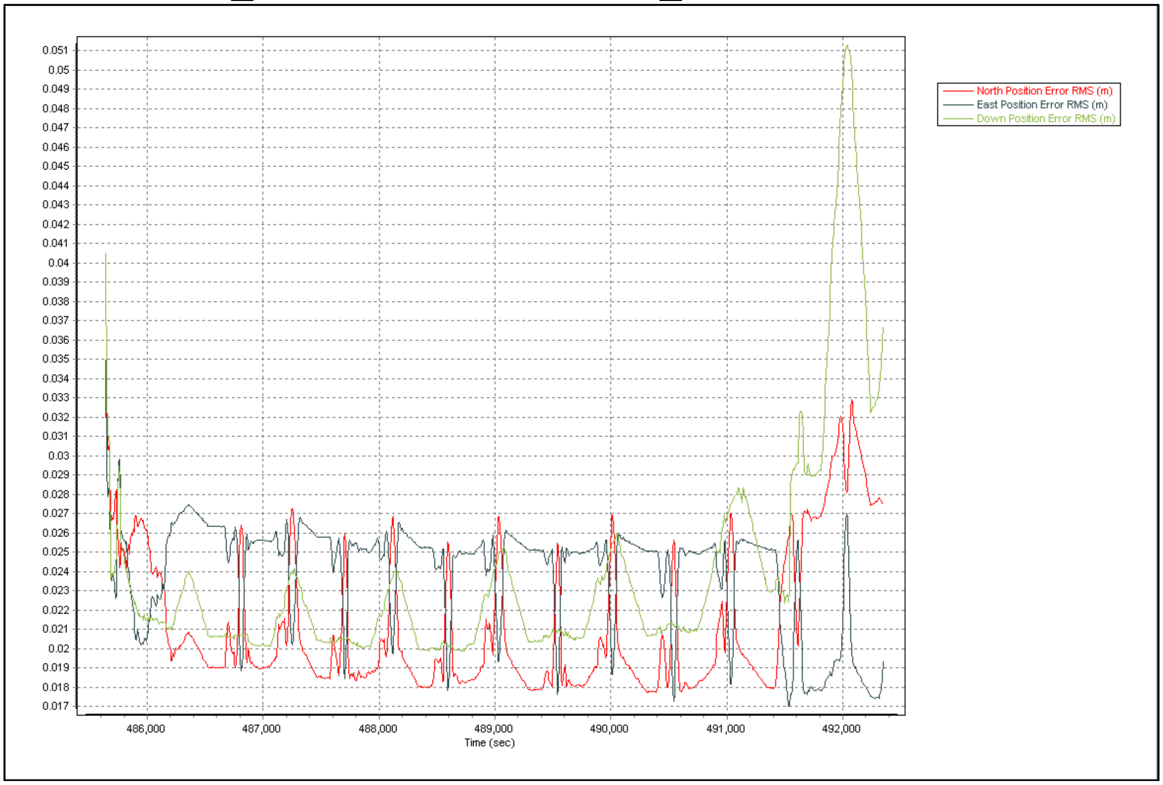
START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
15:07:33.954	15:10:57.855	28	1689	70	30.10	18.00	ON	NAR	ON	0.00	268.32
15:15:29.358	15:18:10.76	29	1699	70	30.10	18.00	ON	NAR	ON	0.00	88.3
15:15:29.358	15:18:10.76	29	1699	70	30.10	18.00	ON	NAR	ON	0.00	88.3
15:23:33.563	15:26:19.365	30	1691	70	30.10	18.00	ON	NAR	ON	0.00	268.29
15:23:33.563	15:26:19.365	30	1691	70	30.10	18.00	ON	NAR	ON	0.00	268.29
15:30:08.067	15:32:48.169	32	1702	70	30.10	18.00	ON	NAR	ON	0.00	88.3
15:37:59.372	15:40:39.674	32	1691	70	30.10	18.00	ON	NAR	ON	0.00	268.3
15:37:59.372	15:40:39.674	32	1691	70	30.10	18.00	ON	NAR	ON	0.00	268.3
15:45:12.477	15:48:00.379	33	1702	70	30.10	18.00	ON	NAR	ON	0.00	88.3
15:53:13.083	15:56:40.085	34	1692	70	30.10	18.00	ON	NAR	ON	0.00	268.29
15:53:13.083	15:56:40.085	35	1692	70	30.10	18.00	ON	NAR	ON	0.00	268.28

16:01:03.088	16:04:22.091	35	1701	70	30.10	18.00	ON	NAR	ON	0.00	88.28
16:09:32.094	16:13:14.497	36	1688	70	30.10	18.00	ON	NAR	ON	0.00	268.29
16:09:32.094	16:13:14.497	36	1688	70	30.10	18.00	ON	NAR	ON	0.00	268.29
16:17:42.4	16:21:16.003	37	1697	70	30.10	18.00	ON	NAR	ON	0.00	88.3
16:26:30.607	16:30:08.51	38	1688	70	30.10	18.00	ON	NAR	ON	0.00	268.3
16:26:30.607	16:30:08.51	38	1688	70	30.10	18.00	ON	NAR	ON	0.00	268.3
16:35:43.714	16:38:06.616	39	1761	70	30.10	18.00	ON	NAR	ON	0.00	358.59
16:35:43.714	16:38:06.616	39	1761	70	30.10	18.00	ON	NAR	ON	0.00	358.59
16:42:39.52	16:45:02.221	40	1766	70	30.10	18.00	ON	NAR	ON	0.00	178.6

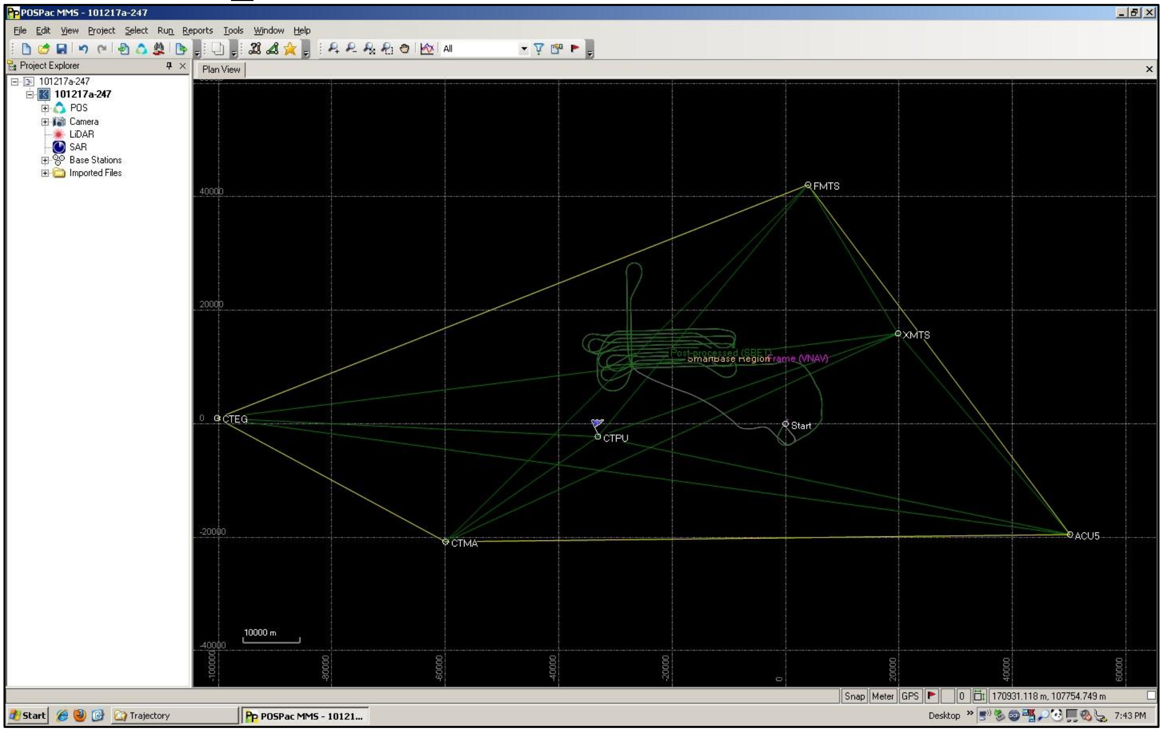
101217A-247_SVS&PDOP



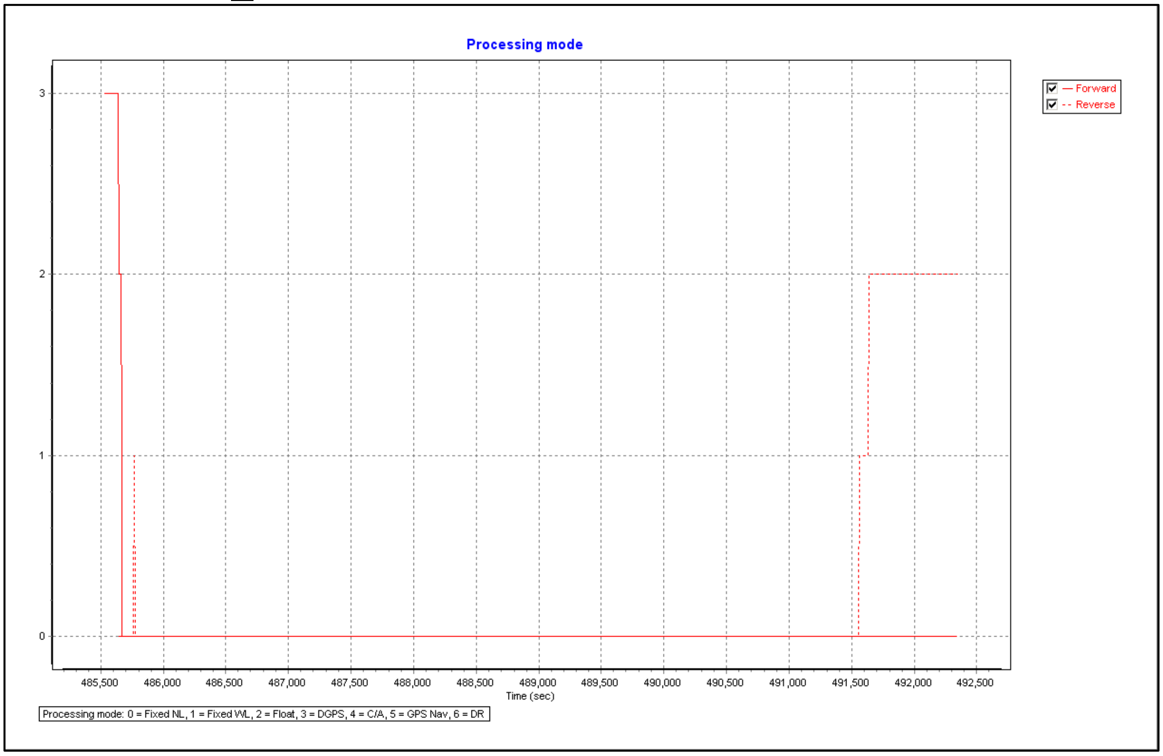
101217A-247_SMOOTHPERFMETRIC_NED



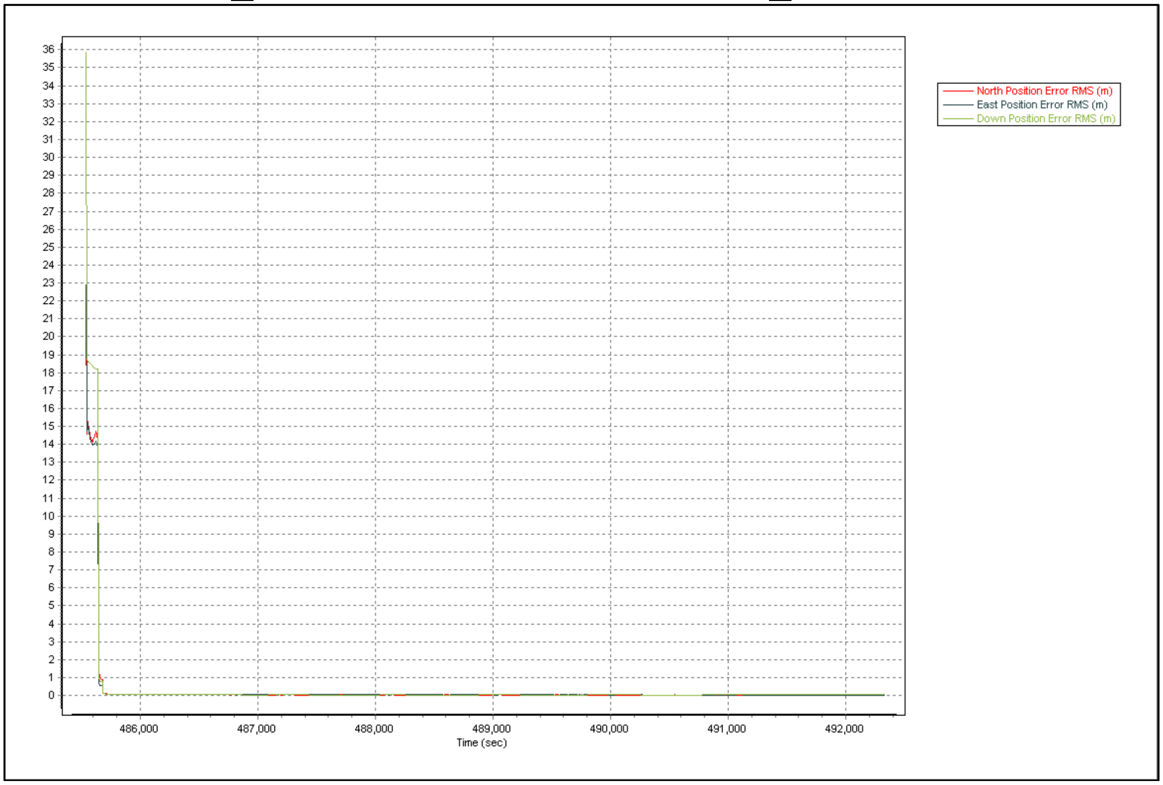
101217A-247_SCREENSHOT



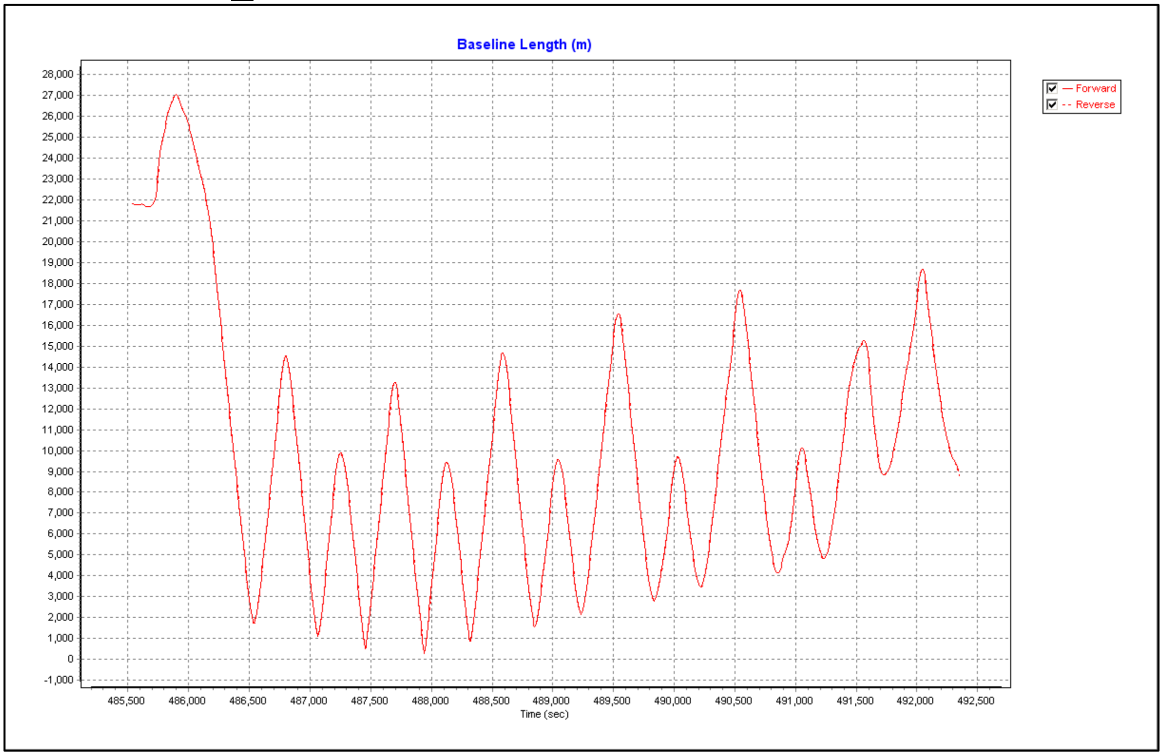
101217A-247_PROCESSMODE



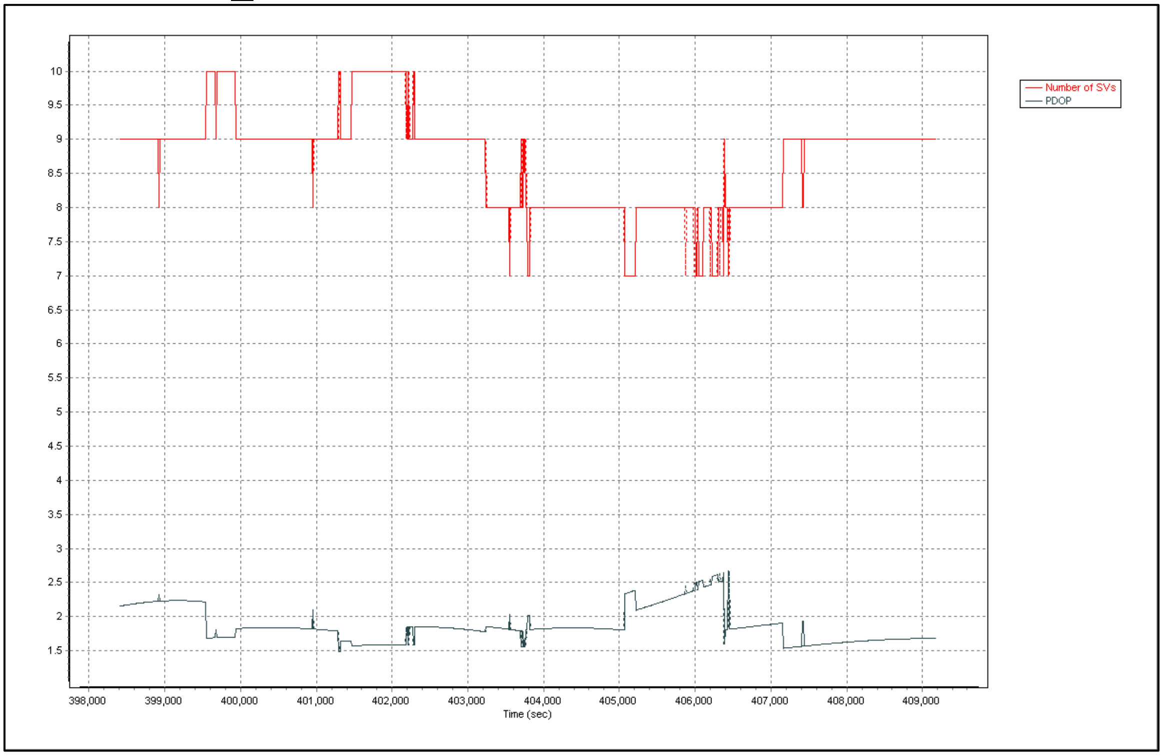
101217A-247_FOWARDPROCPERFMETRIC_NED



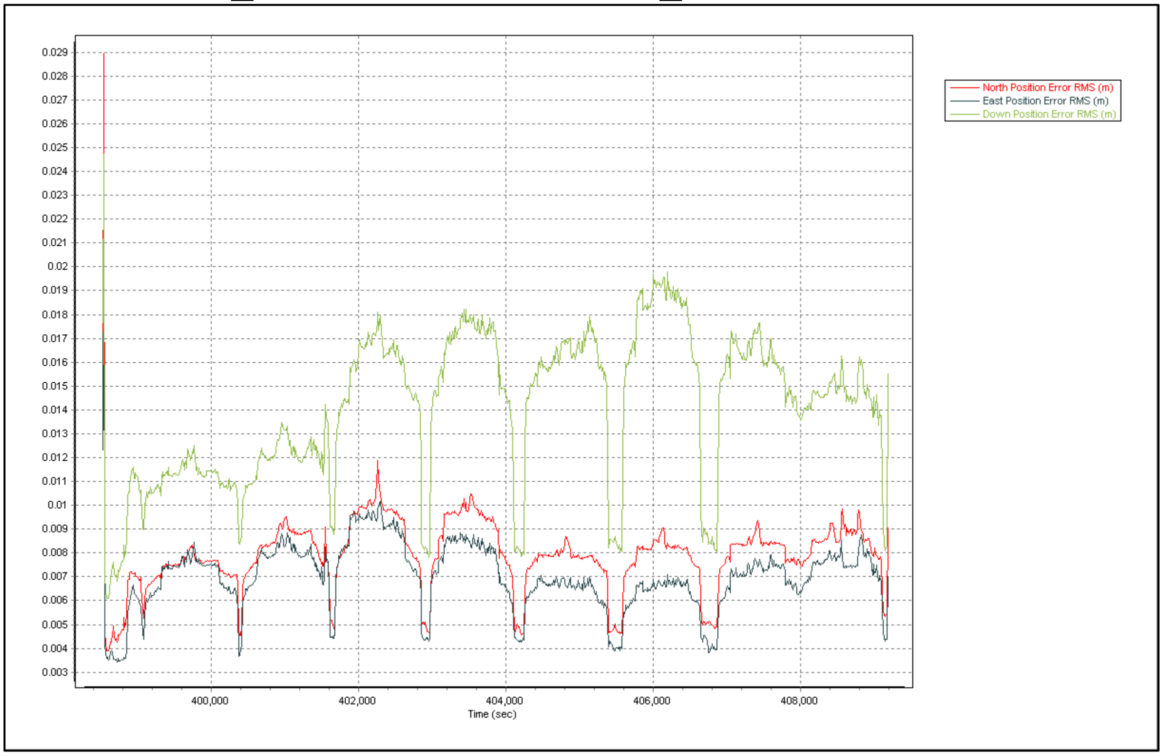
101217A-247_BASELINE



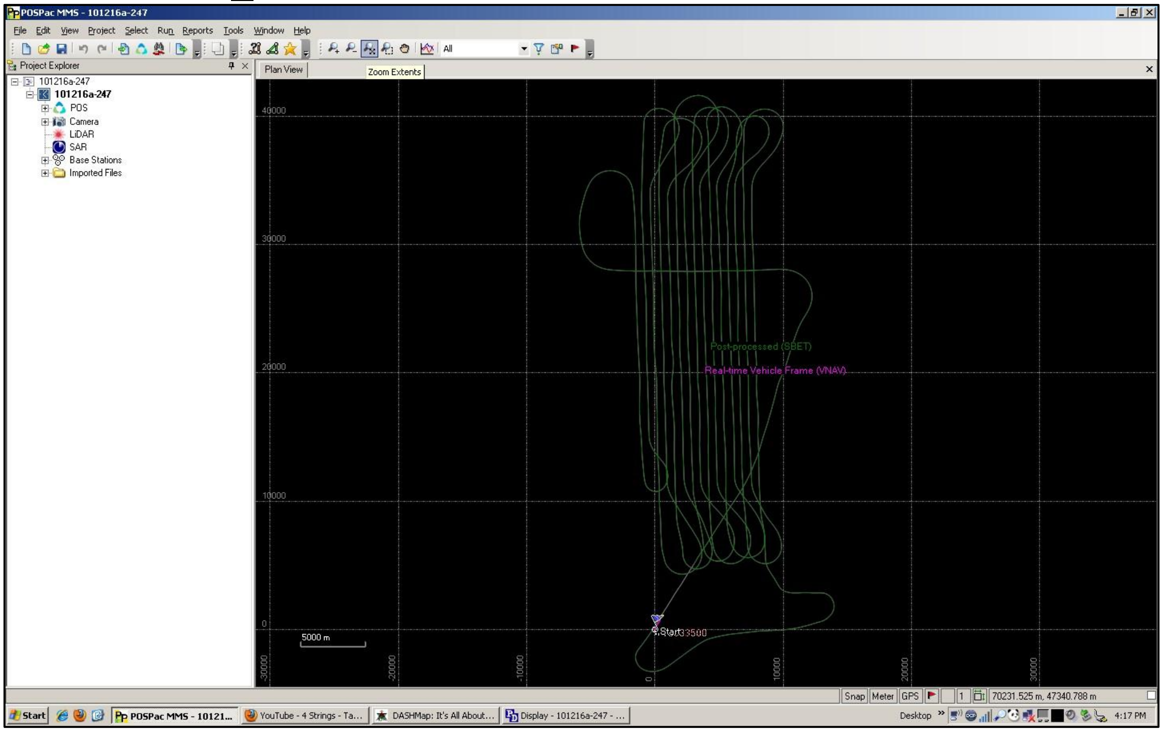
101216A-247_SVS&PDOP



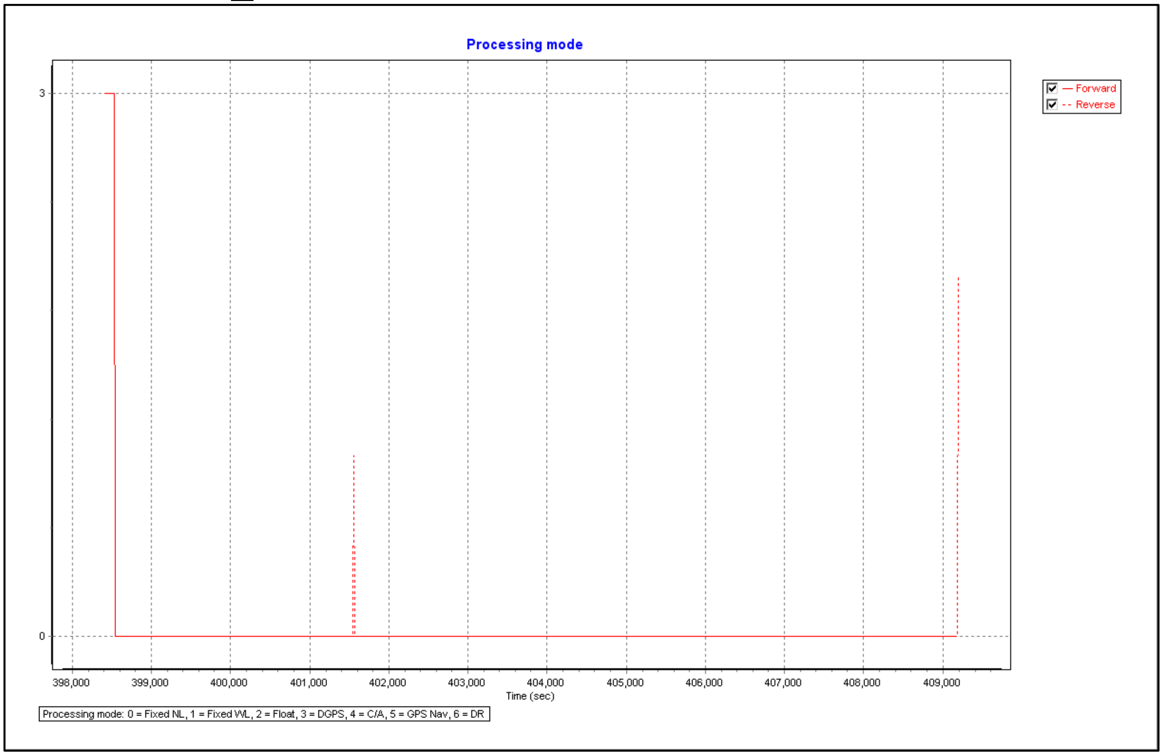
101216A-247_SMOOTHPERFMETRIC_NED



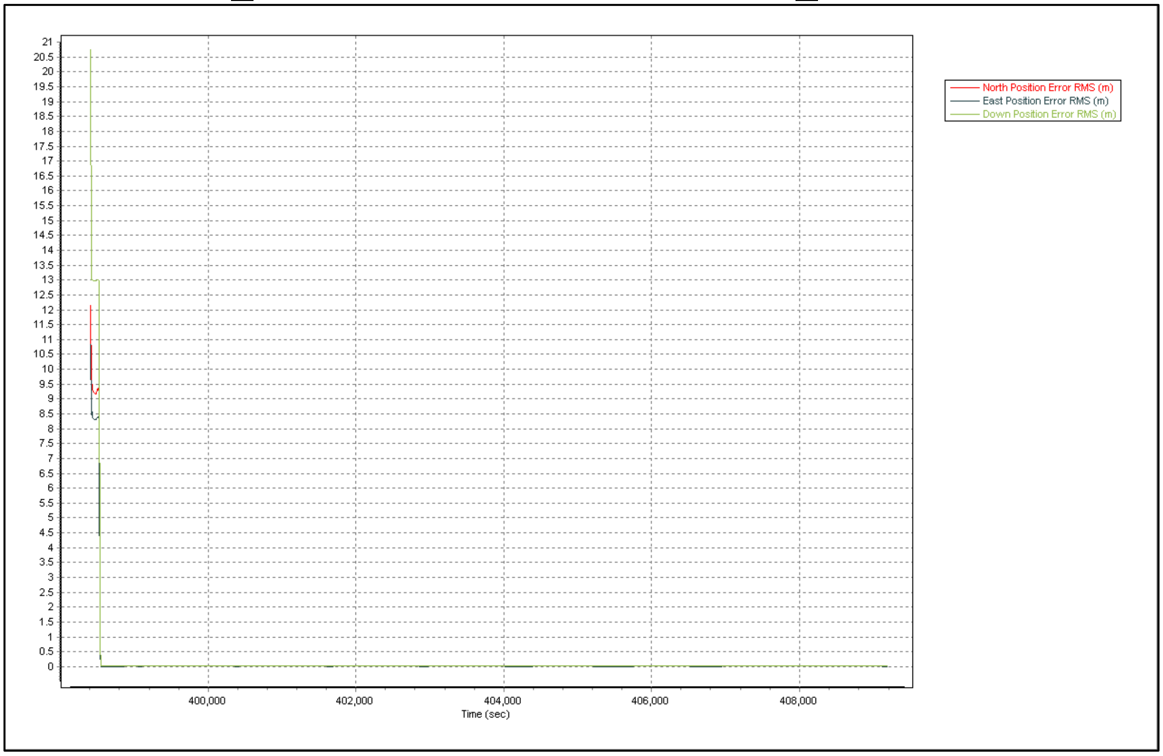
101216A-247_SCREENSHOT



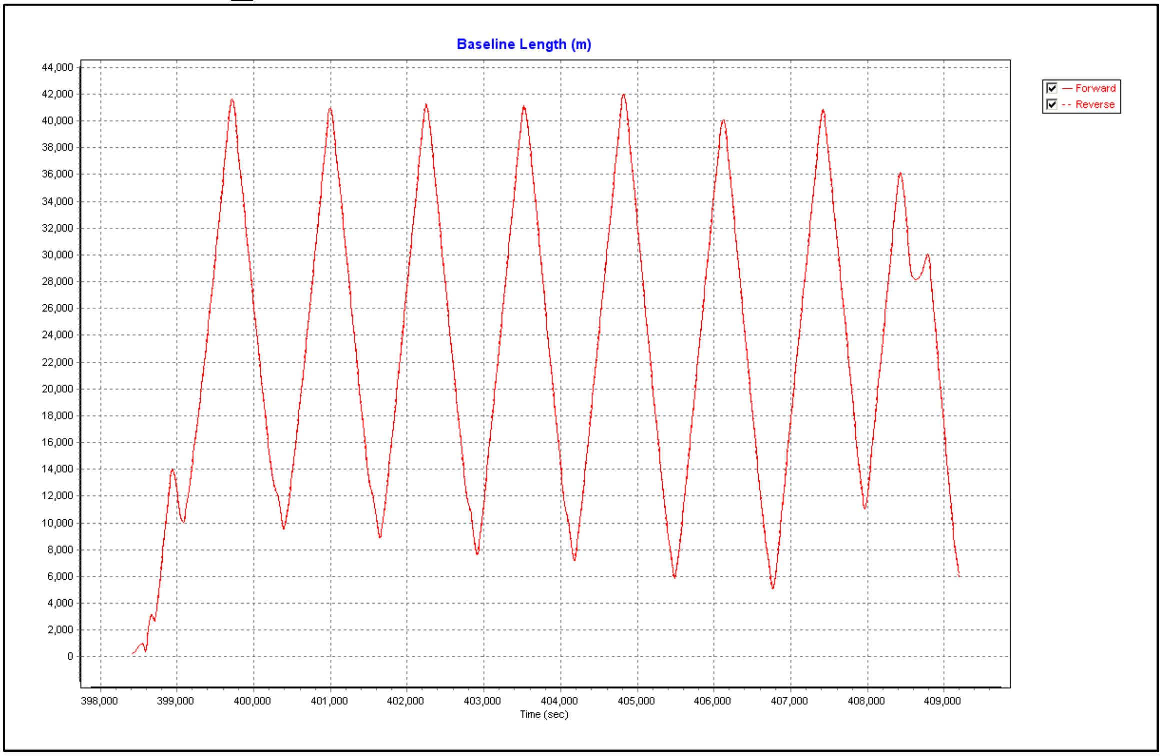
101216A-247_PROCESSMODE



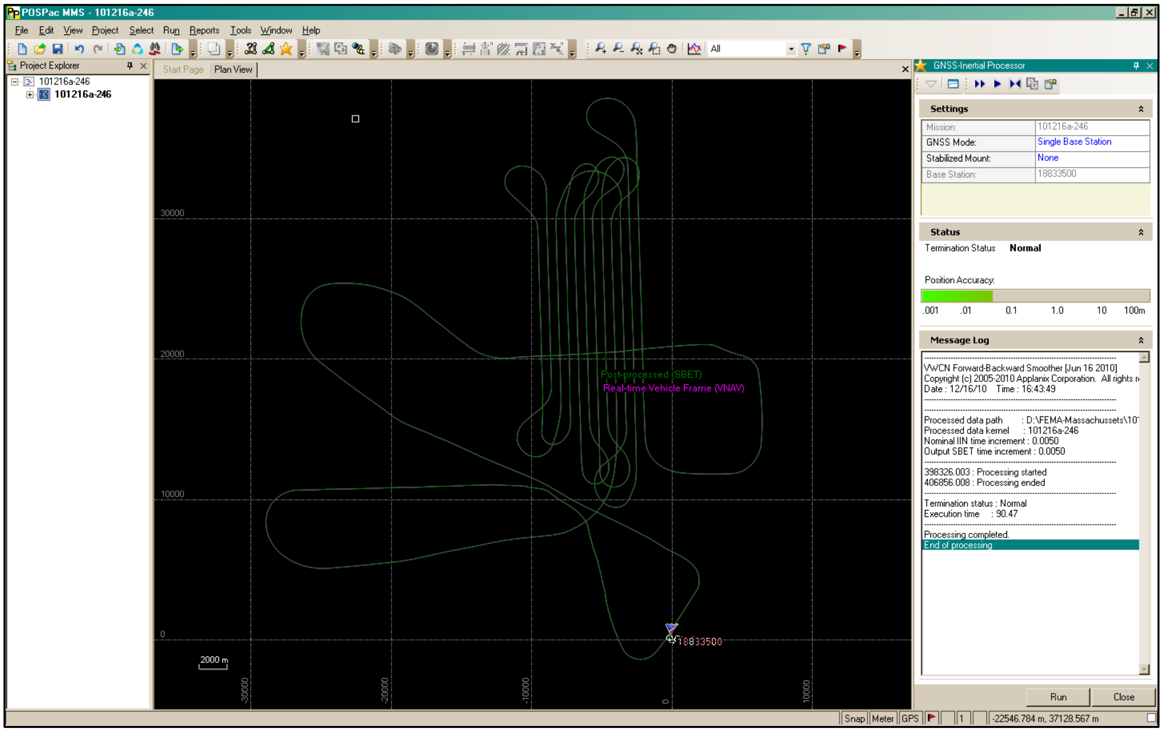
101216A-247_FORWARDPROCPERFMETRIC_NED



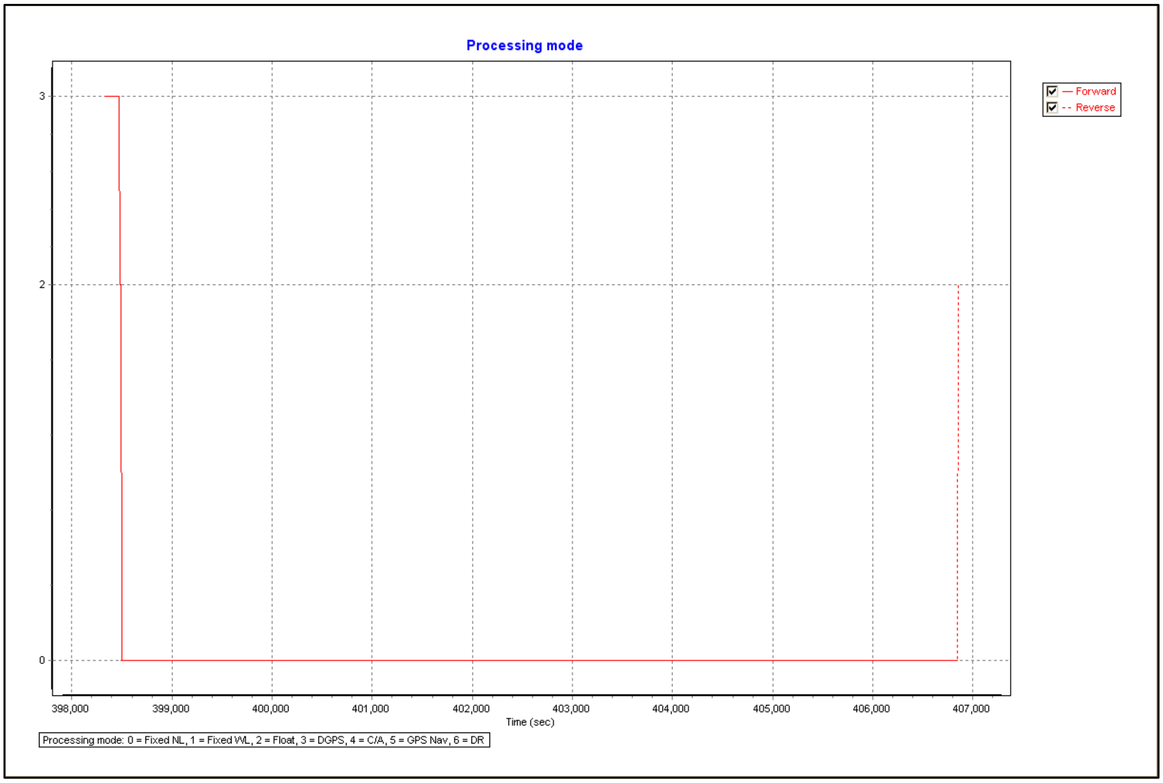
101216A-247_BASELINE



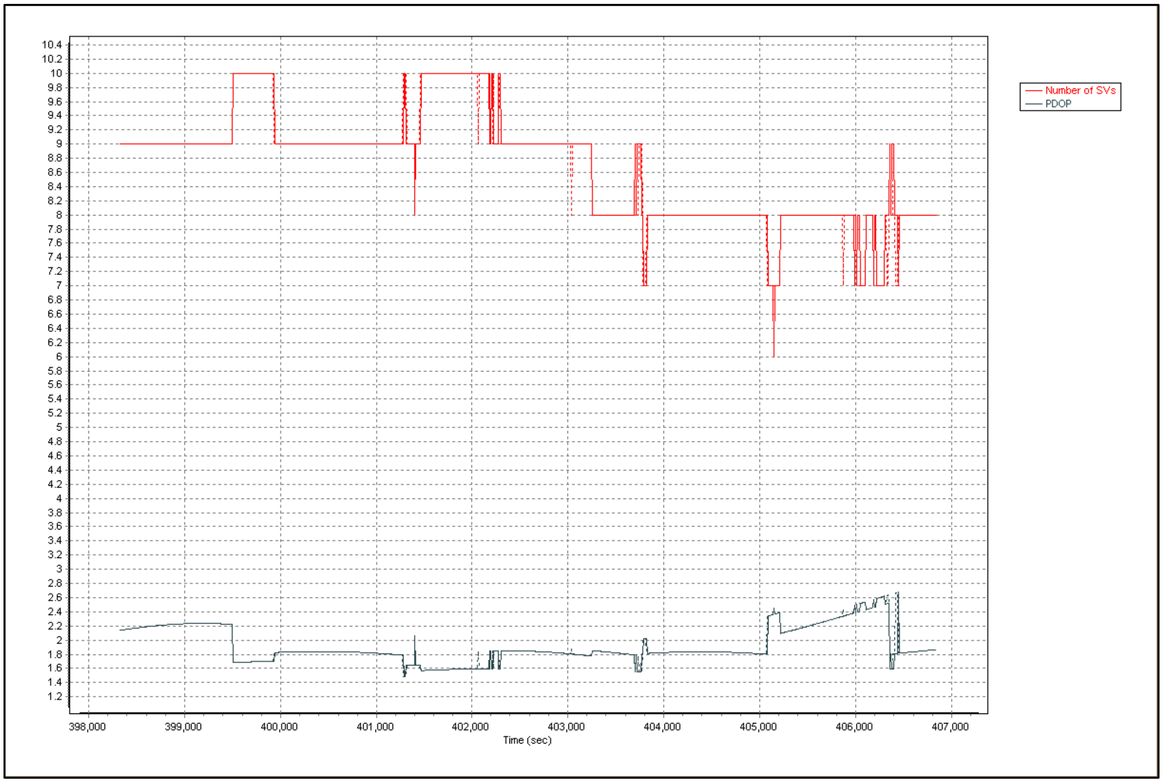
101216A-246-TRAJECTORY



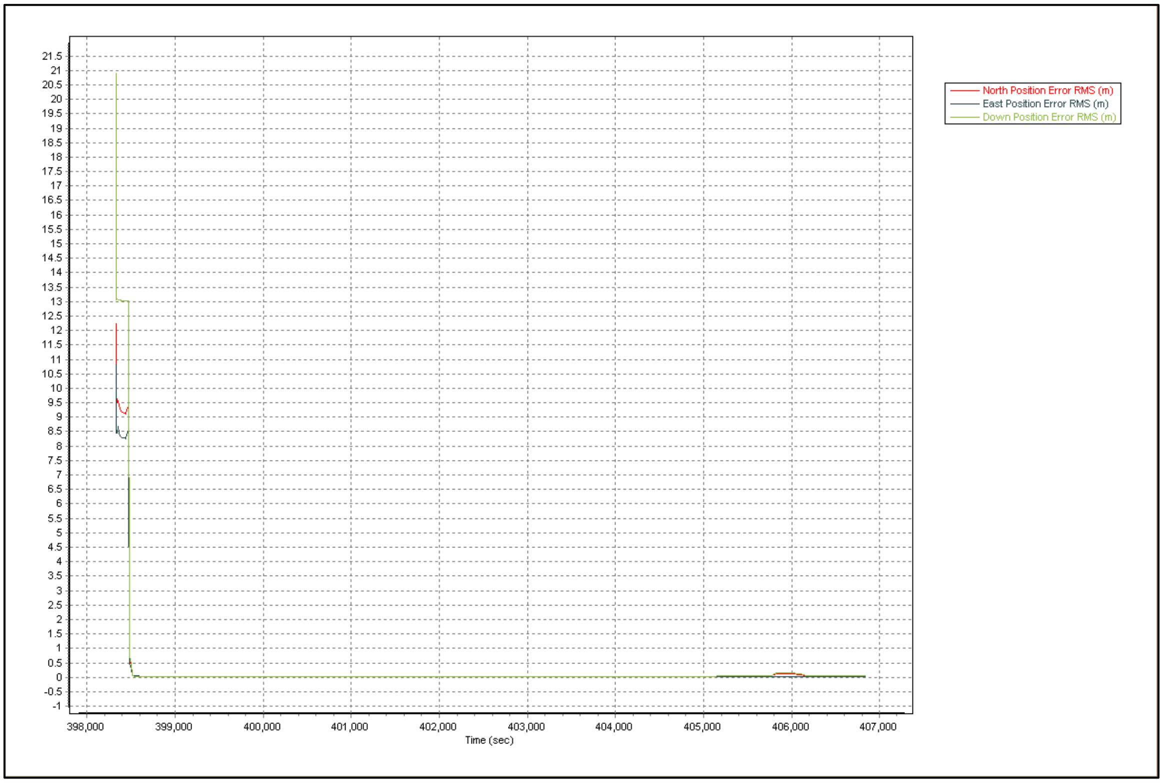
101216A-246-PROCMODE



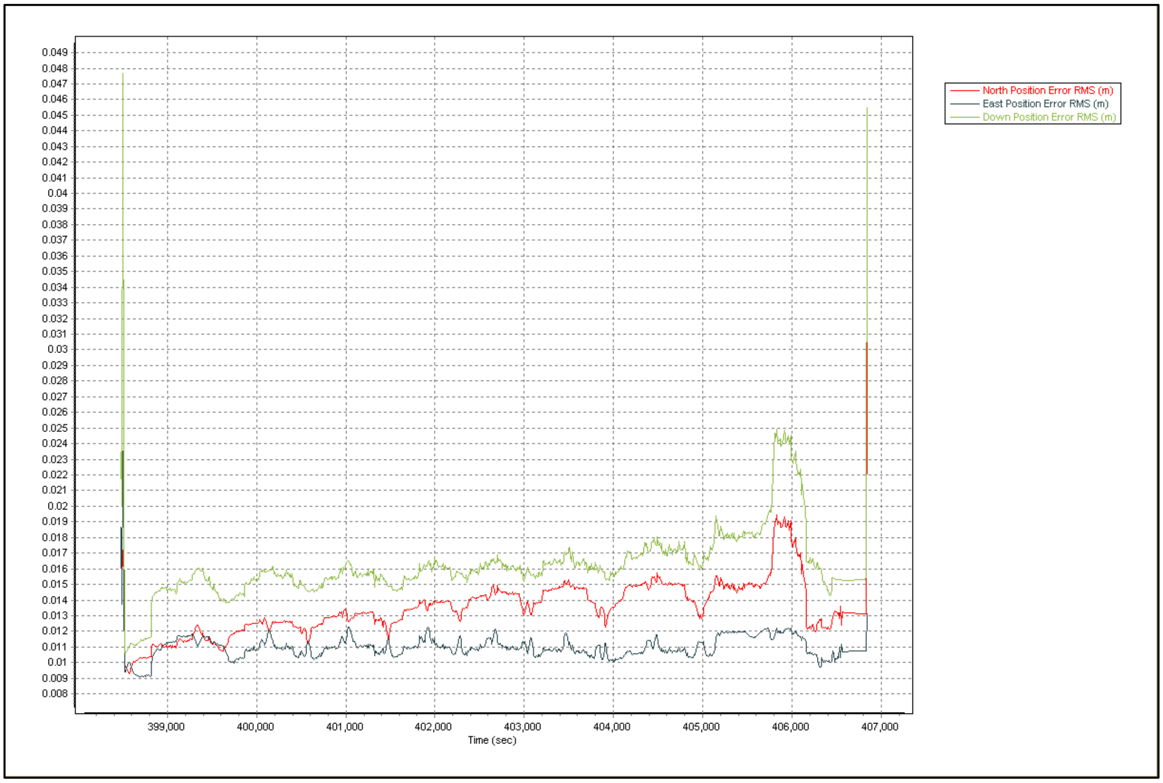
101216A-246-PDOP&SVS



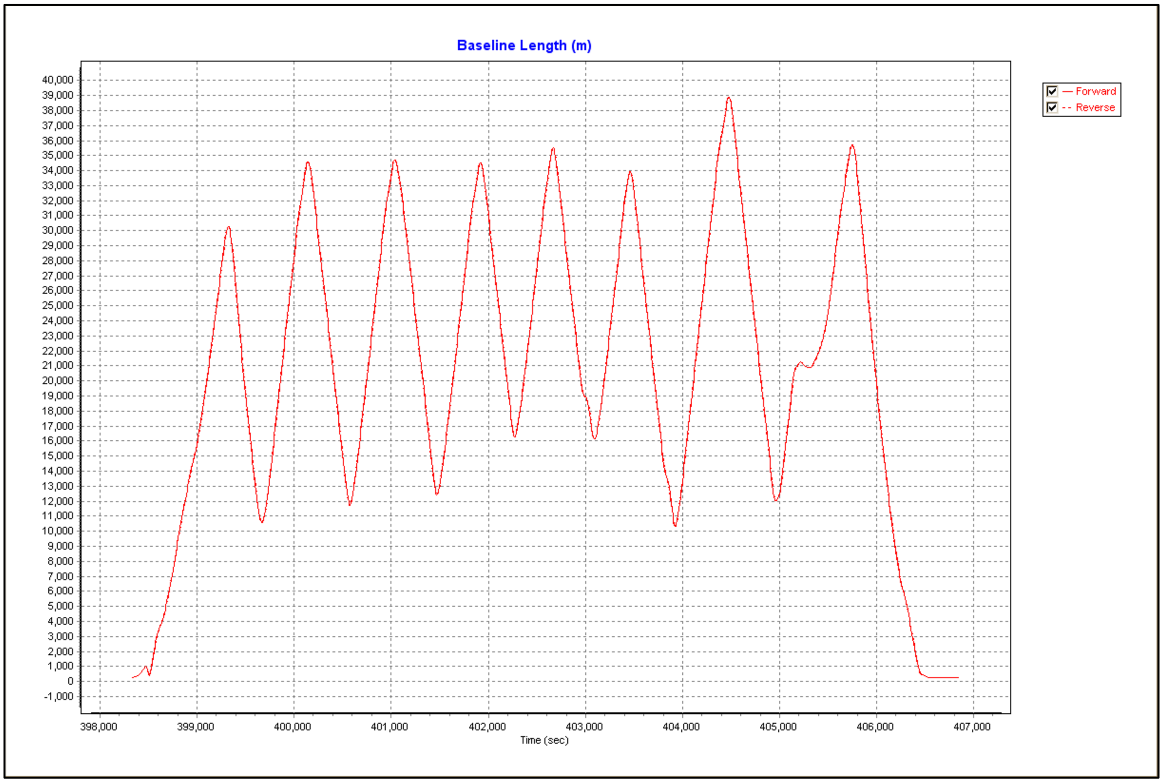
101216A-246-NEDPOSITIONERROR-SMOOTHED



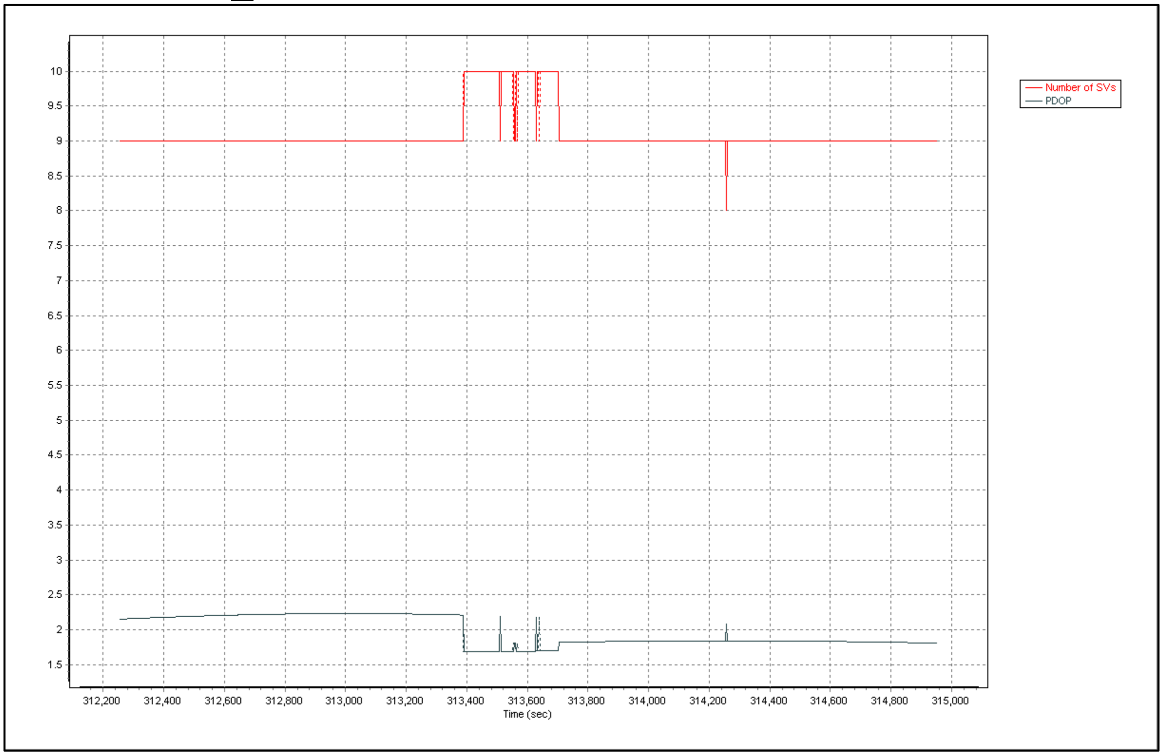
101216A-246-NEDPOSITIONERROR-FORWARD



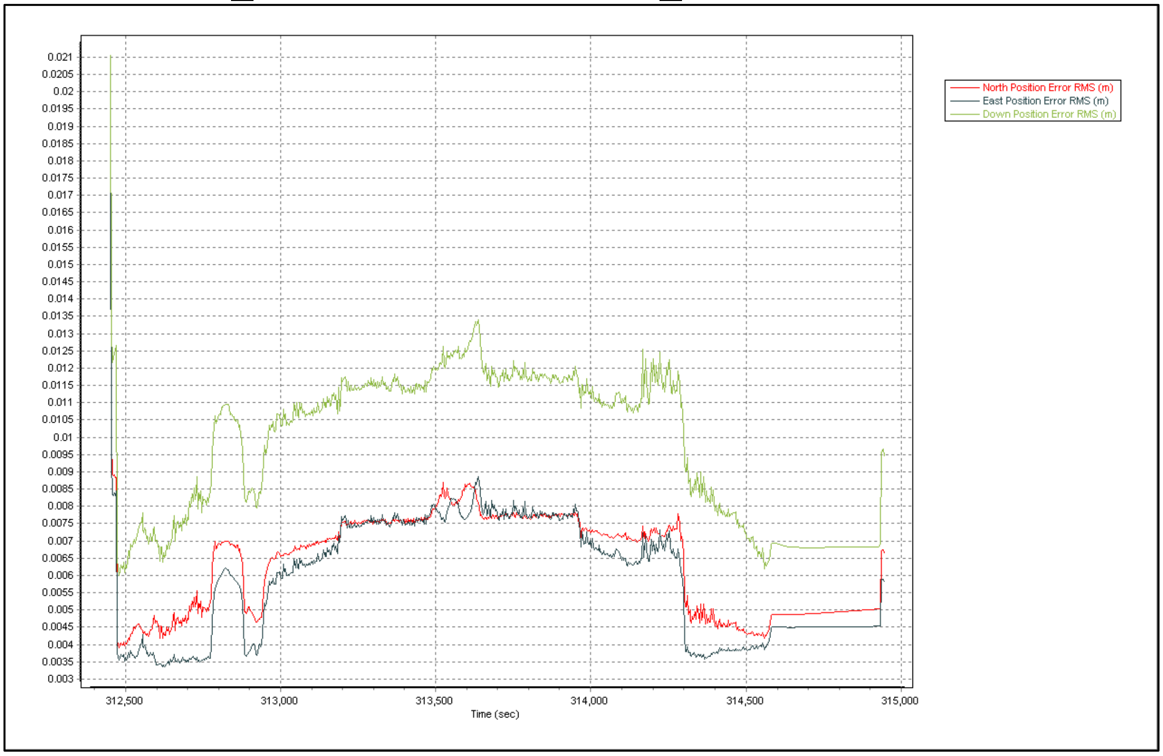
101216A-246-BASELINELENGTH



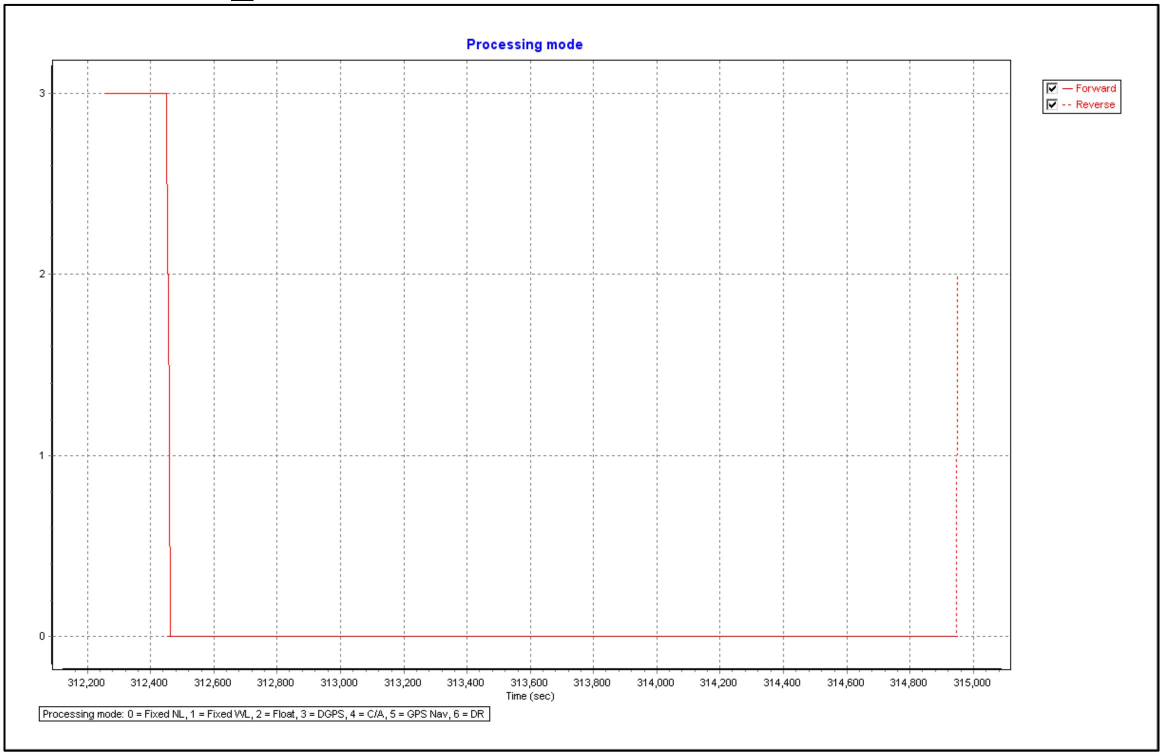
101215A-247_SVS&PDOP



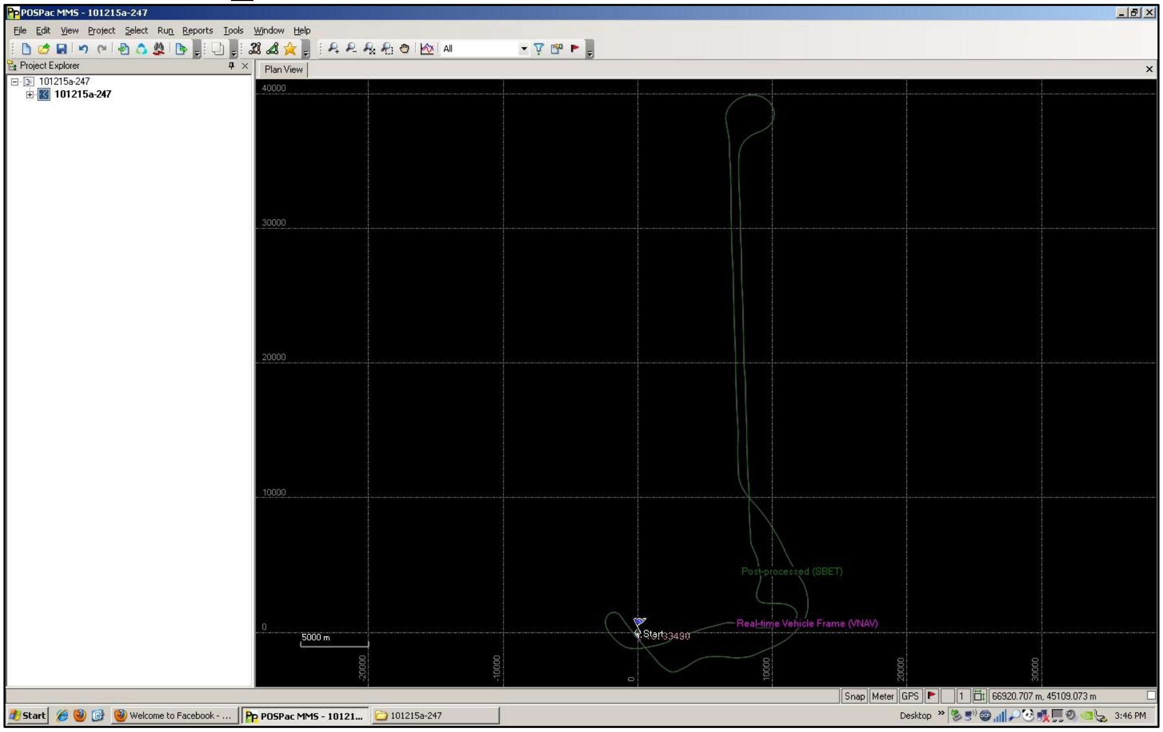
101215A-247_SMOOTHPERFMETRIC_NED



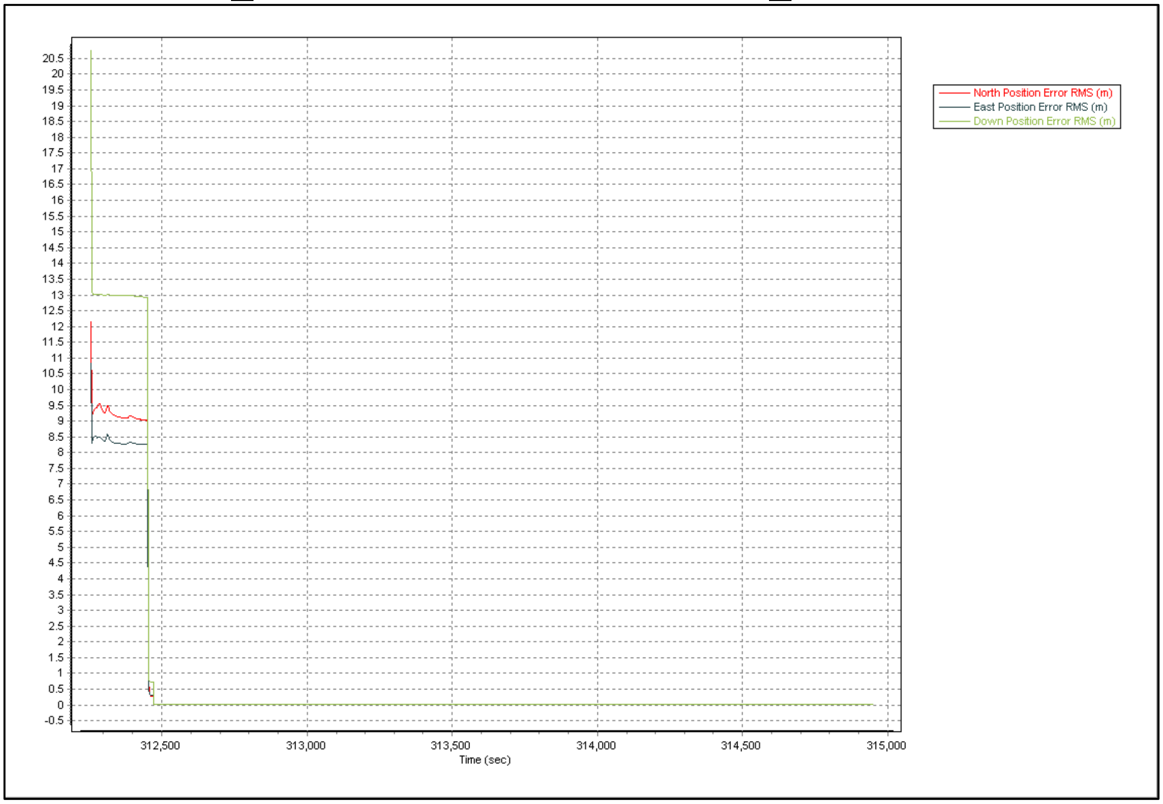
101215A-247_PROCESSMODE



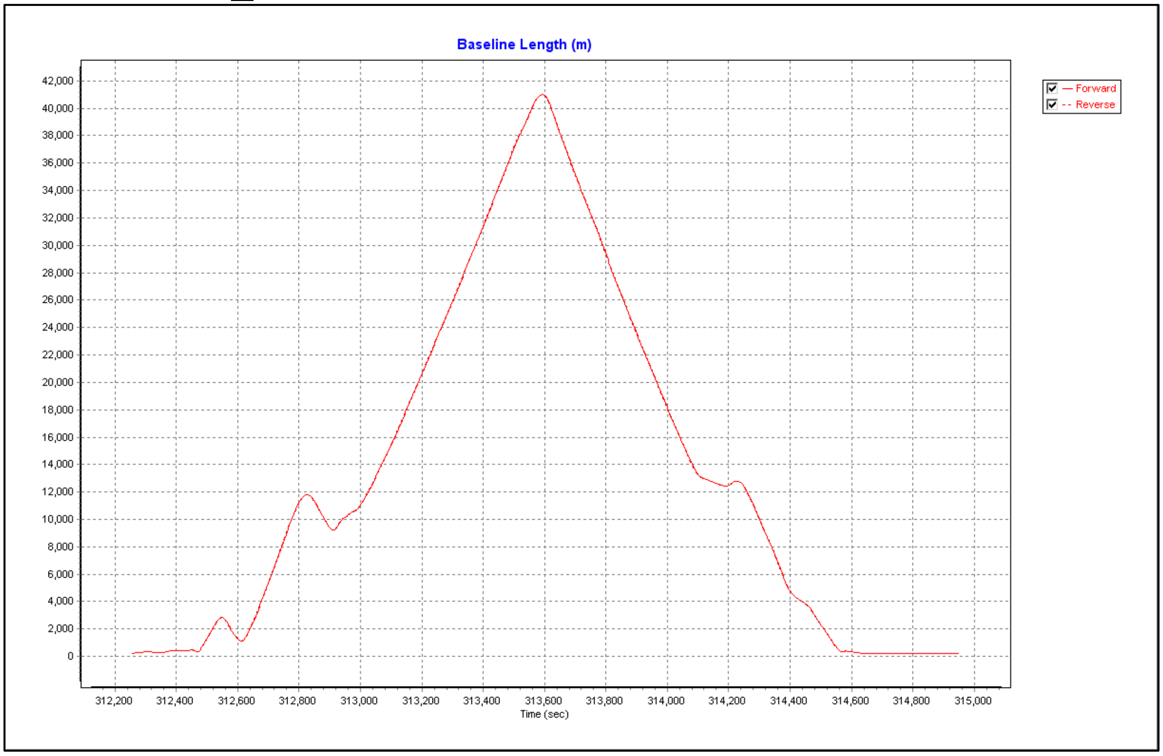
101215A-247_SCREENSHOT



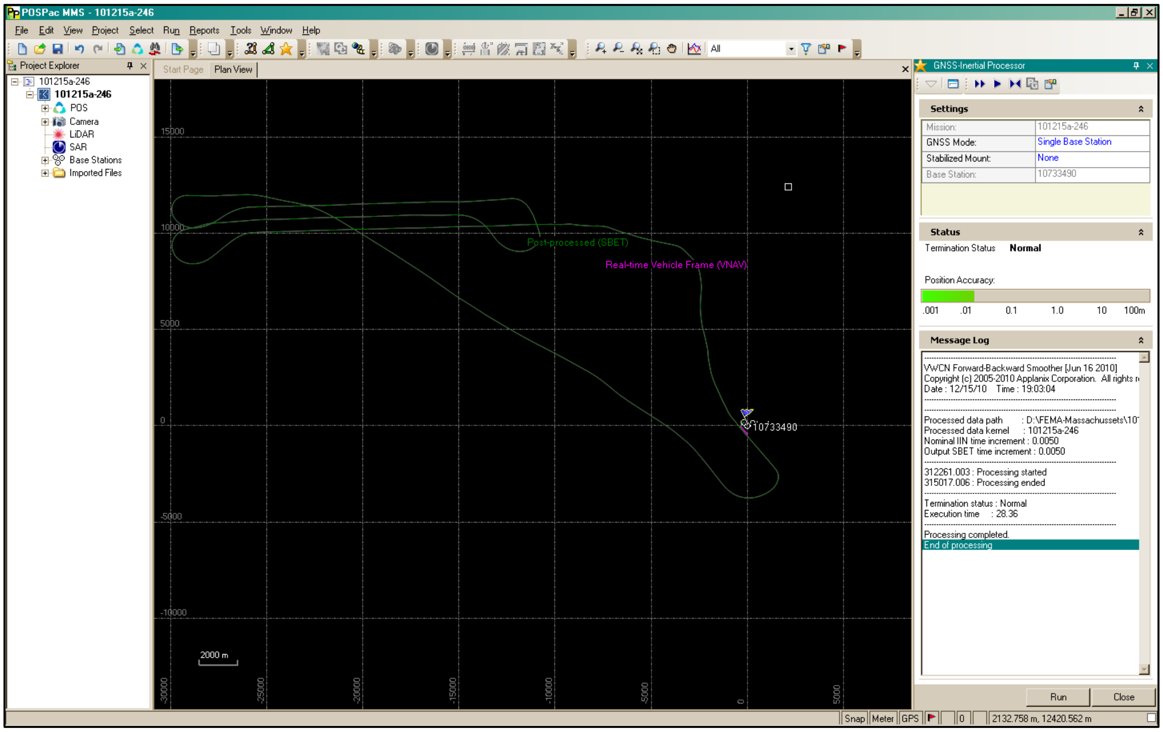
101215A-247_FOWARDPROCPERFMETRIC_NED



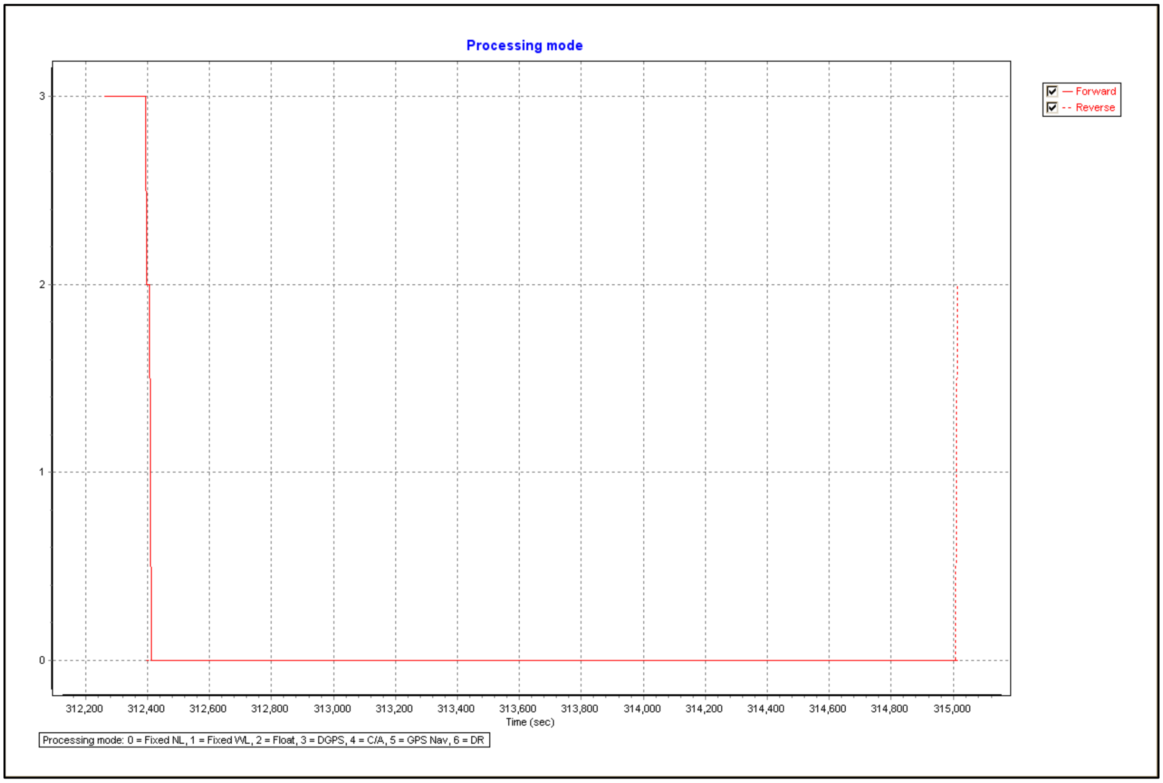
101215A-247_BASELINE



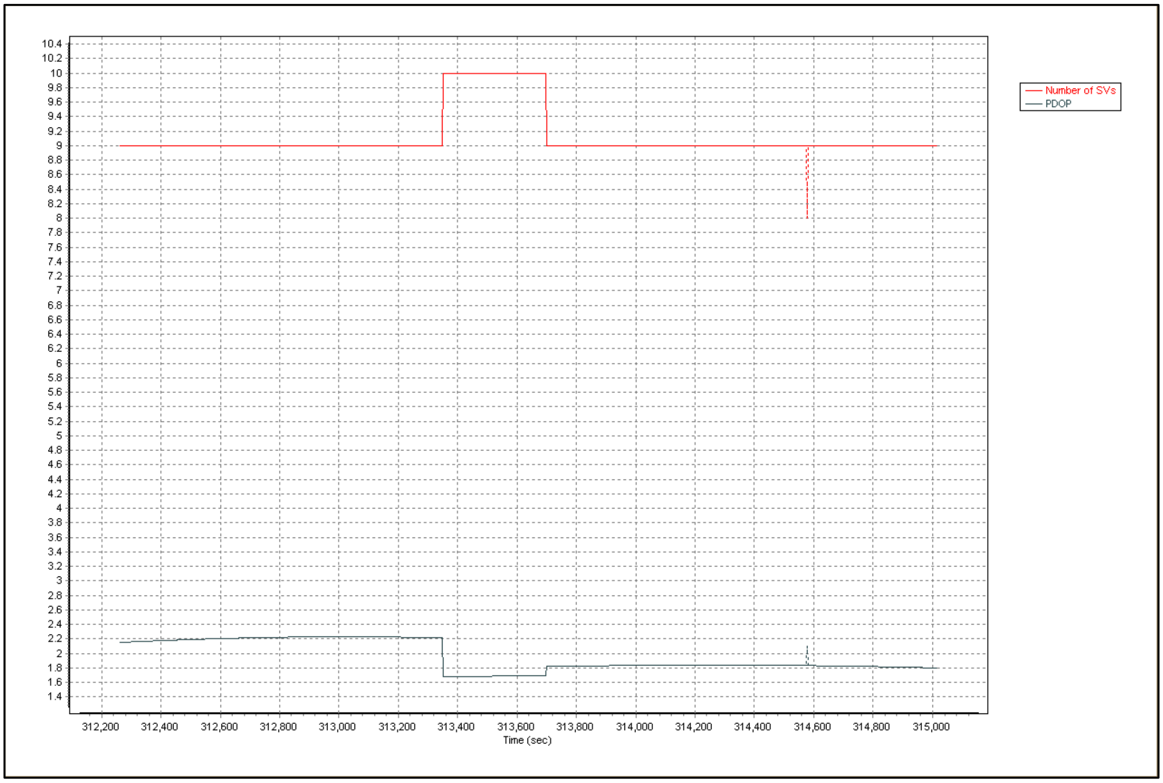
101215A-246-TRAJECTORY



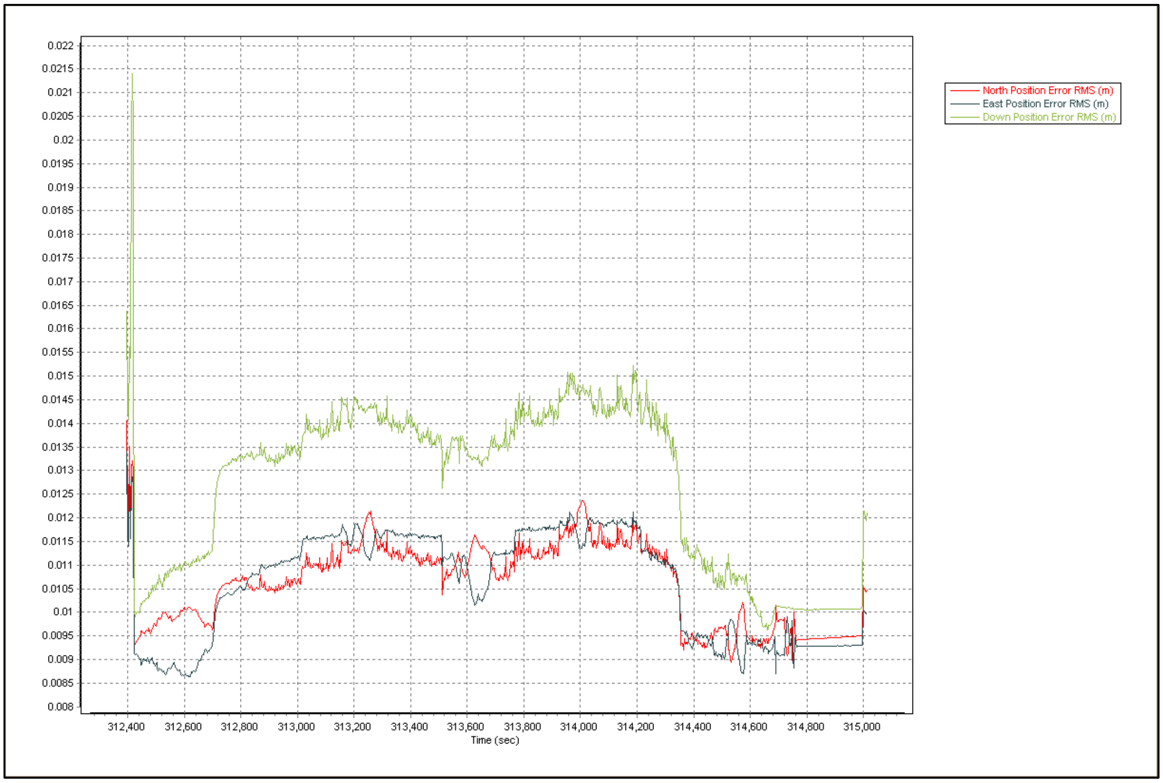
101215A-246-PROCMODE



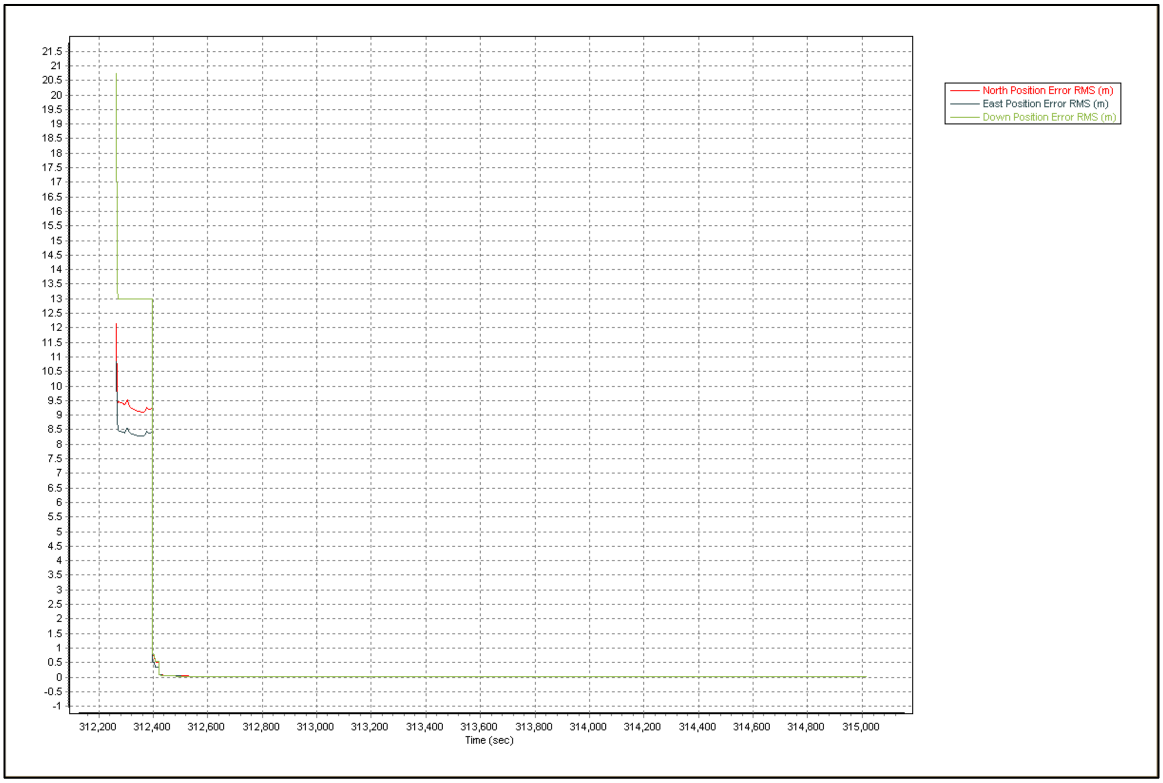
101215A-246-PDOP&SVS



101215A-246-NEDPOSITIONERROR-SMOOTHED



101215A-246-NEDPOSITIONERROR-FORWARD



101215A-246-BASELINELENGTH

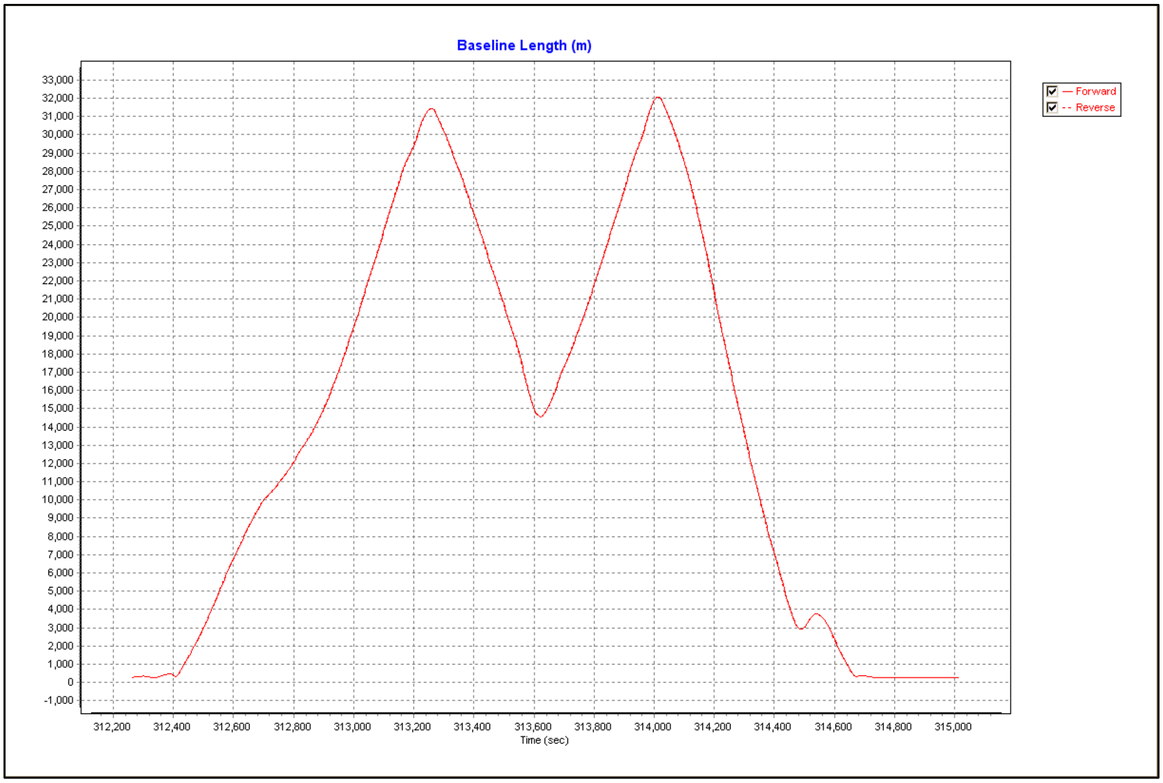


PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive
Lexington, Kentucky 40503
Phone 859-277-8700 + Fax 859-277-8901
www.photoscience.com

March 29, 2011

Post Flight Report
PSI Project 7556-005
OWD Quincy LiDAR

CONTRACT: ______________________
Client: ____________________________
Project Name: OWD Quincy Sub Block
Attached Reference file: *7556-005_OWD-Quincy_MA_Background.ZIP*

General Specifications: 1-meter nominal spacing LiDAR Acquisition and processing with a 24.5 cm vertical accuracy at 95% confidence level.

Acquisition Dates: LiDAR data for the OWD-Quincy data was acquired on the dates of 12/17/2010 with one lift.

Equipment Used: The data was collected with an Optech Gemini LiDAR system, Serial Number 246, Base GPS Receiver used was a Trimble 5700 collecting data at half second intervals. The aircraft used was a Cessna 206 model, tail number N7266Z. The pilot was Mark Young and the Operator was Jeremy Berry. The Base Station was set on the monument “BED A, AI5558” at the Lauren Hanscom Field Airport (BED) by the flight crew.

Project: The project consisted of 27 flight lines of 184.82 miles. The project was flown at an altitude of 5,000 feet above ground and at a planned average speed of 116 knots with a field of view of 36 degrees. The scan rates used was 30.1 Hz with a Laser Pulse Rate of 71,429 Hz with Multi-Pulse enabled. The full swath width was 989.18 meters with a planned sidelap of 30%. The point spacing was <1 meter with a NADIR point density of 1.2 points per square meter and an average point density of 3.03 points per square meter. The planned vertical accuracy was 0.13 meters. The area consisted of approximately 39 square miles.

GPS Base Station / Monument:. The Base Station was set on the monument “BED A, AI5558” at the Lauren Hanscom Field Airport (BED) by the flight crew. Information on this monument is included in the attached .ZIP file under “Base Station Data”.

Control: 10 control points were collected as part of the project and used to calibrate the project data, remove any bias and verify accuracy. This data is compared to the collected model and results indicated below. This control data in included in the attached .ZIP file under “Control”.

Flight Files: The planned flight files are included as reference in the attached .ZIP file under "Flight Files".

Flight Logs: Flight Logs used by the crew are included in the attached .ZIP file under "Flight Logs" and include the following type information:

- job #/name
- block or AOI
- date (s) flown
- aircraft tail #
- lines - #
- lines - direction
- lines – altitude
- lines – speed
- conditions
- comments
- pilot name
- operator name
- AGC switch
- GPS base station used

Processing Summary: Data is included in the attached .ZIP file under "Processing Summary" which includes GPS / IMU processing summary data including at a minimum:

- Processing Logs
- Message Logs
- Extract Logs
- Laser configuration files for each lift
- Max Horizontal GPS Variance (cm)
- Max Vertical GPS Variance (cm)
- Notes on GPS quality (High, Good, etc.)
- GPS separation plot
- GPS altitude plot
- PDOP plot
- Plot of GPS distance from base station/s

Project Coverage: within the attached .ZIP file in the "Project Coverage" directory is the overall boundary Shape File and the as flown trajectory Shape Files which include the project calibration flight lines (cross flights).

Accuracy: The LiDAR data was tested against the Control check points indicated above and the results are included in the "Accuracy Results" directory in the attached .ZIP file.

The LiDAR data as collected tested at 0.057 (meters) fundamental vertical accuracy at 95% confidence level, within the accuracies indicated in the specifications, as provided.

Sincerely,

Forrest Godby
Senior Project Manager / Flight Operations Manager

```
336763.387,4698913.379,QUI101
336299.766,4693540.724,QUI102
334264.691,4685336.018,QUI103
332023.567,4682584.608,QUI104
338371.657,4681113.933,QUI105
335421.148,4679867.328,QUI106
333310.834,4689260.503,QUI107
331148.929,4694883.980,QUI108
331079.973,4686332.119,NGS_MY2936
315439.609,4704518.423,NGS_MY6363
```

DELORME

XMap® 4.5

Scale 1 : 150,000

1" = 2.37 mi

Data Zoom 10-0

TN

MN (15.1°W)

L:\7556005\Quincy\quincy.ctl

Number	Easting	Northing	Known Z	Laser Z	Dz
QUI101	336763.387	4698913.379	1.607	1.720	+0.113
QUI102	336299.766	4693540.724	1.889	1.870	-0.019
QUI103	334264.691	4685336.018	8.432	8.410	-0.022
QUI104	332023.567	4682584.608	2.344	2.290	-0.054
QUI105	338371.657	4681113.933	5.661	5.680	+0.019
QUI106	335421.148	4679867.328	3.581	3.620	+0.039
QUI107	333310.834	4689260.503	1.622	1.620	-0.002
QUI108	331148.929	4694883.980	4.738	4.770	+0.032
NGS_MY2936	331079.973	4686332.119	35.199	35.100	-0.099
NGS_MY6363	315439.609	4704518.423	45.319	outside	*

Average dz	+0.001
Minimum dz	-0.099
Maximum dz	+0.113
Average magnitude	0.044
Root mean square	0.057
Std deviation	0.060

BED_MA_Concord_FEMA_Base Station Monument

See file dsdata.txt for more information about the datasheet.

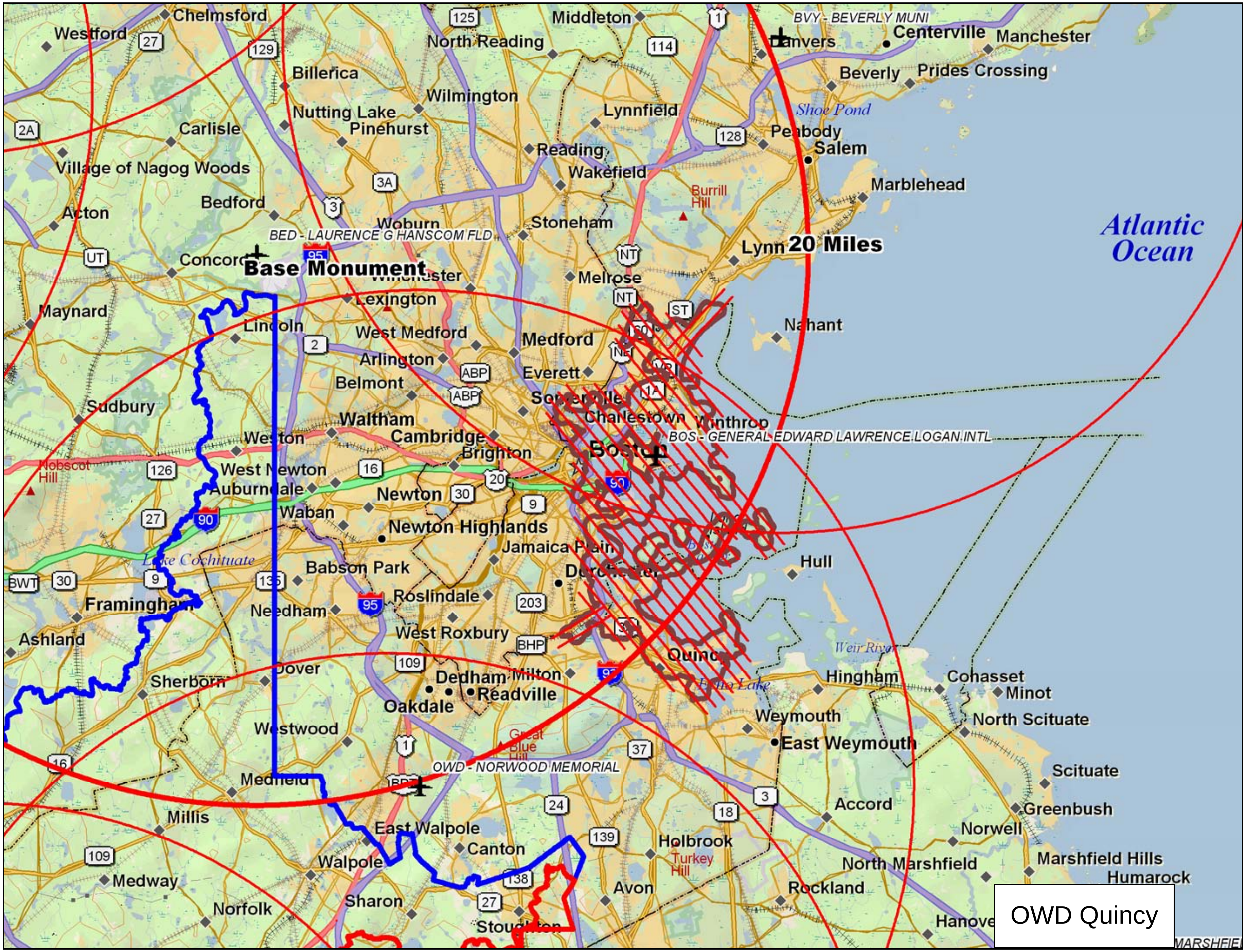
```
DATABASE =  ,PROGRAM = datasheet, VERSION = 7.85
1        National Geodetic Survey,   Retrieval Date = OCTOBER 29, 2010
 AI5558 ***********************************************************************
 AI5558  PACS         -  This is a Primary Airport Control Station.
 AI5558  DESIGNATION -  BED A
 AI5558  PID         -  AI5558
 AI5558  STATE/COUNTY-  MA/MIDDLESEX
 AI5558  USGS QUAD   -
 AI5558
 AI5558                         *CURRENT SURVEY CONTROL
 AI5558  ___________________________________________________________________
 AI5558* NAD 83(2007)-  42 28 07.77843(N)    071 16 59.30167(W)     ADJUSTED
 AI5558* NAVD 88     -        42.05   (meters)     138.0    (feet)  GPS OBS
 AI5558  ___________________________________________________________________
 AI5558  EPOCH DATE  -        2002.00
 AI5558  X           -   1,512,043.591 (meters)                     COMP
 AI5558  Y           -  -4,462,815.458 (meters)                     COMP
 AI5558  Z           -   4,284,170.733 (meters)                     COMP
 AI5558  LAPLACE CORR-            4.06  (seconds)                   DEFLEC09
 AI5558  ELLIP HEIGHT-          14.280 (meters)         (02/10/07) ADJUSTED
 AI5558  GEOID HEIGHT-         -27.77  (meters)                     GEOID09
 AI5558
 AI5558  ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
 AI5558  Type    PID    Designation                       North   East  Ellip
 AI5558  -------------------------------------------------------------------
 AI5558  NETWORK AI5558 BED A                              1.00   0.86   2.27
 AI5558  -------------------------------------------------------------------
 AI5558
 AI5558.This mark is at Laurence G Hanscom Fld Airport (BED)
 AI5558
 AI5558.The horizontal coordinates were established by GPS observations
 AI5558.and adjusted by the National Geodetic Survey in February 2007.
 AI5558
 AI5558.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
 AI5558.See National Readjustment for more information.
 AI5558.The horizontal coordinates are valid at the epoch date displayed above.
 AI5558.The epoch date for horizontal control is a decimal equivalence
 AI5558.of Year/Month/Day.
 AI5558
 AI5558.The orthometric height was determined by GPS observations and a
 AI5558.high-resolution geoid model.
 AI5558
 AI5558.GPS derived orthometric heights for airport stations designated as
 AI5558.PACS or SACS are published to 2 decimal places.  This maintains
 AI5558.centimeter relative accuracy between the PACS and SACS.  It does
 AI5558.not indicate centimeter accuracy relative to other marks which are
 AI5558.part of the NAVD 88 network.
 AI5558
 AI5558.Photographs are available for this station.
```

```
AI5558
AI5558.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AI5558
AI5558.The Laplace correction was computed from DEFLEC09 derived deflections.
AI5558
AI5558.The ellipsoidal height was determined by GPS observations
AI5558.and is referenced to NAD 83.
AI5558
AI5558.The geoid height was determined by GEOID09.
AI5558
AI5558;                    North         East     Units Scale Factor Converg.
AI5558;SPC MA M     -   913,166.589   217,834.126   MT  0.99997548   +0 08 44.4
AI5558;SPC MA M     - 2,995,947.38    714,677.46   sFT  0.99997548   +0 08 44.4
AI5558;UTM  19      - 4,704,357.395   312,305.643   MT  1.00003346   -1 32 31.2
AI5558
AI5558!             -  Elev Factor  x  Scale Factor =   Combined Factor
AI5558!SPC MA M     -   0.99999776  x   0.99997548  =   0.99997324
AI5558!UTM  19      -   0.99999776  x   1.00003346  =   1.00003122
AI5558
AI5558:                Primary Azimuth Mark                     Grid Az
AI5558:SPC MA M     -  BED B                                    098 36 23.5
AI5558:UTM  19      -  BED B                                    100 17 39.1
AI5558
AI5558|---------------------------------------------------------------------|
AI5558| PID    Reference Object                     Distance      Geod. Az  |
AI5558|                                                           dddmmss.s |
AI5558| AI5559 BED B                               458.707 METERS 0984507.9 |
AI5558| MY0669 BED ARP                             APPROX. 0.5 KM 2854318.4 |
AI5558|---------------------------------------------------------------------|
AI5558
AI5558                          SUPERSEDED SURVEY CONTROL
AI5558
AI5558  ELLIP H (06/04/02)   14.273  (m)                          GP(       ) 4 1
AI5558  NAD 83(1996)-  42 28 07.77845(N)    071 16 59.30211(W) AD(       ) B
AI5558  ELLIP H (05/22/00)   14.281  (m)                          GP(       ) 4 1
AI5558
AI5558.Superseded values are not recommended for survey control.
AI5558.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AI5558.See file dsdata.txt to determine how the superseded data were derived.
AI5558
AI5558_U.S. NATIONAL GRID SPATIAL ADDRESS: 19TCH1230504357(NAD 83)
AI5558_MARKER: DD = SURVEY DISK
AI5558_SETTING: 66 = SET IN ROCK OUTCROP
AI5558_STAMPING: BED A 1999
AI5558_MARK LOGO: NOS
AI5558_MAGNETIC: N = NO MAGNETIC MATERIAL
AI5558_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
AI5558+STABILITY: POSITION/ELEVATION WELL
AI5558_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AI5558+SATELLITE: SATELLITE OBSERVATIONS - May 20, 2002
AI5558
AI5558  HISTORY     - Date     Condition        Report By
AI5558  HISTORY     - 1999     MONUMENTED       WOOLPT
AI5558  HISTORY     - 20020520 GOOD             INDIV
AI5558
AI5558                          STATION DESCRIPTION
AI5558
```

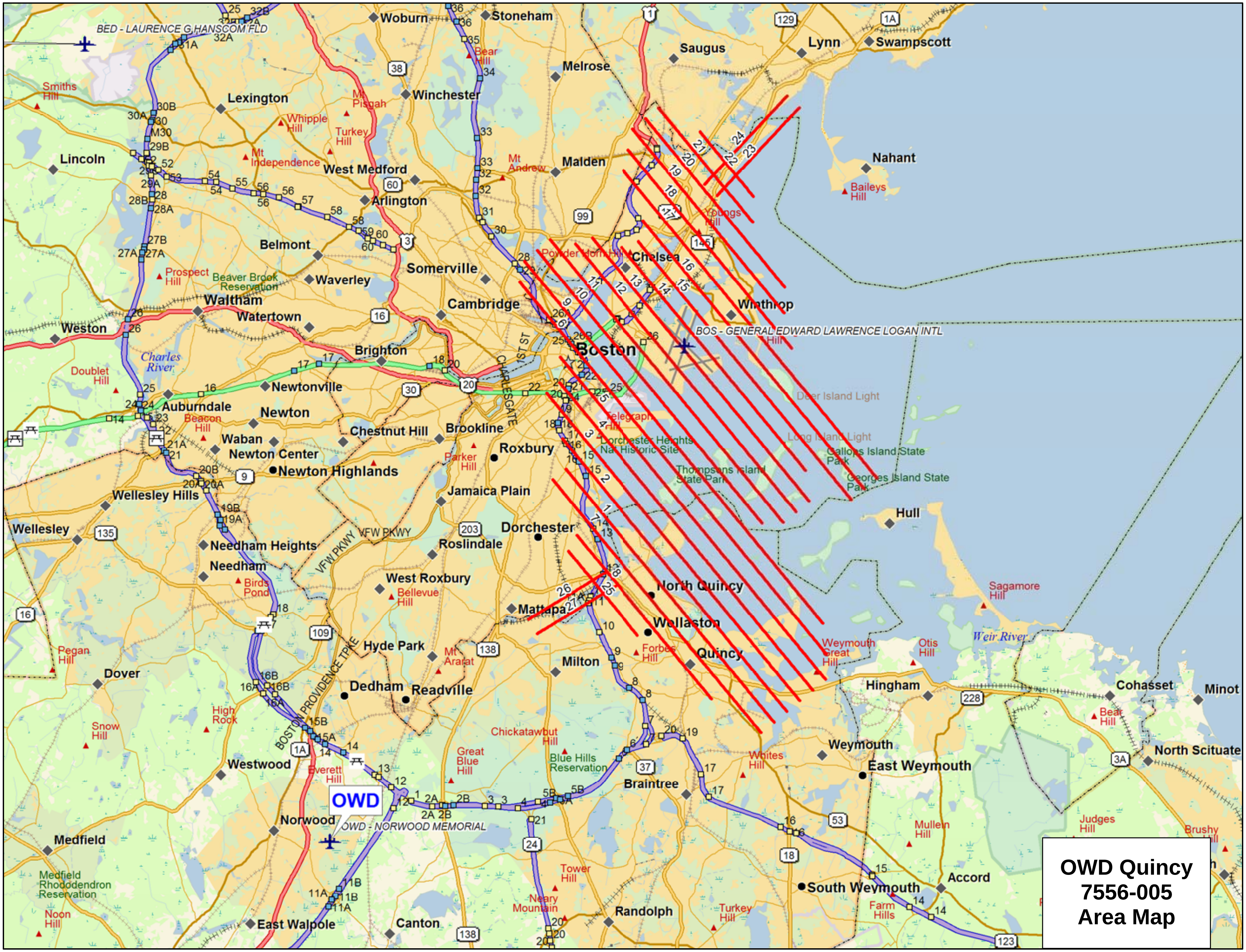
```
AI5558'DESCRIBED BY WOOLPERT CONSULTANTS 1999 (ARL)
AI5558'THE STATION IS LOCATED ABOUT 4.95 MI (7.97 KM) EAST OF CONCORD, 3.00
AI5558'MI (4.83 KM) WEST-NORTHWEST OF LEXINGTON, AT THE L.G.  HANSCOM FIELD
AI5558'AIRPORT, IN THE HIGHEST POINT OF HILL IN THE WEST ANGLE FORMED BY THE
AI5558'INTERSECTION OF RUNWAYS.  OWNERSHIP--MASSACHUSETTS PORT AUTHORITY, C/O
AI5558'AIRPORT MANAGER BARBARA PATZNER, CIVIL AIR TERMINAL, HANSCOM FIELD,
AI5558'BEDFORD MA 01730.  PHONE (617) 274-7200.  CONTACT THE AIRPORT MAMAGER
AI5558'AT LEAST 24 HOURS PRIOR TO ACCESS TO ARRANGE FOR AN ESCORT.
AI5558'TO REACH THE STATION FROM THE JUNCTION OF INTERSTATE HIGHWAY 95 AND
AI5558'STATE HIGHWAY 2A, EXIT 45, GO WEST FOR 1.60 MI (2.57 KM) ON HIGHWAY 2A
AI5558'TO A PAVED ROAD ON THE RIGHT.  TURN RIGHT AND GO NORTH FOR 0.50 MI
AI5558'(0.80 KM) ON THE PAVED ROAD TO A FORK.  BEAR LEFT AND GO NORTH FOR
AI5558'0.55 MI (0.89 KM) ON THE PAVED ROAD, FOLLOWING SIGNS TO THE CIVIL AIR
AI5558'TERMINAL, AND A GATE AT THE NORTHWEST CORNER OF THE AIRPORT TERMINAL
AI5558'BUILDING.  PASS THROUGH THE GATE AND PROCEED NORTH 0.10 MI (0.16 KM)
AI5558'ACROSS THE WEST RAMP TO TWY SIERRA.  GO NORTHEAST 0.5 MI (0.8 KM)
AI5558'ALONG TWY SIERRA TO TWY ECHO.  HEAD EAST 0.3 MI (0.5 KM) ALONG TWY
AI5558'ECHO, PAST TWY GULF TO STATION ON THE LEFT, SET ON THE EAST SIDE OF
AI5558'THE HILL NEAR THE CROWN.
AI5558'THE STATION IS LOCATED ONLINE WITH THE THIRD SET OF TWY LIGHTS WEST OF
AI5558'A TWY LEADING TO THE EAST RAMP, 121.20 M (397.64 FT) SOUTH SOUTHWEST
AI5558'OF THE EDGE OF PAVEMENT OF RWY 11-29, ROCK OUTCROP, 73.34 M (240.62
AI5558'FT) NORTH NORTHEAST OF THE EDGE OF PAVEMENT OF TWY ECHO, 48.23 M
AI5558'(158.23 FT) SOUTHWEST OF A SAFETY BOUNDARY MARKER FOR RWY 11-29, AND
AI5558'7.50 M (24.61 FT) EAST OF THE TOP OF SLOPE THE STATION IS A STANDARD
AI5558'NOS DISK STAMPED-- BED A 1999-- SET IN A EXPOSED PORTION OF THE ROCK
AI5558'LEDGE, AND IS SUBSET 3 CM INTO THE ROCK.  THIS STATION IS DESIGNATED
AI5558'AS THE PRIMARY AIRPORT CONTROL STATION.
AI5558
AI5558                          STATION RECOVERY (2002)
AI5558
AI5558'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2002 (KL)
AI5558'FOUND IN GOOD CONDITION BY MASSPORT - HANSCOM FIELD AIRPORT OPERATIONS
AI5558'
AI5558'(KL)  CONTACT NUMBER FOR ACCESS TO SURVEY MARK HAS CHANGED.  NEW
AI5558'NUMBER IS 781-869-8000  BARBARA PATZNER, AIRPORT MANAGER
AI5558'

*** retrieval complete.
Elapsed Time = 00:00:00
```

Reformatory Branch Trail
Hartwell Rd
Shaw Cir
Evergreen Ave
Nellian St
Charles St
Summer St
Sarah Ave
Lynnfield St
Fayette Rd
S Rd
Maguire
BED ARP
BED ARP
BED A
Fuller Ln
Dow St
Hunter St
Robbins St
Chenault St
Grenier St
Forbes St
Hartwell Pl
Barksdale St
Hartwell Ave
E Ramp
Eglin St
Arnold St
Marrett St
Old Bedford Rd
Airport Rd
Bestic Dr
McCord St
Wood St
Shadyside Ave
Virginia Rd
Hanscom Dr
Schilling Cir
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Google
© 2011 Europa Technologies
Google
42°28'09.97" N 71°17'09.84" W
elev 127 ft
Jun 19, 2010
Eye alt 12317 ft

XMap® 4.5

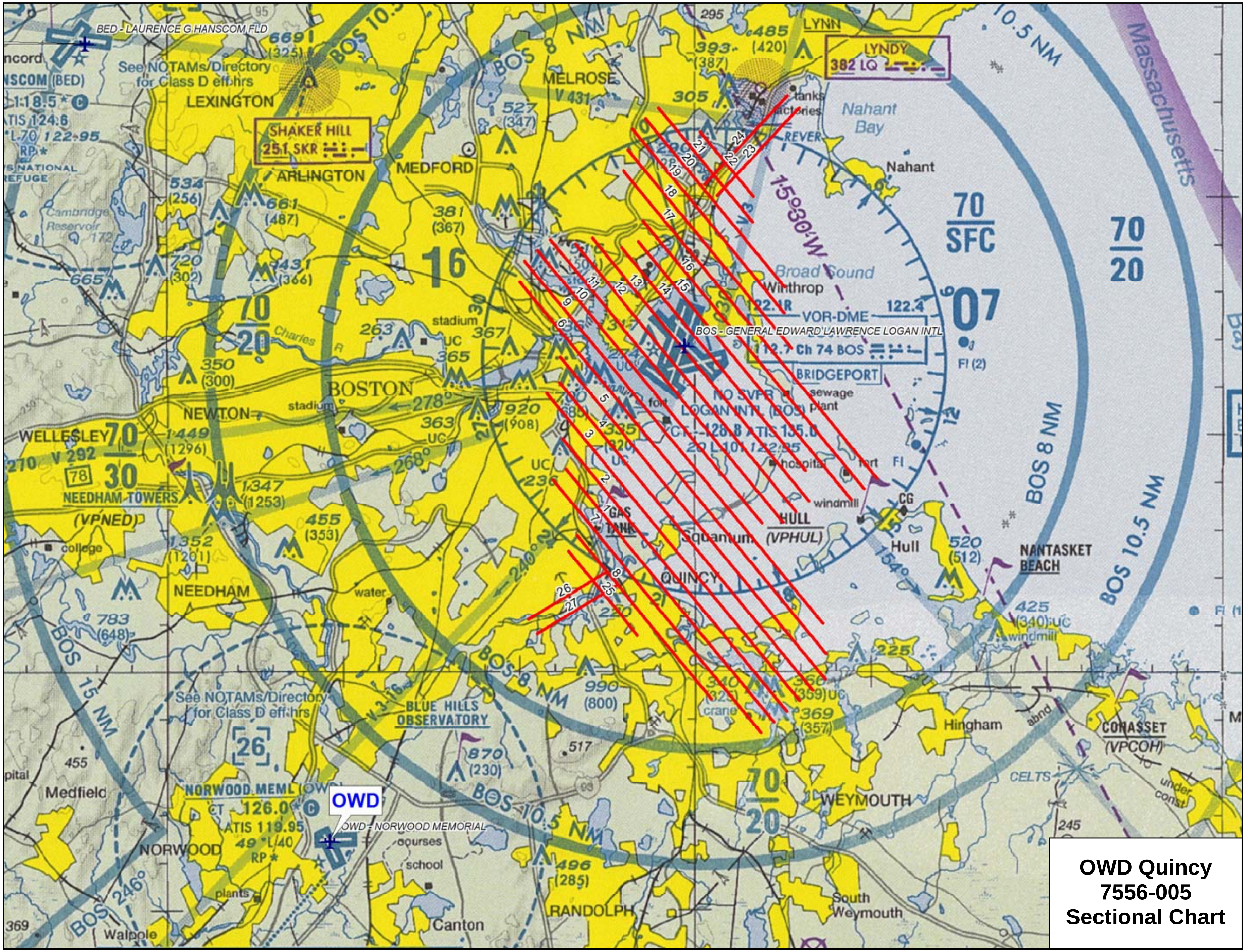


OWD Quincy
20 Miles
Base Monument
BED - LAURENCE G HANSCOM FLD
BOS - GENERAL EDWARD LAWRENCE LOGAN INTL
BVY - BEVERLY MUNI
OWD - NORWOOD MEMORIAL
Atlantic Ocean
Boston
Quincy
Scale 1 : 300,000
1" = 4.73 mi
Data Zoom 9-0



TN
MN (15.1°W)

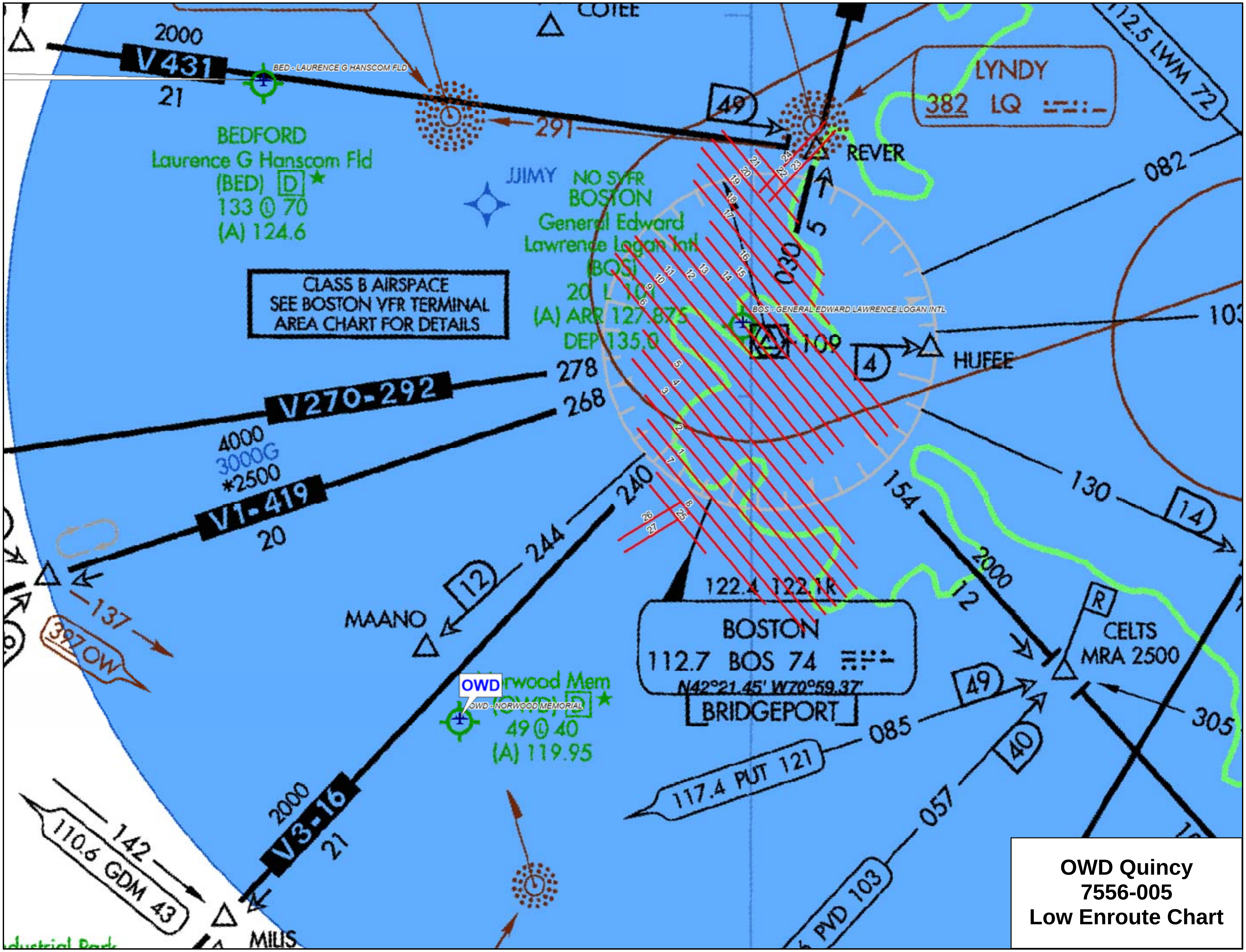
Scale 1 : 200,000
1" = 3.16 mi
Data Zoom 10-0



OWD Quincy
7556-005
Sectional Chart

DeLorme

XMap® 4.5



OWD Quincy
7556-005
Low Enroute Chart

Scale 1 : 250,000

1" = 3.95 mi

Data Zoom 10-0

TN

MN (15.1°W)

Mass Area: OWD-Quincy Project No 7556-005

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

Flight Logs

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	7.9	5010	OWD A	OWD_QUINC OWD_QUINC				
2	8.6	5010	OWD A	OWD_QUINC OWD_QUINC				
3	9.6	5010	OWD A	OWD_QUINC OWD_QUINC				
4	9.6	5000	OWD A	OWD_QUINC OWD_QUINC				
5	10.1	5000	OWD A	OWD_QUINC OWD_QUINC				
6	11.7	5010	OWD A	OWD_QUINC OWD_QUINC				
7	7.9	5010	OWD A	OWD_QUINC OWD_QUINC				
8	5.1	5010	OWD A	OWD_QUINC OWD_QUINC				
9	11.3	5010	OWD A	OWD_QUINC OWD_QUINC				
10	8.6	5010	OWD A	OWD_QUINC OWD_QUINC				
11	8.9	5010	OWD A	OWD_QUINC OWD_QUINC				
12	8.4	5010	OWD A	OWD_QUINC OWD_QUINC				
13	8.2	5010	OWD A	OWD_QUINC OWD_QUINC				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________ AIRCRAFT Tail Number: ____________

Pilot: ____________ Sensor Serial Number: ____________ **Date:** ____________

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	7.0	5010	OWD A	OWD_QUINC OWD_QUINC				
15	8.1	5020	OWD A	OWD_QUINC OWD_QUINC				
16	8.4	5020	OWD A	OWD_QUINC OWD_QUINC				
17	9.6	5010	OWD A	OWD_QUINC OWD_QUINC				
18	6.2	5010	OWD A	OWD_QUINC OWD_QUINC				
19	5.8	5020	OWD A	OWD_QUINC OWD_QUINC				
20	5.3	5020	OWD A	OWD_QUINC OWD_QUINC				
21	3.6	5030	OWD A	OWD_QUINC OWD_QUINC				
22	2.0	5000	OWD A	OWD_QUINC OWD_QUINC				
23	2.9	5000	OWD A	OWD_QUINC OWD_QUINC				
24	2.9	5010	OWD A	OWD_QUINC OWD_QUINC				
25	2.7	5010	OWD A	OWD_QUINC OWD_QUINC				
26	2.2	5030	OWD A	OWD_QUINC OWD_QUINC				
27	2.2	5030	OWD A	OWD_QUINC OWD_QUINC				

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: ____________________ AIRCRAFT Tail Number: ____________________

Pilot: ____________________ Sensor Serial Number: ____________________ **Date:** ____________________

Mass Area: OWD-Quincy   Project No 7556-005   Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

	FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
8	1	7.9	5010	Bepa ~~OWD-A~~	OWD_QUINC OWD_QUINC	12-17-2010	246	JB	
8	2	8.6	5010	~~OWD~~ A	OWD_QUINC OWD_QUINC				
9	3	9.6	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				
9	4	9.6	5000	~~OWD-A~~	OWD_QUINC OWD_QUINC				
9	5	10.1	5000	~~OWD-A~~	OWD_QUINC OWD_QUINC				
10	6	11.7	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				
8	7	7.9	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				
7	8	5.1	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				
10	9	11.3	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				
9	10	8.6	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				
9	11	8.9	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				Plane Shadow in data
8	12	8.4	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				
8	13	8.2	5010	~~OWD-A~~	OWD_QUINC OWD_QUINC				

112

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young
AIRCRAFT Tail Number: N72667
Sensor Serial Number: 246
Date: 12-17-2010

	FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
8	14	7.0	5010	~~OWD A~~	OWD_QUINC OWD_QUINC	12-17-2010	246	QB	
8	15	8.1	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
8	16	8.4	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
9	17	9.6	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
7	18	6.2	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
7	19	5.8	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
7	20	5.3	5020	~~OWD A~~	OWD_QUINC OWD_QUINC				
6	21	3.6	5030	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	22	2.0	5000	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	23	2.9	5000	~~OWD A~~	OWD_QUINC OWD_QUINC				
6	24	2.9	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	25	2.7	5010	~~OWD A~~	OWD_QUINC OWD_QUINC				
6	26	2.2	5030	~~OWD A~~	OWD_QUINC OWD_QUINC				
5	27	2.2	5030	~~OWD A~~	OWD_QUINC OWD_QUINC				

92

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Berry
Pilot: Young

AIRCRAFT Tail Number: N72607
Sensor Serial Number: 246

Date: 12-17-2010

204 miles 3.5 hours.

Mass Area: SFZ Blackstone Project No 7556-005 Flight Logs

Contact: Photo Science; F Godby at 859 277-8700 or Cell: 859 421-5258

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
1	12.9	5250	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
2	12.9	5250	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
3	12.9	5250	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
4	12.9	5250	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
5	12.9	5240	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
6	12.9	5250	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
7	12.9	5260	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
8	12.9	5280	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
9	12.9	5270	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
10	12.9	5250	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
11	12.9	5260	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	Clouds possible @ S end
12	12.9	5280	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	
13	12.9	5290	SFZ_Blac	SFZ_Blacksto / SFZ_BLACKS	12/16	247	✓	3.5mi S of N end possible clouds

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galiefi

Pilot: Greenwell

AIRCRAFT Tail Number: N24486

Sensor Serial Number: 247

Date: 12/16/2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
14	10.7	5320	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	Clouds possible on line
15	10.7	5320	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/16	247	✓	Clouds possible on line
16 ✓	10.7	5310	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
17	10.7	5330	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
18	8.1	5310	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
19	8.1	5340	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
20	8.1	5360	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
21	8.1	5360	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
22	8.1	5390	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
23	6.2	5430	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
24	6.2	5450	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
25	6.2	5430	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
26	6.2	5370	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			
27 ✓	6.2	5290	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	—			

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galiefi **AIRCRAFT Tail Number:** N2448G

Pilot: Greenwell **Sensor Serial Number:** 247 **Date:** 12/16/2010

FLIGHT LINE	FL MILES	ALTITUDE	BASE STATION	FLIGHT FILES	DATE FLOWN	S/N	FIELD QC	Comments
28	6.5	5560	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	247	✓	
29	5.0	5580	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
30	5.0	5580	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
31	4.7	5570	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
32	4.8	5590	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
33	5.1	5650	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
34	6.5	5680	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
35	6.5	5670	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
36	6.8	5650	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
37	7.0	5640	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
38	7.0	5620	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
39	4.3	5810	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	
40	4.3	5750	SFZ_Blac	SFZ_Blacksto SFZ_BLACKS	12/17	"	✓	

Flight Logs should be FAXED to 859-277-8901 immediately after each days flights with lines and other details noted

Operator: Galieti
Pilot: Greenwell

AIRCRAFT Tail Number: N24486
Sensor Serial Number: 247

Date: ______

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report For Airborne GPS

Project: Fema MAss

Location: K SFZ (N. Central State, RI) **Project Number:** 7556-005

Completed by: Berry / Galieti **Date:**

Receiver: Trimble "2"

Receiver Type: 5700

Antenna Type: Zephyr

Station ID: CENTRAL

Start -- H.I. (m): 1.482 / 1.481 / 1.482 m

End -- H.I. (m): 1.482

H.I. (ft): 4.86 ft

Start Time: 920 AM

End Time: 1048 AM

Time Zone: EST

Operator: Berry

Comments 1012150-246 (VOID)
1012150-247

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema MAS
Project Number	7556-005
ALTM-NAV-pln File	SFZ Blackstone.ph

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 15, 2010				
Takeoff Time (Z):	1447Z	Local:		Airport	SFZ
Landing Time (Z)	1525Z	Local:		Airport	SFZ

Project's Scanning Requirements			
FOV (half-degrees):	± 10.0°	Altitude AGL (ft):	5000'
Scan Rate:	30.10 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	–
		Range	–

Data Information	
LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101215a
from, to	000→

	Ground	Airport
Begin Temp	-8°C	SFZ
Begin Dewpoint	-16°C	
Begin Pressure	29.53	
End Temp		
End Dewpoint		
End Pressure		

320
14

GPS Base Location(s)	CENTRAL @ KSFZ (Central State)
PDOP Avoidance	Good all day
Static or Flyover?	Static --> if flyovers, times: –

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
28	1455	1459	5560	W	116	100%	8	Bumpy Cloudy
29	1502	1505	5590	E	116	100%	-13	possible cloud
30	1509	1511	5580	W	116	100%	9	Clouded out
31								
								VOID
								ALL Lines reflown
								on 12/17
								by Sn 247

Sheet ___ of ___

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	SFZ_Blackstone
Project Number	7556-005
ALTM-NAV .pln File	SFZ_Blackstone.pln

Pilot	Greenwell
Operator	Galiefi
Aircraft	N2448G

Date Flown: 12/15/2010		
Takeoff Time (Z): 1445	Local:	Airport KSFZ
Landing Time (Z)	Local:	Airport

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft): 5000	
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples
			Range

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	101215a
from, to	0 → 6

	Ground	Airport
Begin Temp	-9°C	KSFZ
Begin Dewpoint	-16°C	
Begin Pressure	29.55	
End Temp	-9 °C	KSFZ
End Dewpoint	-16°C	
End Pressure	29.55	

GPS Base Location(s)	KSFZ (PAC)	
PDOP Avoidance		
Static or Flyover?	static	--> if flyovers, times:

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
1	1457	1500	5180	358	115	~99	4	cloud interference @ N end
1	1500	1504	5160	358	109	~99	2	cloud inter. @ S end
2	1508	1514	5260	178	111	~100	8	possible cloud interf.

3:15

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: Fema Mass

Location: KSFZ

Project Number: 7556-005

Completed by: Berry/Galiati

Date: December 16, 2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr Geodetic

Station ID: Central

Start -- H.I. (m): 1.565/1.565/1.565 m

End -- H.I. (m): 1.565m

H.I. (ft): 5.135ft

Start Time: 9:20 Am

End Time: 2:04 Pm

Time Zone: EST

Operator: Berry

Comments 101216a-246
101216a-247

PSI\FORMS\Station Occupation Report August 9, 2010

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Ferne-Mass
Project Number	7556-005
ALTM-NAV pln File	SFZ Blackstone.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 16, 2010				
Takeoff Time (Z):	1440Z	Local:	940 AM EST	Airport	SFZ
Landing Time (Z)	1655Z	Local:	1155 AM EST	Airport	SFZ

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000'
Scan Rate:	30 Hz	MPiA (circled) or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto (circled)	
Ground Speed:	116 kts	A.R.F.: Samples – / Range –	

Data Information	
LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101216a
from, to	000 → 019

	Ground	Airport
Begin Temp	-3°C	SFZ
Begin Dewpoint	-10°C	
Begin Pressure	29.75	
End Temp	-1	SFZ
End Dewpoint	-10	
End Pressure	29.74	

GPS Base Location(s)	Central
PDOP Avoidance	Good all day
Static or Flyover?	Static --> if flyovers, times: –

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
29	1453	1454	5500'	W	116	100%	–	Wend refight Atmospheric returns / Clouds
19	1502	1507	5350'	N	116	100%	-9	Smooth Clouds around
20	1510	1514	5350'	S	116	100%	10	" "
21	1517	1521	5380'	N	116	100%	-9	" "
22	1525	1528	5350'	S	116	100%	10	" "
23	1533	1536	5450'	N	116	100%	-9	" "
24	1539	1543	5400'	S	116	100%	9	" "
27	1545	1549	5310'	N	116	100%	-9	" "
26	1552	1555	5400'	S	116	100%	9	" "
25	1559	1602	5450'	N	116	100%	-10	" "
18	1605	1609	5310'	S	116	100%	10	" " Cloud last third
17	1613	1619	5320'	N	116	100%	-9	" "
16	1622	1627	5350'	S	116	100%	10	" "
Impor	1634	1637	5800	W	116	100%	3	" "

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	SFZ_Blackstone
Project Number	7556-005
ALTM-NAV .pln File	SFZ_Blackstone.pln

Pilot	Greenwell
Operator	Galleti
Aircraft	N2448G

Date Flown:	12/16/10		
Takeoff Time (Z): 1430	Local: 9:30 AM	Airport KSFZ	
Landing Time (Z):	Local:	Airport	

Project's Scanning Requirements			
FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.:	Samples / Range

Data Information	
LiDAR Unit	Optech Gemini sn247
HD #	2
POS File Name	101216a
from, to	~~0~~ 7 → 32

	Ground	Airport
Begin Temp	-7 °C	KBED
Begin Dewpoint	-11 °C	
Begin Pressure	29.75	
End Temp	6 °C	
End Dewpoint	-11 °C	
End Pressure	29.73	

GPS Base Location(s)	SFZ Blackstone (PAC)	
PDOP Avoidance		
Static or Flyover?	static	--> if flyovers, times:

light SCT clouds in area @~4K 25004

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
1	1453	1459	5270	358	101	~100	10	
2	1503	1510	5350	178	116	100	13	
3	1514	1521	5260	358	118	100	9	Bottom half.
4	1525	1531	5240	178	117	100	12	
5	1535	1541	5250	358	119	100	7	
6	1546	1552	5360	178	117	106	11	
7	1556	1603	5230	358	118	100	8	
8	1607	1613	5330	178	118	100	12	
9	1617	1624	5270	358	116	100	8	
10	1629	1635	5360	178	121	100	11	
11	1646	1646	5230	358	118	100	4	Clouds possible @ S end.
12	1650	1656	5310	178	120	100	13	
13	1701	1707	5270	359	117	100	7	3.5 mi S of N end possible clouds
14	1712	1717	5380	178	120	~100	12	clouds very possible on line
15	1720	1726	5330	358	113	~100	7	
cross line	1729	1732	5160	090	133	100	4	

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project: SFZ_Blackstone

Location: SFZ_Blackstone (PAC)

Project Number: 7556-005

Completed by: Nathan Galieti

Date: 12/17/10

Receiver: Trimble 2

Receiver Type: Trimble 5700

Antenna Type: Zephyr Geodetic

Station ID: SFZ_Blackstone

Start -- H.I. (m): ~~1.54~~ 1.574 / 1.573 m

End -- H.I. (m): 1.574 m

H.I. (ft): 5.16 ft.

Start Time: 9:33 AM

End Time: 12:14 PM

Time Zone: EST

Operator: Galieti

Comments 10/217a-247

PSI\FORMS\Station Occupation Report June 10, 2010

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	SFZ Blackstone
Project Number	7556-005
ALTM NAV pln File	SFZ-Blackstone.pln

Pilot	Greenwell		
Operator	Galieti		
Aircraft	N2448G		

Date Flown:	12/17/10				
Takeoff Time (Z):	1445	Local:	9:45 EST	Airport	KSFZ
Landing Time (Z):		Local:		Airport	

Project's Scanning Requirements

FOV (half-degrees):	± 18 °	Altitude AGL (ft):	5000
Scan Rate:	30 Hz	MPiA or SPiA	
Pulse Rate:	70 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples / Range	

Data Information

LiDAR Unit	Optech Gemini sn247
HD #	1
POS File Name	~~101417a~~ 101216a
from, to	0 →

note wrong date entered

	Ground	Airport
Begin Temp	-11 °C	KSFZ
Begin Dewpoint	-13 °C	
Begin Pressure	29.80	
End Temp	0 °C	KSFZ.
End Dewpoint	-9 °C	
End Pressure	29.81	

GPS Base Location(s)	SFZ_Blackstone PAC	
PDOP Avoidance		
Static or Flyover?	Static	--> if flyovers, times:

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
28	1507	1511	5530	268	115	100	6	
29	1515	1518	5580	88	118	100	6	
30	1523	1526	5540	268	113	100	6	
31	1530	1532	5590	88	109	100	8	
32	1537	1540	5540	268	115	100	6	
33	1546	1548	5590	88	114	100	8	
34	1553	1556	5540	268	113	100	6	
35	1601	1604	5580	88	116	100	7	
36	1609	1613	5550	268	112	100	6	
37	1617	1621	5580	88	113	100	6	
38	1626	1630	5540	268	111	100	6	
39	1635	1638	5780	358	118	100	9	
40	1642	1645	5810	178	121	106	10	

PHOTO SCIENCE
Geospatial Solutions

Station Occupation Report
For Airborne GPS

Project:	FEMA - MASSACHUSETTS		
Location:	KBED @ Bedford Municipal	*Project Number:*	7556-005
Completed by:	Berry / Galich	*Date:*	12-17-2010

Receiver: Trimble "4"

Receiver Type: 5700

Antenna Type: Zephyr Geodetic

Station ID: KBED (BED A)

Start -- H.I. (m): 1.499 1.496

End -- H.I. (m): 1.494

H.I. (ft): 4.92

Start Time: 7:08 AM EST

End Time: 12:11 PM EST

Time Zone: EST

Operator: Berry

Comments 101217a-246

SVN 34

1045-1215

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	Fema_Massachussets
Project Number	7556-005
ALTM-NAV pln File	OWD_Quincy.pln

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown: December 17, 2010			
Takeoff Time (Z): 1245Z	Local: 745AM EST	Airport BED
Landing Time (Z)	Local:	Airport

Project's Scanning Requirements

FOV (half-degrees):	± 18.0°	Altitude AGL (ft): 5000
Scan Rate:	30.1 Hz	MPiA or SPiA
Pulse Rate:	71 kHz	Fixed or Auto
Ground Speed:	116 kts	A.R.F.: Samples 1000, Range 300m

Data Information

LiDAR Unit	Optech Gemini sn246
HD #	246 HD1
POS File Name	101217a
from, to	000 → /

	Ground	Airport
Begin Temp	-12°C	BED
Begin Dewpoint	-14°C	
Begin Pressure	2979	
End Temp		
End Dewpoint		
End Pressure		

GPS Base Location(s)	BED A	
PDOP Avoidance	1045-1215am (SVN34 back online @ 921Am)	
Static or Flyover?	Static	--> if flyovers, times: -

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
Improv	1258	1301	5000'	NE	116 Kts	100%	-8	Clear and Smooth
24	1301	1303	5000'	NE	116 Kts	100%	-8	"
23	1308	1309	5000'	SW	116 Kts	100%	7	"
22	1313	1314	5000'	NW	116 Kts	100%	-6	"
21	1318	1320	5000'	SE	116 Kts	100%	2	"
20	1325	1328	5000'	NW	116 Kts	100%	-4	"
19	1332	1335	5000'	SE	116 Kts	100%	2	"
18	1339	1342	5000'	NW	116 Kts	100%	-4	"
17	1345	1350	5000'	SE	116 Kts	100%	2	"
16	1353	1358	5000'	NW	116 Kts	100%	-4	"
15	1401	1405	5000'	SE	116 Kts	100%	3	"
14	1409	1413	5000'	NW	116 Kts	100%	-7	"
13	1417	1421	5000'	SE	116 Kts	100%	4	"
12	1424	1429	5000'	NW	116 Kts	100%	-5	"
11	1432	1436	5000'	SE	116 Kts	100%	4	"
10	1439	1443	5000'	NW	116 Kts	100%	-5	"
9	1446	1448	5000'	SE	116 Kts	100%	3	Need to redo (ARF not set to ON)
6	1455	1501	5000'	NW	116 Kts	100%	-5	
5	1504	1510	5000'	SE	116 Kts	100%	3	
4	1514	1518	5000'	NW	116 Kts	100%	-5	

LIDAR MISSION RECORD SHEET – Optech

PHOTO SCIENCE
Geospatial Solutions

2670 Wilhite Drive - Lexington KY - 40503 - 859.277.8700 - www.photoscience.com

Project Name	FemaMass
Project Number	7586-003
ALTM-NAV pln File	Old_Quincy

Pilot	Young
Operator	Berry
Aircraft	N7266Z

Date Flown:	December 17, 2010		
Takeoff Time (Z): 1245	Local: 745AmEST	Airport	BED
Landing Time (Z) 1645	Local: 1145AmES	Airport	BED

Project's Scanning Requirements			
FOV (half-degrees):	± 18.6 °	Altitude AGL (ft):	5000
Scan Rate:	30.1 Hz	MPiA or SPiA	
Pulse Rate:	71 kHz	Fixed or Auto	
Ground Speed:	116 kts	A.R.F.: Samples	1600
		Range	460

Data Information	
LiDAR Unit	Optech Gemini sn246
HD #	246HD1
POS File Name	101217a
from, to	000 → /

	Ground	Airport
Begin Temp	-2°c	BED
Begin Dewpoint	4°c	
Begin Pressure	2979	
End Temp	-1°c	BED
End Dewpoint	-9°c	
End Pressure	2983	

GPS Base Location(s)	Central	
PDOP Avoidance	See sheet 1	
Static or Flyover?	Static	--> if flyovers, times: –

Flight Line Name/#	Start Time	End Time	Alt. (AMSL)	Heading	Speed	Returns	Crab	NOTES (weather, visibility, winds, ride, etc.)
3	1521	1526	5000'	SE	116 kts	100%	5	
2	1530	1534	5000'	NW	116kts	100%	-5	
1	1537	1541	5000'	SE	116 kts	100%	5	
7	1545	1549	5000'	NW	116kts	100%	-5	
8	1551	1554	5000'	SE	116kts	100%	4	
25	1557	1558	5000	NW	116kts	100%	-5	
26	1600	1604	5000	SW	116kts	100%	6	
27	1606	1608	5000'	NE	116kts	100%	-12	
9	1614	1620	5000'	S	116kts	100%	5	Reflight of 9

```
Plan Type : Fixed Survey

******************Survey Totals********************************
Total Passes      : 27
Total Length      : 297.56 km
Total Flight Time : 04:10:46
Total Laser Time  : 01:22:39
Total Swath Area  : 206.04 km^2
Total AOI Area    : 344.702 km^2


Number of Sub-Areas : 1

******************Area 1********************************

Area Flight Profile
-----------------------------
Total Length  : 297.56 km
Flight Time   : 04:10:46
Laser Time    : 01:22:39
Swath Area    : 55.989 km^2
AOI Area      : 344.702 km^2
Altitude      : 5000 ft AGL
Speed         : 116.6 kts
Flight Lines  : 27
Pass Heading  : 140.51
Pass Spacing  : 188.16 m
Overlap       : 30% = 801.02 m
Turn Time     : 5 min

Area LIDAR Settings
-----------------------------
Desired Res     : 0.912 m
Density         : 1.2 ppm^2
Cross Track Res : 0.835 m
Down Track Res  : 0.997 m
Scan Frequency  : 30.1 Hz
Scan Angle      :  18 deg
Scan Cutoff     :  0.02 deg
Scan Offset     : 0 deg
System PRF      : 71.429 kHz
Swath Width     : 989.18 m
DEM Estimates
-----------------------------
DEM Min Z       : -3
DEM Max Z       : 181

Cost Estimates
-----------------------------
Area Cost       : $0
Time Cost       : $0
```

```
           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KBED
Mission       : 101217A
Wheels Up     : 1245Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 17, 2010
Julian Day    : 351
Temperature   : -12C
Visibility    : >10
Clouds        : NONE
Precipitation : NONE
Wind Dir      : 280
Wind Speed    : 8
Pressure      : 2979
           Statistics
------------------------------
Laser Time    : 01:42:28

========================================
08:01:34.032 GMT : 00:00:02 (212) GPS 1PPS Lost
08:01:34.032 GMT : 00:00:03 (166) Divergence Error
08:01:34.032 GMT : 00:00:03 (107) Rx Shutter Closed
08:01:34.032 GMT : 00:00:03 (109) Tx Shutter Closed
08:01:34.032 GMT : 00:00:04 (164) Beam Wide
08:01:34.032 GMT : 00:00:08 (213) GPS 1PPS Ok
08:01:34.032 GMT : 00:00:09 (120) Laser PS Comm Ok
08:01:34.032 GMT : 00:00:09 (112) Laser Emission Off
08:01:34.032 GMT : 00:00:12 (204) POSAV Connected
08:01:34.032 GMT : 00:00:12 (207) POSAV Rate Not 50 Hz
08:01:34.032 GMT : 00:00:13 (211) POSAV new status
08:01:34.032 GMT : 00:00:26 (215) Nav Data Ok
08:01:34.032 GMT : 00:00:27 (208) POSAV Rate Is 50 Hz
08:01:34.032 GMT : 00:00:27 (211) POSAV new status
08:01:34.032 GMT : 00:00:29 (211) POSAV new status
08:01:34.032 GMT : 00:02:03 (211) POSAV new status
08:01:34.032 GMT : 00:03:28 (211) POSAV new status
12:24:53.564 GMT : 12:24:52 (153) Eyesafety Disabled
12:24:53.764 GMT : 12:24:52 (162) Roll Comp On
12:24:54.364 GMT : 12:24:53 (164) Beam Wide
12:24:54.464 GMT : 12:24:53 (144) MultiPulse Mode Varies
12:24:59.564 GMT : 12:24:58 (166) Divergence Error
12:25:00.264 GMT : 12:24:59 (165) Beam Narrow
```

12:34:05.667 GMT : 12:34:04 (211) POSAV new status
12:57:06.579 GMT : 12:57:05 (106) Rx Shutter Open
12:57:06.779 GMT : 12:57:05 (108) Tx Shutter Open
12:58:18.18 GMT : 12:58:17 (113) Laser Emission On
13:01:54.782 GMT : 13:01:53 (112) Laser Emission Off
13:01:59.582 GMT : 13:01:58 (113) Laser Emission On
13:03:43.784 GMT : 13:03:42 (112) Laser Emission Off
13:08:02.387 GMT : 13:08:01 (113) Laser Emission On
13:09:50.288 GMT : 13:09:49 (112) Laser Emission Off
13:13:25.19 GMT : 13:13:24 (113) Laser Emission On
13:14:47.591 GMT : 13:14:46 (112) Laser Emission Off
13:18:52.095 GMT : 13:18:51 (113) Laser Emission On
13:20:57.196 GMT : 13:20:56 (112) Laser Emission Off
13:25:36.6 GMT : 13:25:35 (113) Laser Emission On
13:28:25.703 GMT : 13:28:24 (112) Laser Emission Off
13:32:29.407 GMT : 13:32:28 (113) Laser Emission On
13:35:34.31 GMT : 13:35:33 (112) Laser Emission Off
13:39:20.613 GMT : 13:39:19 (113) Laser Emission On
13:42:42.917 GMT : 13:42:42 (112) Laser Emission Off
13:45:55.82 GMT : 13:45:55 (113) Laser Emission On
13:50:38.924 GMT : 13:50:37 (112) Laser Emission Off
13:53:36.827 GMT : 13:53:35 (113) Laser Emission On
13:58:04.332 GMT : 13:58:03 (112) Laser Emission Off
14:01:12.635 GMT : 14:01:11 (113) Laser Emission On
14:05:22.84 GMT : 14:05:21 (112) Laser Emission Off
14:09:54.845 GMT : 14:09:53 (113) Laser Emission On
14:13:47.85 GMT : 14:13:47 (112) Laser Emission Off
14:17:05.353 GMT : 14:17:04 (113) Laser Emission On
14:21:13.258 GMT : 14:21:12 (112) Laser Emission Off
14:24:40.263 GMT : 14:24:39 (113) Laser Emission On
14:29:05.468 GMT : 14:29:04 (112) Laser Emission Off
14:32:05.972 GMT : 14:32:05 (113) Laser Emission On
14:36:14.277 GMT : 14:36:12 (112) Laser Emission Off
14:39:27.481 GMT : 14:39:26 (113) Laser Emission On
14:43:54.587 GMT : 14:43:53 (112) Laser Emission Off
14:46:39.49 GMT : 14:46:38 (113) Laser Emission On
14:48:25.993 GMT : 14:48:24 (112) Laser Emission Off
14:55:24.602 GMT : 14:55:23 (113) Laser Emission On
15:01:30.71 GMT : 15:01:29 (112) Laser Emission Off
15:04:45.114 GMT : 15:04:44 (113) Laser Emission On
15:10:28.621 GMT : 15:10:27 (112) Laser Emission Off
15:13:41.125 GMT : 15:13:40 (113) Laser Emission On
15:18:58.132 GMT : 15:18:56 (112) Laser Emission Off
15:21:47.436 GMT : 15:21:46 (113) Laser Emission On
15:26:46.243 GMT : 15:26:45 (112) Laser Emission Off
15:30:02.147 GMT : 15:30:01 (113) Laser Emission On
15:34:36.953 GMT : 15:34:35 (112) Laser Emission Off
15:37:53.557 GMT : 15:37:52 (113) Laser Emission On
15:41:54.563 GMT : 15:41:53 (112) Laser Emission Off
15:45:00.867 GMT : 15:45:00 (113) Laser Emission On
15:49:10.672 GMT : 15:49:09 (112) Laser Emission Off
15:51:58.576 GMT : 15:51:57 (113) Laser Emission On
15:54:44.38 GMT : 15:54:42 (112) Laser Emission Off
15:57:07.783 GMT : 15:57:06 (113) Laser Emission On

```
15:58:51.985 GMT : 15:58:50 (112) Laser Emission Off
16:02:38.29 GMT : 16:02:37 (113) Laser Emission On
16:04:20.093 GMT : 16:04:18 (112) Laser Emission Off
16:06:56.096 GMT : 16:06:54 (113) Laser Emission On
16:08:17.698 GMT : 16:08:16 (112) Laser Emission Off
16:14:37.006 GMT : 16:14:36 (113) Laser Emission On
16:20:16.914 GMT : 16:20:16 (112) Laser Emission Off
16:23:41.819 GMT : 16:23:40 (107) Rx Shutter Closed
16:23:42.019 GMT : 16:23:40 (109) Tx Shutter Closed

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KBED
Mission       : 101217A
Wheels Up     : 1245Z
Flight Length :
HOBBS Start   :
HOBBS End     :

           Weather
------------------------------
Date          : December 17, 2010
Julian Day    : 351
Temperature   : -12C
Visibility    : >10
Clouds        : NONE
Precipitation : NONE
Wind Dir      : 280
Wind Speed    : 8
Pressure      : 2979
           Statistics
------------------------------
Laser Time    : 01:42:28

=======================================

           Flight Log
------------------------------
Project Number: 7556-005
S/N           : 246
Operator      : BERRY
Pilot(s)      : YOUNG
Aircraft      : N7266Z
Airport       : KBED
Mission       : 101217A
Wheels Up     : 1245Z
Flight Length :
HOBBS Start   :
HOBBS End     :
```

Weather

Date : December 17, 2010
Julian Day : 351
Temperature : -12C
Visibility : >10
Clouds : NONE
Precipitation : NONE
Wind Dir : 280
Wind Speed : 8
Pressure : 2979

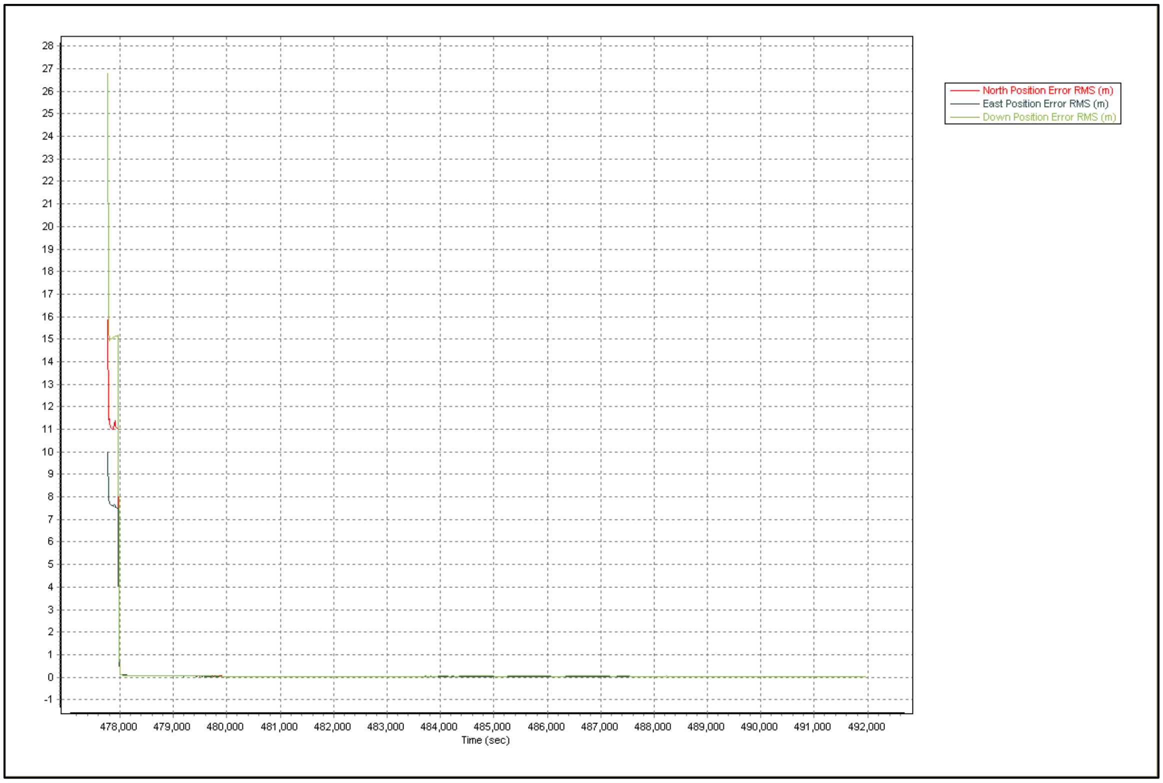
Statistics

Laser Time : 01:42:28

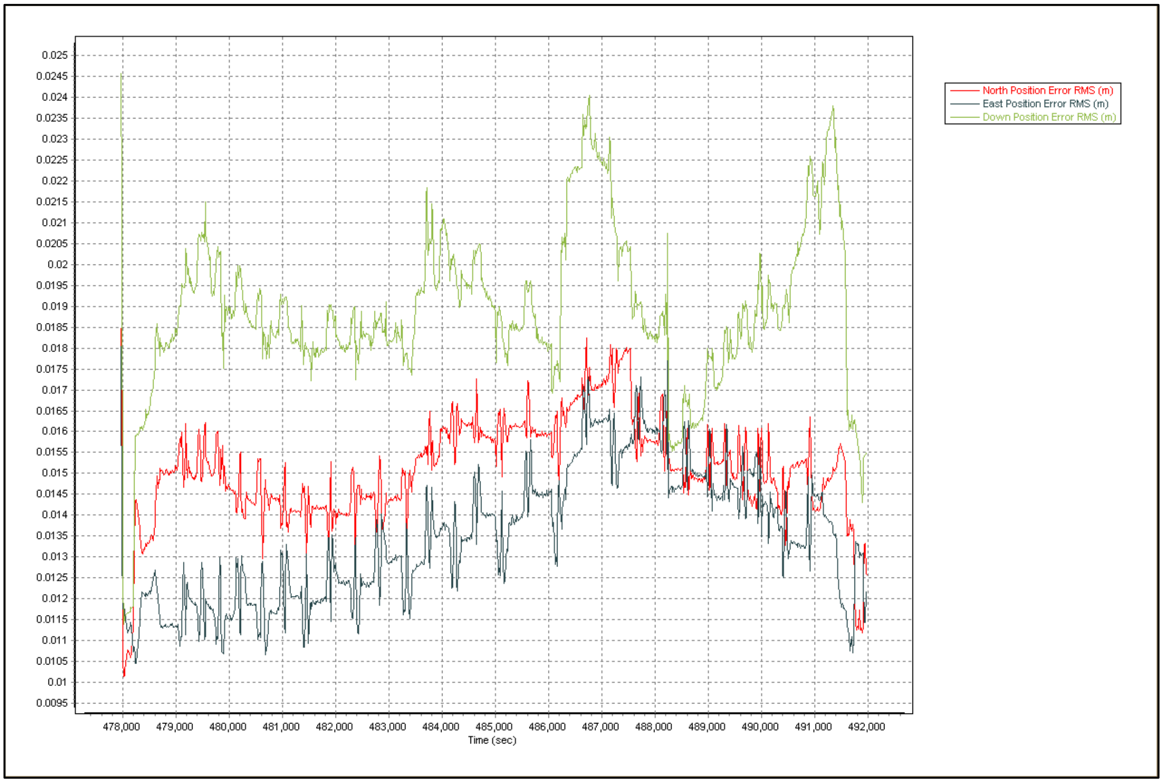
START	STOP	LINE#	ALT	PRF	FREQ	ANGLE	MP	DIV	RC	HDG	Plan File
13:01:57.182	13:01:54.582	24	1538	70	30.10	18.00	ON	NAR	ON	0.00	43
13:01:59.582	13:03:44.384	24	1535	70	30.10	18.00	ON	NAR	ON	0.00	43
13:08:03.087	13:09:51.288	22	1533	70	30.10	18.00	ON	NAR	ON	0.00	320.45
13:13:25.69	13:14:48.791	21	1517	70	30.10	18.00	ON	NAR	ON	0.00	320.46
13:18:52.495	13:20:57.696	20	1533	70	30.10	18.00	ON	NAR	ON	0.00	320.46
13:25:36.8	13:28:27.003	19	1531	70	30.10	18.00	ON	NAR	ON	0.00	320.48
13:32:30.207	13:35:36.11	18	1528	70	30.10	18.00	ON	NAR	ON	0.00	140.47
13:39:20.613	13:42:44.017	17	1527	70	30.10	18.00	ON	NAR	ON	0.00	140.5
13:45:56.42	13:50:35.324	16	1527	70	30.10	18.00	ON	NAR	ON	0.00	140.5
13:53:36.727	13:58:05.732	15	1522	70	30.10	18.00	ON	NAR	ON	0.00	140.49
14:01:13.535	14:05:24.24	14	1530	70	30.10	18.00	ON	NAR	ON	0.00	140.49
14:09:54.845	14:13:48.55	13	1522	70	30.10	18.00	ON	NAR	ON	0.00	320.48
14:17:05.954	14:21:14.458	12	1530	70	30.10	18.00	ON	NAR	ON	0.00	320.48
14:24:40.963	14:29:06.568	11	1523	70	30.10	18.00	ON	NAR	ON	0.00	140.48
14:32:06.972	14:36:14.877	10	1529	70	30.10	18.00	ON	NAR	ON	0.00	140.47
14:39:28.481	14:43:56.087	9	1528	70	30.10	18.00	ON	NAR	ON	0.00	320.49

14:46:39.99	14:48:25.493	9	1531	70	30.10	18.00	ON	NAR	ON	0.00	140.49
14:55:25.202	15:01:28.21	6	1527	70	30.10	18.00	ON	NAR	ON	0.00	320.49
15:04:46.014	15:10:29.521	4	1527	70	30.10	18.00	ON	NAR	ON	0.00	140.5
15:13:41.826	15:18:53.332	3	1525	70	30.10	18.00	ON	NAR	ON	0.00	140.5
15:21:48.136	15:26:47.943	2	1526	70	30.10	18.00	ON	NAR	ON	0.00	140.5
15:30:02.747	15:34:33.653	1	1523	70	30.10	18.00	ON	NAR	ON	0.00	320.51
15:37:54.457	15:41:55.263	6	1524	70	30.10	18.00	ON	NAR	ON	0.00	140.49
15:45:01.467	15:49:07.572	8	1526	70	30.10	18.00	ON	NAR	ON	0.00	140.5
15:51:59.176	15:54:45.68	25	1526	70	30.10	18.00	ON	NAR	ON	0.00	140.49
15:57:07.683	15:58:52.185	25	1527	70	30.10	18.00	ON	NAR	ON	0.00	320.49
16:02:39.09	16:04:20.693	27	1527	70	30.10	18.00	ON	NAR	ON	0.00	238.77
16:06:56.896	16:08:19.598	9	1530	70	30.10	18.00	ON	NAR	ON	0.00	140.49
16:14:37.606	16:20:19.014	9	1525	70	30.10	18.00	ON	NAR	ON	0.00	140.49

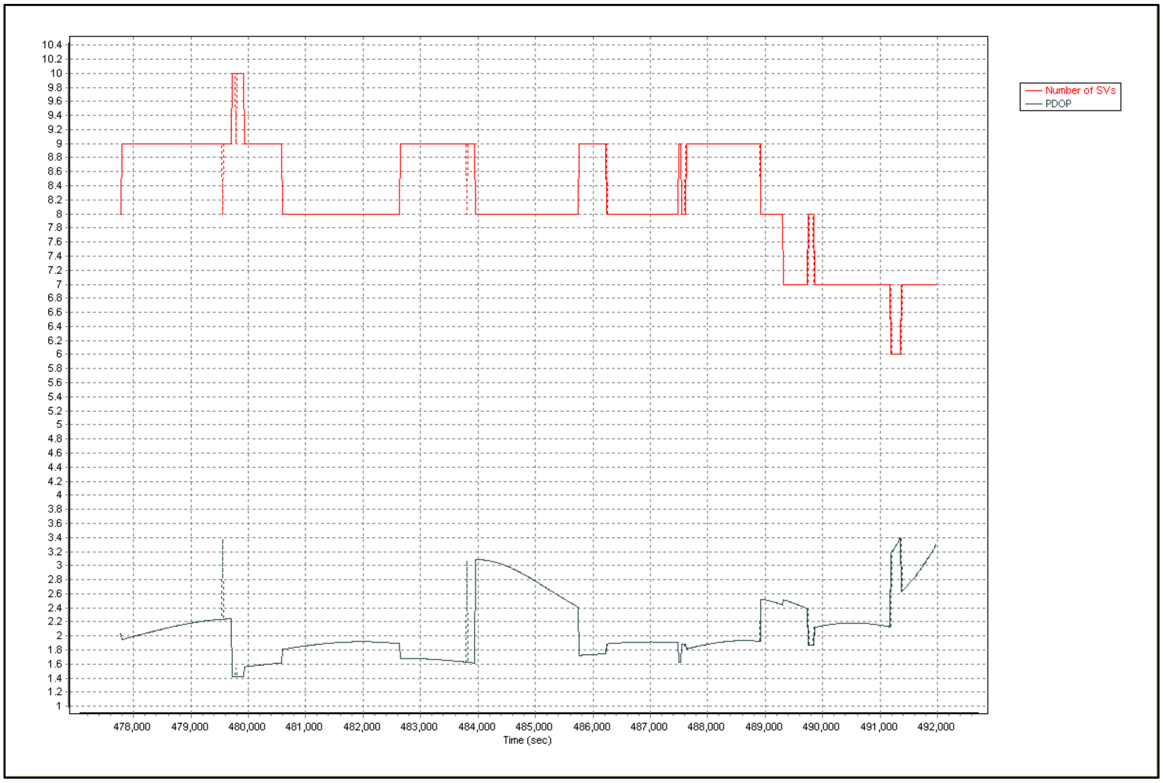
101217A-246-NEDPOSITIONERROR-FORWARD



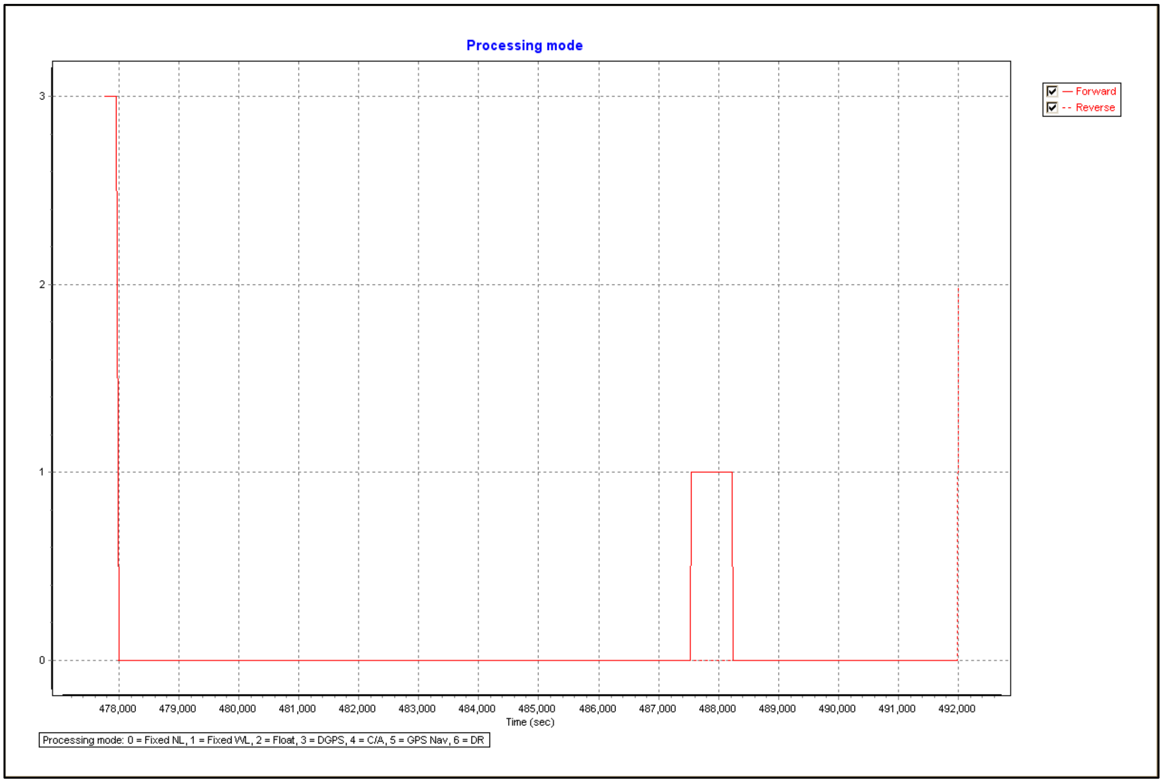
101217A-246-NEDPOSITIONERROR-SMOOTHED



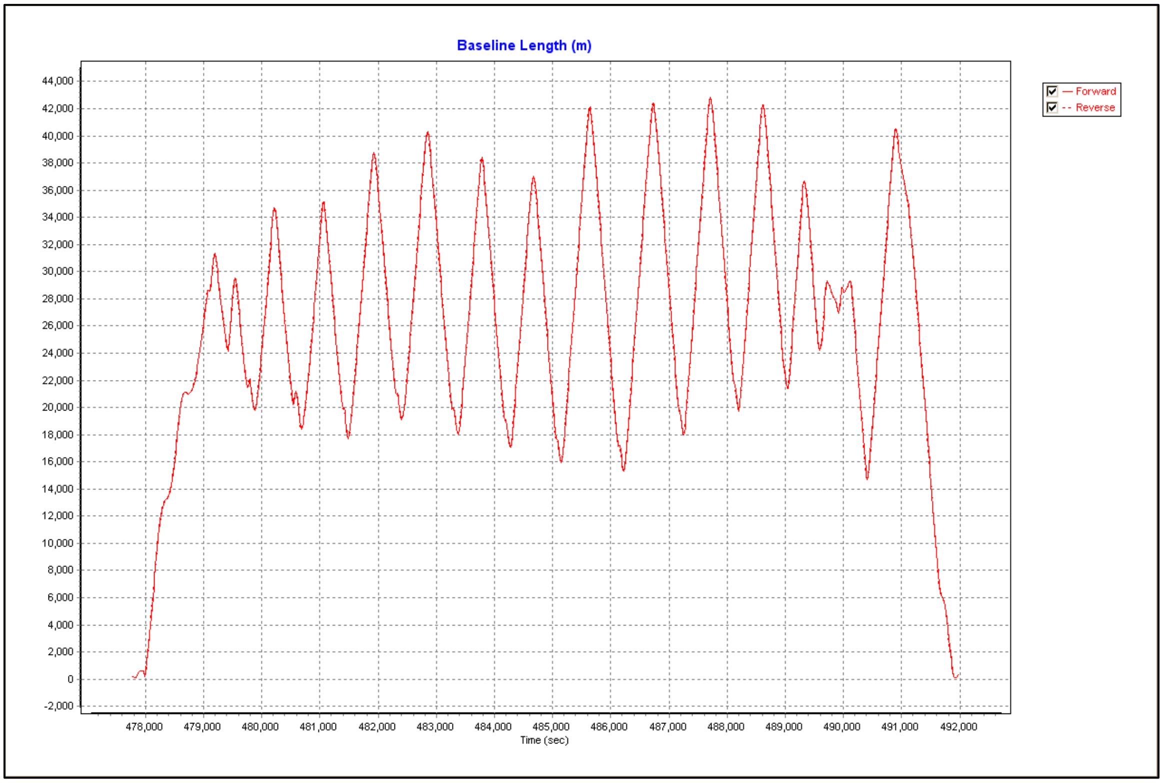
101217A-246-PDOP&SVS



101217A-246-PROCMODE



101217A-246-BASELINELENGTH



Appendix F: Quality Assurance

Project Name:	Charles		
Project Description:			
State:	MA. RI		
HUC-8:	1070004		
Provider Name:	Photo Science		
Collection Area:			
Specification Level:	High		
Contour Accuracy:			
NPS:	0.63		0.63
	Point Cloud		Bare Earth
Date Delivered:	3/7/2011	4/8/2011. updated point cloud data delivered	4/8/2011
Date QC:	3/16/2011	4/19/2011	4/18/2011
Media:	Hard Drive		Hard Drive
Contents of Media:	.las points		.las points by tile
Reviewed By:	Dan Hoff		

	Included	Comments
	Included	Comments
GPS Base Station INFO		**Report as a whole still needs to be assembled**
GPS base station - names	P	
GPS base station - lat/longs	P	not in report
GPS base station - heights	P	not in report
GPS base station - Maximum PDOP	F	cannot find, only appear to have graph
GPS base station - map	P	
GPS base station - spatial data	F	do not have
GPS/IMU		
GPS quality - Max horizontal variance (cm).	F	saids it is included in attached folder on report, cannot find--
GPS quality - Max vertical variance (cm).	F	saids it is included in attached folder on report, cannot find--
GPS quality - Notes on GPS quality	P	
GPS quality - GPS separation plot	F	cannot find, appears it may be somwhere under processing summary-- needs to be clear in report
GPS quality - GPS altitude plot	F	cannot find, appears it may be somwhere under processing summary-- needs to be clear in report
GPS quality - PDOP plot	P	needs to be in report
GPS quality - Plot of GPS distance from base stations	P	please attach to report, was difficult to find (under control)
Coverage		
Coverage - Verification of AOI coverage	P	
Coverage - Spatial data	P	coverage area .shp only
Flights		
Flights - Calibration lines	P	seems to be part fo as flown .shp
Flights - As-flown trajectories	P	
Flights - Spatial data	P	
Control		
Control - Ground control and base station layout	P	please attach map to report
Control - Spatial data	F	no .shp found
Data verification/QC		
Data verification process documented	P	

Flight logs	Included
Incorporated as appendix	F
Job # / name	P
Lift #	P
Block or AOI designator	P
Date	P
Aircraft tail number, type	P
Pilot name	P
Operator name	P
Airport of operations	P
GPS base station names	P
Flight lines	
Flight line	P
Line #	P
Direction	P
Start/stop	P
Altitude	P
Scan angle/rate	P
Speed	P
Conditions	P
Comments	P
Settings	
AGC switch setting	
Laser pulse rate	P
Mirror rate	
Field of view	P
Comments	P

Point File Information QC		
LAS Version:	1.2	
Total Number of Tiles:	342	
Number of tiles to be reviewed:	**31**	(25 point cloud)
All LAS		
Coverage Area SqMi	281.6	including overlapping tiles at edge, scope calls for 283. (Fail)
Voids or Gaps	Pass	Voids only over water
Average Point Spacing	0.63	
QC tiles with NPS > Spec Level	Pass	Only at edges of collection area
5% LAS Review		
Tile selection	Done	
LASinfo	Pass	
LAS2DEM	Pass	100% Review

Macro Review			
LAS Point Cloud Files	Pass/Fail	Comments	
Projection	P		
Datum	P		
Units	P		
Area covered 100m buffer	F	total coverage area is less than scope, does not cover entire boundary of HUC 8	seems to be covered in Narragansett and Blackstone, Merrimack not delivered yet- do not yet have missing area
Data Voids	P		
Correct Header	P		
Correct NPS	P		
Returns Contain			
GPS time stamp	P		
GPS second in microsec	P		
Easting	P		
Northing	P		
Elevation	P		
Intensity	P		
Return #	P		
Classification	N/A		
Classification is correct	N/A		
Cloud file structure conforms to layout	P		
Cloud file naming conforms to project	P		
Tiles checked for gaps and voids	P		

Micro Review	Pass/Fail		
Total Number of Tiles:	342		
Number of tiles to be reviewed:	25		
Excessive Noise	P	Please see QAQC feature class, mainly comment pertaining to noise well above the ground	Appears to be enough good points to generate surface regardless
Elevation Steps	P		
LP360 Scan and profile	P		

Macro Review		
LAS Bare Earth	**Pass/Fail**	**Comments**
Projection	P	
Datum	P	
Units	P	
Area covered 100m buffer	F	total coverage area is less than scope, and does not cover entire boundary of HUC 8
Data Voids	P	
Correct Header	P	
Correct NPS	P	
Returns Contain		
GPS time stamp	P	
GPS second in microsec	P	Negative
Easting	P	
Northing	P	
Elevation	P	
Intensity	P	
Return #	P	
Classification	P	8,2,1
Classification is correct	P	
Cloud file structure conforms to layout	P	
Cloud file naming conforms to project	P	
Tiles checked for gaps and voids	P	
Micro Review		
Total Number of Tiles:	31	
Number of tiles to be reviewed:	342	
Excessive Noise	P	noise is removed from ground classified points
Elevation Steps	P	
2% Artifacts	P	
LP360 Scan and profile	P	

Project Name:	Quincy, MA				
Project Description:	Region 1 County wide LiDAR collection for Quincy County Massachutes				
State:	Massachusetts				
HUC-8:					
Provider Name:	Photo Science				
Collection Area:					
Specification Level:	Highest				
Contour Accuracy:	2ft				
NPS:	1 meter				
Date Delivered:	2/17/2011				
Date QC:	3/8/2011				
Media:	DVD				
Contents of Media:					
Reviewed By:	Dan Hoff				

	Included	Comments
GPS Base Station INFO	P	
GPS base station - names	P	
GPS base station - lat/longs	P	
GPS base station - heights	P	
GPS base station - Maximum PDOP	P	
GPS base station - map	P	
GPS base station - spatial data	P	
GPS/IMU		
GPS quality - Max horizontal variance (cm).	P	
GPS quality - Max vertical variance (cm).	P	
GPS quality - Notes on GPS quality	P	
GPS quality - GPS separation plot	P	
GPS quality - GPS altitude plot	P	
GPS quality - PDOP plot	P	
GPS quality - Plot of GPS distance from base stations		
Coverage		
Coverage - Verification of AOI coverage	P	
Coverage - Spatial data	P	
Flights		
Flights - Calibration lines	P	
Flights - As-flown trajectories	P	
Flights - Spatial data	P	
Control		
Control - Ground control and base station layout	P	
Control - Spatial data	P	
Data verification/QC		
Data verification process documented	P	

Flight logs	Included	Comments
Incorporated as appendix	P	Should be part of the report as a flight log appendix and referenced as such
Job # / name	P	
Lift #	P	Is this the mission number
Block or AOI designator	P	Project Name
Date	P	
Aircraft tail number, type	P	
Pilot name	P	
Operator name	P	
Airport of operations	P	
GPS base station names	P	Included in the report, but FEMA PM61 table 4.2 has them listed as part of the flight log
Flight lines		
Flight line	P	
Line #	P	
Direction	P	
Start/stop	P	
Altitude	P	
Scan angle/rate	P	
Speed	P	
Conditions	P	
Comments	P	
Settings		
AGC switch setting	P	Automatic Gain Control…older systems
Laser pulse rate	P	
Mirror rate	P	
Field of view	P	Double the scan angle is the field of view
Comments	P	

Point File Information QC			
LAS Version:	1.2		
Total Number of Tiles:	138		
Number of tiles to be reviewed:	**10**		
All LAS	Point Cloud	Bare Earth	
Coverage Area SqMi	98.5	98.5	From LAS boundry
Voids or Gaps	Pass	Pass	# of records matches
Average Point Spacing	1.12	0.78	LASinfo mean
QC tiles with NPS > Spec Level	Pass	Pass	greater than 1 only on edge/over lake
5% LAS Review			
Tile selection	Y		
LASinfo	Y		
LAS2DEM	Y	100% Review	

Macro Review		
LAS Point Cloud Files	Pass/Fail	Comments
Projection	P	
Datum	P	
Units	P	Vertical units meters
Area covered 100m buffer	P	
Data Voids	P	there are a considerable number of voids in the data, however, all of them are over water and don't seem to affect the surface. The NPS is still within range; pass.
Correct Header	P	
Correct NPS	P	only tiles considerably over 1 are on borders and contain large percentage of no data values.
Returns Contain		
GPS time stamp	P	
GPS second in microsec	P	
Easting	P	
Northing	P	
Elevation	P	
Intensity	P	
Return #	P	
Classification	P	
Classification is correct	P	no classifications
Cloud file structure conforms to layout	P	
Cloud file naming conforms to project	P	
Tiles checked for gaps and voids	P	
Micro Review		
Total Number of Tiles:	138	
Number of tiles to be reviewed:	**10**	
	Pass/Fail	
Excessive Noise	P	
Elevation Steps	P	
LP360 Scan and profile	P	

Macro Review		
LAS Bare Earth		
Projection	P	
Datum	P	
Units	P	
Area covered 100m buffer	P	
Data Voids	P	there are a considerable number of voids in the data, however, all of them are over water and don't seem to affect the surface. The NPS is still within range; pass.
Correct Header	P	
Correct NPS	P	only tiles considerably over 1 are on borders and contain large percentage of no data values.
Returns Contain		
GPS time stamp	P	
GPS second in microsec	P	
Easting	P	
Northing	P	
Elevation	P	
Intensity	P	
Return #	P	
Classification	P	
Classification is correct	P	
Cloud file structure conforms to layout	P	
Cloud file naming conforms to project	P	
Tiles checked for gaps and voids	P	
Micro Review		
Total Number of Tiles:	138	
Number of tiles to be reviewed:	10	
Excessive Noise	P	
Elevation Steps	P	
2% Artifacts	P	
LP360 Scan and profile	P	

Name	Version	Gen_Day	Gen_Year	Pnt_Type	SysID	Software	Num_Pnts	MinX	MaxX	MinY	MaxY	MinZ	MaxZ	Return_1	Return_2	Return_3	Return_4	Return_5	Num_VLR
19_02904668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5237895	289500.01	291000	4668000	4669499.99	57.17	1471.86	3761902	983670	407543	84780	0	3
19_02904670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5760390	289500.01	291000	4669500	4670999.99	104.57	1565.74	3810803	1257479	565954	126154	0	3
19_02904671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6353621	289500.01	291000	4671000	4672499.99	74.13	180.83	3767725	1694186	740877	150833	0	3
19_02904672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5616266	289500.01	291000	4672500	4673999.99	73.62	187.9	3558184	1511115	496070	50897	0	3
19_02904674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5643085	289500.01	291000	4674000	4675499.99	106.27	202.64	3686132	1466100	446319	44534	0	3
19_02914666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5500634	291000.01	292500	4666500	4667999.99	-264.04	1175.63	3908247	1133130	397605	61652	0	3
19_02914668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4915438	291000.01	292500	4668000	4669499.99	48.62	152.87	3917443	712936	243532	41527	0	3
19_02914670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5194430	291000.01	292500	4669500	4670999.99	42.9	156.24	3540869	1134526	440777	78258	0	3
19_02914671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6951452	291000.01	292500	4671000	4672499.99	76.57	146.94	4372815	1821340	656277	101020	0	3
19_02914672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6567722	291000.01	292500	4672500	4673999.99	93.84	185.97	3681020	2027360	750061	109281	0	3
19_02914674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7459341	291000.01	292500	4674000	4675499.99	74.33	204.78	4047283	2301195	948107	162756	0	3
19_02924664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6684778	292500.01	294000	4663500	4664999.99	55.69	123.22	4234726	1796996	564329	88727	0	3
19_02924665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6726888	292500.01	294000	4665000	4666499.99	53.51	142.64	4137552	1904192	597512	87632	0	3
19_02924666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6476962	292500.01	294000	4666500	4667999.99	51.89	164.7	4056272	1824522	530298	65870	0	3
19_02924668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5784161	292500.01	294000	4668000	4669499.99	34.79	262.51	4069619	1316727	359755	38060	0	3
19_02924670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5068565	292500.01	294000	4669500	4670999.99	56.98	246.43	3833530	942907	261299	30829	0	3
19_02924671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6785821	292500.01	294000	4671000	4672499.99	82.68	173.06	4042708	2123567	564130	55416	0	3
19_02924672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6976831	292500.01	294000	4672500	4673999.99	71.95	157.76	4091628	2215370	608349	61484	0	3
19_02924674	1.2	97	2011	1	NIIRS10	GeoCue GeoCoder	6298410	292500.01	294000	4674000	4675499.99	71.58	1303.17	3954843	1745915	534386	63266	0	0
19_02944662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5990799	294000.01	295500	4662000	4663499.99	47.22	359.74	3887217	1521019	496668	85895	0	3
19_02944664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5503081	294000.01	295500	4663500	4664999.99	48.99	110.66	3736297	1328227	382056	56501	0	3
19_02944665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4941228	294000.01	295500	4665000	4666499.99	17.95	118.14	3012706	1395448	462921	70153	0	3
19_02944666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5816090	294000.01	295500	4666500	4667999.99	56.71	175.01	3527032	1706212	519088	63758	0	3
19_02944668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5179016	294000.01	295500	4668000	4669499.99	62.22	119.46	3710694	1151854	283995	32473	0	3
19_02944670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5672636	294000.01	295500	4669500	4670999.99	46.95	431.37	3797345	1417084	410847	47360	0	3
19_02944671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6529119	294000.01	295500	4671000	4672499.99	51.85	148.12	3767829	2068891	615568	76831	0	3
19_02944672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6273362	294000.01	295500	4672500	4673999.99	48.3	194.81	3627385	1922406	628473	95098	0	3
19_02944674	1.2	97	2011	1	NIIRS10	GeoCue GeoCoder	6133256	294000.01	295500	4674000	4675499.99	58.41	273.35	3658049	1851326	553583	70298	0	3
19_02964662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5545930	295500.01	297000	4662000	4663499.99	61.81	124.42	3523733	1494955	457517	69725	0	3
19_02964664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6098176	295500.01	297000	4663500	4664999.99	36.32	168.28	3820386	1726967	484392	66431	0	3
19_02964665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5486295	295500.01	297000	4665000	4666499.99	38.3	164.07	3834896	1270822	338170	42407	0	3
19_02964666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6276813	295500.01	297000	4666500	4667999.99	42.6	116.51	3850485	1799666	543808	82854	0	3
19_02964668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5907074	295500.01	297000	4668000	4669499.99	18.43	115.21	3811499	1566181	466975	62419	0	3
19_02964670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5674757	295500.01	297000	4669500	4670999.99	33.01	125.31	3622667	1547052	448747	56291	0	3
19_02964671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5531850	295500.01	297000	4671000	4672499.99	51.03	126.36	3504128	1511040	453231	63451	0	3
19_02964672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6138890	295500.01	297000	4672500	4673999.99	40.95	141.78	3847677	1697129	515802	78282	0	3
19_02964674	1.2	97	2011	1	NIIRS10	GeoCue GeoCoder	6640418	295500.01	297000	4674000	4675499.99	54.34	165.57	3840394	2061120	635549	103355	0	3
19_02964676	1.2	98	2011	1		TerraScan	6503540	295500.01	297000	4675500	4676999.99	17.6	234.36	3779820	1963721	654947	105052	0	3
19_02974660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7056906	297000.01	298500	4660500	4661999.99	72.91	181.36	4099722	2141771	710165	105248	0	3
19_02974662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5790078	297000.01	298500	4662000	4663499.99	39.53	1600.53	4220335	1176944	344860	47939	0	3
19_02974664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6081830	297000.01	298500	4663500	4664999.99	53.56	110.18	4003185	1505291	494832	78522	0	3
19_02974665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6088400	297000.01	298500	4665000	4666499.99	23.1	177.63	3852536	1637641	520777	77446	0	3
19_02974666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5943704	297000.01	298500	4666500	4667999.99	18.74	120.7	3908218	1510976	461742	62768	0	3
19_02974668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6226475	297000.01	298500	4668000	4669499.99	43.92	140.16	4072980	1594319	491730	67446	0	3
19_02974670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6222933	297000.01	298500	4669500	4670999.99	42.58	128.29	4012780	1650963	499732	59458	0	3
19_02974671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6303115	297000.01	298500	4671000	4672499.99	30.39	137.54	3889254	1824136	530461	59264	0	3

19_02974672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6860894	297000.01	298500	4672500	4673999.99	45.56	145.82	4002459	2100503	675462	82470	0	3
19_02974674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6409058	297000.01	298500	4674000	4675499.99	48.82	146.21	3961550	1817409	563392	66707	0	3
19_02974676	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6592374	297000.01	298500	4675500	4676999.99	52.28	163.31	4001808	1894712	606353	89501	0	3
19_02974677	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6896968	297000.01	298500	4677000	4678499.99	35.5	153.91	3948652	1840124	889470	218722	0	3
19_02974678	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7166674	297000.01	298500	4678500	4679999.99	27.08	147.38	3924497	2032846	980473	228858	0	3
19_02984654	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	1144753	298500.01	299880.43	4655288.52	4655999.99	58.95	138.65	738225	289894	100612	16022	0	3
19_02984656	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6095613	298500.01	300000	4656000	4657499.99	23.49	139.27	3522926	1844250	633965	94472	0	3
19_02984658	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6022485	298500.01	300000	4657500	4658999.99	20.29	131.48	3701047	1690154	551751	79533	0	3
19_02984659	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6394529	298500.01	300000	4659000	4660499.99	63.37	138.7	3820077	1853243	626183	95026	0	3
19_02984660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6191392	298500.01	300000	4660500	4661999.99	57.48	189.1	3784578	1716886	603630	86298	0	3
19_02984662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5376537	298500.01	300000	4662000	4663499.99	55.64	1575.79	3856548	1135729	340427	43833	0	3
19_02984664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5587800	298500.01	300000	4663500	4664999.99	38.25	141.82	3737497	1350909	440102	59292	0	3
19_02984665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5963209	298500.01	300000	4665000	4666499.99	6.85	338.68	3751213	1609689	527244	75063	0	3
19_02984666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6130208	298500.01	300000	4666500	4667999.99	40.03	103.96	3688317	1741785	601495	98611	0	3
19_02984668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5544018	298500.01	300000	4668000	4669499.99	9.85	1517.84	3657958	1392592	439606	53862	0	3
19_02984670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5385515	298500.01	300000	4669500	4670999.99	26.76	111.59	3737168	1241679	363212	43456	0	3
19_02984671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6262747	298500.01	300000	4671000	4672499.99	33.55	126.73	3944750	1721848	532331	63818	0	3
19_02984672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5106647	298500.01	300000	4672500	4673999.99	34.8	660.48	3206728	1402473	440074	57372	0	3
19_02984674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5870672	298500.01	300000	4674000	4675499.99	27.48	159.19	3869392	1488335	457678	55267	0	3
19_02984676	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6463986	298500.01	300000	4675500	4676999.99	-1.93	151.29	3840498	1918394	624407	80687	0	3
19_02984677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6360432	298500.01	300000	4677000	4678499.99	17.85	173.21	4087365	1598242	574191	100634	0	3
19_02984678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5778208	298500.01	300000	4678500	4679999.99	31.21	186.22	3809466	1382223	498210	88309	0	3
19_03004654	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	1155720	300172.48	301500	4655266.68	4655999.99	65.58	1564.78	712275	319055	108505	15885	0	3
19_03004656	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6010862	300000.01	301500	4656000	4657499.99	56.13	1582.43	3755572	1614453	557328	83509	0	3
19_03004658	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6630576	300000.01	301500	4657500	4658999.99	69.07	1582.08	4015373	1851470	659014	104719	0	3
19_03004659	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5708817	300000.01	301500	4659000	4660499.99	1.51	1580.16	3846297	1332233	462857	67430	0	3
19_03004660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5134338	300000.01	301500	4660500	4661999.99	51.96	1465.04	3747057	1038881	311972	36428	0	3
19_03004662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5660705	300000.01	301500	4662000	4663499.99	39.54	142.97	3887007	1280401	433642	59655	0	3
19_03004664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6177076	300000.01	301500	4663500	4664999.99	58.8	136.93	3772987	1697946	607277	98866	0	3
19_03004665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6296084	300000.01	301500	4665000	4666499.99	35.32	124.57	3811422	1766864	622515	95283	0	3
19_03004666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5915373	300000.01	301500	4666500	4667999.99	2.53	114.88	3752128	1561146	526372	75727	0	3
19_03004668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5635507	300000.01	301500	4668000	4669499.99	16.11	242.13	3797493	1329620	445960	62434	0	3
19_03004670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5778451	300000.01	301500	4669500	4670999.99	37.9	116.9	3767008	1441478	500136	69829	0	3
19_03004671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6283140	300000.01	301500	4671000	4672499.99	21.61	142.51	3684454	1874501	639706	84479	0	3
19_03004672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5981630	300000.01	301500	4672500	4673999.99	39.37	121.04	3671644	1674359	561747	73880	0	3
19_03004674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5891670	300000.01	301500	4674000	4675499.99	15.91	113.82	3647280	1625120	547677	71593	0	3
19_03004676	1.2	97	2011	1		TerraScan	10116840	300000.01	301500	4675500	4676999.99	25.25	172.45	6991757	2304966	720686	99431	0	3
19_03004677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6452984	300000.01	301500.26	4676999.96	4678500.05	32.48	128.21	4069187	1751666	551359	80772	0	3
19_03004678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6417756	300000.01	301500.26	4678499.96	4680000.05	-6.7	129.68	4092513	1704455	546176	74612	0	3
19_03024654	1.2	97	2011	1		TerraScan	5490538	301500.01	303000	4654500	4655999.99	60.75	1561.43	3405975	1412341	563588	108634	0	3
19_03024656	1.2	97	2011	1		TerraScan	9066200	301500.01	303000	4656000	4657499.99	48.34	1549.09	5148174	2679492	1056875	181659	0	3
19_03024658	1.2	97	2011	1		TerraScan	8588213	301500.01	303000	4657500	4658999.99	79.96	1424.65	5072481	2330302	991025	194405	0	3
19_03024659	1.2	97	2011	1		TerraScan	8133175	301500.01	303000	4659000	4660499.99	59.79	1564.02	5095291	2052259	825048	160577	0	3
19_03024660	1.2	97	2011	1		TerraScan	7824712	301500.01	303000	4660500	4661999.99	46.44	1443.93	5194080	1830058	689086	111488	0	3
19_03024662	1.2	97	2011	1		TerraScan	8087510	301500.01	303000	4662000	4663499.99	65.78	1444.1	4909585	2177051	856175	144699	0	3
19_03024664	1.2	97	2011	1		TerraScan	8346792	301500.01	303000	4663500	4664999.99	39.59	1442.04	5015582	2278067	896844	156299	0	3
19_03024665	1.2	97	2011	1		TerraScan	8291675	301500.01	303000	4665000	4666499.99	21.65	1442.07	4902715	2306269	911264	171427	0	3

19_03024666	1.2	97	2011	1		TerraScan	7852577	301500.01	303000	4666500	4667999.99	18.53	1447.53	4873922	2017746	811611	149298	0	3
19_03024668	1.2	97	2011	1		TerraScan	7751668	301500.01	303000	4668000	4669499.99	1.36	1445.02	4919455	1969128	738345	124740	0	3
19_03024670	1.2	97	2011	1		TerraScan	8123391	301500.01	303000	4669500	4670999.99	34.52	1445.8	4904234	2242342	829829	146986	0	3
19_03024671	1.2	97	2011	1		TerraScan	9073669	301500.01	303000	4671000	4672499.99	8.81	145.89	4906545	2867286	1106939	192899	0	3
19_03024672	1.2	97	2011	1		TerraScan	8352751	301500.01	303000	4672500	4673999.99	5.9	244.42	5040811	2238085	897780	176075	0	3
19_03024674	1.2	97	2011	1		TerraScan	7727307	301500.01	303000	4674000	4675499.99	-2.82	1549.21	4824649	1994471	760360	147827	0	3
19_03024676	1.2	97	2011	1		TerraScan	8109944	301500.01	303000	4675500	4676999.99	11.48	1443.68	4942029	2194602	827459	145854	0	3
19_03024677	1.2	97	2011	1		TerraScan	5750776	301499.96	303000.03	4677000	4678500.02	29.72	114.58	3608106	1611092	476828	54750	0	3
19_03024678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6465550	301499.96	303000.03	4678499.99	4680000.02	28.34	130.11	3785892	1980281	620413	78964	0	3
19_03034656	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7076459	303000.01	304500	4656000	4657499.99	34.46	1431.22	3839584	2073512	954124	209239	0	3
19_03034658	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7442728	303000.01	304500	4657500	4658999.99	63.63	1434.31	3835566	2310107	1062892	234163	0	3
19_03034659	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6467301	303000.01	304500	4659000	4660499.99	34.33	1435.48	3689901	1783462	818753	175185	0	3
19_03034660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5521674	303000.01	304500	4660500	4661999.99	59.26	201.39	3749785	1237363	458290	76236	0	3
19_03034662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5924372	303000.01	304500	4662000	4663499.99	29.57	127.12	3646310	1604658	579655	93749	0	3
19_03034664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5741039	303000.01	304500	4663500	4664999.99	12.11	116.08	3788181	1365166	498214	89478	0	3
19_03034665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5926223	303000.01	304500	4665000	4666499.99	3.54	112.15	3720192	1531601	575606	98824	0	3
19_03034666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5119912	303000.01	304500	4666500	4667999.99	-5.15	1555.08	3394755	1185373	455813	83971	0	3
19_03034668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6188712	303000.01	304500	4668000	4669499.99	13.99	95.46	3774451	1622907	662314	129040	0	3
19_03034670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6263436	303000.01	304500	4669500	4670999.99	40.24	102.69	3792903	1737206	628502	104825	0	3
19_03034671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5677713	303000.01	304500	4671000	4672499.99	22	85.51	3701901	1428113	474840	72859	0	3
19_03034672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6710809	303000.01	304500	4672500	4673999.99	-35.45	103.62	3853914	1879732	809637	167526	0	3
19_03034674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7609969	303000.01	304500	4674000	4675499.99	-35.62	104.71	3901320	2410693	1071379	226577	0	3
19_03034676	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	7064961	303000.01	304500	4675500	4676999.99	10.51	115.84	3892694	2123284	881440	167543	0	3
19_03034677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6303057	303000.04	304500	4676999.99	4678499.99	-3.14	108.78	3783645	1889297	561293	68822	0	3
19_03034678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6207749	303000.04	304500	4678499.99	4679999.99	32.25	128.09	3755938	1832338	554632	64841	0	3
19_03034680	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6494499	303000.04	304500	4679999.99	4681499.99	23.9	148.99	3746840	2082031	602110	63518	0	3
19_03044656	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6013050	304500.01	306000	4656000	4657499.99	26.45	1433.77	3979790	1355329	562778	115153	0	3
19_03044658	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6679145	304500.01	306000	4657500	4658999.99	33.34	1434.26	4093484	1656691	755020	173950	0	3
19_03044659	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4906559	304500.01	306000	4659000	4660499.99	43.9	279.89	2763776	1429110	600149	113524	0	3
19_03044660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6552225	304500.01	306000	4660500	4661999.99	53.4	132.52	3914536	1802604	707252	127833	0	3
19_03044662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6242039	304500.01	306000	4662000	4663499.99	10.92	108.07	3970271	1608428	571676	91664	0	3
19_03044664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6917938	304500.01	306000	4663500	4664999.99	-9.27	105.78	4036897	1967432	773295	140314	0	3
19_03044665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7049130	304500.01	306000	4665000	4666499.99	19.59	92.49	4040855	2054324	805238	148713	0	3
19_03044666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6486062	304500.01	306000	4666500	4667999.99	17.44	95.91	3985579	1722291	660128	118064	0	3
19_03044668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6815071	304500.01	306000	4668000	4669499.99	8.19	92.46	4012453	1906584	756044	139990	0	3
19_03044670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5912183	304500.01	306000	4669500	4670999.99	4.24	87.6	3977051	1334852	508830	91450	0	3
19_03044671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5902261	304500.01	306000	4671000	4672499.99	8.8	85.95	3984763	1345813	488786	82899	0	3
19_03044672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5946902	304500.01	306000	4672500	4673999.99	29.29	404.86	4033287	1353755	473265	86595	0	3
19_03044674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6593625	304500.01	306000	4674000	4675499.99	-10.48	92.36	3882818	1777934	773700	159173	0	3
19_03044676	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	7072913	304500.01	306000	4675500	4676999.99	-8.3	95.6	4029802	2052581	833292	157238	0	3
19_03044677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6212698	304499.93	306000.4	4676999.99	4678500.04	2.54	101.3	3870781	1794312	487487	60118	0	3
19_03044678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6228236	304499.93	306000.4	4678499.99	4680000.04	22.27	113.15	3920988	1776277	477447	53524	0	3
19_03044680	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5731978	304500.01	306000.4	4679999.99	4681500.04	19.64	103.8	3769886	1517640	399781	44671	0	3
19_03044682	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5198800	304500.01	306000.4	4681499.99	4683000.04	-3.88	104.81	3774515	1137131	260917	26237	0	3
19_03064658	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6717749	306000.01	307500	4657500	4658999.99	39.88	144.75	3837243	1938282	792336	149888	0	3
19_03064659	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4885983	306000.01	307500	4659000	4660499.99	30.08	117.35	3226023	1105320	462231	92409	0	3
19_03064660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5963147	306000.01	307500	4660500	4661999.99	26.9	101.96	3686210	1509847	636554	130536	0	3

19_03064662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6416338	306000.01	307500	4662000	4663499.99	17.68	115.64	3817651	1736470	716837	145380	0	3
19_03064664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6519777	306000.01	307500	4663500	4664999.99	29.26	201.78	3820486	1803752	747645	147894	0	3
19_03064665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6203151	306000.01	307500	4665000	4666499.99	-10.92	131.19	3853834	1585597	638616	125104	0	3
19_03064666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6319713	306000.01	307500	4666500	4667999.99	7.56	386.36	3728217	1711177	728273	152046	0	3
19_03064668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6842493	306000.01	307500	4668000	4669499.99	14.72	100.1	3697889	2024923	916231	203450	0	3
19_03064670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6445608	306000.01	307500	4669500	4670999.99	-18.89	90.32	3827573	1729080	733783	155172	0	3
19_03064671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6204196	306000.01	307500	4671000	4672499.99	10.92	88.78	3806459	1637965	640997	118775	0	3
19_03064672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5745429	306000.01	307500	4672500	4673999.99	18.94	358.78	3767086	1375436	512252	90655	0	3
19_03064674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4873333	306000.01	307500	4674000	4675499.99	33.57	254.16	3683095	824130	309418	56690	0	3
19_03064676	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6246041	306000.01	307500	4675500	4676999.99	33.34	107.44	3777621	1628599	698895	140926	0	3
19_03064677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5206842	305999.6	307500.1	4676999.99	4678500.04	20.05	90.9	3476006	1335947	350617	44272	0	3
19_03064678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5257928	305999.6	307500.1	4678499.99	4680000.04	33.91	95.16	3695986	1222392	302680	36870	0	3
19_03064680	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5120366	305999.6	307500.1	4679999.99	4681500.04	-1.1	91.18	3792778	1071699	232706	23183	0	3
19_03064682	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5459512	305999.6	307500.1	4681499.99	4683000.04	2.44	98.68	4034285	1159580	242015	23632	0	3
19_03064683	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5075114	305999.6	307500.1	4682999.99	4684500.04	-24.18	163.94	4000284	892871	169811	12148	0	3
19_03064684	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5595307	305999.6	307500.1	4684499.99	4686000.04	9.43	120.5	4106163	1212678	253715	22751	0	3
19_03064686	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5038328	305999.6	307500.1	4686000	4687500.04	17.58	92.71	3942042	910689	172053	13544	0	3
19_03064688	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5372754	305999.6	307500.1	4687499.99	4689000.03	12.75	102.86	3940384	1189478	225115	17777	0	3
19_03084662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6263482	307500.01	309000	4662000	4663499.99	-10.04	1431.88	3573795	1720437	786563	182687	0	3
19_03084664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6575904	307500.01	309000	4663500	4664999.99	29.72	1432.13	3577414	1939331	862683	196476	0	3
19_03084665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6665583	307500.01	309000	4665000	4666499.99	7.75	1444.19	3806469	1849271	826717	183126	0	3
19_03084666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6502088	307500.01	309000	4666500	4667999.99	10.56	1440.66	3692449	1792989	823776	192874	0	3
19_03084668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6967118	307500.01	309000	4668000	4669499.99	24.93	1439.79	3754004	2017210	965875	230029	0	3
19_03084670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7633706	307500.01	309000	4669500	4670999.99	5.12	1438.7	3667680	2519785	1179986	266255	0	3
19_03084671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5403092	307500.01	309000	4671000	4672499.99	1.95	1438.78	3618149	1194243	488722	101978	0	3
19_03084672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5128252	307500.01	309000	4672500	4673999.99	-0.46	1440.81	3601726	1054142	399846	72538	0	3
19_03084674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6025110	307500.01	309000	4674000	4675499.99	1.48	1435.51	3772260	1518128	611213	123509	0	3
19_03084676	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6310597	307500.01	309000	4675500	4676999.99	5.83	1432.19	3784098	1645953	722798	157748	0	3
19_03084677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6401523	307500.11	308999.93	4676999.98	4678500	-1.61	114.85	3722436	1918545	660425	100117	0	3
19_03084678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6496316	307499.64	308999.94	4678499.97	4679999.99	-32.43	125.06	3772217	1947634	675660	100805	0	3
19_03084680	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6608065	307499.64	308999.93	4679999.98	4681500.03	18.99	110.33	3808869	2004318	697661	97217	0	3
19_03084682	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6169345	307499.64	308999.93	4681499.97	4683000.02	-6.62	113.37	3902289	1653127	542007	71922	0	3
19_03084683	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6438973	307499.65	308999.93	4682999.97	4684500.03	1.44	117.62	4007289	1801811	561580	68293	0	3
19_03084684	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	4911041	307499.64	308999.93	4684499.98	4686000.03	-1.1	112.76	3223410	1265358	379394	42879	0	3
19_03084686	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5769375	307499.64	308999.93	4685999.98	4687500.03	-1.67	81.38	3868981	1415985	431456	52953	0	3
19_03084688	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5937560	307499.65	308999.93	4687499.98	4689000.03	-0.26	104.76	3770926	1596788	499638	70208	0	3
19_03084689	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6725508	307499.65	308999.93	4688999.98	4690500.03	23.46	127.71	4115970	1919386	611130	79022	0	3
19_03084690	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6966527	307499.65	308999.94	4690499.98	4692000.04	28.62	134.24	4175870	2013263	681953	95441	0	3
19_03084692	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6679549	307499.64	308999.93	4691999.98	4693500.02	13.54	127.25	4208829	1842452	557169	71099	0	3
19_03084694	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	7151174	307499.64	308999.93	4693499.98	4695000.02	23.74	98.75	4117350	2239125	699945	94754	0	3
19_03084695	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	7025744	307499.65	308999.93	4694999.98	4696500.02	25.15	607.15	4035714	2161409	715627	112994	0	3
19_03084696	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5841581	307499.65	308999.93	4696499.98	4698000.02	22.27	105.54	3933121	1430943	424250	53267	0	3
19_03084698	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6049930	307499.65	308999.93	4697999.98	4699500.02	-1.56	108.78	3878323	1598879	503903	68825	0	3
19_03094662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6734492	309000.01	310500	4662000	4663499.99	10.96	1392.46	3983854	1745121	811135	194382	0	3
19_03094664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6105542	309000.01	310500	4663500	4664999.99	43.61	1387.56	3459372	1626139	806761	213270	0	3
19_03094665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6255503	309000.01	310500	4665000	4666499.99	0.15	1383.72	3901291	1482520	693735	177957	0	3
19_03094666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7794244	309000.01	310500	4666500	4667999.99	9.41	1394.02	4128524	2308246	1092546	264928	0	3

19_03094668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7326490	309000.01	310500	4668000	4669499.99	-0.63	1391.15	4086171	2051329	956151	232839	0	3
19_03094670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7071895	309000.01	310500	4669500	4670999.99	17.67	1382.22	3926701	1975421	940404	229369	0	3
19_03094671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7298692	309000.01	310500	4671000	4672499.99	-19.86	1375.81	4184032	2063998	862531	188131	0	3
19_03094672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6184724	309000.01	310500	4672500	4673999.99	22.24	1376.48	4087286	1383585	590352	123501	0	3
19_03094674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7072288	309000.01	310500	4674000	4675499.99	5.78	1378.58	4106523	1901964	863887	199914	0	3
19_03094676	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	7739262	309000.01	310500	4675500	4676999.99	15.42	1379.42	4151474	2236126	1084366	267296	0	3
19_03094677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6817913	308999.94	310500	4676999.98	4678500	6.11	123.28	4022250	2047393	655850	92420	0	3
19_03094678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6235615	308999.94	310500	4678499.97	4679999.99	2.23	140.51	4000446	1615247	540156	79766	0	3
19_03094680	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5553329	308999.94	310500	4679999.98	4681500	-15.49	148.31	3995492	1190666	329759	37412	0	3
19_03094682	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5625418	308999.94	310500	4681499.97	4683000	-21.73	94.27	3832648	1330915	407700	54155	0	3
19_03094683	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	4891189	308999.94	310500	4682999.97	4684500	-6.85	113.31	3125497	1283490	420388	61814	0	3
19_03094684	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	4964177	308999.94	310500	4684499.97	4686000	-15.37	99.19	3402262	1172331	347131	42453	0	3
19_03094686	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5481835	308999.94	310500	4685999.97	4687500	-2.83	89.67	3707839	1309250	414081	50665	0	3
19_03094688	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6051917	308999.94	310500	4687499.98	4689000	-30.74	107.98	3739497	1670114	561488	80818	0	3
19_03094689	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5518652	308999.82	310500	4688999.98	4690500	-8.4	113.27	3712650	1361073	395592	49337	0	3
19_03094690	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6550102	308999.83	310500	4690499.97	4692000	29.1	138.04	3769954	1957379	705109	117660	0	3
19_03094692	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6030083	308999.82	310500	4691999.98	4693500	7.63	125.07	3852704	1598869	509767	68743	0	3
19_03094694	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6464873	308999.82	310500	4693499.97	4695000	3.54	104.24	3886953	1852740	626046	99134	0	3
19_03094695	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6477956	308999.82	310500	4694999.97	4696500	-6.61	91.03	3989876	1795779	596624	95677	0	3
19_03094696	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6670549	308999.82	310500	4696499.97	4698000	-33.78	100.13	3993144	1923050	654770	99585	0	3
19_03094698	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6493432	308999.82	310500	4697999.97	4699500	22.03	133.63	3897547	1838903	654411	102571	0	3
19_03094700	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5618610	308999.82	310500	4699499.97	4701000	44.73	126.62	3386756	1586039	566491	79324	0	3
19_03094701	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6430289	308999.82	310500	4700999.98	4702500	14.42	145.98	3773145	1913853	656169	87122	0	3
19_03104662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7758199	310500.01	312000	4662000	4663499.99	31.67	1379.55	4065811	2257267	1146221	288900	0	3
19_03104664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7776439	310500.01	312000	4663500	4664999.99	16.96	1375.6	3997400	2317457	1172314	289268	0	3
19_03104665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6880217	310500.01	312000	4665000	4666499.99	21.24	1372.59	3927807	1868351	863541	220518	0	3
19_03104666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7295529	310500.01	312000	4666500	4667999.99	42.7	1376.68	4118911	2024531	933685	218402	0	3
19_03104668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7565550	310500.01	312000	4668000	4669499.99	20.29	1373.12	3917481	2240896	1117759	289414	0	3
19_03104670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7427517	310500.01	312000	4669500	4670999.99	-0.47	1367.02	3987124	2119802	1045709	274882	0	3
19_03104671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6996501	310500.01	312000	4671000	4672499.99	4.43	1370.47	3964583	1905636	895732	230550	0	3
19_03104672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7156107	310500.01	312000	4672500	4673999.99	-7.62	1364.5	3920432	2009540	970742	255393	0	3
19_03104674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	8103530	310500.01	312000	4674000	4675499.99	-14	1369.77	4118337	2494412	1210026	280755	0	3
19_03104676	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	7910778	310500.01	312000	4675500	4676999.99	28.79	1369.25	3931234	2475080	1213590	290874	0	3
19_03104677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5757463	310500.01	312000	4677000	4678499.99	17.84	156.45	3893926	1517576	317822	28139	0	3
19_03104678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5277431	310500.01	312000	4678500	4679999.99	-24.71	94.61	3759486	1230944	262124	24877	0	3
19_03104680	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5099795	310500.01	312000	4680000	4681499.99	-0.61	1543.65	3630270	1203593	244060	21872	0	3
19_03104682	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	4922385	310500.01	312000	4681500	4682999.99	-6.53	90.3	3480983	1175046	242864	23492	0	3
19_03104683	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5528371	310500.01	312000	4683000	4684499.99	-2.39	100.24	4039483	1212831	252031	24026	0	3
19_03104684	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5241238	310500.01	312000	4684500	4685999.99	-393.56	1552.26	4108174	941225	177882	13957	0	3
19_03104686	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5326251	310500.01	312000	4686000	4687499.99	-13.87	1549.87	4029367	1073804	206797	16283	0	3
19_03104688	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5289780	310500.01	312000	4687500	4688999.99	41.46	165.24	3779430	1248451	241946	19953	0	3
19_03104689	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	4829141	310500.01	312000	4689000	4690499.99	35.86	122.28	3560435	1052058	200872	15776	0	3
19_03104690	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	4737269	310500.01	312000	4690500	4691999.99	38.25	118.15	3310862	1166178	237728	22501	0	3
19_03104692	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	4839523	310500.01	312000	4692000	4693499.99	20.66	107.29	3640678	986248	195676	16921	0	3
19_03104694	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5338781	310500.01	312000	4693500	4694999.99	-17.53	105.57	3708001	1331367	273093	26320	0	3
19_03104695	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5215374	310500.01	312000	4695000	4696499.99	-6.65	119.18	3822765	1163664	211780	17165	0	3
19_03104696	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5312628	310499.57	312000	4696500	4697999.99	23.11	122.78	3789410	1267720	237292	18206	0	3

19_03104698	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5347254	310499.57	312000	4697999.96	4699499.99	41.88	111.64	3907292	1181273	238738	19951	0	3
19_03104700	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5638145	310499.57	312000	4699499.96	4700999.99	8.09	197.56	4013833	1333041	269001	22270	0	3
19_03104701	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	5644543	310499.57	312000	4700999.96	4702499.99	34.24	119.13	4081684	1314619	234053	14187	0	3
19_03124660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6266120	312000.01	313500	4660500	4661999.99	59.14	1380.21	3858568	1511904	717231	178417	0	3
19_03124662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5380530	312000.01	313500	4662000	4663499.99	29.62	1416.06	3884420	948666	444175	103269	0	3
19_03124664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7392596	312000.01	313500	4663500	4664999.99	37.22	1448.26	3915629	2160429	1053714	262824	0	3
19_03124665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6349931	312000.01	313500	4665000	4666499.99	25.84	1429.46	3888931	1635096	676094	149810	0	3
19_03124666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6168602	312000.01	313500	4666500	4667999.99	-61.67	1394.71	4024582	1381341	611589	151090	0	3
19_03124668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6723940	312000.01	313500	4668000	4669499.99	-7.17	1412.84	3788525	1852646	867990	214779	0	3
19_03124670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6974420	312000.01	313500	4669500	4670999.99	8.9	1424.89	3852589	1890452	966744	264635	0	3
19_03124671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7524814	312000.01	313500	4671000	4672499.99	15.02	1424.39	3893949	2155808	1149706	325351	0	3
19_03124672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	8171064	312000.01	313500	4672500	4673999.99	46.85	1379.08	3978333	2578311	1273518	340902	0	3
19_03124674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6302142	312000.01	313500	4674000	4675499.99	32.72	1358.51	3450299	1796426	842983	212434	0	3
19_03124676	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	2380224	312000.01	312544.58	4675500	4676999.99	29.92	1345.37	1165944	754820	370013	89447	0	3
19_03124677	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2008549	312000.01	312667.36	4677000	4678499.99	37.33	121.1	1296678	552687	144271	14913	0	3
19_03124678	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	1972587	312000.01	312723.51	4678500	4679999.99	6.32	109.95	1352249	481324	125977	13037	0	3
19_03124680	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2090696	312000.01	312755.66	4680000	4681499.99	-3.51	76.45	1395781	538333	141162	15420	0	3
19_03124682	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2574126	312000.01	312796.66	4681500	4682999.99	20.86	89.95	1656349	716549	180556	20672	0	3
19_03124683	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2579401	312000.01	312820.55	4683000	4684499.99	39.26	92.4	1713496	703506	150395	12004	0	3
19_03124684	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2545527	312000.01	312860.72	4684500	4685999.99	-15.03	99.35	1732130	636895	161845	14657	0	3
19_03124686	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2584570	312000.01	312913.95	4686000	4687499.99	9.9	115.08	1901941	548796	124722	9111	0	3
19_03124688	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2972645	312000.01	312976.1	4687500	4688999.99	3.74	1529.79	2050156	732954	173836	15699	0	3
19_03124689	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	3143787	312000.01	313011.78	4689000	4690499.99	10.58	514.19	2194261	759409	175192	14925	0	3
19_03124690	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	3334008	312000.01	313024.01	4690500	4691999.99	10.62	128.27	2272910	834466	205017	21615	0	3
19_03124692	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2931914	312000.01	313038.8	4692000	4693499.99	-3.95	105.03	2069255	688408	158919	15332	0	3
19_03124694	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2905082	312000.01	313075.5	4693500	4694999.99	8.87	93.33	2206278	571499	118413	8892	0	3
19_03124695	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	3478544	312000.01	313133.64	4695000	4696499.99	-38.81	117.81	2369915	892804	198809	17016	0	3
19_03124696	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	2894556	312000.01	313177.81	4696500	4697999.99	42.41	129.25	2155064	596456	131683	11353	0	3
19_03124698	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	3291423	312000.01	313216.68	4698000	4699499.99	48.64	156.23	2157843	896895	216383	20302	0	3
19_03124700	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	3910974	312000.01	313256.29	4699500	4700999.99	38.49	132.85	2581356	1062176	245477	21965	0	3
19_03124701	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	3898004	312000.01	313286.05	4701000	4702499.99	27.7	99.64	2704436	957031	218399	18138	0	3
19_03144660	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4736896	313500.01	315000	4660500	4661999.99	58.11	1540.54	3021520	1142379	471225	101772	0	3
19_03144662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6533170	313500.01	315000	4662000	4663499.99	24.7	1543.2	4007611	1696849	678630	150080	0	3
19_03144664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5459345	313500.01	315000	4663500	4664999.99	37.05	1543.79	3795995	1192506	402096	68748	0	3
19_03144665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6377147	313500.01	315000	4665000	4666499.99	35.98	1543.47	3829488	1752005	660402	135252	0	3
19_03144666	1.2	96	2011	1	NIIRS10	GeoCue GeoCoder	6323985	313500.01	315000	4666500	4667999.99	5.34	1543.41	3969947	1594035	626376	133627	0	3
19_03144668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5647844	313500.01	315000	4668000	4669499.99	4.91	1543.37	3917442	1214449	433569	82384	0	3
19_03144670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6102831	313500.01	315000	4669500	4670999.99	-28.75	1543.2	3976463	1441551	564205	120612	0	3
19_03144671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6525324	313500.01	315000	4671000	4672499.99	1.93	1543.05	3876819	1785342	713701	149462	0	3
19_03144672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6653546	313500.01	315000	4672500	4673999.99	18.57	1545.15	3878158	1845152	766423	163813	0	3
19_03144674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5723467	313500.01	315000	4674000	4675499.99	26.95	1546.2	3397247	1556965	636187	133068	0	3
19_03144676	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	729201	313628.76	314999.98	4675500	4675923.5	62.13	1544.04	393954	218389	96539	20319	0	3
19_03154664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6373483	315000.01	316500	4663500	4664999.99	22.08	1550.75	4175866	1728509	430611	38497	0	3
19_03154665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6176372	315000.01	316500	4665000	4666499.99	55.31	1549.87	4250059	1571714	330350	24249	0	3
19_03154666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5913048	315000.01	316500	4666500	4667999.99	24.12	1551.69	4098931	1400379	376160	37578	0	3
19_03154668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5700293	315000.01	316500	4668000	4669499.99	19.73	1554.19	4207003	1185263	285174	22853	0	3
19_03154670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5631713	315000.01	316500	4669500	4670999.99	13.52	1556.9	4279666	1090068	243175	18804	0	3

19_03154671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4788137	315000.01	316500	4671000	4672499.99	7.26	1547.65	3754825	852321	171049	9942	0	3
19_03154672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4396698	315000.01	316500	4672500	4673999.99	14.42	1549.62	3112054	1019650	246226	18768	0	3
19_03154674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	845977	315000.01	316499.43	4674000	4675499.99	30.67	1512.35	576460	216056	49711	3750	0	3
19_03154676	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	14298	315000.02	315253.99	4675500	4675552.93	58.86	94.02	8880	4411	939	68	0	3
19_03164665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6141975	316500.01	318000	4665000	4666499.99	66.84	1546.97	3925499	1752644	427683	36149	0	3
19_03164666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5670884	316500.01	318000	4666500	4667999.99	60.72	1547.32	3841820	1502336	307176	19552	0	3
19_03164668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5465875	316500.01	318000	4668000	4669499.99	-37.88	1548.34	3927067	1239643	278444	20721	0	3
19_03164670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5149357	316500.01	318000	4669500	4670999.99	11.6	1549.93	4015100	937751	185875	10631	0	3
19_03164671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4531050	316500.01	318000	4671000	4672499.99	-5.45	1551.38	3620201	763773	136902	10174	0	3
19_03164672	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	955738	316500.01	317809.53	4672500	4673999.99	32.83	1539.63	722750	186451	42657	3880	0	3
19_03164674	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5755	316500.01	316552.01	4674000	4674080.09	47.75	68.68	4500	1058	186	11	0	3
19_03184665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6607848	318000.01	319500	4665000	4666499.99	49.87	1545.17	3891697	2047688	592626	75837	0	3
19_03184666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6302322	318000.01	319500	4666500	4667999.99	26.81	1548.98	3763073	1898025	562013	79211	0	3
19_03184668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5460911	318000.01	319500	4668000	4669499.99	-15.03	1556.7	3782609	1312498	330658	35146	0	3
19_03184670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4837925	318000.01	319500	4669500	4670999.99	7.68	1559.11	3796658	861745	168288	11234	0	3
19_03184671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	2211386	318000.01	319500	4671000	4672079.08	-13.56	1552.03	1891386	268723	48450	2827	0	3
19_03204662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4828333	319500.01	321000	4662000	4663499.99	29.86	1458.75	3176065	1235580	369895	46793	0	3
19_03204664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5298171	319500.01	321000	4663500	4664999.99	42.58	1465.92	3562357	1281163	403883	50768	0	3
19_03204665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6630344	319500.01	321000	4665000	4666499.99	38.23	1472.64	4311633	1728795	524723	65193	0	3
19_03204666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6528255	319500.01	321000	4666500	4667999.99	27.91	1447.37	4202658	1766695	493219	65683	0	3
19_03204668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5978202	319500.01	321000	4668000	4669499.99	-9.56	1439.68	4026176	1462430	431853	57743	0	3
19_03204670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5347075	319500.01	321000	4669500	4670999.99	-2.8	1472.38	3855395	1242320	234611	14749	0	3
19_03204671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	1319836	319500.01	321000	4671000	4671553.88	-0.46	1469.48	923996	314018	75458	6364	0	3
19_03214662	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	7155544	321000.01	322500	4662000	4663499.99	48.79	1466.69	4299439	2164175	621193	70737	0	3
19_03214664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6451499	321000.01	322500	4663500	4664999.99	44.95	1461.82	4149446	1712137	527300	62616	0	3
19_03214665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	6200902	321000.01	322500	4665000	4666499.99	-251.2	1442.86	3877300	1740076	518348	65178	0	3
19_03214666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5890691	321000.01	322500	4666500	4667999.99	18.14	1448.12	3869956	1550624	424284	45827	0	3
19_03214668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5285871	321000.01	322500	4668000	4669499.99	-9.9	1465.24	3658263	1239965	348036	39607	0	3
19_03214670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	1516476	321000.01	322424.03	4669500	4670999.98	7.64	1481.34	1165891	285522	60695	4368	0	3
19_03214671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	58274	321000.01	321081.53	4671000	4671466.91	11.34	35.85	35539	18439	4098	198	0	3
19_03224664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5596058	322500.01	324000	4663500	4664999.99	27.18	1458.81	3676474	1481860	396279	41445	0	3
19_03224665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5503450	322500.01	324000	4665000	4666499.99	16.8	1469.43	3803937	1316101	342225	41187	0	3
19_03224666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4877437	322500.01	324000	4666500	4667999.99	-11.5	1464.62	3689104	946889	218670	22774	0	3
19_03224668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4813325	322500.01	324000	4668000	4669499.99	-5.18	1462.64	3493445	1041604	255395	22881	0	3
19_03224670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	278501	322743.2	323656.05	4669500	4669755.74	8.27	1377.38	203238	60452	13863	948	0	3
19_03244664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5597001	324000.01	325500	4663500	4664999.99	-2.54	1499.99	3763725	1418052	373556	41668	0	3
19_03244665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5368956	324000.01	325500	4665000	4666499.99	30.9	1473.21	3902237	1155046	285038	26635	0	3
19_03244666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5215243	324000.01	325500	4666500	4667999.99	-26.79	1468.08	4121062	873896	201485	18800	0	3
19_03244668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4339067	324000.01	325500	4668000	4669499.99	1.45	1499.82	3236534	892036	192801	17696	0	3
19_03244670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	34483	324676.16	325500	4669500	4669711.11	48.76	70.64	32140	2164	170	9	0	3
19_03264665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4829266	325500.01	327000	4665000	4666499.99	28.6	118.59	3858321	792959	167402	10584	0	3
19_03264666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5234442	325500.01	327000	4666500	4667999.99	20.41	118.2	3879217	1088212	246999	20014	0	3
19_03264668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5078956	325500.01	327000	4668000	4669499.99	28.68	111.05	3839826	1028577	195258	15295	0	3
19_03264670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	1731704	325500.01	327000	4669500	4670381.99	29.52	93.19	1228822	416190	80355	6337	0	3
19_03274664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5757724	327000.01	328500	4663500	4664999.99	13.95	217.92	3879908	1502169	347607	28040	0	3
19_03274665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5304658	327000.01	328500	4665000	4666499.99	-159.39	357.98	3778925	1230302	275780	19651	0	3
19_03274666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5324371	327000.01	328500	4666500	4667999.99	28.27	123.41	3699954	1306584	291956	25877	0	3

19_03274668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5225910	327000.01	328500	4668000	4669499.99	38.81	285.65	3631234	1300418	272401	21857	0	3
19_03274670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	3889518	327000.01	328500	4669500	4670906.26	15.38	155.57	2714299	957750	201589	15880	0	3
19_03284664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4940512	328500.01	330000	4663500	4664999.99	46.43	132.41	3629366	1089513	209824	11809	0	3
19_03284665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4892567	328500.01	330000	4665000	4666499.99	11.52	126.19	3808838	906708	166506	10515	0	3
19_03284666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4434844	328500.01	330000	4666500	4667999.99	57.94	149.26	3736410	599599	94036	4799	0	3
19_03284668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	4450618	328500.01	330000	4668000	4669499.99	53.94	122.85	3744879	608283	92940	4516	0	3
19_03284670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	5104632	328500.01	330000	4669500	4670999.99	16.33	192.43	3978579	947381	169470	9202	0	3
19_03284671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	511649	328630.79	330000	4671000	4671932.62	47.75	101.64	412859	82423	15408	959	0	3
19_03304664	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	404897	330000.01	330884.07	4663500	4664999.99	61.83	115.51	307646	83937	12799	515	0	3
19_03304665	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	2183485	330000.01	330899.4	4665000	4666499.99	50.86	120.78	1718141	393077	68807	3460	0	3
19_03304666	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	2314169	330000.01	330922.68	4666500	4667999.99	60.28	115.17	1725494	502619	82708	3348	0	3
19_03304668	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	2291044	330000.01	330917.23	4668000	4669499.99	26.88	261.87	1778376	428564	79690	4414	0	3
19_03304670	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	2474720	330000.01	330870.31	4669500	4670999.99	38.99	90.06	1928198	466771	76607	3144	0	3
19_03304671	1.2	75	2011	1	NIIRS10	GeoCue GeoCoder	1018204	330000.01	330891.45	4671000	4671885.28	-266.59	1117.32	813500	175895	27755	1054	0	3

GTModelTypeGeoKey	GeographicTypeGeoKey	GeogCitationGeoKey	GeogGeodeticDatumGeoKey	GeogPrimeMeridianGeoKey	GeogAngularUnitsGeoKey	GeogAngularUnitSizeGeoKey
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293
ModelTypeProjected	GCS_NAD83	GCS_North_American_1983	Datum_North_American_Datum_1983	PM_Greenwich	Angular_Degree	0.017453293

GeogEllipsoidGeoKey	GeogSemiMajorAxisGeoKey	GeogInvFlatteningGeoKey	GeogPrimeMeridianLongGeoKey	ProjectedCSTypeGeoKey	PCSCitationGeoKey	ProjCoordTransGeoKey
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator
Ellipse_GRS_1980	6378137	298.2572221	0	PCS_NAD83_UTM_zone_-242081N	NAD_1983_UTM_Zone_19N	CT_TransverseMercator

ProjLinearUnitsGeoKey	ProjLinearUnitSizeGeoKey	ProjNatOriginLatGeoKey	ProjFalseEastingGeoKey	ProjFalseNorthingGeoKey	ProjCenterLongGeoKey	ProjScaleAtNatOriginGeoKey	VerticalCitationGeoKey
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)
Linear_Meter	1	0	500000	0	-69	0.9996	NAVD88 - Geoid09 (Meters)

VerticalUnitsGeoKey	Path
Linear_Meter	F:\Charles_Classified_LAS\19_02904668.las
Linear_Meter	F:\Charles_Classified_LAS\19_02904670.las
Linear_Meter	F:\Charles_Classified_LAS\19_02904671.las
Linear_Meter	F:\Charles_Classified_LAS\19_02904672.las
Linear_Meter	F:\Charles_Classified_LAS\19_02904674.las
Linear_Meter	F:\Charles_Classified_LAS\19_02914666.las
Linear_Meter	F:\Charles_Classified_LAS\19_02914668.las
Linear_Meter	F:\Charles_Classified_LAS\19_02914670.las
Linear_Meter	F:\Charles_Classified_LAS\19_02914671.las
Linear_Meter	F:\Charles_Classified_LAS\19_02914672.las
Linear_Meter	F:\Charles_Classified_LAS\19_02914674.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924664.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924665.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924666.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924668.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924670.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924671.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924672.las
Linear_Meter	F:\Charles_Classified_LAS\19_02924674.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944662.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944664.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944665.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944666.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944668.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944670.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944671.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944672.las
Linear_Meter	F:\Charles_Classified_LAS\19_02944674.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964662.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964664.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964665.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964666.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964668.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964670.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964671.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964672.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964674.las
Linear_Meter	F:\Charles_Classified_LAS\19_02964676.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974660.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974662.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974664.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974665.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974666.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974668.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974670.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974671.las

Linear_Meter	F:\Charles_Classified_LAS\19_02974672.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974674.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974676.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974677.las
Linear_Meter	F:\Charles_Classified_LAS\19_02974678.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984654.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984656.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984658.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984659.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984660.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984662.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984664.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984665.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984666.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984668.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984670.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984671.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984672.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984674.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984676.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984677.las
Linear_Meter	F:\Charles_Classified_LAS\19_02984678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004654.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004656.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004658.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004659.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004660.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03004678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024654.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024656.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024658.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024659.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024660.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024665.las

Linear_Meter	F:\Charles_Classified_LAS\19_03024666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03024678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034656.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034658.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034659.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034660.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03034680.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044656.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044658.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044659.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044660.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044680.las
Linear_Meter	F:\Charles_Classified_LAS\19_03044682.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064658.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064659.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064660.las

Linear_Meter	F:\Charles_Classified_LAS\19_03064662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064680.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064682.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064683.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064684.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064686.las
Linear_Meter	F:\Charles_Classified_LAS\19_03064688.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084680.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084682.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084683.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084684.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084686.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084688.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084689.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084690.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084692.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084694.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084695.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084696.las
Linear_Meter	F:\Charles_Classified_LAS\19_03084698.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094666.las

Linear_Meter	F:\Charles_Classified_LAS\19_03094668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094680.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094682.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094683.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094684.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094686.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094688.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094689.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094690.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094692.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094694.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094695.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094696.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094698.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094700.las
Linear_Meter	F:\Charles_Classified_LAS\19_03094701.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104680.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104682.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104683.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104684.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104686.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104688.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104689.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104690.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104692.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104694.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104695.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104696.las

Linear_Meter	F:\Charles_Classified_LAS\19_03104698.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104700.las
Linear_Meter	F:\Charles_Classified_LAS\19_03104701.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124660.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124677.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124678.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124680.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124682.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124683.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124684.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124686.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124688.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124689.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124690.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124692.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124694.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124695.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124696.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124698.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124700.las
Linear_Meter	F:\Charles_Classified_LAS\19_03124701.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144660.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03144676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154670.las

Linear_Meter	F:\Charles_Classified_LAS\19_03154671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03154676.las
Linear_Meter	F:\Charles_Classified_LAS\19_03164665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03164666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03164668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03164670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03164671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03164672.las
Linear_Meter	F:\Charles_Classified_LAS\19_03164674.las
Linear_Meter	F:\Charles_Classified_LAS\19_03184665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03184666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03184668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03184670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03184671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03204662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03204664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03204665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03204666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03204668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03204670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03204671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03214662.las
Linear_Meter	F:\Charles_Classified_LAS\19_03214664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03214665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03214666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03214668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03214670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03214671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03224664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03224665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03224666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03224668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03224670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03244664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03244665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03244666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03244668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03244670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03264665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03264666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03264668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03264670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03274664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03274665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03274666.las

Linear_Meter	F:\Charles_Classified_LAS\19_03274668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03274670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03284664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03284665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03284666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03284668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03284670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03284671.las
Linear_Meter	F:\Charles_Classified_LAS\19_03304664.las
Linear_Meter	F:\Charles_Classified_LAS\19_03304665.las
Linear_Meter	F:\Charles_Classified_LAS\19_03304666.las
Linear_Meter	F:\Charles_Classified_LAS\19_03304668.las
Linear_Meter	F:\Charles_Classified_LAS\19_03304670.las
Linear_Meter	F:\Charles_Classified_LAS\19_03304671.las

Appendix G: Deliverables

STARR

Date: July 15, 2011

Contract # HSFEHQ-090D-0370

Task Order # HSFEHQ -10-J-0005

Subject:

STARR Elevation Data (LiDAR)

Transmittal:

To: **Marie Sparrow**
FEMA Engineering Library
%Zimmerman Associates, Inc
847 South Pickett Street
Alexandria, VA 22304

From: **James Huffines**
Greenhorne & O'Mara, Inc
5565 Centerview Drive
Ste 107
Raleigh, NC 27606

Transmitted:

- ☐ For Your Use
- ☐ For Your Approval/Signature
- ☐ For Your Information
- ☐ For Your Review
- ☐ As Requested
- ☒ For Storage

The following:

COPIES	DATE	DESCRIPTION
1	7/15/11	Charles HUC8, MA terrain data - see readme.txt included on hard drive for directory structure.
		Includes: Ground Control data, QC Checkpoint (FVA/CVA) data, PreFlight Report, PostFlight Report, Tile Index shapefile, Collection Area shapefile, Point Cloud (All Returns) LAS files, Bare Earth (Fully Classified) LAS files, QC Testing Results, QA Review spreadsheet, Compliance Certificates for Survey and LiDAR, Metadata for Survey, Point Cloud Data, and Bare Earth Data, and TSDN

Remarks:

If you have any questions or require additional information please feel free to contact me at 919-532-2332.
Please sign this transmittal upon receipt and mail to address shown above or fax to 919-851-8393.

Printed Name and Date: ______________________________

Signature: ____

Work Item List - drogers_pts - January 21, 2011

Work Item Details - Project # 11-01-0717S

Data Submission | Review

Save and Close | Continue >

Develop Topographic Data : Data Submission (Suffolk County-wide)

Click the Submit Data arrow to view data content or to Submit Data Files.
Click the Submission Status arrow to view the status of submitted data. Once all data has been uploaded and has passed all validation, click "Continue".

Expand All | Collapse All

Project and Task Information

Project Name:	Charles HUC8 - LIDAR - FY10
Case Number:	11-01-0717S
Task Description:	ground control
Baseline Task End Date:	11/30/2010
Projected Preliminary Date:	

Submit Data

Submission Contents

/R01/MASSACHUSETTS_25/SUFFOLK_25025/SUFFOLK_025C/11-01-0717S/SubmissionUpload/Terrain/2142860

Update Contents | Submit Data Files...

Work Item List - drogers_pts - January 21, 2011

Work Item Details - Project # 11-01-0717S

Data Submission | Review

Save and Close | Continue >

Develop Topographic Data : Data Submission (Suffolk County-wide)

Click the Submit Data arrow to view data content or to Submit Data Files.
Click the Submission Status arrow to view the status of submitted data. Once all data has been uploaded and has passed all validation, click "Continue".

Expand All | Collapse All

Project and Task Information

Project Name:	Charles HUC8 - LIDAR - FY10
Case Number:	11-01-0717S
Task Description:	acquisition
Baseline Task End Date:	01/07/2011
Projected Preliminary Date:	

Submit Data

Submission Contents

/R01/MASSACHUSETTS_25/SUFFOLK_25025/SUFFOLK_025C/11-01-0717S/SubmissionUpload/Terrain/2142862

Update Contents | Submit Data Files...

Download Sample Metadata Template to view the data file submission format.

Work Item List - drogers_pts - January 21, 2011

Work Item Details - Project # 11-01-0717S

Data Submission | Review

Save and Close | Continue >

Develop Topographic Data : Data Submission (Suffolk County-wide)

Click the Submit Data arrow to view data content or to Submit Data Files.
Click the Submission Status arrow to view the status of submitted data. Once all data has been uploaded and has passed all validation, click "Continue".

Expand All Collapse All

Project and Task Information

Project Name:	Charles HUC8 - LIDAR - FY10
Case Number:	11-01-0717S
Task Description:	processing
Baseline Task End Date:	02/28/2011
Projected Preliminary Date:	

Submit Data

Submission Contents

/R01/MASSACHUSETTS_25/SUFFOLK_25025/SUFFOLK_025C/11-01-0717S/SubmissionUpload/Terrain/2142861

Update Contents | Submit Data Files...

Appendix H: Guidance Documents

U.S. Department of Homeland Security
500 C Street, SW
Washington, DC 20472

FEMA

DATE

MEMORANDUM FOR: Mitigation Division Directors Regions I-X, CTPs, Mapping Partners

FROM: Doug Bellomo, Director
Risk Analysis Division

SUBJECT: Procedure Memorandum No. XX—Standards for Lidar and Other High Quality Digital Topography

EFFECTIVE DATES: August 1, 2010

Background: Beginning in Fiscal Year (FY) 2010, Federal Emergency Management Agency (FEMA) initiated a five-year program for Risk Mapping, Assessment, and Planning (Risk MAP). FEMA's vision for the Risk MAP program is to deliver quality data that increases public awareness and leads to mitigation actions that reduce risk to life and property. To achieve this vision, FEMA will transform its traditional flood identification and mapping efforts into a more integrated process of accurately identifying, assessing, communicating, planning for, and mitigating flood risks.

Under Risk MAP, FEMA seeks to:

- Deliver new data and products that expand risk awareness and promote mitigation planning that leads to risk reduction actions.
- Increase production efficiencies for Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FISs).

Issue: To implement FEMA's Risk MAP vision and provide the high quality topographic data necessary to meet Risk MAP's goals, FEMA Regions and Mapping Partners need upgraded guidance concerning the accuracy, and processing of high quality topographic data including Light Detection and Ranging (lidar) data. To that end, this Procedure Memorandum will supersede Appendix A: Guidance for Aerial Mapping and Surveying of the *Guidelines and Specifications for Flood Hazard Mapping Partners* (Guidelines) in key areas (defined in the Procedure Memorandum Attachments), and must be implemented beginning with all topographic data collected by FEMA beginning in FY 2010.

Actions Taken: When procuring topographic data under the Risk MAP Program the Mapping Partner assigned to obtain topographic data or perform independent QA of topographic data must meet the specifications detailed in this Procedure Memorandum's attachments. The attachments align FEMA's high quality topographic specifications, found in Appendix A of the Guidelines, with the United States Geological Survey (USGS) *Lidar Guidelines and Base Specifications* v13 so that data procured and used by the Federal government is consistent across agencies and is updated to industry standards. Further, adherence to these specifications will support the Risk MAP Program by closing gaps in existing flood hazard data; supporting risk assessments; and better communicating risks to community officials and the public.

Existing elevation data, not acquired by FEMA, but planned for use on a new flood hazard analysis must comply with the accuracy, density and the final product metadata requirements detailed in the attachments and, but is not required to comply with the other specifications included and referenced below.

Consistent with FEMA's overall approach to flood hazard identification, this Procedure Memorandum aligns FEMA topographic data specifications to level of risk, and accounts for different slopes in the terrain that can affect the accuracy of base flood elevations and the delineation of mapped floodplains. These specifications represent the minimum requirements. Where funding partners are involved or where the engineering requirements dictate, projects may use higher specification levels or include additional processing. Quality assurance requirements for high quality topographic data are also provided.

Attachments:
Attachment 1 – Definitions
Attachment 2 – Alignment of FEMA Appendix A to USGS *Lidar Guidelines and Base Specification* v13
Attachment 3 – Topographic Breakline and Hydro-Enforcement Specifications
Attachment 4 – Topographic Data Quality Review Process

Distribution List:

Attachment 1 – Definitions

Digital Elevation Data – Includes all of the following terms: mass points, point clouds, breaklines, contours, TINs, DEMs, DTMs or DSMs.

- **Breakline –** A linear feature demarking a change in the smoothness or continuity of a surface such as abrupt elevation changes or a stream line. The two most common forms of breaklines are as follows:
  - A **soft breakline** ensures that known elevations, or z-values, along a linear feature are maintained (e.g., elevations along a pipeline, road centerline or drainage ditch), and ensures the boundary of natural and man-made features on the Earth's surface are appropriately represented in the digital terrain data by use of linear features and polygon edges They are generally synonymous with 3-D breaklines because they are depicted with series of x/y/z coordinates.
  - A **hard breakline** defines interruptions in surface smoothness, e.g., to define streams, shorelines, dams, ridges, building footprints, and other locations with abrupt surface changes. Although some hard breaklines are three dimensional (3-D) breaklines, they are often depicted as two dimensional (2-D) breaklines because features such as shorelines and building footprints are normally depicted with a series of horizontal coordinates only which are often digitized from digital orthophotographs that include no elevation data.
- **Contours –** Lines of equal elevation on a surface. An imaginary line on the ground, all points of which are at the same elevation above or below a specified vertical datum.
- **Digital Elevation Model (DEM) –** An elevation model created for use in computer software where bare-earth elevation values have regularly spaced intervals in latitude and longitude (x and y). The Δx and Δy values are normally measured in feet or meters to even units; however, the National Elevation Dataset (NED) defines the spacing interval in terms of arc-seconds of latitude and longitude, e.g., 1/3rd arc-second.
- **Digital Surface Model (DSM) –** An elevation model created for use in computer software that is similar to DEMs or DTMs except that DSMs depict the elevations of the top surfaces of buildings, trees, towers, and other features elevated above the bare earth.
- **Digital Terrain Model (DTM) –** An elevation model created for use in computer software of bare-earth mass points and breaklines. DTMs are technically superior to a gridded DEM for many applications because distinctive terrain features are more clearly defined and precisely located, and contours generated from DTMs more closely approximate the real shape of the terrain.
- **Mass Points –** Irregularly spaced points, each with latitude and longitude location coordinates and elevation values typically used to form a TIN.
- **Metadata –** Project descriptive information about the elevation dataset.
- **Point Cloud –** Often referred to as the "raw point cloud", this is the first data product of a lidar instrument. In its crudest form, a lidar raw point cloud is a collection of range measurements and sensor orientation parameters. After initial processing, the range and orientation of each laser value is converted to a position in a three dimensional frame of reference and this spatially coherent cloud of points is the base for further processing and analysis. The raw point cloud typically includes first, last, and intermediate returns for each laser pulse. In addition to spatial information, lidar intensity returns provide texture or color information. The combination of three dimensional spatial information and spectral information contained

in the lidar dataset allows great flexibility for data manipulation and extraction. As used in this procedure memorandum, two additional lidar data processing terms are defined as follows:

- **Lidar Preliminary Processing –** The initial processing and analysis of laser data (GPS/IMU/laser ranges) to fully “calibrated point clouds” in some specified tile format. All lidar data will be set to ASPRS LAS Class 1 (unclassified) and must include testing for Fundamental Vertical Accuracy (FVA). The tile format can change later, if necessary.
- **Lidar Post-Processing –** The final processing and classification of lidar data to the required ASPRS LAS classes, per project specifications. This must include testing for Consolidated Vertical Accuracy (CVA). At this point, the datasets are referred to as the “classified point cloud.”

- **Triangulated Irregular Network (TIN) –** A set of adjacent, non-overlapping triangles computed from irregularly-spaced points with lattitude, longitude, and elevation values. The TIN data structure is based on irregularly-spaced point, line, and polygon data interpreted as mass points and breaklines and stores the topological relationship between triangles and their adjacent neighbors. The TIN model may be preferable to a DEM when it is critical to preserve the precise location of narrow or small features, such as levees, ditch or stream centerlines, isolated peaks or pits in the data model.
- **Z-Values –** The elevations of the 3-D surface above the vertical datum at designated x/y locations.

Geospatial Accuracy Standard – A common accuracy testing and reporting methodology that facilitates sharing and interoperability of geospatial data. Published in 1998, the National Standard for Spatial Data Accuracy (NSSDA) is the Federal Geographic Data Committee (FGDC) standard relevant to digital elevation data when assuming that errors follow a normal error distribution. However, after it was learned that lidar datasets do not necessarily follow a normal distribution in vegetated terrain, the National Digital Elevation Program (NDEP) published its “Guidelines for Digital Elevation Data” and the American Society for Photogrammetry and Remote Sensing (ASPRS) published the “ASPRS Guidelines: Vertical Accuracy Reporting for Lidar Data,” both of which were published in 2004 and use newer terms defined below as Fundamental Vertical Accuracy (FVA), Supplemental Vertical Accuracy (SVA) and Consolidated Vertical Accuracy (CVA). All of these standards, designed for digital elevation data, replace the National Map Accuracy Standard (NMAS) that is applicable only to graphic maps defined by map scale and contour interval.

Accuracy – The closeness of an estimated value (e.g., measured or computed) to a standard or accepted (true) value of a particular quantity. Note: With the exception of GPS Continuously Operating Reference Stations (CORS), assumed to be known with zero errors relative to established datums, the true locations of 3-D spatial coordinates or other points are not known, but only estimated. Therefore, the accuracy of other coordinate information is unknown and can only be estimated. Other accuracy definitions are as follows.

- **Absolute Accuracy –** A measure that accounts for all systematic and random errors in a data set. Absolute accuracy is stated with respect to a defied datum or reference system.
- **Accuracy$_r$ –** The NSSDA reporting standard in the horizontal component that equals the radius of a circle of uncertainty, such that the true or theoretical horizontal location of the

point falls within that circle 95-percent of the time. $\text{Accuracy}_r = 1.7308 \times \text{RMSE}_r$. Horizontal accuracy is defined as the positional accuracy of a dataset with respect to a horizontal datum.

- **Accuracy_z —** The NSSDA reporting standard in the vertical component that equals the linear uncertainty value, such that the true or theoretical vertical location of the point falls within that linear uncertainty value 95-percent of the time. $\text{Accuracy}_z = 1.9600 \times \text{RMSE}_z$. Vertical accuracy is defined as the positional accuracy of a dataset with respect to a vertical datum.
- **Consolidated Vertical Accuracy (CVA) –** The result of a test of the accuracy of vertical checkpoints (z-values) consolidated for two or more of the major land cover categories, representing both open terrain and other land cover categories. Computed by using the 95th percentile, CVA is always accompanied by Fundamental Vertical Accuracy (FVA).
- **Fundamental Vertical Accuracy (FVA) –** The value by which vertical accuracy can be equitably assessed and compared among datasets. The FVA is determined with vertical checkpoints located only in open terrain, where there is a very high probability that the sensor will have detected the ground surface. FVA is calculated at the 95% confidence level in open terrain only, using $\text{RMSE}_z \times 1.9600$,
- **Local Accuracy –** A value that represents the uncertainty in the coordinates of a control point relative to the coordinates of other directly-connected, adjacent control points at the 95-percent confidence level. The reported local accuracy is an approximate average of the individual local accuracy values between this control point and other observed control points used to establish the coordinates of the control point.
- **Network Accuracy –** A value that represents the uncertainty in the coordinates of a control point with respect to the geodetic datum at the 95-percent confidence level. For National Spatial Reference System (NSRS) network accuracy classification in the U.S., the datum is considered to be best expressed by the geodetic values at the CORS supported by the National Geodetic Survey (NGS). By this definition, the local and network accuracy values at CORS sites are considered to be infinitesimal, i.e., to approach zero.
- **Percentile –** Any of the values in a dataset of errors dividing the distribution of the individual errors in the dataset into one hundred groups of equal frequency. Any of those groups can specify a specific percentile, e.g., the 95th percentile as defined below.
- **Precision –** A statistical measure of the tendency of a set of random numbers to cluster about a number determined by the dataset. *Precision* relates to the quality of the method by which the measurements were made and is distinguished from *accuracy* which relates to the quality of the result. The term "precision" not only applies to the fidelity with which required operations are performed, but, by custom, has been applied to methods and instruments employed in obtaining results of a high order of precision. Precision is exemplified by the number of decimal places to which a computation is carried and a result stated.
- **Positional Accuracy** – The accuracy of the position of features, including horizontal and/or vertical positions.
- **Relative Accuracy** – A measure that accounts for random errors in a data set. Relative accuracy may also be referred to as point-to-point accuracy. The general measure of relative accuracy is an evaluation of the random errors (systematic errors and blunders removed) in determining the positional orientation (e.g., distance, azimuth) of one point or feature with respect to another.
- **Root Mean Square Error (RMSE) –** The square root of the average of the set of squared differences between dataset coordinate values and coordinate values from an independent

source of higher accuracy for identical points. The vertical RMSE ($RMSE_z$), for example, is calculated as the square root of $\sum(Z_n - Z'_n)^2/N$, where:

  - Z_n is the set of N z-values (elevations) being evaluated, normally interpolated (for TINs and DEMs) from dataset elevations of points surrounding the x/y coordinates of checkpoints
  - Z'_n is the corresponding set of checkpoint elevations for the points being evaluated
  - N is the number of checkpoints
  - n is the identification number of each of the checkpoints from 1 through N.
- **Supplemental Vertical Accuracy (SVA) –** The result of a test of the accuracy of z-values over areas with ground cover categories or combination of categories other than open terrain. Computed by using the 95th percentile, SVA is always accompanied by Fundamental Vertical Accuracy (FVA). SVA values are computed individually for different land cover categories. Each land cover type representing 10% of more of the total project area is typically tested and reported as an SVA. SVA specifications are normally target values that may be exceeded so long as overall CVA requirements are satisfied.
- **95% Confidence Level** – Accuracy reported at the 95% confidence level means that 95% of the positions in the dataset will have an error with respect to true ground position that is equal to or smaller than the reported accuracy value. The reported accuracy value reflects all uncertainties, including those introduced by geodetic control coordinates, compilation, and final computation of ground coordinate values in the product. Where errors follow a normal error distribution, $Accuracy_z$ defines vertical accuracy at the 95% confidence level (computed as $RMSE_z$ x 1.9600), and $Accuracy_r$ defines horizontal (radial) accuracy at the 95% confidence level (computed as $RMSE_r$ x 1.7308).
- **95th Percentile –** Accuracy reported at the 95th percentile indicates that 95% of the errors will be of equal or lesser value and 5% of the errors will be of larger value. This term is used when errors may not follow a normal error distribution, e.g., in forested areas where the classification of bare-earth elevations may have a positive bias. Vertical accuracy at the 95% confidence level and 95th percentile may be compared to evaluate the degree to which actual errors approach a normal error distribution.

Resolution – In the context of elevation data, resolution is synonymous with the horizontal density of elevation data points for which two similar terms are used:

- **Nominal Pulse Spacing (NPS)** – The estimated average spacing of irregularly-spaced lidar points in both the along-track and cross-track directions resulting from: the laser pulse repetition frequency (e.g., 100,000 pulses of laser energy emitted in one second from a 100 kHz sensor); scan rate (sometimes viewed as the number of zigzags per second for this common scanning pattern); field-of-view; and flight airspeed. Lidar system developers currently provide "design NPS" as part of the design pulse density, although the American Society for Photogrammetry and Remote Sensing (ASPRS) is currently developing standard procedures to compute the "empirical NPS" which should be approximately the same as the "design NPS" when accepting statistically insignificant loss of returns and disregarding void areas, from water for example. The NPS assessment is made against single swath first return data located within the geometrically usable center portion (typically ~90%) of each swath. Average along-track and cross-track pulse spacing should be comparable. When point density is increased by relying on overlap or double-coverage it should be documented in metadata and not by changing the project's reported NPS. The NPS should be equal to or less than the Digital Elevation Model (DEM) post spacing when gridded DEMs are required as part of project specifications. This same definition for NPS could similarly apply to irregularly-spaced mass points from photogrammetry or Interferometric Synthetic Aperture Radar (IFSAR) data. NPS pertains to lidar only and is not intended to pertain to photogrammetry or IFSAR.

- **DEM Post Spacing –** Sometimes confused with Nominal Pulse Spacing, the DEM Post Spacing is defined as the constant sampling interval in x- and y-directions of a DEM lattice or grid. This is also called the horizontal resolution of a gridded DEM or the DEM grid spacing. It is standard industry practice to have:
  - 1-meter DEM post spacing for elevation data with 1-foot equivalent contour accuracy;
  - 2-meter DEM post spacing for elevation data with 2-foot equivalent contour accuracy;
  - 5-meter DEM post spacing for elevation data with 5-foot equivalent contour accuracy.

Attachment 2 – Alignment of FEMA Appendix A to USGS Lidar Specification v13

FEMA is aligning Appendix A of the *Guidelines and Specifications for Flood Hazard Mapping Partners* (Guidelines) to the USGS *Lidar Guidelines and Base Specification* v13 to modernize the FEMA specifications to current industry practice, leverage the expertise of the USGS Geography discipline, maintain Federal standards across agencies, and support the use of elevation products acquired as part of Risk MAP by other agencies for other purposes thus maximizing the Government's investment.

Overall, new elevation data purchased by FEMA must comply with the USGS *Lidar Guidelines and Base Specification* v13, except where specifically noted in this Procedure Memorandum.

Because FEMA's needs for elevation are specific to floodplain mapping, FEMA has some unique requirements that differ from the USGS specifications. To supplement the existing USGS specifications, FEMA-specific items such as cross section surveys, bridges, and other features in Appendix A of the Guidelines remain valid except where superseded by more current information provided in this attachment. Table 1 summarizes the sections in Appendix A that are fully superseded, partially superseded or not superseded by this Procedure Memorandum.

Table 2.1 Currency of Major Sections within FEMA's Appendix A: Guidance for Aerial Mapping and Surveying

Section	Name	Status
A.1	Introduction	Is not superseded and remains valid.
A.2	Industry Geospatial Standards	Remains valid but is appended by additional standards which use newer standards from the National Digital Elevation Program (NDEP) and American Society for Photogrammetry and Remote Sensing (ASPRS) to test elevation data for Fundamental Vertical Accuracy (FVA), Supplemental Vertical Accuracy (SVA), and Consolidated Vertical Accuracy (CVA).
A.3	Accuracy Guidelines	Partly superseded, especially Table 2, below, that specifies variable vertical accuracy standards and nominal pulse spacing (NPS), depending on the risk level and terrain slope within the floodplain being mapped.
A.4	Data Requirements	Major portions are superseded. Subsection A.4.2.3 pertaining to breaklines, subsection A.4.3 pertaining to elevation data vertical accuracy, and subsection A.4.5 pertaining to mapping area, are superseded. Subsection A.4.11 pertaining to other digital topographic data requirements, including Table A-3, Digital Topographic Data Requirements Checklist, is now superseded by other FEMA procurement guidelines. Subsection A.4.9 on data formats is partially superseded by the addition of lidar LAS formatted datasets. Subsections pertaining to cross sections (A.4.6) and hydraulic structures (A.4.7) remain valid.
A.5	Ground Control	Is not superseded and remains valid.
A.6	Ground Surveys	Is not superseded and remains valid.

Section	Name	Status
A.7	Photogrammetric Surveys	Remains valid but is appended by additional standards which require low confidence areas to be delineated for photogrammetry as well as lidar and interferometric synthetic aperture radar (IFSAR). The vast majority of section A.7 remains valid and unchanged.
A.8	Airborne LiDAR	Superseded with references the USGS *Lidar Guidelines and Base Specification* v13; and by NDEP and ASPRS guidelines for accuracy testing and reporting of lidar data.

2.1Elevation Specifications Based on Risk Levels

FEMA maintains a national dataset that estimates flood risk. The basic data is calculated at the Census Block Group level, and is also aggregated to the sub-watershed, watershed and county levels. These data assign a risk value and a risk rank to each area. The areas are grouped into 10 classes with an equal number of members based on risk rank. These 10 classes are called risk deciles.

The table below provides the minimum elevation standards for new engineering analyses produced by FEMA. The highest and high specifications are suitable for either basic or enhanced engineering analyses. The medium and low specifications are suitable for basic engineering analyses. Where more than 20% of the project area covered by the new elevation will have enhanced engineering analyses, the next higher elevation specification level may be appropriate. When the scope of the enhanced engineering analyses is not sufficient to justify increasing the overall project specification level, the bulk elevation data collection may be enhanced by field survey in areas of enhanced engineering analyses if necessary.

Table 2.2. Vertical Accuracy Requirements based on Flood Risk and Terrain Slope within the Floodplain being mapped

Level of Flood Risk	Typical Slopes	Specification Level	Vertical Accuracy, 95% Confidence Level FVA/CVA	Lidar Nominal Pulse Spacing (NPS)
High (Deciles 1,2,3)	Flattest	Highest	24.5 cm/36.3 cm	≤1 meter
High (Deciles 1,2,3)	Rolling or Hilly	High	49.0 cm/72.6 cm	≤2 meters
High (Deciles 2,3,4,5)	Hilly	Medium	98.0 cm/145 cm	≤3.5 meters
Medium (Deciles 3,4,5,6,7)	Flattest	High	49.0 cm/72.6 cm	≤2 meters
Medium (Deciles 3,4,5,6,7)	Rolling	Medium	98.0 cm/145 cm	≤3.5 meters

Medium (Deciles 4,5,6,7)	Hilly	Low	147 cm/218 cm	≤5 meters
Low (Deciles 7,8,9,10)	All	Low	147 cm/218 cm	≤5 meters

Whereas contour lines are for visual interpretation and are unnecessary for FEMA's automated H&H analyses, the term "equivalent contour accuracy" is used to show the accuracy of contour lines that could be produced from a DEM if needed for manual analysis; this is also for the benefit of those who do not understand NSSDA terminology that defines vertical accuracy at the 95% confidence level. Table 3 explains "equivalent contour accuracy" for various standard contour intervals, referenced also in terms of vertical root mean square error ($RMSE_z$), National Standard for Spatial Data Accuracy (NSSDA) $Accuracy_z$, SVA and CVA.

Table 2.3. Accuracy Terms that Equal "Equivalent Contour Accuracy"

Equivalent Contour Accuracy	FEMA Specification Level	$RMSE_z$	NSSDA $Accuracy_z$ 95% confidence level	SVA (target)	CVA (mandatory)
1 ft		0.30 ft or 9.25 cm	0.60 ft or18.2 cm	0.60 ft or18.2 cm	0.60 ft or18.2 cm
2 ft	Highest	0.61 ft or 18.5 cm	1.19 ft or 36.3 cm	1.19 ft or 36.3 cm	1.19 ft or 36.3 cm
4 ft	High	1.22 ft or 37.1 cm	2.38 ft or 72.6 cm	2.38 ft or 72.6 cm	2.38 ft or 72.6 cm
5 ft		1.52 ft or 46.3 cm	2.98 ft or 90.8 cm	2.98 ft or 90.8 cm	2.98 ft or 90.8 cm
8 ft	Medium	2.43 ft or 73.9 cm	4.77 ft or 1.45 m	4.77 ft or 1.45 m	4.77 ft or 1.45 m
10 ft		3.04 ft or 92.7 cm	5.96 ft or1.82 m	5.96 ft or1.82 m	5.96 ft or1.82 m
12 ft	Low	3.65 ft or 1.11m	7.15 ft or 2.18 m	7.15 ft or 2.18 m	7.15 ft or 2.18 m

FEMA's requirements for elevation data are specific to flood risk analysis. As a result, FEMA's requirements diverge from the USGS specification which is intended to serve a different purpose. Two of the key differences with the FEMA specifications are the requirements for vertical accuracy and nominal pulse spacing. The FEMA requirements in these areas are only similar to the USGS requirements in the highest specification level, but otherwise differ for the lower accuracy levels.

All data collected must go through lidar preliminary processing and the unclassified point cloud must be tested as specified in the USGS specification. Where the Mapping Activity Statement (MAS) requires bare earth post-processing of the floodplain area of interest (AOI), the elevation data must be tested and comply with both the FVA and CVA requirements. Where no bare earth post-processing is specified, only the FVA requirements apply for lidar preliminary processing.

Many other organizations require higher-accuracy lidar data for diverse applications and combine their resources to solve multiple needs with lidar. FEMA prefers to acquire elevation data through partnerships so that the resulting data will meet a broader variety of end user needs and be more consistent with the overall USGS specification. These partnership elevation collection activities will frequently utilize specifications that exceed the minimums described above in Table 2. Before committing funds to a new elevation mapping project, FEMA Regional staff should first determine whether funds could be spent more effectively by cooperating with other agencies to more cost-effectively acquire elevation data. FEMA is a member of the National Digital Elevation Program (NDEP) which was formed, in part, to avoid duplication of effort among state and federal government agencies acquiring digital elevation data. USGS maintains state geospatial liaisons that are a good source of information regarding the status of existing and/or planned mapping activities in their states.

2.2 Light Detection and Ranging (lidar)

Lidar is capable of delivering 1- foot equivalent contour accuracy with sub-meter NPS used to produce DEMs with 1-meter DEM gridded post spacing. Therefore, lidar could satisfy FEMA's requirements for elevation data in high risk, moderate risk, and low risk areas. Lidar is often the best technology for mapping the elevations of the bare earth terrain in dense vegetation.

If this technology is selected for high risk areas, lidar will be collected in accordance with the USGS *Lidar Guidelines and Base Specification*, v13, for the National Geospatial Program except as noted. FEMA does not require the data to be hydro-flattened, as specified in v13. Also, FEMA does not require all data to be processed to the bare earth terrain, but instead limits the area to be processed to areas in the vicinity of floodplains that will require hydraulic modeling. See FEMA's Procurement Guidelines for specifics on this topic.

The following USGS specifications are most relevant to FEMA and are consistent with FEMA requirements:

- Fundamental Vertical Accuracy (FVA) pertains only to open, non-vegetated terrain. The FVA is specified at a higher level of accuracy than other land cover categories. The FVA is a mandatory specification that must be satisfied in order to be usable by FEMA for flood risk mapping within the specified level of flood risk.
- Supplemental Vertical Accuracy (SVA) pertains to other major land cover categories representative of the floodplain being mapped. SVA values are target values, where one SVA category can test higher and another lower than the target SVA value so long as the overall CVA is satisfied for the consolidated equivalent contour accuracy.
- Consolidated Vertical Accuracy (CVA) pertains to all land cover categories combined. Compliance with the CVA specification is mandatory in order for an elevation dataset to qualify for satisfaction of a specified equivalent contour accuracy.
- For the highest specification level equivalent to 2 foot contour accuracy, the relative accuracy should be ≤ 7 cm $RMSE_z$ within individual swaths; ≤ 10 cm $RMSE_z$ within swath overlap (between adjacent swaths). These relative accuracy specifications double to 14 and 20 cm, respectively, for risk areas that utilize the high elevation specification with 4 foot equivalent contour accuracy. This specification is not applicable to lower risk areas.
- Consistent with USGS *Lidar Guidelines and Base Specification*, v13, a regular grid, with cell size equal to the design NPS*2 will be laid over the first return data within the geometrically usable center portion of each swath. At least 90% of the cells in the grid shall contain at least one lidar point.
- All data collected will be delivered consistent with the USGS Raw Point Cloud deliverable requirements.

- Where lidar post-processing is performed, the deliverables must also include the classified point cloud deliverable. The data will be delivered in full compliance with LAS classes 1 (processed, but unclassified), 2 (bare-earth ground), 7 (noise), 9 (water), 10 (ignored), and 11 (withheld). All points not identified as "withheld" are to be classified. "Overlap" classification (Class 12) shall not be used.
- The horizontal datum shall be referenced to the latest adjustment of the North American Datum of 1983 (NAD83 [NSRS2007]).
- The vertical datum shall be referenced to the North American Vertical Datum of 1988 (NAVD88) whenever available. Areas outside of the continental U.S. where NAVD88 is not available should be referenced to a reproducible local datum that can be used to support floodplain management.
- The most recent approved Geoid model from the National Geodetic Survey (NGS) shall be used to perform conversions from ellipsoidal heights to orthometric heights.
- The standard coordinate reference system and units shall be Universal Transverse Mercator (UTM), meters. Considerations for other standard coordinate systems such as State Plane can be made for projects which are contributed to by mapping partners.
- The single non-overlapped tiling scheme shall be established and agreed upon by the data producer and FEMA prior to collection, consistent with the USGS *Lidar Guidelines and Base Specifications,* v13.
- Specifications for breaklines and hydro-enforcement are addressed in Attachment B.
- Specifications for lidar accuracy testing by land cover categories within the floodplain being mapped are addressed in Attachment C.

Lidar dataset deliverables shall include the following:

1. Metadata should comply with the requirements in the USGS *Lidar Guidelines and Base Specification*, v13. In addition, the finished elevation product for hydraulic modeling should be documented by a FGDC-compliant metadata file that complies with the FEMA Elevation Metadata Profile. Project documentation must also include a Pre-flight Operations Plan and Post-flight Aerial Survey and Calibration Report as described in Attachment 4.
2. Raw point cloud data shall comply with the requirements in the USGS Lidar Guidelines and Base Specification, v13.
3. Classified point cloud data shall comply with requirements in the USGS Lidar Guidelines and Base Specification, v13.
4. Optional breaklines, when produced, shall be delivered in compliance with guidance in Attachment 3
5. Optional digital bare earth elevation data product(s) (e.g., DEM, DTM, contours) in file formats specified in the Statement of Work.

2.3 Photogrammetry

Photogrammetry is also capable of delivering 1-foot equivalent contour accuracy and a DEM with 1-meter post spacing. Therefore, photogrammetry could also satisfy FEMA's requirements for elevation data in high risk, moderate risk, and low risk areas. Except for the new requirement to delineate areas of low confidence, existing guidance published in section A.7, Photogrammetric Surveys, in Appendix A of FEMA's Guidelines, remain current for new aerial image acquisition with either film or digital cameras.

The USGS annually contracts for leaf-off orthoimagery of selected areas under the National Geospatial Program, typically producing digital orthophotographs with pixel resolution of 30 cm (~1 foot) or 15 cm (~6 inches), as do many states and local governments; and the USDA contracts for leaf-on orthoimagery of major areas of the U.S. annually under the National Agricultural Imagery Program (NAIP) with pixel resolution of 1 meter. Although intended for production of digital orthophotos, those same images could be reused for production of digital elevation data because the aerotriangulation (AT) solution for production of orthophotos can be reused for establishing stereo models from which DEMs can be produced by photogrammetric auto-correlation and/or manual compilation. Elevation accuracies typically achievable by reuse of digital imagery and AT metrics are as follows:

- Typically acquired at an elevation of approximately 4,800 feet above mean terrain, imagery and AT solutions used to produce digital orthophotos with 6-inch pixel resolution should be acceptable for elevation data with 2.5-foot equivalent contour accuracy
- Typically acquired at an elevation of approximately 9,600 feet above mean terrain, imagery and AT solutions used to produce digital orthophotos with 1-foot pixel resolution should be acceptable for elevation data with 5-foot equivalent contour accuracy
- Typically acquired at an elevation of approximately 30,000 feet above mean terrain, imagery and AT solutions used to produce digital orthophotos with 1-meter pixel resolution should be acceptable for elevation data with 15-foot equivalent contour accuracy.

Photogrammetric dataset deliverables shall include the following:

1. Metadata shall include:
    - Collection Report detailing mission planning and flight logs, flying heights, camera parameters, forward overlap and sidelap.
    - Survey Report detailing the collection of control and reference points used for calibration and QA/QC.
    - Aerial triangulation (AT) report detailing compliance with relevant accuracy statistics.
    - Processing Report detailing photogrammetric processed used to manually compile elevation data or to semi-automatically compile elevation data with automated image correlation or other techniques.
    - QA/QC reports.
    - Geo-referenced extents of each delivered dataset.
2. Digital bare earth elevation data product (DEM, DTM, mass points, breaklines, contours) specified in the Statement of Work.
3. Optional breaklines, when produced, shall be delivered in compliance with guidance in Attachment 3

2.4 Ground Surveys

All ground surveys must be performed in accordance with procedures in Section A.5, Ground Control, and Section A.6, Ground Surveys, in Appendix A of FEMA's Guidelines. Cross-section surveys and hydraulic structure surveys shall also be performed in accordance with sections A.4.6 and A.4.7, respectively, of Appendix A.

2.5 Low Confidence Areas

Regardless of technology used, FEMA requires that low confidence areas be delineated by the data provider to indicate areas where the vertical data may not meet the data accuracy requirements due to heavy vegetation even though the specified nominal pulse spacing was met or exceeded in those areas. The metadata must explain steps taken to minimize the areas delineated as low confidence areas. Accuracy test points are normally retained within such areas and are not discarded. The data provider must take reasonable steps to minimize areas delineated as low confidence areas, taking into consideration the density of the vegetation in the floodplain being mapped and other factors.

These low confidence areas must be delivered as polygons in accordance with a database schema. The database schema for polygons defining low confidence areas is as follows.

Feature Dataset: TOPOGRAPHIC **Feature Class:** CONFIDENCE
Feature Type: Polygon
Contains M Values: No **Contains Z Values:** No
Annotation Subclass: None
XY Resolution: Accept Default Setting **Z Resolution:** Accept Default Setting
XY Tolerance: 0.003 **Z Tolerance:** N/A

2.5.1 Description

This polygon feature class will depict areas where the ground is obscured by dense vegetation, meaning that the resultant bare-earth digital terrain model (DTM) may not meet the required accuracy specifications in these obscured areas. Low confidence areas can pertain to lidar, photogrammetry or IFSAR.

2.5.2 Table Definition

Field Name	Data Type	Allow Null Values	Default Value	Domain	Precision	Scale	Length	Responsibility
OBJECTID	Object ID							Assigned by Software
SHAPE	Geometry							Assigned by Software
DATESTAMP_DT	Date	Yes			0	0	8	Assigned by Contractor
SHAPE_LENGTH	Double	Yes			0	0		Calculated by Contractor
SHAPE_AREA	Double	Yes			0	0		Calculated by

								Contractor
TYPE	Long Integer	No	1	Obscure	0	0		Assigned by Contractor

2.5.3 Feature Definition

Code	Description	Definition	Capture Rules
1	Low Confidence Area	"Low confidence areas" are defined by the data provider to indicate areas where the vertical data may not meet the data accuracy requirements due to heavy vegetation even though the nominal pulse spacing was met or exceeded in those areas.	Capture as closed polygon. Compiler does not need t z-values of vertices; feature class will be 2-D only.

Attachment 3 – Topographic Breakline and Hydro-Enforcement Specifications

FEMA has no minimum breakline requirements; breaklines are optional and depend upon the procedures used to perform hydrologic and hydraulic modeling. The FEMA Project Manager should specify the breaklines requirements if desired based on the planned approach for hydraulic analysis or the mapping partner may propose breakline requirements based on the anticipated hydraulic modeling approach.

When optional breaklines are produced, the following breakline topology rules must be followed for the applicable feature classes. The topology must be validated by each contractor prior to delivery to FEMA.

Name: BREAKLINES_Topology			Cluster Tolerance: 0.003 Maximum Generated Error Count: Undefined State: Analyzed without errors	
Feature Class	**Weight**	**XY Rank**	**Z Rank**	**Event Notification**
COASTALSHORELINE	5	1	1	No
HYDROGRAPHICFEATURE	5	1	1	No
PONDS_AND_LAKES	5	1	1	No
HYDRAULICSTRUCTURE	5	1	1	No
ISLAND	5	1	1	No

Topology Rules

Name	Rule Type	Trigger Event	Orgin (FeatureClass::Subtype)	Destination (FeatureClass::Subtype)
Must not intersect	The rule is a line-no intersection rule	No	HYDRAULICSTRUCTURE::All	HYDRAULICSTRUCTURE::All
Must not intersect	The rule is a line-no intersection rule	No	HYDROGRAPHICFEATURE::All	HYDROGRAPHICFEATURE::All
Must not intersect	The rule is a line-no intersection rule	No	COASTALSHORELINE::All	COASTALSHORELINE::All
Must not intersect	The rule is a line-no intersection rule	No	PONDS_AND_LAKES::All	PONDS_AND_LAKES::All
Must not intersect	The rule is a line-no intersection rule	No	ISLAND::All	ISLAND::All
Must not overlap	The rule is a line-no overlap line rule	No	HYDROGRAPHICFEATURE::All	COASTALSHORELINE::All
Must not self-intersect	The rule is a line-no self intersect rule	No	HYDRAULICSTRUCTURE::All	HYDRAULICSTRUCTURE::All
Must not self-intersect	The rule is a line-no self intersect rule	No	HYDROGRAPHICFEATURE::All	HYDROGRAPHICFEATURE::All
Must not self-intersect	The rule is a line-no self intersect rule	No	COASTALSHORELINE::All	COASTALSHORELINE::All

Name	Rule Type	Trigger Event	Orgin (FeatureClass::Subtype)	Destination (FeatureClass::Subtype)
Must not self-intersect	The rule is a line-no self intersect rule	No	PONDS_AND_LAKES::All	PONDS_AND_LAKES::All
Must not self-intersect	The rule is a line-no self intersect rule	No	ISLAND::All	ISLAND::All

Attachment 4 – Topographic Data Quality Review and Reporting Process

To complement the topographic data specifications in this procedure memorandum, this attachment describes data quality review processes and reporting obligations to be performed on new topographic data procured by FEMA as part of a flood hazard study or Risk MAP project. The mapping partner responsible for producing the elevation data is responsible for the quality of the product. In addition, FEMA may assign another mapping partner to perform Independent QA/QC of Topographic Data

Existing topographic data leveraged by FEMA should be certified to meet or tested for the vertical accuracy requirements specified in this procedure memo. In addition, the quality reviews described here are best practices that may be applied to existing topographic data. However, some of the documentation needed to perform some of these reviews may not be readily available for existing data..

4.1 Quality Reviews and Reporting Performed by Data Provider

The mapping partner responsible for producing new elevation data must submit copies of QA reports as specified in USGS Lidar Guidelines and Base Specification version 13. Unless the responsibility for checkpoint surveys and vertical accuracy testing is specifically assigned to a different mapping partner performing Independent QA/QC, the mapping partner responsible for producing the elevation data must test the unclassified point cloud data for Fundamental Vertical Accuracy (FVA) and, when lidar post-processing is performed must also test the bare earth product for Supplemental Vertical Accuracy (SVA) and Consolidated Vertical Accuracy (CVA).

4.1.1 Ground Survey of Quality Review Checkpoints

Quality review checkpoint surveys shall be performed in accordance with procedures in Section A.6.4, Checkpoint Surveys and A.6.5 Survey Records, in Appendix A of FEMA's Guidelines.

Checkpoints surveyed for accuracy reporting shall not be used by the data provider in the calibration or adjustment of the topographic data.

4.1.2 Assessment of Initial Vertical Accuracy

Assessment of the fully calibrated, raw point cloud initial vertical accuracy is required to ensure data has successfully completed preliminary processing. The absolute and relative accuracy of the data, relative to known control, shall be verified prior to classification and subsequent product development , by calculating FVA, measured in open, non-vegetated terrain. The spatial distribution of checkpoints for FVA testing should be based on the entire project collection area, distributed to avoid clustering, and support vertical accuracy reporting that is representative of the whole project.

If the project area exceeds 2,000 square miles it must be divided into smaller blocks of 2,000 square miles or less and tested as individual areas. In addition, the division of large project areas should apply the following rules if applicable:

- Divide areas by vendor used
- Divide areas by sensor type (manufacturer)
- Divide areas by flight dates if significant temporal difference is present
- Other logical project divisions based factors that might have a systematic relationships to data quality.

Reporting of positional accuracy shall be in accordance with ASPRS/NDEP standards as well as the USGS *Lidar Guidelines and Base Specification*, v13, Section II.13 and shall use the following statement:

Tested ____ (meters) fundamental vertical accuracy at 95% confidence level

Reporting on the assessment of the point cloud initial vertical accuracy shall include the following at a minimum:

- ***A description of the process used to test the points***
- A graphic depicting the spatial distribution of the ground survey checkpoints
- Descriptive statistics and RMSEz in FVA calculations

4.1.3 Assessment of Bare Earth Vertical Accuracy

When bare earth post-processing is included in the project, assessment of the vertical accuracy for the delivered bare earth elevation product is required to ensure data has successfully completed post processing. Reporting of positional accuracy shall be in accordance with ASPRS/NDEP standards for FVA and CVA. Testing should be performed on the bare earth deliverable as specified in the mapping activity statement, along with the following guidance:

- If an assessment of initial vertical accuracy (FVA) was conducted prior to the processing of the data (section 4.1.2), the FVA checkpoints can again be used in the CVA computations if located within the area to be processed
- The SVA for up to three significant land cover categories, in terms of percentage of the project area covered, shall be tested in addition to the open/bare ground areas already tested for FVA Land cover categories making up 10% or more of the project area should be included in the SVA testing
- For smaller projects less than 1,000 square miles, fewer check points for SVA testing is acceptable. The number of checkpoints shall be reduced to control the QA cost to about 10% of the acquisition and processing cost. The checkpoints should be distributed evenly across the SVA land cover types.
- Processing areas greater than 2,000 square miles must be divided into smaller blocks of 2,000 square miles or less and tested as individual areas. In addition,

the division of large processing areas should apply the following rules if applicable:

- Divide areas by vendor used
- Divide areas by sensor type (manufacturer)
- Divide areas by flight dates if significant temporal difference is present
- Other logical project divisions based factors that might have a systematic relationships to data quality.

1.

- Each block of 2,000 square miles or less shall be tested for FVA, SVA, and CVA

Checkpoints used for testing SVA of the bare earth elevation product must be located in the areas where bare earth post-processing was performed, distributed to avoid clustering, and support vertical accuracy reporting that is representative of the post processed areas. The SVA results will then be combined with the FVA results to compute CVA for the entire project area.

Reporting on the assessment of the vertical accuracy of the post-processed, delivered elevation data shall include the following at a minimum:

- ***A description of the process used to test the points***
- A graphic depicting the spatial distribution of the ground survey checkpoints
- An analysis of checkpoints that have errors exceeding the 95th percentile in SVA and CVA calculations
- Descriptive statistics and RMSEz in FVA calculations

4.1.4 Aerial Data Acquisition and Calibration

The mapping partner responsible for producing new elevation data must also submit a pre-flight Operations Plan and a post-flight Aerial Acquisition and Calibration Report will be provided to FEMA and/or their representatives by the data acquisition provider and uploaded to the MIP by the data provider. This information will aid future quality review efforts. The required reporting includes the following, outlined in Tables 4.1 and 4.2.

Table 4.1. Pre-flight Operations Plan

Item	Contents	Format
Flight Operations	• Planned flight lines	MS Word or

Plan	• Planned GPS stations • Planned control • Planned airport locations • Calibration plans • Quality procedures for flight crew (project-related for pilot and operator) • Planned scanset (sensor settings and altitude) • Type of aircraft • Procedure for tracking, executing, and checking reflights • Considerations for terrain, cover, and weather in project	PDF

Table 4.2. Post-flight Aerial Acquisition and Calibration Report

Item	Contents	Format
GPS Base station info	• Base station name • Latitude/Longitude (ddd-mm-ss.sss) • Base height (Ellipsoidal meters) • Maximum Position Dilution of Precision PDOP • Map of locations	Excel, TXT, MS Word, or PDF for data; ESRI shape file for map of locations (data and info may be in attribute table)
GPS/IMU processing summary	• Max Horizontal GPS Variance (cm) • Max Vertical GPS Variance (cm) • Notes on GPS quality (High, Good, etc.) • GPS separation plot • GPS altitude plot • PDOP plot • Plot of GPS distance from base station/s	MS Word or PDF with screenshots
Coverage	• Verification of project coverage	ESRI shape files reflecting the actual coverage area and not the applicable tiles.
Flights	• As-flown trajectories • Calibration lines	ESRI shape files

Item	Contents	Format
Flight logs	• Incorporated as appendix Should include: • Job # / name • Lift # • Block or AOI designator • Date • Aircraft tail number, type • Flight line, line #, direction, start/stop, altitude, scan angle/rate, speed, conditions, comments • Pilot name • Operator name • AGC switch setting • Laser pulse rate • Mirror rate • Field of view • Airport of operations • GPS base station names or numbers Comments	
Control	• Ground control and base station layouts	ESRI shape files
Data verification/QC	• Description of data verification/QC process • Results of verification and QC steps	MS Word, Excel or PDF

4.2 Quality Reviews and Reporting Performed by Independent QA/QC

When a mapping partner is assigned to perform *Independent QA of Topographic Data* macro and micro reviews of the submitted reports and data shall be performed. Macro reviews are automated processes or are checks required to establish overall data quality and shall be applied to the entire project area. Micro reviews are typically manual in nature and shall be used to check no less than 3 project tiles or 5% of the total number of project tiles, whichever is the greater amount.

Tables 4.3 and 4.4 outline macro and micro reviews to be conducted on the raw point cloud and for data that is post-processed. Some reviews are duplicated between the raw point cloud and post-processing phases due to the potential for errors to be introduced into the data during post-processing.

Table 4.3. Review of fully calibrated raw point cloud

Macro Reviews	
Product	**Reviewed for**
Pre-flight Operations Plan	• Compliance with section 4.1.4 and checklists in 4.2.1 • Compliance with the specifications outlined in the Mapping Activity Statement
Post-flight Aerial Acquisition and Calibration Report	• Compliance with section 4.1.4 and checklists in 4.2.1 • Compliance with the specifications outlined in the Mapping Activity Statement

Macro Reviews	
Product	**Reviewed for**
LAS Point Cloud Files	• Project area coverage – buffered by a minimum of 100 meters • Data voids • Inclusion of GPS time stamp • Correct projection, datum and units • Multiple Discrete Returns (at least 3 returns per pulse) • Correct header information • Other LAS attributes required by Mapping Activity Statement such as intensity values • Correct nominal pulse spacing as required by specific risk and/or level of study and buy-up options.
Metadata	• Compliance with the FEMA Terrain Metadata Profile
Micro Reviews	
Product	**Reviewed for**
LAS Point Cloud Files	• Excessive noise • Elevation steps • Other anomalies present in the point cloud

Table 4.4. Review of post-processed data

Macro Reviews	
Product	**Reviewed for**
LAS Point Cloud Files	• Compliance with checklists in section 4.2.1 • Project area coverage – buffered by a minimum of 100 meters • Data voids • Inclusion of GPS time stamp • Correct projection, datum and units • Multiple Discrete Returns (at least 3 returns per pulse) • Correct header information • Other LAS attributes required by Mapping Activity Statement such as intensity values • Correct nominal pulse spacing as required by specific risk and/or level of study and buy-up options. • Easting, northing and elevation reported to nearest 0.01m or 0.01 ft • Correct file-naming convention
Metadata	• Compliance with the FEMA Terrain Metadata Profile

Macro Reviews	
Product	**Reviewed for**
Micro Reviews	
Product	**Reviewed for**
LAS Point Cloud Files	• Excessive noise • Elevation steps • Other anomalies present in the point cloud • Correct classification and cleanliness: no more than 2% of the project area classified to bare ground shall contain artifacts such as buildings, trees, overpasses or other above-ground features in the ground point classification (Class 2). In addition, no more than 2% of the project area shall contain incorrect classifications of points. (USGS *Lidar Guidelines and Base Specification*, v13, Section IV.14. •
Optional - Breaklines	• Correct topology • Horizontal placement • Completeness • Continuity *See Attachment 3 for breakline topology rules to be checked against*

If the mapping partner responsible *Independent QA of Topographic Data* is tasked to perform assessment of vertical accuracy of the elevation data as described above in sections 4.1.2 and 4.1.3:

- Assessment of FVA only for pre-processed data to be stored and FVA, SVA, and CVA for post-processed data
- Review of data provider vertical accuracy assessment reports

4.2.1 Recommended Checklists

The following checklists are recommended for use during Independent QA/QC review to facilitate the process.

Pre-flight review checklist

Checklist	Pass / Fail	Comments
Planned lines – sufficient coverage, spacing, and length		
Planned GPS stations		
Planned ground control – sufficient to control and boresight		
Calibration plans		
Vendor quality procedures		
Lidar sensor scan set – planned for proper scan angle, sidelap, design pulse.		
Aircraft utilizes ABGPS		

Sensor supports project design pulse density		
Type of aircraft – supports project design parameters		
Reflight procedure – tracking, documenting, processing		
Project design supports accuracy requirements of project		
Project design accounts for land cover and terrain types		

Post-flight review checklists

Checklist for QA of Flight Logs		
Checklist	Included Yes/No	Comments
Flight logs – job #/name		
Flight logs – block or AOI		
Flight logs – date		
Flight logs – aircraft tail #		
Flight logs – lines - #		
Flight logs – lines - direction		
Flight logs – lines – start/stop		
Flight logs – lines – altitude		
Flight logs – lines – scan angle		
Flight logs – lines – speed		
Flight logs – conditions		
Flight logs – comments		
Flight logs - pilot name		
Flight logs - operator name		
Flight logs - AGC switch		
Flight logs – GPS base stations		

Checklist for Aerial Acquisition Report		
Checklist	Included? Yes/No	Comments
GPS base station – names		
GPS base station – lat/longs		
GPS base station – heights		
GPS base station – map		
GPS quality – separation plot		
GPS quality – PDOP plot		

GPS quality - horizontal Acc.		
GPS quality - vertical Acc.		
Sensor calibration process		
Verification of AOI coverage		
As-flown trajectories		
Ground control layout		
Data verification process documented		

Final terrain product review checklists

Checklist for QA of Terrain Products		
Checklist	**Pass/Fail**	**Comments**
Vertical datum correct		
Horizontal datum correct		
Projection correct		
Vertical units correct		
Horizontal units correct		
Each return contains – GPS week, GPS second, easting, northing, elevation, intensity, return # and classification		
No duplicate entries		
GPS second reported to nearest microsecond		
Easting, northing, and elevation reported to nearest 0.01 m or 0.01 ft		
Classifications correct – 1. Unclassified; 2. Bare-earth ground; 7. Noise; 9. Water; 10. Ignored ground; 11. Withheld		
Cloud file structure conforms to project tile layout		
Naming conforms project requirements		
Deliverable tiles checked for significant gaps not covered by aerial acquisition checks and/or caused by data post-processing/filtering		

M.4 Terrain Submittal Standards

M.4.1 Overview

This section describes the format and type of terrain data required to be submitted to FEMA for FISs. All data must be submitted in digital format. The Mapping Partner performing "Develop Topographic Data" is required to submit the data in this section.

The Mapping Partner should refer to Appendix A of these Guidelines for guidance on terrain data production. This section is not intended to detail the specifications and procedures for coastal hydrographic surveys. The reader is referred to the following additional sources for details on coastal surveys:

- National Oceanic and Atmospheric Administration (NOAA) NOS Hydrographic Survey Specifications and Deliverables (April 2007);
- NOAA Office of Coast Survey Hydrographic Surveys Division Field Procedures Manual (March 2007); and
- U.S. Army Corps of Engineers (USACE) National Coastal Mapping Program Joint LiDAR Bathymetry Technical Center for Expertise.
- Appendix D of the *Guidelines and Specifications for Flood Hazard Mapping Partners* (February 2007).

The submitting Mapping Partner must retain copies of all Project-related data for a period of 3 years. The submitting Mapping Partner will need these data for responding to the following:

- Questions from FEMA or the receiving Mapping Partner during the review of the final draft materials;
- Comments and appeals submitted to FEMA during the 90-day appeal period following the issuance of preliminary maps; and
- Other concerns and issues that may develop during the processing of the new or revised FIS report and FIRM.

M.4.2 Requirements

M.4.2.1 Data Files

The minimum data required for the terrain data submission are the source terrain and topographic maps from the terrain data used in the study. These data can be contained in a single file or in tiled files. When tiled files are submitted, they must be accompanied by a tiling index file. If any processing has been performed, the original and final files must be submitted as well. For instance, if terrain data were blended from three different sources to create the final terrain data, the original of the three sources and the final terrain file that results from the blending process must be submitted. This information is required to be a georeferenced, digital submittal. The following information must be submitted when it is used to perform a study:

- LiDAR data (bare earth and all returns);
- Tiling index for data files;
- Breaklines and Mass Points;
- Contours;
- Bathymetry;
- Digital Elevation Models (DEMs);
- Hydro-corrected DEMs;
- Triangulated Irregular Networks (TINs);
- Hydro-corrected TINs;
- USGS topographic data;
- All other terrain data; and
- LiDAR data generated as part of the project must be submitted as two separate files: one for bare earth only, and one for all returns if bare earth processing was performed as part of this project. For existing LiDAR data not processed as part of the project, the bare earth data must be submitted, and the submittal of the all returns data (if available) is optional.

A project narrative describing the SOW, direction from FEMA, issues, information for next Mapping Partner, etc. (see DCS User Guide for additional details).

M.4.2.2 General Correspondence

A file that compiles general correspondence must be submitted by the Mapping Partner assigned to "Develop Topographic Data." General correspondence is the written correspondence generated or received by the Mapping Partner to fulfill the requirements of developing topographic data. Correspondence includes any documentation generated during this task such as letters; transmittals; memoranda; general status reports and queries; SPRs; technical issues that need to be documented; and direction given by FEMA.. Contractual documents, such as a signed SOW or MAS, are not to be submitted as a part of this appendix.

M.4.2.3 Certification of Work

FEMA-funded (including CTP-funded projects if they are a part of FEMA's flood mapping program) terrain data development must be certified using the Certification of Compliance Form provided in Figure M-11 in section M.10. Submittal of this certification at "Develop Topographic Data" workflow step is required if this is the only task performed by the Mapping Partner. Mapping Partners that are contracted to perform multiple mapping tasks can submit one certification form to certify all the work performed. A PDF file of this form with the original signature, data, and seal affixed to the form must be submitted digitally in the general directory identified in section M.4.2.8. This form must be signed by a registered or certified professional from the firm contracted to perform the work, or by the responsible official of a government agency. A digital version of this form is available at www.fema.gov.

M.4.2.4 Acceptable File Formats

Terrain data used to perform the study must be submitted in a georeferenced, digital format as listed below. These data can be contained in a single file or in a tiled set of files. Any tiled data must have an accompanying index spatial file.

- Contours, Masspoints, and breaklines – Personal geodatabase, DXF, or shapefile
- DEMs – ESRI grid, GeoTIFF, or ASCII grid
- LiDAR – LAS file, ASCII x, y, z file
- Terrain – ESRI ArcGIS
- Word – project narrative
- PDF – correspondence and certification

PDF files must be created using the source file (e.g., Word file), if the source file is created by the Mapping Partner, rather than raster scans of hard copy text documents. PDF files created must allow copying of text and pasting to another document. In addition, ESRI shapefiles must include .PRJ files.

M.4.2.5 Metadata

A metadata file in XML format that complies with the NFIP Terrain Metadata Profiles (provided in Section M.14) must be included with the submittal. The profiles follow the FGDC Content Standard for metadata and define additional domains and business rules for some elements that are mandatory for FEMA, based on the specific submittal type. For each spatial data source in the metadata file, the Mapping Partner must assign a Source Citation Abbreviation.

If metadata is available from an agency or organization that provided data for use in the study, it should be included in the metadata submittal in addition to the NFIP Terrain Metadata Profiles. Reference the data providers' original metadata record in the Lineage section of the NFIP metadata profile. If there is a Web-accessible metadata record for the original data set, the URL to the metadata may be provided in the optional Source Citation - Online Linkage element. Otherwise, the Source Contribution [free text] element may include information on how to access the metadata record for the data sets obtained.

M.4.2.6 Transfer Media

Mapping Partners must submit files via the internet by uploading to the MIP (http://www.hazards.fema.gov) or by mailing the files to FEMA on one or more of the following electronic media:

- CD-ROM;
- DVD; or
- External Hard Drive (for very large data submissions with a return label for shipment back to the partner).

In special situations or as technology changes, other media may be acceptable if coordinated with FEMA.

When data is mailed to FEMA, all submitted digital media must be labeled with at least the following information:

- Mapping Partner's name;
- Community name and State for which the FIS was prepared;
- Terrain Data;
- Date of submission (formatted mm/dd/yyyy); and
- Disk [*sequential number*] of [*number of disks*]. The media must be numbered sequentially, starting at Disk 1. [Number of disks] represents the total number of disks in the submission.

M.4.2.7 Transfer Methodology

Terrain artifacts can be uploaded to the MIP by following the guidelines for Data Submission and Validation located on the MIP (https://hazards.fema.gov) under "User Guidance" in the "Guides & Documentation" tab of "MIP User Care".

M.4.2.8 Directory Structure and Folder Naming Conventions

The files presented in section M.4.2 Requirements must be submitted to the MIP or mailed to FEMA within the following directory structure. Data files must be organized under an applicable 8-digit Hydrologic Unit Code (HUC-8). The following folders can be created either on a local work space (i.e., a personal computer) or within the work space for the community on the MIP. If the following folders are generated locally, these newly created folders and their contents must be uploaded to the MIP. Terrain files are arranged into appropriate directories based on data type.

- \HUC-8\General
  - Project narrative
  - Certification
- \HUC-8\Correspondence
  - Letters; transmittals; memoranda; general status reports and queries; SPRs; technical issues; direction by FEMA; and internal communications, routing slips, and notes.
- \HUC-8\All_Returns
  - LIDAR data – All Returns
  - LIDAR Tile Index spatial file (if used)
- \HUC-8\Bare_Earth
  - LIDAR data – Bare Earth Points
  - LIDAR Tile Index spatial file (if used)
- \HUC-8\Breaklines
  - 3D breakline spatial files
  - 3D breakline Tile Index spatial file (if used)

  - 2D breakline spatial files
  - 2D breakline Tile Index spatial file (if used)
  - Mass Points
- \HUC-8\Contours
  - Contour spatial files
  - Contour Tile Index spatial file (if used)
  - Bathymetric files
  - Bathymetric Tile Index spatial file (if used)
- \HUC-8\DEM
  - Uncorrected DEM files
  - Tile Index spatial file (if used)
- \HUC-8\HDEM
  - Hydrologically correct DEM files
  - Tile Index spatial file (if used)
- \HUC-8\TIN
  - Uncorrected TIN files
  - Terrain (ESRI ArcGIS format)
  - Tile index spatial file (if used)
- \HUC-8\HTIN
  - Hydrologically corrected TIN files
  - Terrain (ESRI ArcGIS format)
  - Tile Index spatial file (if used)
- \HUC-8\Supplemental Data
  - As-built drawings
  - GIS representation of structures

U.S. Geological Survey
National Geospatial Program
Lidar Guidelines and Base Specification

Version 13 – ILMF 2010

The U.S. Geological Survey National Geospatial Program (NGP) has cooperated in the collection of numerous lidar datasets across the nation for a wide array of applications. These collections have used a variety of specifications and required a diverse set of products, resulting in many incompatible datasets and making cross-project analysis extremely difficult. The need for a single base specification, defining minimum collection parameters and a consistent set of deliverables, is apparent.

Beginning in late 2009, an increase in the rate of lidar data collection due to American Reinvestment and Recovery Act (ARRA) funding for The National Map makes it imperative that a single data specification be implemented to ensure consistency and improve data utility. Although the development of this specification was prompted by the ARRA stimulus funding, the specification is intended to remain durable beyond ARRA funded NGP projects.

The primary intent of this specification is to create consistency across all NGP funded lidar collections, in particular those undertaken in support of the National Elevation Dataset (NED). Unlike most other "lidar specs" which focus on the derived bare-earth DEM product, this specification places unprecedented emphasis on the handling of the source lidar point cloud data. This is to assure that the complete source dataset collected remains intact and viable to support the wide variety of non-DEM science and mapping applications that benefit from lidar technology. In the absence of other comprehensive specifications or standards, it is hoped that this specification will, to the highest degree practical, be adopted by other USGS programs and disciplines, and by other Federal agencies.

Adherence to these minimum specifications ensures that bare-earth Digital Elevation Models (DEMs) derived from lidar data is suitable for ingestion into the NED (National Elevation Dataset) at the 1/9 arc-second resolution, and can be resampled for use in the 1/3 and 1 arc-second NED resolutions. It also ensures that the point cloud source data are handled in a consistent manner by all data providers and delivered to the USGS in clearly defined formats. This allows straight-forward ingest into CLICK (Center for Lidar Information, Coordination, and Knowledge) and simplifies subsequent use of the source data by the broader scientific community, particularly with regard to cross-collection analysis.

It must be stressed that this is a **base specification,** defining <u>minimum parameters</u>. It is expected that local conditions in any given project area, specialized applications for the data, or the preferences of cooperators, may mandate more stringent requirements. The

USGS encourages the collection of more detailed, accurate, or value-added data. A list of common upgrades to the minimum requirements defined here is provided in Appendix 1.

In addition, it is recognized that the USGS NGP also employs lidar technology for specialized scientific research and other projects whose requirements are incompatible with the provisions of this Specification. In such cases, and with properly documented justification supporting the need for the variance, waivers of any part or all of this Specification may be granted.

It is conceivable that in some cases, based on specific topography, land cover, intended application, or other factors, the USGS-NGP may require specifications more rigorous than those defined in this document. It is expected that this would be highly uncommon.

Lidar is still a relatively new technology; adolescent but not fully matured.. Advancements and improvements in instrumentation, software, processes, applications, and understanding are constantly being made. It would not be possible to develop a set of guidelines and specifications that address all of these advances. The current document is based on our understanding of and experience with the industry and technology at the present time. Furthermore, we acknowledge that there is a lack of commonly accepted "best practices" for numerous processes and technical assessments (i.e., measurement of NPS, point clustering, classification accuracy, etc.). The USGS encourages the development of such best practices through the appropriate industry and professional governance organizations, and we eagerly await the opportunity to include them in future revisions to this and other similar documents.

It is not the intention of the USGS to stifle the development of the lidar industry, nor to discourage innovation within the technology. Technical alternatives to any part of this document may be submitted with any proposal and will be given due professional consideration.

I. COLLECTION

1. Multiple Discrete Return, capable of at least 3 returns per pulse

   Note: Full waveform collection is both acceptable and welcomed; however, waveform data is regarded as supplemental information. The requirement for deriving and delivering multiple discrete returns remains in force in all cases.

2. Intensity values for each return.

3. Nominal **Pulse** Spacing (NPS) of 1-2 meters, dependent on the local terrain and landcover conditions. Assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath. Average along-track and cross-track point spacings should be comparable.

4. Collections designed to achieve the NPS through swath overlap or multiple passes are generally discouraged. Such collections may be permitted with prior approval.

5. Data Voids [areas => $(4*NPS)^2$, measured using 1^{st}-returns only] within a single swath are not acceptable, except:

   - where caused by water bodies
   - where caused by areas of low near infra-red (NIR) reflectivity such as asphalt or composition roofing.
   - where appropriately filled-in by another swath

6. The spatial distribution of geometrically usable points is expected to be uniform and free from clustering. In order to ensure uniform densities throughout the data set:

   - A regular grid, with cell size equal to the design NPS*2 will be laid over the data.
   - At least 90% of the cells in the grid shall contain at least 1 lidar point.
   - Assessment to be made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.
   - Acceptable data voids identified previously in this specification are excluded.

   Note: This requirement may be relaxed in areas of significant relief where it is impractical to maintain a consistent NPS.

7. Scan Angle: Total FOV should not exceed 40^o (+/-20^o from nadir) USGS quality assurance on collections performed using scan angles wider than 34^o will be particularly rigorous in the edge-of-swath areas. Horizontal and vertical accuracy shall remain within the requirements as specified below.

   Note: This requirement is primarily applicable to oscillating mirror lidar systems. Other instrument technologies may be exempt from this requirement.

8. Vertical Accuracy of the lidar data will be assessed and reported in accordance with the guidelines developed by the NDEP and subsequently adopted by the ASPRS. The complete guidelines may be found in Section 1.5 of the Guidelines document. See:

   http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf

   Vertical accuracy requirements using the NDEP/ASPRS methodology are:

   FVA <= 24.5cm ACCz, 95% (12.5cm RMSEz)
   CVA <= 36.3cm, 95th Percentile
   SVA <= 36.3cm, 95th Percentile

   - Accuracy for the lidar point cloud data is to be reported independently from accuracies of derivative products (i.e., DEMs). Point cloud data accuracy is to be tested against a TIN constructed from bare-earth lidar points.
   - Each landcover type representing 10% or more of the total project area must be tested and reported as an SVA.
   - For SVAs, the value is provided as a target. It is understood that in areas of dense vegetation, swamps, or extremely difficult terrain, this value may be exceeded. Overall CVA requirements must be met in spite of "busts" in individual SVAs.

   Note: These requirements may be relaxed in cases:

   - *where there exists a demonstrable and substantial increase in cost to obtain this accuracy.*
   - *where an alternate specification is needed to conform to previously contracted phases of a single larger overall collection effort, i.e., multi-year statewide collections, etc.*
   - *where the USGS agrees that it is reasonable and in the best interest of all stakeholders to use an alternate specification.*

9. Relative accuracy <=7cm $RMSE_Z$ within individual swaths; <=10cm RMSEz within swath overlap (between adjacent swaths).

10. Flightline overlap 10% or greater, as required to ensure there are no data gaps between the usable portions of the swaths. Collections in high relief terrain are expected to require greater overlap. Any data with gaps between the geometrically usable portions of the swaths will be rejected.

11. Collection Area: Defined Project Area, buffered by a minimum of 100 meters.

12. Collection Conditions:

   - Atmospheric: Cloud and fog-free between the aircraft and ground
   - Ground:
     - Snow free. Very light, undrifted snow may be acceptable in special cases, with prior approval.

- No unusual flooding or inundation, except in cases where the goal of the collection is to map the inundation.

- Vegetation: Leaf-off is preferred, however:
  - As numerous factors will affect vegetative condition at the time of any collection, the USGS NGP only requires that penetration to the ground must be adequate to produce an accurate and reliable bare-earth surface suitable for incorporation into the 1/9 (3-meter) NED.
  - Collections for specific scientific research projects may be exempted from this requirement, with prior approval.

II. DATA PROCESSING and HANDLING

1. All processing should be carried out with the understanding that all point deliverables are required to be in fully compliant LAS format, v1.2 or v1.3. Data producers are encouraged to review the LAS specification in detail.
2. If full waveform data is collected, delivery of the waveform packets is required. LAS v1.3 deliverables with waveform data are to use external "auxiliary" files with the extension ".wdp" for the storage of waveform packet data. See the LAS v1.3 Specification for additional information.
3. GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse. Adjusted GPS Time is defined to be Standard (or satellite) GPS time minus $1*10^9$. See the LAS Specification for more detail.
4. Horizontal datum shall be referenced to the North American Datum of 1983/HARN adjustment. Vertical datum shall be referenced to the North American Vertical Datum of 1988 (NAVD 88). The most recent NGS-approved Geoid model shall be used to perform conversions from ellipsoidal heights to orthometric heights.
5. The USGS preferred Coordinate Reference System for the Conterminous United States (CONUS) is: UTM, NAD83, Meters. Each discrete project is to be processed using the predominant UTM zone for the overall collection area.

   State Plane Coordinate Reference Systems that have been accepted by the European Petroleum Survey Group (EPSG) and that are recognized by ESRI GIS software may be used by prior agreement with the USGS.

   Alternative projected coordinate systems for collections in Alaska, Hawaii, and other areas Outside the Conterminous United States (OCONUS) must be approved by the USGS prior to collection.
6. All references to the Unit of Measure "Feet" or "Foot" must specify either "International" or "U.S. Survey"
7. Long swaths (those which result in a LAS file larger than 2GB) should be split into segments no greater than 2GB each. Each segment will thenceforth be

regarded as a unique swath and shall be assigned a unique File Source ID. Other swath segmentation approaches may be acceptable, with prior approval. Renaming schemes for split swaths are at the discretion of the data producer. The Processing Report shall include detailed information on swath segmentation sufficient to allow reconstruction of the original swaths if needed.

8. Each swath shall be assigned a unique File Source ID. The Point Source ID field for each point within each LAS swath file shall be set equal to the File Source ID prior to any processing of the data. See the LAS Specification.
9. Point Families (multiple return "children" of a single "parent" pulse) shall be maintained intact through all processing prior to tiling. Multiple returns from a given pulse shall be stored in sequential (collected) order.
10. All collected swaths are to be delivered as part of the "Raw Data Deliverable". This includes calibration swaths and cross-ties. All collected points are to be delivered. No points are to be deleted from the swath LAS files. This in no way requires or implies that calibration swath data are to be included in product generation. Excepted from this are extraneous data outside of the buffered project area (aircraft turns, transit between the collection area and airport, transit between fill-in areas, etc.). These points may be permanently removed.
11. Outliers, blunders, noise points, geometrically unreliable points near the extreme edge of the swath, and other points deemed unusable are to be identified using the "Withheld" flag, as defined in the LAS specification.
    - This applies primarily to points which are identified during pre-processing or through automated post-processing routines.
    - If processing software is not capable of populating the "Withheld" bit, these points may be identified using Class=11.
    - "Noise points" subsequently identified during manual Classification and Quality Assurance/Quality Control (QA/QC) may be assigned the standard LAS classification value for "Noise" (Class=7), regardless of whether the noise is "low" or "high" relative to the ground surface.
12. The ASPRS/LAS "Overlap" classification (Class=12) shall not be used. ALL points not identified as "Withheld" are to be classified.
    - If overlap points are required to be differentiated by the data producer or cooperating partner, they must be identified using a method that does not interfere with their classification, such as:
        - Overlap points are tagged using Bit:0 of the User Data byte, as defined in the LAS specification. (SET=Overlap).
        - Overlap points are classified using the Standard Class values + 16.
        - Other techniques as agreed upon in advance
    - The technique utilized must be clearly described in the project metadata files.

Note: A standard bit setting for identification of overlap points has been planned for a future version of LAS.

13. Positional Accuracy Validation: The absolute and relative accuracy of the data, both horizontal and vertical, and relative to known control, shall be verified <u>prior</u> to classification and subsequent product development. This validation is obviously limited to the Fundamental Vertical Accuracy, measured in clear, open areas. A detailed report of this validation is a required deliverable.

14. Classification Accuracy: It is expected that due diligence in the classification process will produce data that meets the following test:

    Within any 1km x 1km area, no more than 2% of non-withheld points will possess a demonstrably erroneous classification value.

    This includes points in Classes 0 and 1 that should correctly be included in a different Class as required by the contract.

    Note: This requirement may be relaxed to accommodate collections in areas where the USGS agrees classification to be particularly difficult.

15. Classification Consistency: Point classification is to be consistent across the entire project. Noticeable variations in the character, texture, or quality of the classification between tiles, swaths, lifts, or other non-natural divisions will be cause for rejection of the entire deliverable.

16. Tiles:

    Note: This section assumes a projected coordinate reference system.

    - A single non-overlapped tiling scheme will be established and agreed upon by the data producer and the USGS prior to collection. This scheme will be used for **all** tiled deliverables.
    - Tile size must be an integer multiple of the cell size of raster deliverables.
    - Tiles must be sized using the same units as the coordinate system of the data.
    - Tiled deliverables shall conform to the tiling scheme, without added overlap.
    - Tiled deliverables shall edge-match seamlessly and without gaps in both the horizontal and vertical.

III. HYDRO-FLATTENING REQUIREMENTS

Note: Please refer to Appendix 2 for reference information on hydro-flattening.

Hydro-flattening pertains only to the creation of derived DEMs. No manipulation of or changes to originally computed lidar point elevations are to be made. Breaklines may be used to help classify the point data.

1. Inland Ponds and Lakes:
   - ~2-acre or greater surface area (~350' diameter for a round pond) at the time of collection.
   - Flat and level water bodies (single elevation for every bank vertex defining a given water body).
   - The entire water surface edge must be at or below the immediately surrounding terrain.
   - Long impoundments such as reservoirs, inlets, and fjords, whose water surface elevations drop when moving downstream, should be treated as rivers.
2. Inland Streams and Rivers:
   - 100' **nominal** width: This should not unnecessarily break a stream or river into multiple segments. At times it may squeeze slightly below 100' for short segments. Data producers should use their best professional judgment.
   - Flat and level bank-to-bank (perpendicular to the apparent flow centerline); gradient to follow the immediately surrounding terrain.
   - The entire water surface edge must be at or below the immediately surrounding terrain.
   - Streams channels should break at road crossings (culvert locations). These road fills should not be removed from DEM. However, streams and rivers should **not** break at elevated bridges. Bridges should be removed from DEM. When the identification of a feature as a bridge or culvert cannot be made reliably, the feature should be regarded as a culvert.
3. Non-Tidal Boundary Waters:
   - Represented only as an edge or edges within the project area; collection does not include the opposing shore.
   - The entire water surface edge must be at or below the immediately surrounding terrain.
   - The elevation along the edge or edges should behave consistently throughout the project. May be a single elevation (i.e., lake) or gradient (i.e., river), as appropriate.

4. Tidal Waters:

   - Water bodies such as oceans, seas, gulfs, bays, inlets, salt marshes, very large lakes, etc. Includes any water body that is affected by tidal variations.
   - Tidal variations over the course of a collection or between different collections, will result in discontinuities along shorelines. This is considered normal and these "anomalies" should be retained. The final DEM should represent as much ground as the collected data permits.
   - Variations in water surface elevation resulting in tidal variations during a collection should NOT be removed or adjusted, as this would require either the removal of valid, measured ground points or the introduction of unmeasured ground into the DEM. The USGS NGP priority is on the ground surface, and accepts there may be occasional, unavoidable irregularities in water surface.
   - Scientific research projects in coastal areas often have very specific requirements with regard to how tidal land-water boundaries are to be handled. For such projects, the requirements of the research will take precedence.

Cooperating partners may require collection and integration of single-line streams within their lidar projects. While the USGS does not require these breaklines be collected or integrated, it does require that if used and incorporated into the DEMs, the following guidelines are met:

1. All vertices along single-line stream breaklines are at or below the immediately surrounding terrain.
2. Single-line stream breaklines are not to be used to introduce cuts into the DEM at road crossings (culverts), dams, or other such features. This is hydro-enforcement and as discussed in Section VI, creates a non-traditional DEM that is not suitable for integration into the NED.
3. All breaklines used to modify the surface are to be delivered to the USGS with the DEMs.

The USGS does not require any particular process or methodology be used for breakline collection, extraction, or integration. However, the following general guidelines must be adhered to:

1. Bare-earth lidar points that are in close proximity breaklines should be excluded from the DEM generation process. This is analogous to the removal of masspoints for the same reason in a traditional photogrammetrically compiled DTM.

   The proximity threshold for reclassification as "Ignored Ground" is at the discretion of the data producer, but in general should be approximately equal to the NPS.

2. These points are to be retained in the delivered lidar point dataset and shall be reclassified as “Ignored Ground” (class value = 10) so that they may be subsequently identified.

3. Delivered data must be sufficient for the USGS to effectively recreate the delivered DEMs using the lidar points and breaklines without significant further editing.

IV. DELIVERABLES

The USGS shall have unrestricted rights to all delivered data and reports, which will be placed in the public domain. This specification places no restrictions on the data provider's rights to resell data or derivative products as they see fit.

1. Metadata

Note: “Metadata” refers to all descriptive information about the project. This includes textual reports, graphics, supporting shapefiles, and FGDC-compliant metadata files.

- Collection Report detailing mission planning and flight logs.
- Survey Report detailing the collection of control and reference points used for calibration and QA/QC.
- Processing Report detailing calibration, classification, and product generation procedures including methodology used for breakline collection and hydro-flattening *(see Sections III and Appendix 1 for more information on hydro-flattening).*
- QA/QC Reports (detailing the analysis, accuracy assessment and validation of:
    - The point data (absolute, within swath, and between swath)
    - The bare-earth surface (absolute)
    - Other optional deliverables as appropriate
- Control and Calibration points: All control and reference points used to calibrate, control, process, and validate the lidar point data or any derivative products are to be delivered.
- Geo-referenced, digital spatial representation of the precise extents of each delivered dataset. This should reflect the extents of the actual lidar source or derived product data, exclusive of Triangular Irregular Network (TIN) artifacts or raster NODATA areas. A union of tile boundaries or minimum bounding rectangle is not acceptable. ESRI Polygon shapefile or geodatabase is preferred.
- Product metadata (FGDC compliant, XML format metadata). One file for each:

    - Project
    - Lift
    - Tiled deliverable product group (classified point data, bare-earth DEMs, breaklines, etc.). Metadata files for individual tiles are not required.
- FGDC compliant metadata must pass the USGS metadata parser (“mp”) with no errors or warnings.

2. Raw Point Cloud

- All returns, all collected points, fully calibrated and adjusted to ground, by swath.
- Fully compliant LAS v1.2 or v1.3, Point Record Format 1, 3, 4, or 5
- LAS v1.3 deliverables with waveform data are to use external “auxiliary” files with the extension “.wdp” for the storage of waveform packet data. See the LAS v1.3 Specification for additional information.
- Georeference information included in all LAS file headers
- GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse.
- Intensity values (native radiometric resolution)
- 1 file per swath, 1 swath per file, file size not to exceed 2GB, as described in Section II, Paragraph 7.

3. Classified Point Cloud

Note: Delivery of a classified point cloud is a standard requirement for USGS NGP lidar projects. Specific scientific research projects may be exempted from this requirement.

- Fully compliant LAS v1.2 or v1.3, Point Record Format 1, 3, 4, or 5
- LAS v1.3 deliverables with waveform data are to use external “auxiliary” files with the extension “.wdp” for the storage of waveform packet data. See the LAS v1.3 Specification for additional information.
- Georeference information included in LAS header
- GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse.
- Intensity values (native radiometric resolution)
- Tiled delivery, without overlap (tiling scheme TBD)

- Classification Scheme (minimum):

Code	Description
1	Processed, but unclassified
2	Bare-earth ground
7	Noise (low or high, manually identified, if needed)
9	Water
10	Ignored Ground (Breakline Proximity)
11	Withheld (if the "Withheld" bit is not implemented in processing software)

Note: Class 7, Noise, is included as an adjunct to the "Withheld" bit. All "noise points" are to be identified using one of these to methods.

Note: Class 10, Ignored Ground, is for points previously classified as bare-earth but whose proximity to a subsequently added breakline requires that it be excluded during Digital Elevation Model (DEM) generation.

4. **Bare Earth Surface (Raster DEM)**

Note: Delivery of a bare-earth DEM is a standard requirement for USGS NGP lidar projects. Specific scientific research projects may be exempted from this requirement.

- Cell Size no greater than 3 meters or 10 feet, and no less than the design Nominal Pulse Spacing (NPS).
- Delivery in an industry-standard, GIS-compatible, 32-bit floating point raster format (ERDAS .IMG preferred)
- Georeference information shall be included in each raster file
- Tiled delivery, without overlap
- DEM tiles will show no edge artifacts or mismatch. A quilted appearance in the overall project DEM surface, whether caused by differences in processing quality or character between tiles, swaths, lifts, or other non-natural divisions, will be cause for rejection of the entire DEM deliverable.
- Void areas (i.e., areas outside the project boundary but within the tiling scheme) shall be coded using a unique "NODATA" value. This value shall be identified in the appropriate location within the file header.
- Vertical Accuracy of the bare earth surface will be assessed and reported in accordance with the guidelines developed by the NDEP and subsequently adopted by the ASPRS. The complete guidelines may be found in Section 1.5 of the Guidelines document. See:

  http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf

Vertical accuracy requirements using the NDEP/ASPRS methodology are:
FVA <= 24.5cm ACCz, 95% (12.5cm RMSEz)
CVA <= 36.3cm, 95th Percentile
SVA <= 36.3cm, 95th Percentile

All QA/QC analysis materials and results are to be delivered to the USGS.

- Depressions (sinks), natural or man-made, are **not** to be filled (as in hydro-conditioning and hydro-enforcement).
- Water Bodies (ponds and lakes), wide streams and rivers ("double-line"), and other non-tidal water bodies as defined in Section III are to be hydro-flattened within the DEM. Hydro-flattening shall be applied to all water impoundments, natural or man-made, that are larger than ~2 acre in area (equivalent to a round pond ~350' in diameter), to all streams that are nominally wider than 100', and to all non-tidal boundary waters bordering the project area regardless of size. The methodology used for hydro-flattening is at the discretion of the data producer.

  Note: Please refer to the Sections III and VI for detailed discussions of hydro-flattening.

5. **Breaklines**

Note: Delivery of the breaklines used in hydro-flattening is a standard requirement for USGS NGP lidar projects. Specific scientific research projects may be exempted from this requirement. If hydro-flattening is achieved through other means, this section may not apply.

- All breaklines developed for use in hydro-flattening shall be delivered as an ESRI feature class (PolylineZ or PolygonZ format, as appropriate to the type of feature represented and the methodology used by the data producer). Shapefile or geodatabase is preferred.
- Each feature class or shapefile will include properly formatted and accurate georeference information in the standard location. All shapefiles must include the companion .prj file.
- Breaklines must use the same coordinate reference system (horizontal and vertical) and units as the lidar point delivery.
- Breakline delivery may be as a continuous layer or in tiles, at the discretion of the data producer. Tiled deliveries must edge-match seamlessly in both the horizontal and vertical.

APPENDIX 1

COMMON DATA UPGRADES

1. Independent 3rd-Party QA/QC by another AE Contractor (encouraged)
2. Higher Nominal Pulse Spacing (point density)
3. Increased Vertical Accuracy
4. Full Waveform collection and delivery
5. Additional Environmental Constraints
   - Tidal coordination, flood stages, crop/plant growth cycles, etc.
   - Shorelines corrected for tidal variations within a collection
6. Top-of Canopy (First-Return) Raster Surface (tiled). Raster representing the highest return within each cell is preferred.
7. Intensity Images (8-bit gray scale, tiled)
8. Detailed Classification (additional classes):

Code	Description
3	Low vegetation
4	Medium vegetation (use for single vegetation class)
5	High vegetation
6	Buildings, bridges, other man-made structures
n	additional Class(es) as agreed upon in advance

9. Hydro-Enforced and/or Hydro-Conditioned DEMs
10. Breaklines (PolylineZ and PolygonZ) for single-line hydrographic features (narrow streams not collected as double-line, culverts, etc.), including appropriate integration into delivered DEMs
11. Breaklines (PolylineZ and PolygonZ) for other features (TBD), including appropriate integration into delivered DEMs
12. Extracted Buildings (PolygonZ): Footprints with maximum elevation and/or height above ground as an attribute.
13. Other products as defined by requirements and agreed upon in advance of funding commitment.

APPENDIX 2

HYDRO-FLATTENING REFERENCE

The subject of modifications to lidar-based DEMs is somewhat new, and although authoritative references are available, there remains significant variation in the understanding of the topic across the industry. The following material was developed to provide a definitive reference on the subject only as it relates to the creation of DEMs intended to be integrated into the USGS NED. The information presented here is not meant to supplant other reference materials and it should not be considered authoritative beyond its intended scope.

The term "**hydro-flattening**" is also new, coined for this document and to convey our specific needs. It is not, at this time, a known or accepted term across the industry. It is our hope that its use and acceptance will expand beyond the USGS with the assistance of other industry leaders.

Hydro-flattening of DEMs is predominantly accomplished through the use of breaklines, and this method is considered standard. Although other techniques may exist to achieve similar results, this section assumes the use of breaklines. The USGS does not require the use of any specific technique.

The Digital Elevation Model Technologies and Applications: The DEM Users Manual, 2nd Edition (Maune *et al.*, 2007) provides the following definitions related to the adjustment of DEM surfaces for hydrologic analyses:

1. **Hydrologically-Conditioned (Hydro-Conditioned)** – Processing of a DEM or TIN so that the flow of water is continuous across the entire terrain surface, including the removal of all spurious sinks or pits. The only sinks that are retained are the real ones on the landscape. Whereas "hydrologically-enforced" is relevant to drainage features that are generally mapped, "hydrologically-conditioned" is relevant to the entire land surface and is done so that water flow is continuous across the surface, whether that flow is in a stream channel or not. The purpose for continuous flow is so that relationships/links among basins/catchments can be known for large areas. This term is specifically used when describing EDNA (see Chapter 4), the dataset of NED derivatives made specifically for hydrologic modeling purposes.

2. **Hydrologically-Enforced (Hydro-Enforced)** – Processing of mapped water bodies so that lakes and reservoirs are level and so that streams flow downhill. For example, a DEM, TIN or topographic contour dataset with elevations removed from the tops of selected drainage structures (bridges and culverts) so as to depict the terrain under those structures. Hydro-enforcement enables hydrologic and hydraulic models to depict water flowing under these structures, rather than appearing in the computer model to be dammed by them because of road deck elevations higher than the water levels. Hydro-enforced TINs also utilize breaklines along shorelines and stream centerlines, for example, where these breaklines form the edges of TIN triangles along the alignment of drainage features. Shore breaklines for streams would be 3-D breaklines

with elevations that decrease as the stream flows downstream; however, shore breaklines for lakes or reservoirs would have the same elevation for the entire shoreline if the water surface is known or assumed to be level throughout. See figures 1.21 through 1.24. See also the definition for "hydrologically-conditioned" which has a slightly different meaning.

While these are important and useful modifications, they both result in surfaces that differ significantly from a traditional DEM. A "hydro-conditioned" surface has had its sinks filled and may have had its water bodies flattened. This is necessary for correct flow modeling within and across large drainage basins. "Hydro-enforcement" extends this conditioning by requiring water bodies be leveled and streams flattened with the appropriate downhill gradient, and also by cutting through road crossings over streams (culvert locations) to allow a continuous flow path for water within the drainage. Both treatments result in a surface on which water behaves as it physically does in the real world, and both are invaluable for specific types of hydraulic and hydrologic (H&H) modeling activities. Neither of these treatments is typical of a traditional DEM surface.

A traditional DEM such as the NED, on the other hand, attempts to represent the ground surface more the way a bird, or person in an airplane, sees it. On this surface, natural depressions exist, and road fills create apparent sinks because the road fill and surface is depicted without regard to the culvert beneath. Bridges, it should be noted, are removed in most all types of DEMs because they are man-made, above-ground structures that have been added to the landscape.

Note: DEMs developed solely for orthophoto production may include bridges, as their presence can prevent the "smearing" of structures and reduce the amount of post-production correction of the final orthophoto. These are "special use DEMs" and are not relevant to this discussion.

For years, raster Digital Elevation Models (DEMs), have been created from a Digital Surface Model (DSM) of masspoints and breaklines, which in turn were created through photogrammetric compilation from stereo imagery. Photogrammetric DSMs inherently contain breaklines defining the edges of water bodies, coastlines, single-line streams, and double-line streams and rivers, as well as numerous other surface features.

Lidar technology, however, does not inherently collect the breaklines necessary to produce traditional DEMs. Breaklines have to be developed separately through a variety of techniques, and either used with the lidar points in the generation of the DEM, or applied as a correction to DEMs generated without breaklines.

In order to maintain the consistent character of the NED as a traditional DEM, the USGS NGP requires that all DEMs delivered have their inland water bodies flattened. This does not imply that a complete network of topologically correct hydrologic breaklines be developed for every dataset; only those breaklines necessary to ensure that the conditions defined in Section III exist in the final DEM.

APPENDIX 3

SAMPLE METADATA TEMPLATE

[to be added]

APPENDIX 4

REFERENCES

Maune, D.F., 2007. Definitions, in *Digital Elevation Model Technologies and Applications: The DEM Users Manual, 2nd Edition* (D.F. Maune, editor), American Society for Photogrammetry and Remote Sensing, Bethesda, MD pp. 550-551

National Digital Elevation Program, 2004. *Guidelines for Digital Elevation Data—Version 1*, 93 p., available online at: http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf (last date accessed: 29 September 2009)

FEMA, 2003. *Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix A: Guidance for Aerial Mapping and Surveying*, 59 p., available online at: http://www.fema.gov/library/viewRecord.do?id=2206 (last date accessed 29 September 2009)

USGS NED Website:	www.ned.usgs.gov
USGS CLICK Website:	www. lidar.cr.usgs.gov
MP-Metadata Parser:	http://geology.usgs.gov/tools/metadata