2011 MSB LiDAR & Imagery Project
(Frequently Asked Questions

Version 1.2
4/20/2012

This document is intended to answer commonly asked questions related to the 2011 MSB LiDAR & Imagery Project.
What is the 2011 MSB LiDAR & Imagery Project?
The project is a collection of high-resolution elevation data and aerial imagery for 3680 square miles of the Matanuska-Susitna Borough (MSB) as well as the development of a number of ancillary datasets (see the section on final products).

What is the Project Area?
See Attachment A for a map of the project area.

Who are the Project Partners?
The following partners have contributed funding and/or resources to the project: Coastal Impact Assistance Program (CIAP); United States Geological Survey (USGS); Alaska Energy Authority (AEA); United States Fish and Wildlife Service (USFWS); The Nature Conservancy (TNC); National Oceanic and Atmospheric Administration (NOAA) Mat-Su Salmon Partnership; United States Army Corps of Engineers (USACE); Alaska Pacific University (APU); & Matanuska Susitna Borough (MSB).

Who are the Project Contractors?
The project has three contractors: Aerometric for data acquisition, post processing, and product development; Lounsbury and Associates, Inc. for elevation check point survey for QA/QC process; and the Alaska Satellite Facility (ASF) of the Geophysical Institute (GI) at UAF for QA/QC of LiDAR.

What are the Final Products?
- Orthorectified, multispectral, 4-band imagery (RGB & NIR); ½ ft resolution, for a 270 sq/mi urban area; 1 ft resolution, for the entire 3680 sq/mi project area
- Point Cloud Data w/ 1m true nominal pulse spacing (nps) and 0.6m nps through overlap (these data meet both USGS & FEMA specs); classified and unclassified; LAS format v.1.2
- Automated “vegetation” classification; low (1-6ft), medium (6-15ft) and high (>15ft)
- Intensity Images
- 1 m first return digital surface model (DSM) (aka top of canopy)
- 1 m bare earth digital elevation model (DEM) w/ hydro-flattening
- 1 m hillshades (1 each for DSM and DEM)
- 2 ft contours
- Building footprints @ 97% accuracy
- Breaklines

What is Orthorectified Imagery?
An orthophoto (aka orthoimage) is an aerial photograph that has been processed to eliminate image displacement so that ground level features appear as though viewed from directly above; tall objects (e.g. trees, towers, buildings) may still appear slightly tilted. The imagery is geometrically corrected so that the scale is uniform. Unlike an uncorrected aerial photograph, an orthophoto can be used to measure true distances, because it is an accurate representation of the earth’s surface, having been adjusted for topographic relief, lens distortion, and camera tilt.

Orthophoto
What is LiDAR?
LiDAR, an acronym for Light Detection And Ranging, is a process that uses up to 200,000 laser pulses per second to map 3-D coordinates of the earth’s surface. It is used to produce a variety of data products, including: point clouds, digital surface models (DSM), digital elevation models (DEM), digital terrain models (DTM), and contours. In addition to these products, LiDAR processing generates other data, including the raw point cloud, processed points, and break lines.

What is Point Cloud Data?
Point Cloud Data is the rawest form of LiDAR data available from this project. Each point in the point cloud contains elevation data calculated from a laser pulse. These points include elevation data for first (e.g. top of tree canopy), intermediate (e.g. shrubs) or last (e.g. bare earth) returns. When a laser pulse encounters only one feature such as bare-earth (e.g. gravel), asphalt, concrete, or a roof top, the first and last return returns will have the same elevation values.

What Classifications are Included in the Classified Point Cloud Data?

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unclassified (withheld bit set); represents edge of swaths</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>Low “Vegetation”</td>
</tr>
<tr>
<td>4</td>
<td>Medium “Vegetation”</td>
</tr>
<tr>
<td>5</td>
<td>High “Vegetation”</td>
</tr>
<tr>
<td>6</td>
<td>Buildings</td>
</tr>
<tr>
<td>7</td>
<td>Noise</td>
</tr>
<tr>
<td>8</td>
<td>Ground Model Key Points (used to develop contours)</td>
</tr>
<tr>
<td>9</td>
<td>Water</td>
</tr>
<tr>
<td>10</td>
<td>Breakline Proximity (ignored ground)</td>
</tr>
<tr>
<td>11</td>
<td>Power Transmission Lines</td>
</tr>
<tr>
<td>13</td>
<td>Surface Clutter (noisy points near the surface)</td>
</tr>
<tr>
<td>14</td>
<td>Bridge Decks</td>
</tr>
</tbody>
</table>
What is Automated “Vegetation” Classification?
Automated “vegetation” classification is a term used to describe the classification of points in the point cloud data into low, medium, and high “vegetation” classes. This classification is only assigned to points that haven’t fallen into other classifications such as buildings and water. The use of the word “vegetation” is a bit of a misnomer since the points can include non-vegetation features, such as automobiles and power poles. The classifications fall into three height categories: low (1-6 ft), medium (6-15 ft), and high (>15 ft).

What are Intensity Images?
The return strength (aka intensity) of each LiDAR pulse can be categorized and used to produce an image product that closely resembles an orthoimage. The intensity data can be provided as a point cloud or it can be exported to an image file (.tiff or .jpg) that can then be used as a backdrop for other GIS layers. The pulse rate of the sensor combined with the range of intensity in an image determines the visibility characteristics.

What is a Digital Surface Model (DSM)?
A DSM is a digital map/model of elevations, typically representing the first return surface. It is a continuous and gridded (aka raster) dataset that represents features found on the surface of the earth, including vegetation (top of canopy), buildings (rooftops), and other man-made structures (automobiles & bridges).

What is a Digital Elevation Model (DEM)?
A DEM is a digital map/model of bare-earth elevations. It is a continuous and gridded (aka raster) dataset that represents bare-earth elevation information, free from vegetation, buildings, and other man-made structures. This term is often used interchangeably with DTM even though there are distinctions between the two (see DTM definition below). For this project we are using the term DEM interchangeably with DTM; our DEM product has been augmented by breaklines and includes hydro-flattening.

What is a Digital Terrain Model (DTM)?
A DTM is a digital map/model of bare-earth elevations. It is a continuous and gridded (aka raster) dataset that represents bare-earth elevation information, free from vegetation, buildings, and other man-made structures AND has been augmented by breaklines to correct for artifacts produced by the original data. An example of an augmentation would be hydro-flattening. For this project we are using the term DEM interchangeably with DTM; our DEM product has been augmented by breaklines and includes hydro-flattening.
What is Hydro-Flattening?
A relatively new term, coined by USGS, hydro-flattening refers to a post-processing effort that uses breaklines in conjunction with elevation information to smooth waterbody surfaces so they have a uniform appearance. Prior to hydro-flattening, waterbodies appear bumpy or rippled; afterward lakes appear flat from shore to shore and rivers have a uniform downstream flow. For example, if a digital drop of water were dropped in the upper reaches of a hydro-flattened river, it would flow down the hydro-flattened surface to the mouth of the river and beyond.

What are Breaklines?
Breaklines represent linear features that mark a change in smoothness or continuity of a surface. Breaklines are typically captured along road edges and along hydrographic features to assist with the accurate depiction of contours and for the hydro-flattening process. Typical breakline examples would include: shorelines, islands, road edges, etc.

What is a Hillshade?
Hillshades are quickly replacing contour lines as the best way to visualize 3-D topographic surfaces. Viewing angles and sun angles can be varied to maximize visual interpretation of the terrain. They are typically displayed using a color elevation ramp, but some hillshades are displayed in gray scale.

What are Contours?
Contours are graphical lines, derived from the DEM, that join points of equal elevation on the surface of the land above or below a reference surface, such as mean sea level. Contours make it possible to measure the height of mountains and steepness of slopes.

What are Building Footprints?
A building footprint is the outline of the base of a building or portion of a building; they are typically exclusive of courtyards and decks. This project will provide footprints for buildings over 400sq/ft in size to a confidence of 97%.
How is the Data Organized?
For data management purposes the project has been divided into 7 blocks/areas:

<table>
<thead>
<tr>
<th>Block</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matanuska</td>
<td>472 sq/mi</td>
</tr>
<tr>
<td>Core Area</td>
<td>503 sq/mi</td>
</tr>
<tr>
<td>Point MacKenzie</td>
<td>583 sq/mi</td>
</tr>
<tr>
<td>Willow</td>
<td>567 sq/mi</td>
</tr>
<tr>
<td>Caswell Lakes</td>
<td>537 sq/mi</td>
</tr>
<tr>
<td>Talkeetna</td>
<td>597 sq/mi</td>
</tr>
<tr>
<td>North Susitna</td>
<td>421 sq/mi</td>
</tr>
</tbody>
</table>

It has also been further divided into 498 individual tiles that are 25sq/km in size. See Attachment B.

What Spatial Referencing System Standards were used for the Project?
Vertical Datum: North American Vertical Datum of 1988
Horizontal Datum: North American Datum of 1983
Projection: Alaska State Plane Zone 4
Horizontal/Vertical Units: U.S. Survey Foot and will be expressed to the nearest tenth (0.1)

What is the Current Status of the LiDAR & Imagery Data Collection Effort?
While every effort was made to collect LiDAR and imagery for the entire project area in 2011, a very small portion of LiDAR in Hatcher Pass and imagery along the Matanuska River corridor were not collected due to problematic collection conditions (e.g. weather). Those areas amount to 2% of the total project area for LiDAR and 4% of the total of the total project area for imagery. See Attachments C & D for status maps. The areas not collected in 2011 will be flown, processed, go through the quality assurance\quality control (QA/QC) process, and be delivered by September 2012.

What is Quality Assurance/Quality Control (QA/QC)?
Quality Assurance (QA) is a procedure or set of procedures intended to ensure that a product or service under development (before work is complete, as opposed to afterwards) meets specified requirements. Quality control (QC) is a measurable set of tasks intended to ensure that a product or service adheres to a defined set of quality criteria or meets the requirements of the client or customer.

What is the QA/QC Process for the 2011 MSB LiDAR & Imagery Project?
Both products are reviewed by Aerometric before being delivered.

The review process for the LiDAR and all ancillary products has been contracted to the Alaska Satellite Facility (ASF). The process includes checks for completeness of delivery, point cloud counts, point cloud classifications, bare-earth DEM (aka DTM), DSM, and intensity image regularity, vertical accuracy, hydro-flattening with uniform lake and surface flow elevations, and contour topology.

The imagery review process has been completed by MSB GIS staff. The process includes checks for general appearance, radiometric evaluation, edgematching, artifacts & smearing, pixel size & missing pixels, infrared band check, leaf off/on, cloud cover, relief displacement, and positional accuracy.

When necessary, corrections or improvements have been requested from Aerometric.
When will the Data be Made Available?
All LiDAR and imagery collected will be made available to the public after it passes through the quality assurance/quality control (QA/QC) process and is considered a final product.

How will the Data be Made Available?
Small datasets will be available for download online; e.g. project, block, and tile boundaries; breaklines; contours; etc. The rest of the data will be made available on hard-drives. The GIS Division is investigating whether MSB Staff will fill orders for external drives, or potentially Aerometric may undertake this responsibility. The order form packet will cover all additional information regarding this topic and will be available on the Borough’s website when it is completed. Other data dissemination options, such as image services, are being investigated as future possibilities.

The best way to receive updated project information is to sign up for the MSB LiDAR/Imagery email list; to be added to the list please send an email request to Heather.Kelley@matsugov.us.

How Frequently will the MSB’s LiDAR & Imagery Data be Updated (Reflown)?
The MSB does not currently have an established re-flight cycle for LiDAR or imagery acquisition.

What are some Frequent Uses for LiDAR & Imagery Data?
- 3-D Visualization
- Floodplain Mapping
- Urban Modeling
- Transportation Planning
- Route Mapping
- Building Site Suitability
- Tower Placement
- Tower Coverage
- Slope Analysis
- Landslide Analysis
- Vegetation Mapping
- Timber Volume Analysis
- Change Detection
- Feature Extraction

Who Should be Contacted with Questions?
Project questions can be addressed to either:
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What Sources were Used to Develop this Document?
Rather than reinvent the wheel, the MSB GIS Division borrowed some of the definitions and descriptions in this document from other publications found online. We thank all sources used. Sources: City of Vancouver; Environmental Systems Research Institute, Inc (ESRI); FEMA - Procedure Memorandum No. 61—Standards for LiDAR and Other High Quality Digital Topography; Matanuska-Susitna Borough GIS Division; NOAA Lidar 101: An Introduction to Lidar Technology, Data, and Applications; PCMagazine; Pennsylvania Department of Conservation and Natural Resources; UAF, Keith Cunningham, Assistant Professor; URISA - Lidar Guidebook: Concepts, Project Design, And Practical Applications; USGS - LiDAR Frequently Asked Questions Doc; USGS - National Geospatial Program - LiDAR Guidelines and Base Specification - Version 13 – ILMF 2010; USGS - National Geospatial Program Lidar Guidelines and Base Specification; Whatis?com - www.whatis.techtarget.com
Legend
- Communities
- Imagery Acquisition Completed
- Project Acquisition Area - 3680 sq/mi
- Large Waterbodies
- MSB Boundary

96% Completed

Mat-Su LiDAR & Imagery Project Imagery Acquisition Status Map

ANCHORAGE
HOUSTON
WASILLA
PARKS HWY
SKWENTNA
PETERSVILLE
TRAPPER CREEK
TALKEETNA
TALKEETNA SPUR
PARKS HWY
EKLUTNA LAKE
SUSITNA RIVER
SUSETNA RIVER
YENTNA RIVER
KNIK-GOOSE BAY RD
TALKEETNA SPUR
PARKS HWY
HOUSTON
WASILLA
PALMER
SUTTON
ANCHORAGE
MSB - IT Dept - GIS Division
Oct 25, 2011

Attachment C