

65218069 AeroMetric - IDOT PTB 156-059

Summary LiDAR QA/QC Report

Final Client Deliverables
Classified LAS 1.2

Report generated on 10/31/2013

This document reports on compliance with the USGS National Geospatial Program LiDAR Base Specification Version 1.0. The complete specification, which also contains a list of abbreviations, acronyms, and a glossary of related terms, can be found [here](#).



0.0 Report on LAS Statistics (By Tile)

The purpose of this section is to show basic quantifiable information about the LAS files tested.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

Horizontal Units: US Survey Feet Vertical Units: US Survey Feet
Number of classified LAS files: 5135

All LAS statistic information can be reviewed in a geographic manner by accessing the shapefile located at
Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_QC\Reports\LiDAR_Final\0_0\IDOT_Tiles_IL_East.shp

Average Point Density: 0.11/1.18 pp Square US Survey Foot / pp Square Meter
Average GSD: 3.46 US Survey Feet

Note: These statistics are for tiled LAS files. Not all LAS files fill tiles completely, especially along project boundaries. This may skew the results by including area, count, and density values for partially filled tiles.

0.0 Report on LAS Statistics (By Tile)

- Class Totals

The purpose of this section is to list the number of points in each classification present in the tested data so that the user can determine if any points were filtered to unintended classes.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

Class(es) Expected: 1,2,3,4,5,6,7,8,9,10
Class(es) Present: 1,2,3,4,5,6,7,8,9,10

Class	Total
1	230,354,430
2	508,417,972
3	17,817,166
4	34,261,392
5	81,621,065
6	5,212,702
7	51,275
8	1,477,666,136
9	9,861,258
10	2,235,228

1.1 Report on Multiple Discrete Returns (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 requires: "Data collection must be capable of at least three returns per pulse. Full waveform collection is acceptable and welcomed; however, waveform data are regarded as supplemental information. Deriving and delivering multiple discrete returns is required in all cases."

The purpose of this section is to report on the presence and quantities of LiDAR returns in the LAS tiled data. Empty return columns can indicate a collection or processing problem dealing with LiDAR return attribute information.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

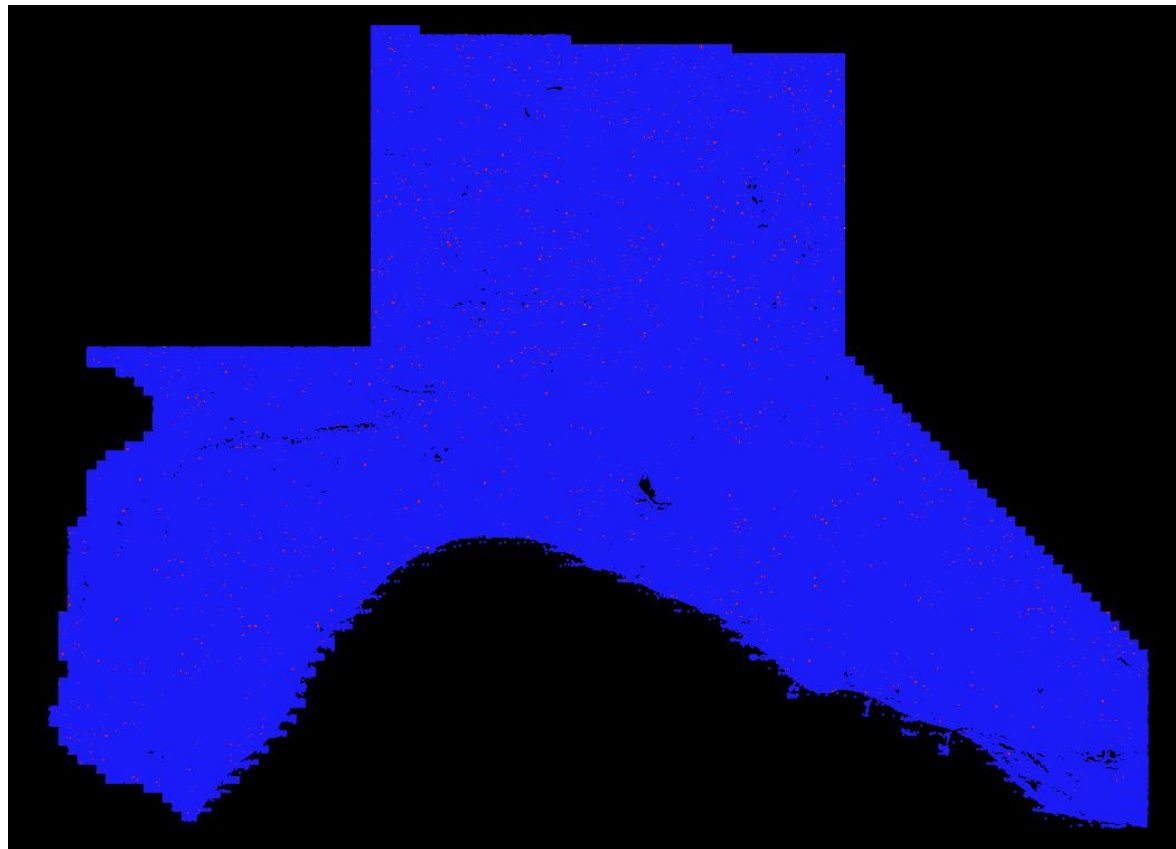
File	First return	Second return	Third return	Other return	Total points
Total	2,328,064,915	39,368,930	64,769	10	2,367,498,624

1.1 Report on Multiple Discrete Returns (Tiled Data) - All Returns

The purpose of this section is to show a graphic of LiDAR tiled data points colored by all returns. Blank tiles can indicate a collection or processing problem dealing with LiDAR return attribute information.

[Data Source - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

[Result Path - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\1_1\ColorByReturns_Classified.jpg](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\1_1\ColorByReturns_Classified.jpg)



First Second Third Fourth or other

1.2 Report on Intensity Values (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 requires: "Intensity values are required for each return. The values are to be recorded in the .las files in their native radiometric resolution."

The purpose of this section is to report on the presence and quantities of LiDAR intensity in the LAS tiled data. It is important to understand that 8-bit intensity LiDAR systems have a valid intensity range from 0-255, and 12-bit intensity LiDAR systems have a valid intensity range from 0-4095.

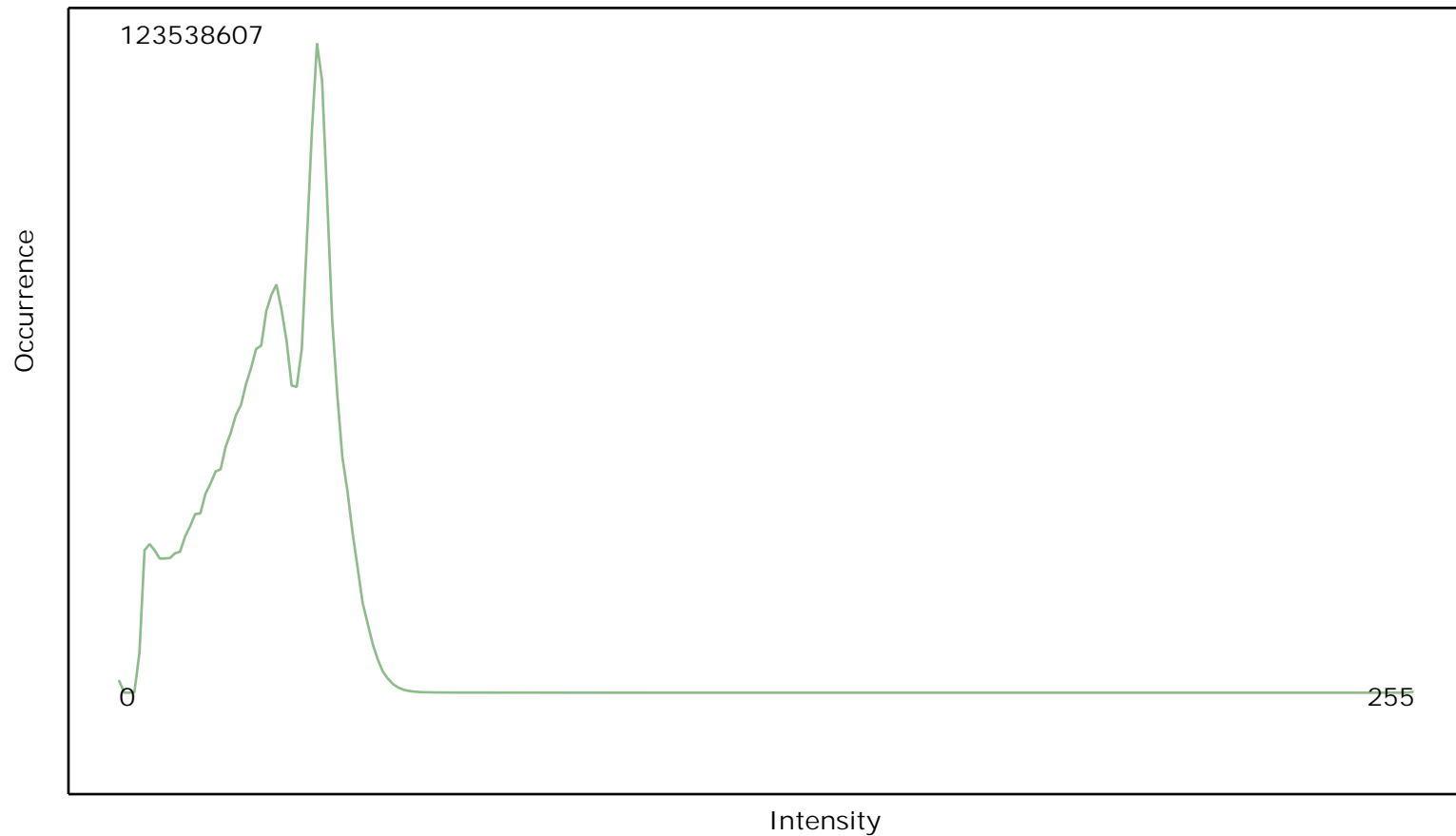
[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

File	Minimum	Maximum	Mean	Median	Mode
Average	00	255	29	31	39

1.2 Report on Intensity Values (Tiled Data)

The purpose of this section is to show a frequency distribution chart of intensities throughout all of the LiDAR tiled files. It is important to understand that 8-bit intensity LiDAR systems have a valid intensity range from 0-255, and 12-bit intensity LiDAR systems have a valid intensity range from 0-4095.

[Data Source - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

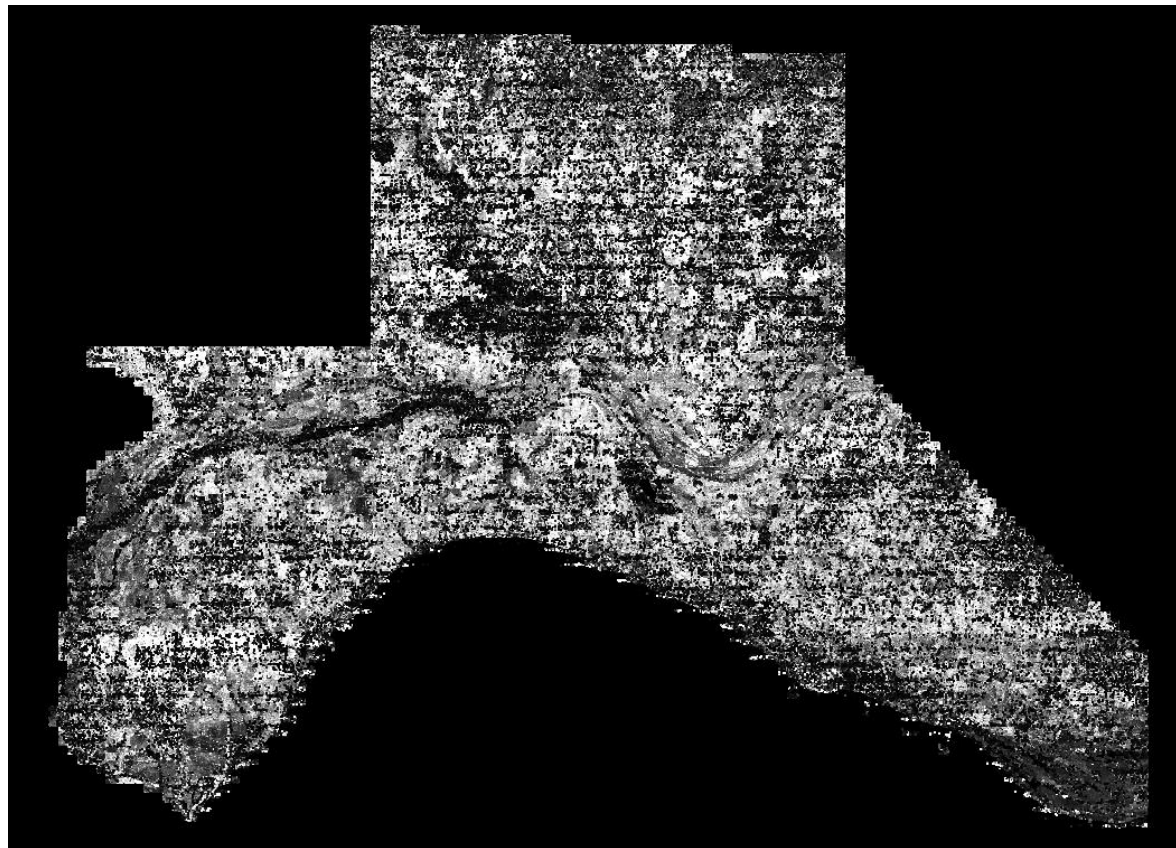


1.2 Report on Intensity Values (Tiled Data)

The purpose of this section is to show a graphic of LiDAR tiled data points colored by intensity. Blank tiles can indicate a processing problem dealing with LiDAR intensity attribute information.

[Data Source - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

[Result Path - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\1_2\ColorByIntensity_Classified.jpg](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\1_2\ColorByIntensity_Classified.jpg)



1.4 Report on Point Density and Nominal Pulse Spacing (NPS) (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 states: "In general, the target NPS for a project should not be achieved through swath overlap or multiple passes. Such collection techniques may be permitted with prior approval."

The purpose of this section is to report on the LiDAR point density and nominal point spacing by tiled file. Point densities and NPS by tile are calculated by including any overlapping swath data within each tile. These statistics are for tiled LAS files. Not all LAS files fill tiles completely, especially along project boundaries. This may skew the calculated density and NPS values for partially filled tiles.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

Units: US Survey Feet

File	Point Density	Nominal Pulse Spacing (NPS)
Average	0.11/1.18	3.46/1.05
	pp Square US Survey Feet/ pp Square Meter	US Survey Feet/ Meter

1.8 Report on Vertical Accuracy (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 states that: "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.

- (1) The minimum vertical accuracy requirement for the unclassified lidar point cloud, using the NDEP/ASPRS methodology, is listed below: . See: http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf
- (2) Fundamental Vertical Accuracy (FVA) \leq 24.5 centimeters (cm) Accuracyz (ACCz), 95 percent (12.5 cm Root Mean Square Error (RMSE)z).
- (3) 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.

Point cloud data accuracy is to be tested against a Triangulated Irregular Network (TIN) constructed from lidar points in clear and open areas. A clear and open area can be characterized with respect to topographic and ground cover variation such that a minimum of 5 times the NPS exists with less than 1/3 of the RMSEz deviation from a low-slope plane. Slopes that exceed 10 percent should be avoided. Ground that has been plowed or otherwise disturbed is not acceptable. All tested locations should be photographed showing the position of the tripod and the surrounding area ground condition."

The purpose of this section is to report on the fundamental vertical accuracy of the LiDAR data measured against surveyed ground check points.

This reports only the Fundamental Vertical Accuracy (FVA)

Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_QC\Reports\LiDAR_Final\1_8\Report_VerticalAccuracy.csv

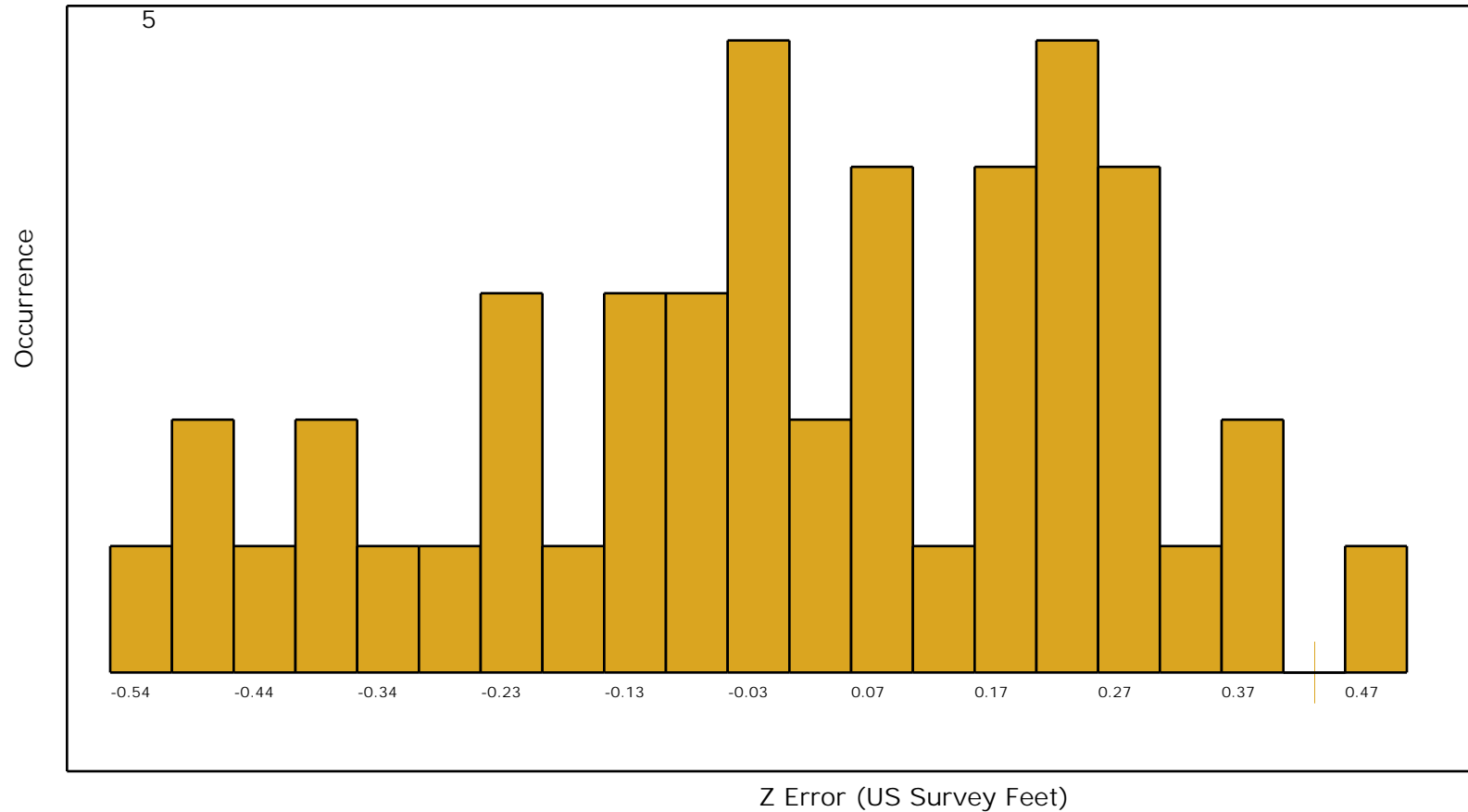
Units: US Survey Feet

	Classified Data
Control Points	48
Points with Coverage	47
Average Z Error	0.00
Maximum Z Error	0.47
Median Z Error	0.02
Minimum Z Error	-0.54
NSSDA Vertical Accuracy	at the 95 confidence level 0.49
Standard Deviation (sigma) of Z for Sample	0.25
RMSE of Z for Sample	0.25 PASS
ASPRS Contour Interval	0.80
NMAS Contour Interval	0.90

1.8 Report on Vertical Accuracy (Tiled Data)

The purpose of this section is to show a frequency distribution chart of the the fundamental vertical accuracy of the LiDAR data measured against surveyed ground check points.

[Data Source - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)



2.1 Report on ASPRS LAS File Format (Tiled Data)

The purpose of this section is to show the LAS format for the LiDAR tiled data.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

All LAS tiled files are formatted as LAS 1.2.

2.3 Report on Global Positioning System (GPS) Times Type (Tiled Data)

The purpose of this section is to show the GPS time type within the LAS files for the LiDAR tiled data.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

All LAS tiled files are formatted as Adjusted GPS Time.

2.4 Report on Datums (Tiled Data)

The purpose of this section is to show the datums of the LAS files for the LiDAR tiled data.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

All LAS tiled files are defined as:

EPSG Code = 5103

Vertical Datum = NAVD88 via Geoid09 on NAD83

2.5 Report on Coordinate Reference System (Tiled Data)

The purpose of this section is to show the projections of the LAS files for the LiDAR tiled data.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

All LAS tiled files are defined as:

EPSG Code = 3443

Projection = NAD83(HARN) / Illinois East (ftUS)

2.6 Report on Units of Reference (Tiled Data)

The purpose of this section is to show the horizontal and vertical units of the LAS files for the LiDAR tiled data.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

All LAS tiles files are defined as:

Horizontal Unit = US Survey Feet

Vertical Unit = US Survey Feet

2.9 Report on Point Families (Tiled Data)

The purpose of this section is to report on the presence and integrity of point families for tiled data.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

All LAS tiled files have point families present.

2.11 Report on Noise Classes and Withheld Points (Tiled Data)

The purpose of this section is to list the presence and quantities of noise and withheld points for all LiDAR tiled data files.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

Class 7	51275
Class 11	0
Withheld	0

2.12 Report on Overlap Points (Tiled Data)

The purpose of this section is to list the presence and quantities of overlap and unclassified points for all LiDAR tiled data files.

[Classified Files - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](#)

Class 12	0
----------	---

2.14 Report on Classification Accuracy – Hillshade Displayed with 1 km X 1km tiles Overlayed

The USGS LiDAR Base Specification Version 1.0 states that: "It is required that due diligence in the classification process will produce data that meet the following tests:

- (1) Following classification processing, no non-withheld points should remain in Class 0.
- (2) Within any 1 kilometer (km) x 1 km area, no more than 2 percent of non-withheld points will possess a demonstrably erroneous classification value.
- (3) Points remaining in Class 1 that should be classified in any other required Class are subject to these accuracy requirements and will be counted towards the 2 percent threshold.

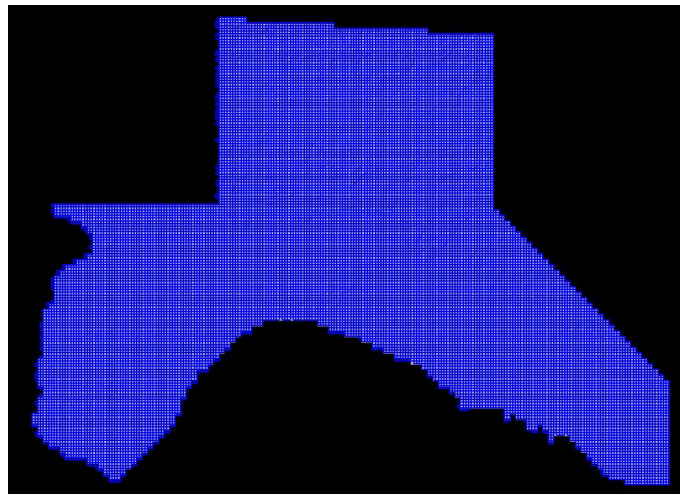
Note: These requirements may be relaxed to accommodate collections in areas where the USGS agrees classification to be particularly difficult.

The purpose of this section is to overlay a 1km x 1km tile scheme over the bare earth surface hillshade product to use for ground filter QC inspections.

[Data Source - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

[Result Path - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\2_14_15\Hillshade_SingleFile.jp2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\2_14_15\Hillshade_SingleFile.jp2)

[Tile Shapefile - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\2_14_15\tile.shp](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\2_14_15\tile.shp)



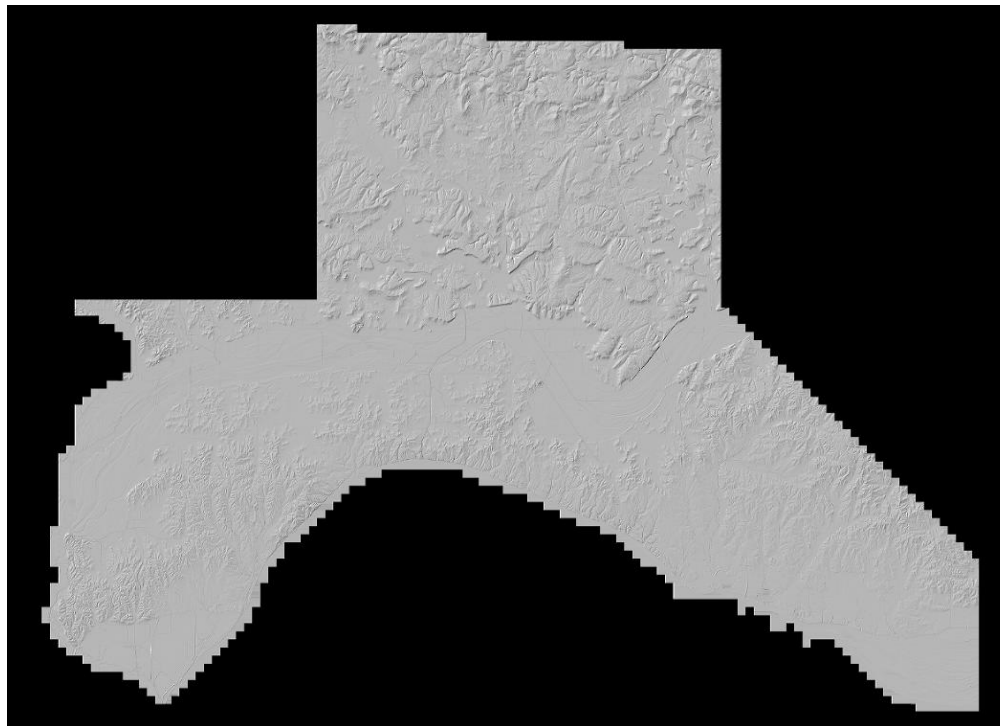
2.15 Report on Classification Consistency – Hillshade Displayed

The USGS LiDAR Base Specification Version 1.0 states that: "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."

The purpose of this section is to show the bare earth surface hillshade product for classification consistency inspection.

[Data Source - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\LAS1.2)

[Result Path - Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\2_14_15\Hillshade_SingleFile.jp2](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Admin\QA_OC\Reports\LiDAR_Final\2_14_15\Hillshade_SingleFile.jp2)



2.16 Report on Tiles

The USGS LiDAR Base Specification Version 1.0 states that:

Tiles:

Note: This section assumes a projected coordinate reference system.

A single non-overlapped tiling scheme (the Project Tiling Scheme) will be established and agreed upon by the data producer and the USGS before collection. This scheme will be used for ALL tiled deliverables.

- (1) Tile size is required to be an integer multiple of the cell size of raster deliverables.
- (2) Tiles are required to be sized using the same units as the coordinate system of the data.
- (3) Tiles are required to be indexed in X and Y to an integer multiple of the tile's X-Y dimensions.
- (4) All tiled deliverables will conform to the Project Tiling Scheme, without added overlap.
- (5) Tiled deliverables will edge-match seamlessly and without gaps.

The purpose of this section is to report on the unallowed presence of skew and overlap in the project tile scheme.

[Tile File: Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\ESRI_shp\IDOT_Tiles_IL_East.shp](Y:\Mapping\Projects\65218069_AeroMetric_IDOT_PTB_156-059\Production\Final_Client_Deliverables\ProjectWide\ESRI_shp\IDOT_Tiles_IL_East.shp)

Units: US Survey Feet

The following lists tiles that are either skewed or overlapped.

Tile	Non-Skewed Tile	Width	Height	Overlap
------	-----------------	-------	--------	---------

NONE

The following lists tile widths/heights in the project.

2000.00/2000.00

Skipped Tests

- 1.3 Report on Point Density and NPS per Flight Line
- 1.5 Overview of Data Voids
- 1.6 Overview of Spatial Distribution Verification
- 1.7 Overview of Scan Angles Exceeding Limitations
- 1.9 Overview of Flight Line Separation (Relative Accuracy)
- 1.10 Flight Line Coverage
- 1.11 Report on Collection Area
- 1.12 Report on Collection Conditions
- 2.2 Report on Waveform Data
- 2.7 Report on LAS File Size
- 2.8 Report on File Source ID
- 2.10 Report on Swath Coverage
- 2.13 Report on Positional Accuracy Validation

USGS QC Module Input Requirements Matrix

Test number	Boresighted LAS (Swath Data)	Classified LAS (Tiled Data)	Shapefile Tile Scheme	Shapefile Boundary	Shapefile SBET(s)	NPS	LiDAR Check Points	Project Name	Description	Logo	Output Folder	PDF Name
0.0		X	X					X	O	O	X	X
1.1	X	X						X	O	O	X	X
1.2	X	X						X	O	O	X	X
1.3	X			O				X	O	O	X	X
1.4		X	X					X	O	O	X	X
1.5	X			O		X		X	O	O	X	X
1.6	X			O		X		X	O	O	X	X
1.7	X			O	X	X		X	O	O	X	X
1.8	X	X					X	X	O	O	X	X
1.9	X			O				X	O	O	X	X
1.10	X			O		X		X	O	O	X	X
1.11	X			X				X	O	O	X	X
1.12					X			X	O	O	X	X
2.1	X	X						X	O	O	X	X
2.2	X	X						X	O	O	X	X
2.3	X	X						X	O	O	X	X
2.4	X	X						X	O	O	X	X
2.5	X	X						X	O	O	X	X
2.6	X	X						X	O	O	X	X
2.7	X							X	O	O	X	X
2.8	X							X	O	O	X	X
2.9	X	X						X	O	O	X	X
2.10	X			X				X	O	O	X	X
2.11	X	X						X	O	O	X	X
2.12	X	X						X	O	O	X	X
2.13	X	X		X		X	X	X	O	O	X	X
2.14		X				X		X	O	O	X	X
2.15		X						X	O	O	X	X
2.16			X					X	O	O	X	X

X = Required

X = Will use Classified LAS if available, else Boresighted (Swath) LAS

O = Optional

O = Optional for single-area density reporting, but required for multi-area (multiple boundary) reporting of individual and aggregate areas