FUGRO EARTHDATA, INC.

Collection Report – USGS Lidar Acquisition

Upper Delta Plain, LA Lidar

Prepared for:

United States Geological Survey
1400 Independence Road
Rolla, MO 65401
(573) 308-3810

May 3, 2017

USGS Contract: G11PC00014
USGS Task Order: G15PD00936
Fugro was tasked with planning, acquiring, processing, and producing derivative products of lidar data collected at an aggregate nominal pulse spacing (ANPS) of 0.7 meters (2ppsm), including overlap, for an Area of Interest (AOI) defined as the Upper Delta Plain in the south eastern portion of Louisiana. The AOI covers approximately 3,805 square miles. A 100-meter buffer was added to the AOI covering approximately 3,843 square miles; all products will be generated to the limit of this buffered boundary.

Lidar data, and derivative products produced in compliance with the task order will be based on the “U.S. Geological Survey National Geospatial Program Lidar Base Specification Version 1.2”. In addition to the Specification Requirements, the task order will meet NEEA QL2.

Acquisition occurred during the acceptable collection windows that existed between January 23 and March 20, 2017; with a re-flight occurring on April 24, 2017.
Collections: 32
Collection Dates: January 23rd – March 20th, 2017; April 24th, 2017
Field of View (FOV): 60 degrees
Average Point Density (planned): 2 ppsm
Flight Level(s) AMT: 3281 ft, 4400 ft
Sensor Type(s): Riegl LMS-Q680i, Riegl LMS-Q780
Sensor Serial Number(s): 165, 961, 216

Figure 2: Executed Collection Footprints

All acquired lidar data was QC’d and accepted for processing.

Below are the acquisition logs and GPS plots from all collections covering the Upper Delta Plain, LA lidar buffered boundary.
## Acquisition and Processing details ----- Collection 1 (January 23, 2017)

### Log:

<table>
<thead>
<tr>
<th>Time</th>
<th>Comments and Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:56</td>
<td>Ground static at K-HUM</td>
</tr>
<tr>
<td>18:29</td>
<td>overfly ENGE cars</td>
</tr>
<tr>
<td>18:41</td>
<td>are acquisition s turn</td>
</tr>
<tr>
<td>15:58</td>
<td>Ground static at K-HUM</td>
</tr>
<tr>
<td>16:50</td>
<td>overfly ENGE cars</td>
</tr>
<tr>
<td>16:34</td>
<td></td>
</tr>
<tr>
<td>18:41</td>
<td></td>
</tr>
</tbody>
</table>

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**Flight Log**

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<tr>
<th>Flight #</th>
<th>Flight ID</th>
<th>Aircraft</th>
<th>altitude (ft)</th>
<th>Speed (mph)</th>
<th>Scan Rate (Hz)</th>
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<tbody>
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<th>Stop Time (UTC)</th>
<th>GPS Receiver</th>
<th>Operator</th>
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Trajectory and GPS Plots:

Estimated Accuracy

[Graph showing estimated accuracy over time]
Combined RMS

SVs
# Acquisition and Processing details ----- Collection 2 (January 26, 2017)

Log:

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<th>Airline</th>
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<th>Comments and Conditions</th>
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Trajectory and GPS Plots:

Estimated Accuracy
Quality Factor

Height
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Acquisition and Processing details ----- Collection 3 (January 26, 2017)

Log:

<table>
<thead>
<tr>
<th>Flight Log</th>
<th>Operator #1</th>
<th>Operator #2</th>
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<tbody>
<tr>
<td>Base ID: 016</td>
<td>Location: KIUM</td>
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<td>Flight #: 1</td>
<td>Weather: 0</td>
<td>Ant: ARI: 1.8</td>
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<tr>
<td>Flight Time (UTC): 18.31:00</td>
<td>Distance: 13.49:00</td>
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<td>Comments and Conditions:</td>
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Trajectory and GPS Plots:

Estimated Accuracy
Quality Factor

Height
Acquisition and Processing details ----- Collection 4 (January 27, 2017)

Log:

<table>
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<th>Flight Log</th>
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<th>GPS Info</th>
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<tbody>
<tr>
<td>Randy Green</td>
<td>Chris Fought</td>
<td>gps on pos never goes green</td>
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<table>
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<th>Stop Time (UTC)</th>
<th>GPS Hr</th>
<th>Operator</th>
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<tbody>
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</table>
Trajectory and GPS Plots:

Estimated Accuracy
Acquisition and Processing details ----- Collection 5 (January 27, 2017)

Log:

<table>
<thead>
<tr>
<th>Time</th>
<th>Flight</th>
<th>Altitude</th>
<th>Speed</th>
<th>Trim</th>
<th>Trim Std KU</th>
<th>WIND</th>
<th>Comments and Conditions</th>
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<tbody>
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Estimated Accuracy
### Acquisition and Processing details ----- Collection 6 (January 27, 2017)

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Estimated Accuracy
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Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Acquisition and Processing details ----- Collection 8 (January 28, 2017)

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Trajectory and GPS Plots:

Estimated Accuracy
Quality Factor

![Quality Factor Graph]

Height

![Height Graph]
Acquisition and Processing details ----- Collection 10 (January 30, 2017)

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Combined RMS

SVs
### Acquisition and Processing details ---- Collection 11 (January 31, 2017)

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| x-86 |          |        |        |           |                  |                |         |     |      |                        |

**Launch:**
- Site: KHUM
- Lift: 15-10, 15-40
- Hub: 274.2, 274.2

**Flight Details:**
- Flight Duration: 1.20, 1.20
- Height: 157.0, 157.0
- Activity: 2.0, 2.0

**Data Logger Details:**
- Data Logger Name: RIEGL FLIGHT LOG
- Data Logger ID: AO29-50-00-07
Trajectory and GPS Plots:

Estimated Accuracy
Acquisition and Processing details ----- Collection 12 (February 15, 2017)

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Richard Webb: Fugro Geospatial, Inc.
Ryan Farwold: Riley Forestry

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Comments and Conditions:
- Ground static at KOHUM
- Unreadable data
- Calibration line
- Cross line
- Post acquisition 1 trim
- Ground static at KOHUM
Trajectory and GPS Plots:

Estimated Accuracy
Quality Factor

![Quality Factor Graph]

Height

![Height Graph]
**PDOP**

[Graph showing PDOP over time with different colored lines indicating PDOP, HDOP, and VDOP.

**Distance from Base**

[Graph showing distance from base over time with a single red line indicating distance.

GPS Time (TOW, GMT zone)

- PDOP
- HDOP
- VDOP

Distance (km)

GPS Time (TOW, GMT zone)

- Distance
Acquisition and Processing details ----- Collection 13 (February 15, 2017)

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**Notes:**
- **Airfield:** KLUH
- **Flight Log:** AO60-50-04-07
- **Local Time:** 09:26
- **Start (UTC):** 06:31:00
- **End (UTC):** 05:47:00
- **Comments and Conditions:**
  - Ground static at KLUH
  - Pre acquisition turn
  - Calibration line
  - Line aborted, restart
  - Cross line
- **Additional Observations:**
  - 14:40: Goto static at KLUH
  - 129: Cross line
Trajectory and GPS Plots:

Estimated Accuracy
## Acquisition and Processing details ----- Collection 14 (February 22, 2017)

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Trajectory and GPS Plots:

Estimated Accuracy
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Comments and Conditions:

- Ground static at KSTR
- Pre acquisition & turn
- Cross tie line
- Calibration line
- Post acquisition & turn
- Ground static at KHUM

Data:

- Operator: Riley Forsyth
- UAV: Fugro Geospatial, Inc.
- Client: KBR
- Area: G3-5
- Registration ID: G3-5
- Log ID: KHUM
- Flight Log: 100
- Flight Log Date: 20-02-17
- Flight Log Time: 17:03:00
- Flight Log Duration: 02:30:00
- Flight Log Comments: Ground static at KSTR, Pre acquisition & turn, Cross tie line, Calibration line, Post acquisition & turn, Ground static at KHUM
Trajectory and GPS Plots:

Estimated Accuracy
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Acquisition and Processing details ----- Collection 16 (February 25, 2017)

Log:
Trajectory and GPS Plots:

Estimated Accuracy
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
PDOP

Distance from Base
Acquisition and Processing details ----- Collection 17 (March 2, 2017)

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Comments and Conditions:
- were stationary at KSUM
- were acquisition end
- were acquisition start
- were acquisition end
Trajectory and GPS Plots:

Estimated Accuracy
Acquisition and Processing details ----- Collection 18 (March 2, 2017)

Log:

![Log](image-url)
Trajectory and GPS Plots:

Estimated Accuracy
Acquisition and Processing details ----- Collection 19 (March 3, 2017)

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Log:
Trajectory and GPS Plots:

Estimated Accuracy
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
PDOP

GPS Time (TOW, GMT zone)
- PDOP
- HDOP
- VDOP

Distance from Base

GPS Time (TOW, GMT zone)
- Distance
Combined RMS

SVs
## Acquisition and Processing details ----- Collection 20 (March 3, 2017)

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### Flight Log

| Flight Date | OPS Day | OPS | OPS | Airport ID | Aircraft | Airspeed | Altitude | Speed | Scan Rate | Yaw | Pitch | Roll | Height | Heading | Heading | Velocity | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading |Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | Heading | 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Trajectory and GPS Plots:

Estimated Accuracy
Acquisition and Processing details ----- Collection 21 (March 3, 2017)

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Trajectory and GPS Plots:

Estimated Accuracy
Combined RMS

SVs
# Acquisition and Processing details ---- Collection 22 (March 3, 2017)

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<th>m/s</th>
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**Flight Log**

**AO60-50-00-02**

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**Comments and Conditions**

- Ground static at KHIUM
- Check tire
- Calibration
- Pool acquisition & turn
- Ground static at KHIUM
Trajectory and GPS Plots:

[Graph showing trajectory and GPS plots]

Estimated Accuracy

[Graph showing estimated accuracy with labels for East, North, Height, and Trace]
Quality Factor

Height
Acquisition and Processing details ----- Collection 23 (March 14, 2017)

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Trajectory and GPS Plots:

Estimated Accuracy
## Acquisition and Processing details ----- Collection 24 (March 14, 2017)

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### Comments and Conditions:
- GROUND-STATIC @ KHUM
- Pre Start
- 15

---

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| 1        | 15004000 | KHUM | 17-070 | 17-370 | 17:37:00 | 17:37:09 | GROUND-STATIC @ KHUM | 15
|          |      |    |              |     | Pre Start               |
| 2        | 30   | 70 | 17.4, 41.5   | 6   | 18:19:02               | 16:24:59    | 320            |
|          |      |    |              |     | 130, 100.00            | A-Line      | 17
| 3        | 49   | 1  | 28.8, 31.4   | 6   | 19:31:48               | 16:36:25    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 18
| 4        | 30   | 9  | 29.4, 39.4   | 6   | 19:41:32               | 16:50:44    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 5        | 1    | 30 | 10.0, 39.0   | 6   | 18:52:19               | 16:19:29    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 6        | 1    | 30 | 10.0, 39.0   | 6   | 19:03:30               | 16:19:30    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 7        | 54   | 1  | 31.9, 16.1   | 6   | 19:16:10               | 16:24:58    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 8        | 1    | 32 | 25.5, 17.5   | 6   | 19:27:15               | 16:37:25    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 9        | 58   | 1  | 34.3, 19.4   | 6   | 19:40:17               | 16:49:23    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 10       | 50   | 9  | 25.5, 17.5   | 6   | 19:51:47               | 16:51:42    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 11       | 58   | 1  | 34.3, 19.4   | 6   | 20:04:37               | 16:33:30    | 320            |
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| 12       | 50   | 9  | 25.5, 17.5   | 6   | 20:16:00               | 16:25:11    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 13       | 30   | 1  | 24.3, 20.3   | 6   | 20:20:31               | 16:37:43    | 320            |
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| 14       | 21   | 9  | 10.5, 15.0   | 6   | 20:43:38               | 16:48:44    | 320            |
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| 15       | 31   | 18 | 12.0, 25.5   | 6   | 20:51:10               | 16:52:55    | 320            |
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| 16       | 30   | 1  | 17.4, 26.7   | 6   | 21:02:49               | 16:37:48    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 17       | 1    | 29 | 10.5, 15.0   | 6   | 21:05:32               | 16:10:26    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17
| 18       | 31   | 18 | 12.0, 25.5   | 6   | 21:12:32               | 16:17:18    | 320            |
|          |      |    |              |     | 130, 100.00            |             | 17

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### Flight Details:
- **Date:** March 14, 2017
- **Aircraft:** Riegl
- **Flight Duration:** 3 hours 37 minutes
- **Activity:** Acquisition and Processing
Trajectory and GPS Plots:

Estimated Accuracy
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
### Acquisition and Processing details ----- Collection 25 (March 14, 2017)

#### Log:

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#### Flight Log

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#### Flight Data

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**Notes:**
- Base 1 ID: 016
- Location: KHUM
- Res ID: GR2-3
- Act ID: C32-5
- Amp(ir): 1.8
- Start Time (UTC): 14-Mar-17 18:00
- Stop Time (UTC): 15-Mar-17 01:45
- Operator: Chris Fought
- Date: With AB

**Flight Log Details:**
- Flight # 11: Wet = 30, Distance = 17.4, UTC = 22.37,00, Altitude (GPD) = 22.42,00, Comments and Conditions = GROUND-STATIC @ KHUM
- Flight # 10: Wet = 21, Distance = 20.4, UTC = 23.09,00, Altitude (GPD) = 25.12,00, Comments and Conditions = Reel Ftsum
- Flight # 9: Wet = 22, Distance = 15.8, UTC = 23.21,00, Altitude (GPD) = 23.19,04, Comments and Conditions =
- Flight # 8: Wet = 23, Distance = 15.2, UTC = 23.32,00, Altitude (GPD) = 23.34,18, Comments and Conditions =
- Flight # 7: Wet = 25, Distance = 20, UTC = 23.46,00, Altitude (GPD) = 23.50,36, Comments and Conditions =
- Flight # 6: Wet = 21, Distance = 26, UTC = 23.51,00, Altitude (GPD) = 23.58,51, Comments and Conditions =
- Flight # 5: Wet = 27, Distance = 21.6, UTC = 23.51,00, Altitude (GPD) = 23.58,51, Comments and Conditions =
- Flight # 4: Wet = 22, Distance = 16, UTC = 23.10,00, Altitude (GPD) = 23.16,08, Comments and Conditions =
- Flight # 3: Wet = 42, Distance = 30.7, UTC = 23.20,11, Altitude (GPD) = 23.28,51, Comments and Conditions =
- Flight # 2: Wet = 31, Distance = 31.3, UTC = 23.33,30, Altitude (GPD) = 23.39,29, Comments and Conditions =
- Flight # 1: Wet = 53, Distance = 31.3, UTC = 23.45,35, Altitude (GPD) = 23.50,37, Comments and Conditions =
- Flight # 12: Wet = 43, Distance = 31.3, UTC = 23.22,19, Altitude (GPD) = 23.28,45, Comments and Conditions =
- Flight # Up DeltaX: Wet = 53, Distance = 17.4, UTC = 23.66,60, Comments and Conditions =
- Flight # 1: Wet = 33, Distance = 17.4, UTC = 23.41,00, Comments and Conditions =
- Flight # 2: Wet = 33, Distance = 17.4, UTC = 23.41,00, Comments and Conditions =
- Flight # Up DeltaX: Wet = 53, Distance = 31.3, UTC = 23.66,60, Comments and Conditions =
- Flight # 1: Wet = 33, Distance = 17.4, UTC = 23.41,00, Comments and Conditions =

**Contact:**
- USGS COLLECTION REPORT
- 1616 East Drive
- Reston, VA 20192
- Telephone: 703-648-6800
- Fax: 703-648-5649
- Email: collections@usgs.gov

**Website:**
- http://www.fs.usda.gov/twca
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Acquisition and Processing details ---- Collection 26 (March 14, 2017)

Log:

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Estimated Accuracy

The graph illustrates the estimated accuracy of GPS data over time, with the x-axis representing GPS Time (TOW, GMT zone) and the y-axis showing the estimated accuracy. The legend indicates the accuracy for East, North, Height, and Trace directions.
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Combined RMS

SVs
Acquisition and Processing details ----- Collection 27 (March 15, 2017)

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<th>Scan Rate (Hz)</th>
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Trajectory and GPS Plots:

Estimated Accuracy
Acquisition and Processing details ----- Collection 28 (March 15, 2017)

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Trajectory and GPS Plots:

Estimated Accuracy
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Acquisition and Processing details ----- Collection 29 (March 15, 2017)

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**Flight Log**

- **Date:** March 15, 2017
- **Location:** KHUM
- **Altitude:** 100 m
- **Speed:** 100 knots
- **Scan Rate:** 100 Hz
- **GND-STATIC:**

**Equipment:**
- **Riegl:**
- **Log:**

**Operator:**
- **Kevin Elliot:**
- **Chris Fought:**

**Comments and Conditions:**
- Free Surf
- Flight
- Weather
- GPS
- Ground-Static
Trajectory and GPS Plots:

Estimated Accuracy
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Acquisition and Processing details ----- Collection 30 (March 16, 2017)

Log:

| Flight Date | QPC Day | Lift | Aircraft | Base 1 ID | Location | Res ID | Unit | Area | Flight # | Start Time UTC | Stop Time UTC | GPS Name | Operator | Date |
|-------------|---------|------|----------|-----------|----------|-------|------|------|----------|--------------|-------------|----------|----------|--------|------|
| 16-Mar-17   | 17-076  | 9    | KBHU     | 016       | KHUM     | 4     | 1.8  | 170319  | 170319 002  | 170319 2135 | UNI433140&type | Eric Mueller | With AB |

Comments and Qualifiers:
- GROUND-STATIC @KHUM
- PRE ACQUISITION CALIBRATION
- CROSS LINE
- CALIBRATION LINE
- POST ACQUISITION CALIBRATION

Remarks:
- Flight start and end times are provided in UTC.
- GPS name for the flight.
- Operator name and whether the flight was with an AB.
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting
Combined RMS

SVs

GPS Time (TOW, GMT zone)

- East  - North  - Up

GPS Time (TOW, GMT zone)

- Too Few  - Minimal  - Acceptable  - Good  - Exceptional
Acquisition and Processing details ----- Collection 31 (March 20, 2017)

Log:

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<th>Time of Day</th>
<th>Location</th>
<th>GPS Data</th>
<th>AOP File</th>
<th>Flight Time</th>
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<th>Comments and Conditions</th>
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Trajectory and GPS Plots:

Top View: Latitude (deg)
Estimated Accuracy

Height

Altitude (m)
Acquisition and Processing details ----- Collection 32 (April 24, 2017)

Log:

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<th>Speed</th>
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<td>GROUND-STATIC @ KHUM</td>
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| | | 16:00 | | | | | | }

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USGS COLLECTION REPORT
Trajectory and GPS Plots:

Estimated Accuracy
Quality Factor

![Quality Factor Graph]

Height

![Height Graph]
Combined Forward/Reverse Separation

Combined Forward/Reverse Weighting