



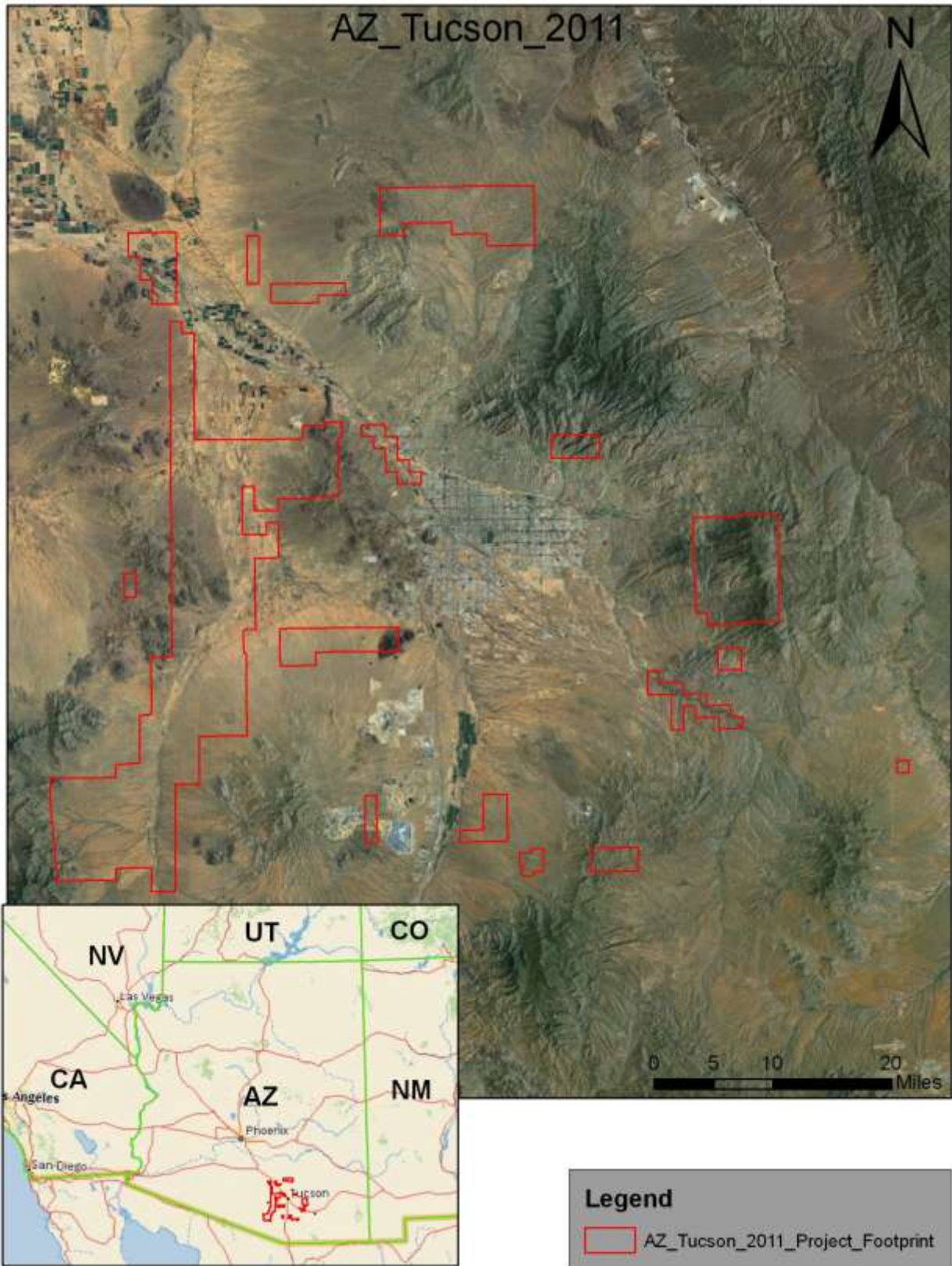
LiDAR Quality Assessment Report

The USGS National Geospatial Technical Operations Center, Data Operations Branch is responsible for conducting reviews of all Light Detection and Ranging (LiDAR) point-cloud data and derived products delivered by a data supplier before it is approved for inclusion in the National Elevation Dataset and the Center for LiDAR Information Coordination and Knowledge. The USGS recognizes the complexity of LiDAR collection and processing performed by the data suppliers and has developed this Quality Assessment (QA) procedure to accommodate USGS collection and processing specifications with flexibility. The goal of this process is to assure LiDAR data are of sufficient quality for database population and scientific analysis. Concerns regarding the assessment of these data should be directed to the Chief, Data Operations Branch, 1400 Independence Road, Rolla, Missouri 65401 or NGTOCooperations@usgs.gov.

Materials Received: 3/26/2012	Project Type: Donated Data
Project ID: AR_Tucson_2011	Project Description: LiDAR for Tucson area
Project Alias(es):	Year of Collection: 2011

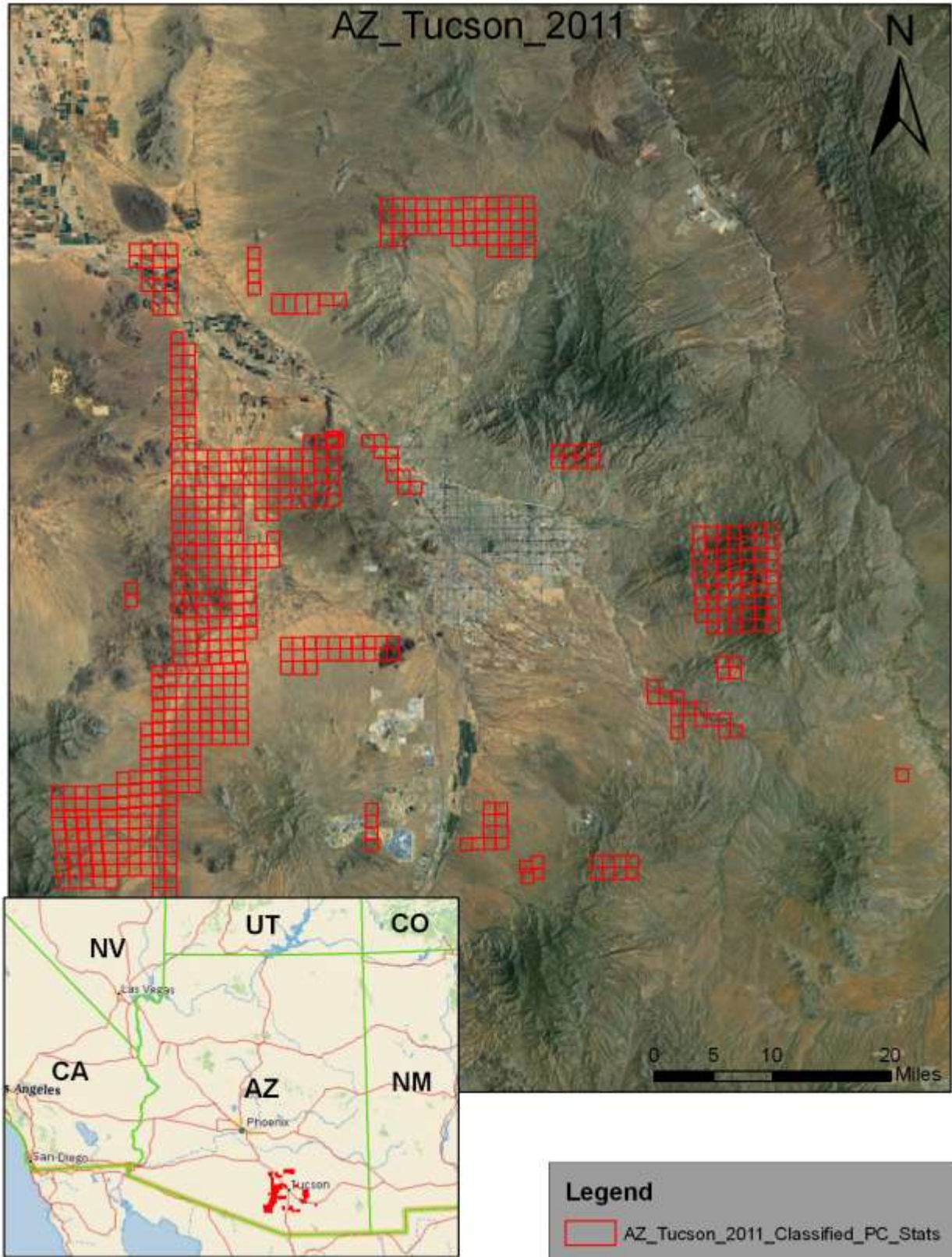
Lot 1 of 1 lots.

Project Extent:
 Project Extent image?



Project Tiling Scheme:

Project Tiling Scheme image?



Contractor:

Applicable Specification:

Licensing Restrictions:

Third Party Performed QA?

Project Points of Contact :

POC Name	Type	Primary Phone	E-Mail
Drew Decker	NSDI Liaison	619-225-6430	ddecker@usgs.gov
Manny Rosas	PAG	520-792-1093	mrosas@pagnet.org

Project Deliverables

All project deliverables must be supplied according to collection and processing specifications. The USGS will postpone the QA process when any of the required deliverables are missing. When deliverables are missing, the Contracting Officer Technical Representative (COTR) will be contacted by the Elevation/Orthoimagery Section supervisor and informed of the problem. Processing will resume after the COTR has coordinated the deposition of remaining deliverables.

- | | |
|---|---|
| <ul style="list-style-type: none"> <input type="checkbox"/> Collection Report <input type="checkbox"/> Survey Report <input type="checkbox"/> Processing Report <input type="checkbox"/> QA/QC Report <input type="checkbox"/> Control and Calibration Points <input checked="" type="checkbox"/> Project Shapefile/Geodatabase <input type="checkbox"/> Control Point Shapefile/Gdb | <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Project Tiling Scheme Shapefile/Gdb <input type="checkbox"/> Breakline Shapefile/Gdb <input checked="" type="checkbox"/> Project XML Metadata <input type="checkbox"/> Swath LAS XML Metadata <input type="checkbox"/> Classified LAS XML Metadata <input type="checkbox"/> Breakline XML Metadata <input type="checkbox"/> Bare-Earth DEM XML Metadata |
|---|---|

Multi-File Deliverables

File Type	Quantity
<input type="checkbox"/> Swath LAS Files	
<input type="checkbox"/> Intensity Image Files	
<input checked="" type="checkbox"/> Tiled LAS Files	585
<input type="checkbox"/> Breakline Files	
<input checked="" type="checkbox"/> Bare-Earth DEM Files	51

Additional Deliverables

	Item
<input checked="" type="checkbox"/>	Contours (Shapefile, DWG)
<input checked="" type="checkbox"/>	Orthos 6in, 1ft
<input checked="" type="checkbox"/>	Bare Earth ASCII Points
<input checked="" type="checkbox"/>	DTM Point File

Errors, Anomalies, Other Issues to document? Yes No

Though the Bare Earth ASCII Points and DTM Point Files are not representative of the DEMs or DTMs and USGS will create DEMs for the project from the tiled point cloud data.

The 51 DEM files checked above as delivered were actually created by USGS.

Tile Scheme is for Orthos.

Project Geographic Information

Areal Extent: 584.987 Sq Mi

Grid Size: 3 Int'l Feet

Tile Size: 5,200 int'l feet

Nominal Pulse Spacing: 0.502
501 int'l feet

Vertical Datum: NAVD88 U.S. feet

Horizontal Datum: NAD83_HARN U.S. feet

Project Projection/Coordinate Reference System:

NAD_1983_HARN_StatePlane_Arizona_Central_FIPS_0202_Feet_Intl international feet.

This Projection Coordinate Reference System is consistent across the following deliverables:

- | | |
|---|---|
| <input checked="" type="checkbox"/> Project Shapefile/Geodatabase | <input type="checkbox"/> Breaklines XML Metadata File |
| <input checked="" type="checkbox"/> Project Tiling Scheme Shapefile/Gdb | <input type="checkbox"/> Bare-Earth DEM XML Metadata File |
| <input type="checkbox"/> Checkpoints Shapefile/Geodatabase | <input type="checkbox"/> Swath LAS Files |
| <input type="checkbox"/> Project XML Metadata File | <input checked="" type="checkbox"/> Classified LAS Files |
| <input type="checkbox"/> Swath LAS XML Metadata File | <input type="checkbox"/> Breaklines Files |
| <input type="checkbox"/> Classified LAS XML Metadata File | <input checked="" type="checkbox"/> Bare-Earth DEM Files |

Check Point Shapefile/Geodatabase CRS

Not Provided

Project XML Metadata CRS

UTM_12N_NAD_1983

Swath LAS XML Metadata CRS

Not Provided

Classified LAS XML Metadata CRS

Not Provided

Breakline XML Metadata CRS

Not Provided

DEM XML Metadata CRS

Not Provided

Swath LAS Files CRS

Not Provided

Breakline Files CRS

Not Provided

Review Cycle

This section documents who performed the QA Review on a project as well as when QA reviews were started, actions passed, received, and completed.

Review Start Date:

3/26/2012

Action to Contractor Date	Issue Description	Return Date
3/26/2012	Request for Project Metadata and check points. *Received Metadata	4/3/2012

Review Complete: 7/12/2012

Metadata Review

Provided metadata files have been parsed using 'mp' metadata parser. Any errors generated by the parser are documented below for reference and/or corrective action.

The Project XML Metadata file parsed [with errors](#).

Type	Description or line numbers	Line(s) (or count)
Severity 5: Misplaced elements		
Error	Altitude Distance Units (4.2.1.3) is not permitted in Spatial Domain (1.5)	41
Error	Time of Day (9.1.2) is not permitted in Process Step (2.5.2)	254
Severity 3: Missing elements		
Error	Metadata Security Classification System (7.10.1) is required in Metadata Security Information (7.10)	188
Error	Metadata Security Handling Description (7.10.3) is required in Metadata Security Information (7.10)	188
Severity 1: Elements with improper values		
Error	improper value for Beginning Time (9.3.2)	21
Error	improper value for Ending Time (9.3.4)	21

Project QA/QC Report Review

ASPRS recommends that checkpoint surveys be used to verify the vertical accuracy of LiDAR data sets. Checkpoints are to be collected by an independent survey firm licensed in the particular state(s) where the project is located. While subjective, checkpoints should be well distributed throughout the dataset. National Standards for Spatial Data Accuracy (NSSDA) guidance states that checkpoints may be distributed more densely in the vicinity of important features and more sparsely in areas that are of little or no interest. Checkpoints should be distributed so that points are spaced at intervals of at least ten percent of the diagonal distance across the dataset and at least twenty percent of the points are located in each quadrant of the dataset.

NSSDA and ASPRS require that a minimum of twenty checkpoints (thirty is preferred) are collected for each major land cover category represented in the LiDAR data. Checkpoints should be selected on flat terrain, or on uniformly sloping terrain in all directions from each checkpoint. They should not be selected near severe breaks in slope, such as bridge abutments, edges of roads, or near river bluffs. Checkpoints are an important component of the USGS QA process. There is the presumption that the checkpoint surveys are error free and the discrepancies are attributable to the LiDAR dataset supplied.

For this dataset, USGS checked the spatial distribution of checkpoints with an emphasis on the bare-earth (open terrain) points; the number of points per class; the methodology used to collect these points; and the relationship between the data supplier and checkpoint collector. When independent control data are available, USGS has incorporated this into the analysis.

Checkpoint Shapefile or Geodatabase:

Checkpoint Distribution Image?

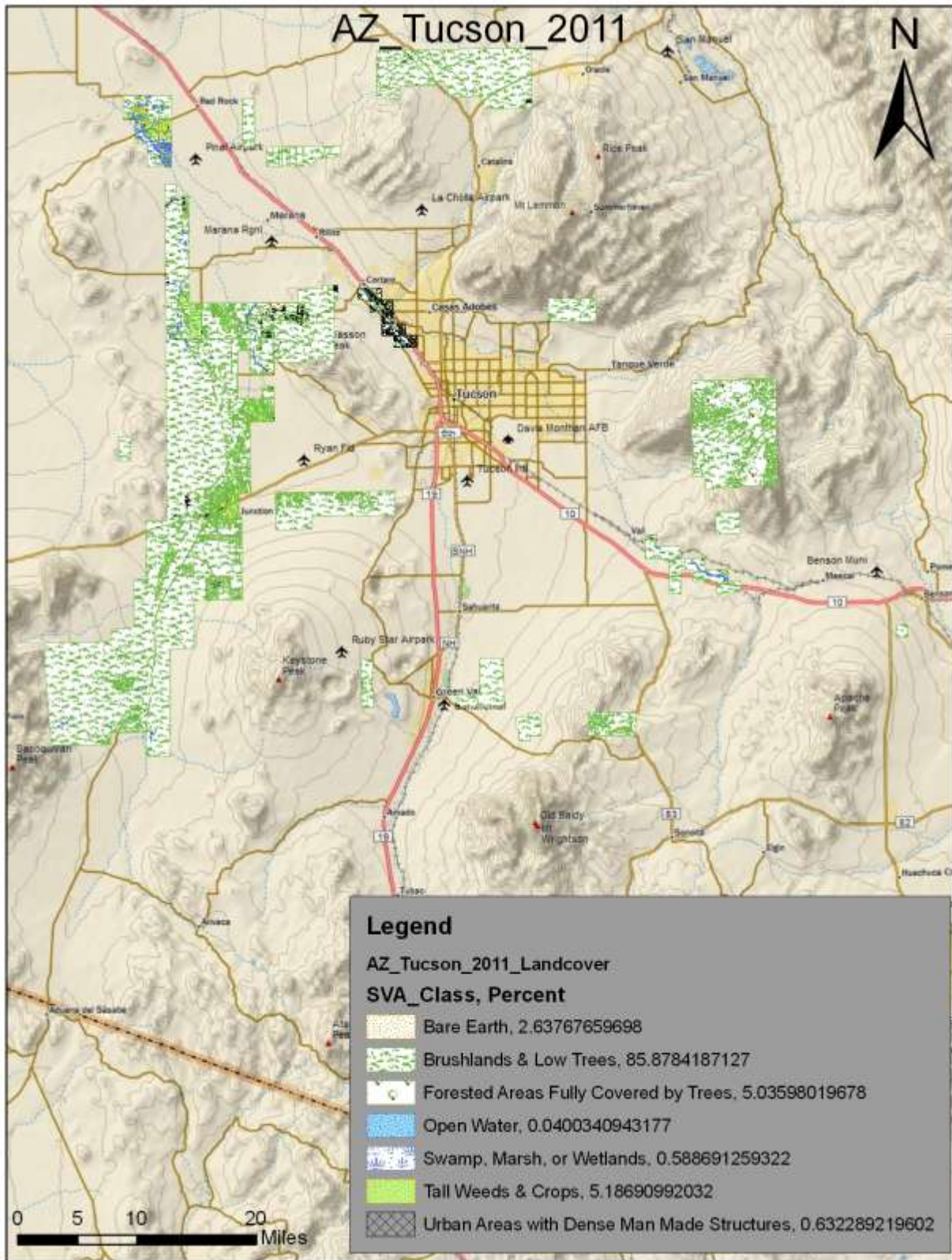
The following land cover classes are represented in this dataset (uncheck any that do not apply):

- Bare Earth
- Tall Weeds and Crops
- Brush Lands and Low Trees
- Forested Areas Fully Covered by Trees
- Urban Areas with Dense Man-Made Structures

There are a minimum of 20 checkpoints for each land cover class represented. Points within each class are uniformly distributed throughout the dataset. USGS was not able to locate independent checkpoints for this analysis. USGS accepts the quality of the checkpoint data for these LiDAR datasets.

Errors, Anomalies, Other Issues to document? Yes No

Image?



SVA Landcovers and Percentages (From Aggregated 2006 NLCD)

Image?

No Checkpoint Data Received for Bare Earth or BrushLands and Low Trees. There is a Vertical Accuracy Statement in the Delivered Project Metadata, but it is not clear if it is referring to FVA or CVA or to Swath LAS, Classified LAS, or the DEMs. Reported Values are Based on this statement.

Image?

North American Vertical Datum 88 (NAVD 88) LiDAR Specifications; .49 Ft RMSE

Pima Control Accuracy Report ----- Report Disclaimer ----- This report does not guarantee accuracy. The report only reflects one statistical representation of the control points, LIDAR data and surface used. This report does not replace a through quality control process. ----- Report Summary ----- Number Easting Northing Known Z Laser Z Dz -----

--	17	1024733.311	293793.960	3689.029	3689.810	+0.781	23	900201.474	
	433915.051	2311.280	2311.940	+0.660	8	901816.338	380958.082	2829.550	
	2830.050	+0.500	19	864544.979	386856.858	2644.035	2644.350	+0.315	10
	874366.355	368701.925	2742.760	2743.060	+0.300	18	912872.663		
	470575.885	2262.299	2262.560	+0.261	11	869956.830	338484.073	2987.611	
	2987.800	+0.189	5	869956.850	338484.087	2987.622	2987.800	+0.178	25
	1117464.586	361379.398	3593.018	3593.180	+0.162	24	915897.099		
	447499.675	2287.622	2287.750	+0.128	12	957538.022	315475.622	3538.412	
	3538.510	+0.098	7	897963.405	397351.263	2526.548	2526.620	+0.072	20
	863325.291	331234.301	2878.193	2878.160	-0.033	21	857454.543		
	304371.690	3005.676	3005.620	-0.056	9	889744.582	365014.266	3114.748	
	3114.620	-0.128	4	1093310.004	371250.627	3427.550	3427.420	-0.130	22
	847155.327	295954.592	3158.344	3157.810	-0.534	1	1004774.162		
	408555.553	2596.998	outside *	2	1119088.015	379722.623	3848.783	outside *	
	3	1195142.157	335654.866	4206.714	outside *	6	918955.007	407346.534	
	2448.660	outside *	13	967499.632	384964.702	2798.074	outside *	14	
	959944.365	328969.538	3593.874	outside *	15	997966.436	307197.451		
	3009.428	outside *	16	1018069.521	330677.428	2972.241	outside *		

Average dz +0.163 Minimum dz -0.534 Maximum dz +0.781 Average magnitude 0.266 Root mean square 0.343 Std deviation 0.311

Accuracy values are reported in terms of Fundamental Vertical Accuracy (FVA), Supplemental Vertical Accuracy(s) (SVA), and Consolidated Vertical Accuracy (CVA).

Accuracy values are reported in:

Required FVA Value is or less.

Target SVA Value is or less.

Required CVA Value is or less.

The reported FVA of the LAS Swath data is .

The reported FVA of the Bare-Earth DEM data is .

SVA are required for each land cover type present in the data set with the exception of bare-earth. SVA is calculated and reported as a 95th Percentile Error.

Land Cover Type	SVA Value	Units
<i>Tall Weeds and Crops</i>	<input type="text"/>	N/A
Brush Lands and Low Trees	<input type="text"/>	U.S. feet
<i>Forested Areas Fully Covered by Trees</i>	<input type="text"/>	N/A
<i>Urban Areas with Dense Man-Made Structur...</i>	<input type="text"/>	N/A

The reported CVA of this data set is: .

LAS Swath File Review

LAS swath files or raw unclassified LiDAR data are reviewed to assess the quality control used by the data supplier during collection. Furthermore, LAS swath data are checked for positional accuracy. The data supplier should have calculated the Fundamental Vertical Accuracy using ground control checkpoints measured in clear open terrain. The following was determined for LAS swath data for this project:

LAS Version

LAS 1.2 LAS1.3 LAS 1.4

Swath File Characteristics

- Separate folder for LAS swath files
- Each swath files <= 2GB
- *If specified, *.wdp files for full waveform have been provided

The reported FVA of the LAS swath data is .

Based on this review, the USGS accepts the LAS swath file data.

Errors, Anomalies, Other Issues to document? Yes No

Image?

Swath Data Not Delivered

LAS Tile File Review

Classified LAS tile files are used to build digital terrain models using the points classified as ground. Therefore, it is important that the classified LAS are of sufficient quality to ensure that the derivative product accurately represents the landscape that was measured. The following was determined for classified LAS files for this project:

Classified LAS Tile File Characteristics

- Separate folder for Classified LAS tile files
- Classified LAS tile files conform to Project Tiling Scheme
- Quantity of Classified LAS tile files conforms to Project Tiling Scheme
- Classified LAS tile files do not overlap
- Classified LAS tile files are uniform in size
- Classified LAS tile files have no points classified as '12'

- Point classifications are limited to the standard values listed below:

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)

- Buy up?

Additional classifications in this data set.

- 3 - Tall weeds and crops (low vegetation)
- 4 - Brush lands and low trees (medium vegetation)
- 5 - Forested areas fully covered by trees
- 6 - Urban area with dense man-made structures

Based on this review, the USGS accepts the classified LAS tile file data.

Errors, Anomalies, Other Issues to document? Yes No

Image?

Spatial Reference System not defined in LAS Files

Image?

Project Tiling Scheme was for the Ortho Photos, LAS Tiling Scheme not present, the "Classified_PC_Stats File can Serve as a Tiling Scheme"

Image?

Class 12 "overlap" was used in classification. DEM's were created in house and excluded this class,

Image?

A few Files had points sitting on unusual classes (20, 22), LAS Files:
12S12E29_LDRY11.las, 12S12E32_C50Y11.las, 12S12E33_LDRY11.las,
12S12E28_LDRY11.las

Breakline File Review

Breaklines are vector feature classes that are used to hydro -flatten the bare earth Digital Elevation Models.

Breakline File Characteristics

- Separate folder for breakline files
- All breaklines captured as PolylineZ or PolygonZ features
- No missing or misplaced breaklines

Based on this review, the USGS accepts the breakline files.

Errors, Anomalies, Other Issues to document? Yes No

Image for error?

No Breaklines Provided.

Bare-Earth DEM Tile File Review

The derived bare-earth DEM file receives a review of the vertical accuracies provided by the data supplier, vertical accuracies calculated by USGS using supplied and independent checkpoints, and a manual check of the appearance of the DEM layer.

Bare-Earth DEM files provided in the following format:

Bare-Earth DEM Tile File Characteristics

- Separate folder for bare-earth DEM files
- DEM files conform to Project Tiling Scheme
- Quantity of DEM files conforms to Project Tiling Scheme
- DEM files do not overlap
- DEM files are uniform in size
- DEM files properly edge match
- Independent check points are well distributed

All accuracy values reported in .

Reported Accuracies

Land Cover Category	# of Points	Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy _z) Required FVA = 0.9604 or less.	Supplemental Vertical Accuracy @95th Percentile Error Target SVA = or less.	Consolidated Vertical Accuracy @95th Percentile Error Required CVA = 0.9604 or less.
Open Terrain	?	0.67228		
<i>Tall Weeds and Crops</i>				
Brush Lands and Low Trees				
<i>Forested Areas Fully Covered by Trees</i>				
<i>Urban Areas with Dense Man-Made Structures</i>				
Consolidated	?			0.67228

- QA performed Accuracy Calculations?

Based on this review, the USGS recommends the bare-earth DEM files for inclusion in the 1/3 Arc-Second National Elevation Dataset.

Based on this review, the USGS accepts the bare-earth DEM files.

Bare-Earth DEM Anomalies, Errors, Other Issues

Errors, Anomalies, Other Issues to document? Yes No

Image?



Classification of Bare Earth is a little rough in parts of the DEMs, though still a good representation of Bare Earth (shaded by slope here).

Image?



Some of the building levels appear quite raised in comparison to surrounding terrain.

Image?

Though there was no breakline enforcement for this dataset, it is a very dry area and water issues were below the spec requirements and the dataset is thus recommended for the 1/3rd Arc Second NED.

Image?

As no control points could be obtained for this project, the vertical accuracy is accepted as reported.

This is the end of the report.

