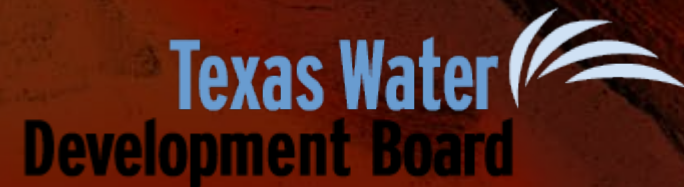


# Texas Strategic Mapping Program Statewide Lidar Derivative Data Initiatives

May 28, 2019

NCTCOG Regional Meeting

Arlington, Texas



A topographic map of Texas is shown in the background, with elevation indicated by colors: green for lower elevations, yellow and orange for mid-elevations, and brown and red for higher elevations. A large white circle is overlaid on the left side of the map, containing the title and a list of bullet points.

# Texas StratMap Program

- 
- Maintain authoritative, trusted **state geospatial layers** based on national standards.
    - Acquire new geospatial data
    - Update existing geospatial data
  - Define a common mapping standard to ensure consistent, high quality data for the State of Texas and the public.
  - Attract partnerships to increase the purchasing power of public funds.

- **Bandera County River Authority and Groundwater District**
- Bexar County Appraisal District
- **Bexar Metro 9-1-1**
- Brazos Central Appraisal District
- Brazos County Emergency Communications
- Brownsville Public Utility Board
- **Capital Area Emergency Communications District**
- **Central Texas Council of Governments**
- City of Austin
- City of Bee Cave
- City of Bryan
- City of Burnet
- City of Cedar Park
- City of College Station
- City of Georgetown
- City of Houston
- City of Hutto
- City of Laredo
- City of Leander
- City of Lockhart
- City of Marble Falls
- City of McAllen
- City of Palestine
- City of Pflugerville
- City of Pharr
- City of Port Isabel
- City of Round Rock
- City of San Antonio
- City of San Marcos
- City of Tyler
- City of Waco
- City of Weslaco
- City of West Lake Hills
- **East Texas Council of Governments**
- **Edwards Aquifer Authority**
- Fort Bend County Drainage District
- Hays County
- Hidalgo County Drainage District #1
- Hidalgo County Metropolitan Planning Organization
- **Hidalgo County Regional Mobility Authority**
- **Houston-Galveston Area Council**
- Laguna Madre Water District
- **Lower Rio Grande Valley Development Council**
- McLennan County
- McLennan County 9-1-1
- National Geospatial-Intelligence Agency
- **Railroad Commission of Texas**
- **Sabine River Authority**
- **San Antonio River Authority**
- Smith County
- Smith County 9-1-1
- Smith County Appraisal District
- **Tarrant Regional Water District**
- **Texas A&M University**
- **Texas Commission on Environmental Quality**
- **Texas Commission on State Emergency Communications**
- **Texas Department of Transportation**
- **Texas Eastern 9-1-1**
- **Texas Forest Service**
- **Texas General Land Office**
- **Texas Municipal Power Agency**
- **Texas Parks and Wildlife Department**
- **Texas Water Development Board**
- **Trinity River Authority**
- **University Lands**
- U.S. Army Corps of Engineers
- U.S. Fish & Wildlife Service
- U.S. Geological Survey
- USDA Natural Resources Conservation Service
- **Williamson County**

 Local/Municipality

 Regional Agency

 State Agency

 Federal Agency

Over 70 Agencies have partnered with the StratMap Program for data acquisitions

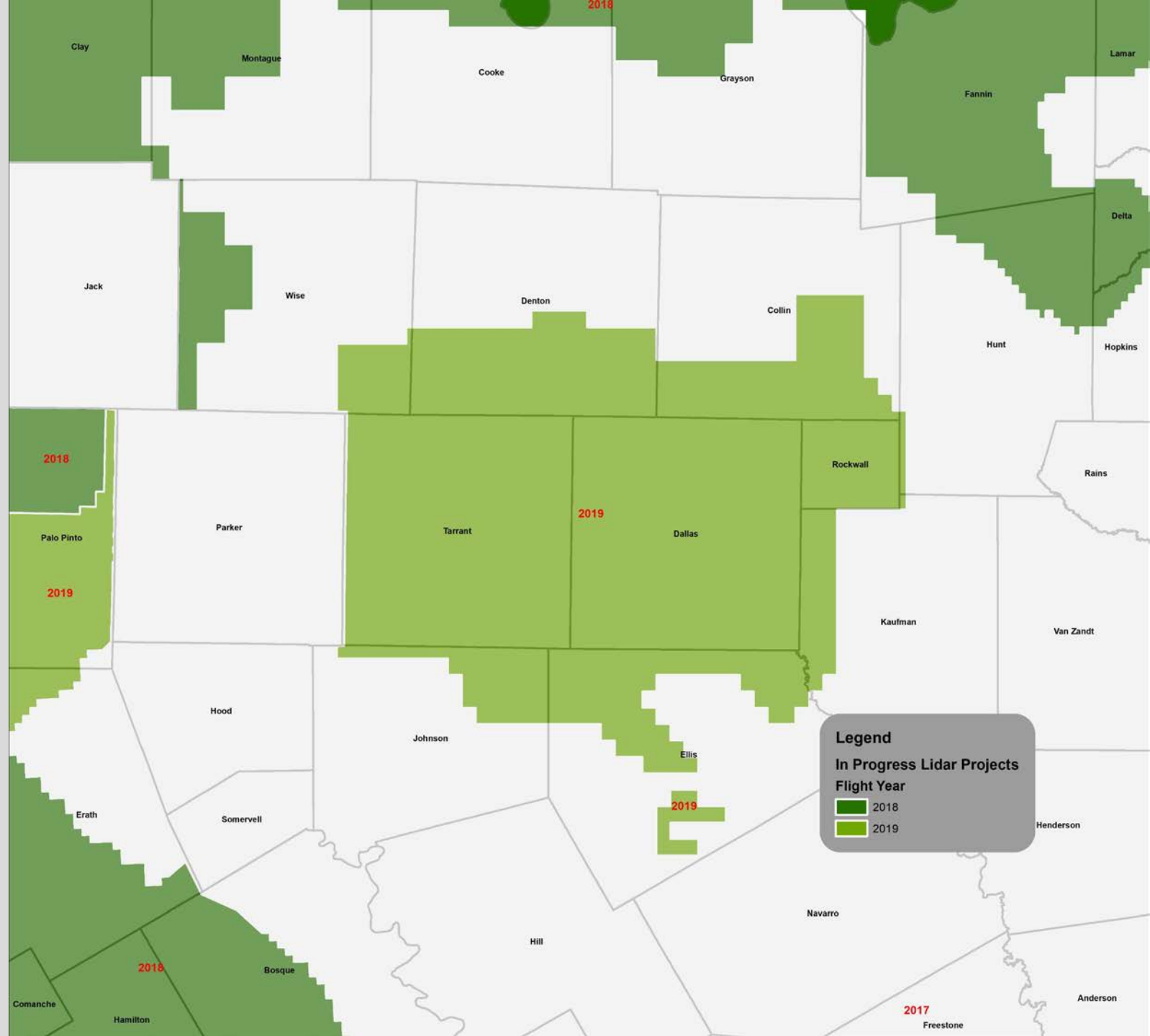
# Statewide Lidar Status

- Lidar has now been collected for the entire State of Texas.
- Processing for much of the state is still ongoing.
- Statewide lidar availability is estimated to be achieved Fall 2020-Summer 2021 depending on the release of ongoing USGS projects.



# Recent Lidar Acquisitions in the Area

- USGS flew new lidar in the region during the 2018 and 2019 leaf-off seasons.
- 2018 data should be available Winter 2019- Spring 2020.
- 2019 data should be available Winter 2020-Spring 2021.



# Lidar Specifications and Products

TNRIS	USGS QL2
0.5m NPS/4 ppsm	0.71m NPS/ 2 ppsm
RMSEz 10cm (non-vegetated)	RMSEz 10cm (non-vegetated)
Classifications: 1,2,3,4,5,6,7,9,10,13,17	Classifications: 1,2,7,9,10,17,18

### Lidar Products Available

- LAS Point Cloud
- Hydro-flattened DEM
- Hydro-breaklines
- File level metadata
- 3<sup>rd</sup> party QAQC Report(StratMap projects only)

### TNRIS Derivative Datasets

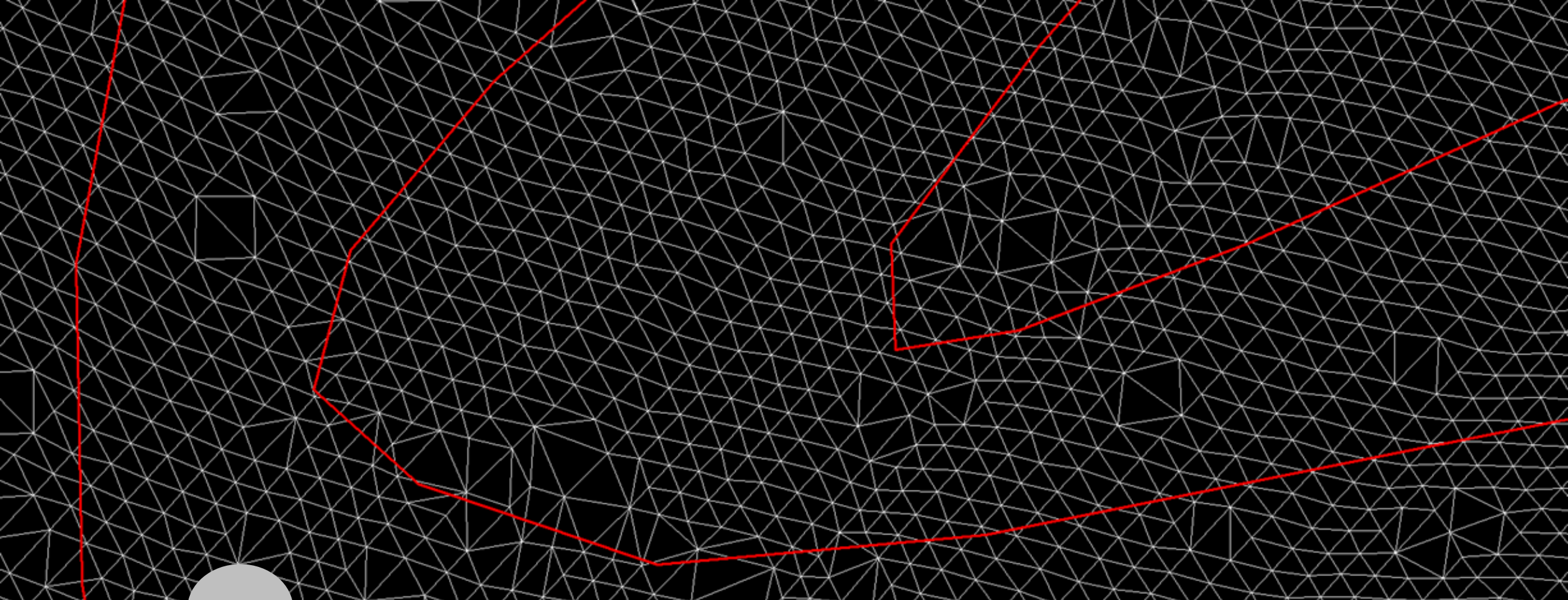
- 2ft and 5ft cartographic contours
- Building footprints(still in production)

All data and derivative datasets will be publicly available for download at [Data.TNRIS.org](http://Data.TNRIS.org)

A map of Virginia with county boundaries. The majority of the state is shaded in orange, representing Federal Lidar coverage. Several counties, primarily in the western and central parts of the state, are shaded in blue, representing StratMap Lidar coverage. A large dark brown semi-circular overlay is on the left side of the map, containing text.

# Federal vs StratMap Lidar

- Over 85% of the State will be covered in Federal Lidar
- Classifying vegetation, building and culverts is a priority for the StratMap Lidar program
- Partnerships for justification and funding are needed to ensure initiatives to classify data becomes a reality



# What are Contours?

- Contours are lines that approximates where the threshold for an elevation interval is exceeded
- Contours represent a range of elevations instead of actual elevations



A topographic map of Texas is shown in the background, with elevation contours and a color gradient from blue (low elevation) to yellow (high elevation). A large, semi-transparent circular overlay is positioned on the left side of the map, containing the title and a list of bullet points.

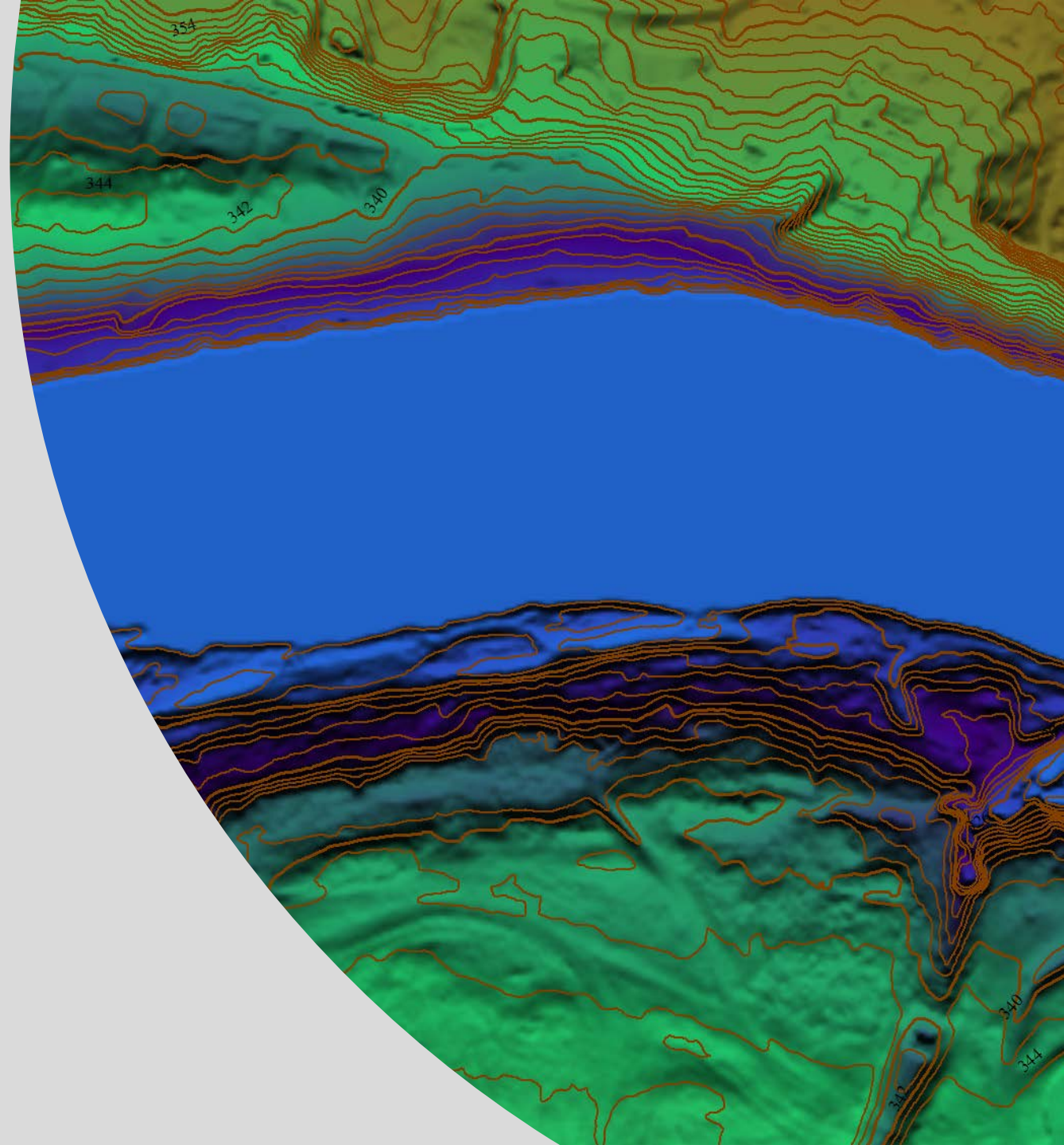
# Contour Data for Texas

- TNRIS produces 5ft and 2ft cartographic contours for lidar projects that support their creation.
- Almost all lidar data available for Texas supports contour creation.
- Statewide contour datasets will be compiled once statewide lidar coverage is completed.
- Requirements for cartographicContour creation:
  - 5ft- 3 meter hydroflattened DEM
  - 2ft – 1 meter hydroflattened DEM

# Cartographic Contours by TNRIS

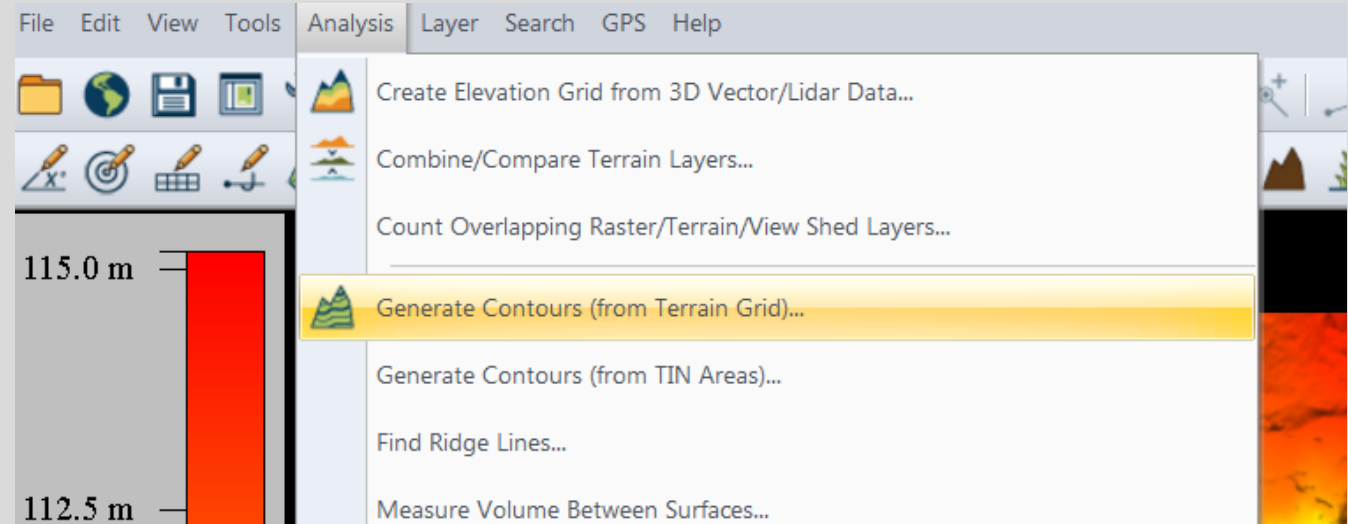
---

- Contours Available at [data.tnris.org](https://data.tnris.org) are produced for cartographic purposes
- These contours should be used for reference and general mapping purposes
- Limitations for TNRIS contours
  - Limited QAQC
  - No Topology checks
  - Minimal smoothing



# Creating Contours from a DEM in Global Mapper

- Turn on the hydro-flattened DEM layer you created.
- Click Analysis and select Generate Contours(from Terrain Grid)



# Contour Creation Method

- Set contour interval to 5ft
- Make sure sample spacing is the same as your DEM resolution
- Make sure No Resampling is selected
- Check smooth Contour lines
- Click OK

Contour Generation Options

Contour Options | Simplification | Tiling | Contour Bounds

Description: GENERATED CONTOURS

Contour Interval: 5 FEET  Only Generate Contour Lines at Specified Height

ADVANCED - Contour Interval Multiplier

Minor Contours: 1 Major Contours: 5

Elevation Range (Default is Entire Loaded Range)

Generate contours within following range of elevations: 95.9 to 115.2 METERS  Start at Minimum Elevation Instead of at First Interval Multiple Within Specified Range

Resolution (in Current Projection Units)

The resolution affects fidelity with which contours are generated. Larger numbers result in less detailed contour lines that take up less space. Typically you'll just want to accept the defaults.

X-axis: 1 meters Y-axis: 1 meters

Resampling: No Resampling (Nearest Neighbor)

Generate Area Features Colored Based on the Current Elevation Shader in Addition to Contours

Generate Spot Elevations at Min/Max Elevations

Interpolate to Fill Small Gaps in Data

Append Unit Labels ('m' or 'ft') to Elevation Labels

Smooth Contour Lines/Areas to Improve Appearance

Export Contours Directly to Package Files Rather Than Displaying in the Main Map View. Use with Gridding Option to Allow Contouring of Very Large Areas

Advanced Options

Create Contours Where Elevations Pass Down to Contour Value Rather than as They Go Down From One (Good for Shoreline Generation)

Discard Closed Contour Lines Shorter than 20 meters

OK Cancel Apply Help

The background is a topographic map with brown contour lines on a black background. A semi-transparent white circle is overlaid on the right side of the map. Inside the circle, the text "Now you have Contours" is written in a black, sans-serif font. Below the text is a short horizontal line.

Now you have  
Contours

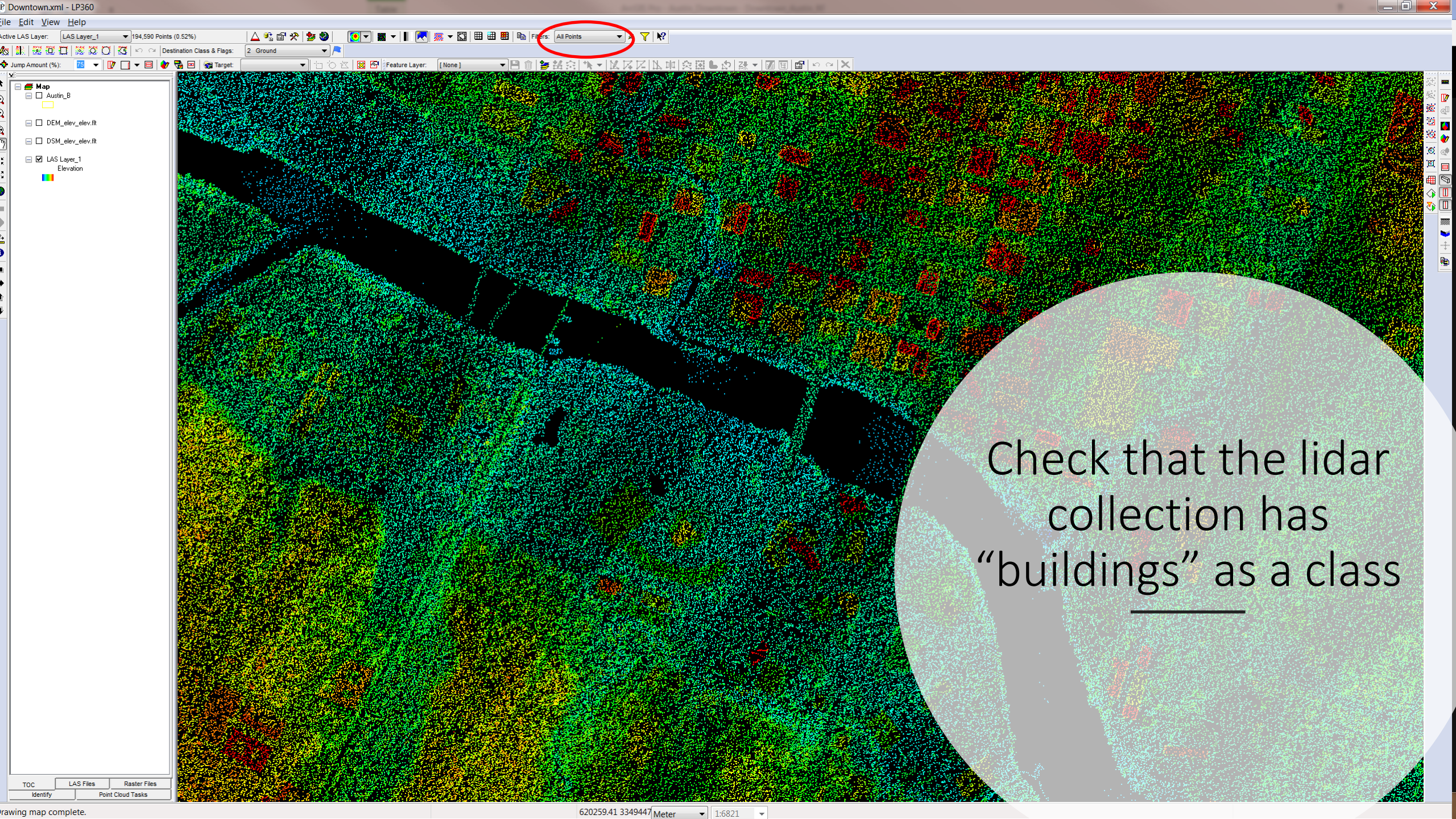
---

An aerial view of a city with 3D building footprints overlaid on a purple-tinted map. The buildings are rendered in white and grey, showing their height and shape. The map below them is a grid of streets with purple highlights indicating building footprints. A large, semi-transparent white circle is overlaid on the left side of the image, partially obscuring the buildings and map.

# Statewide 3D Building Footprints Initiative

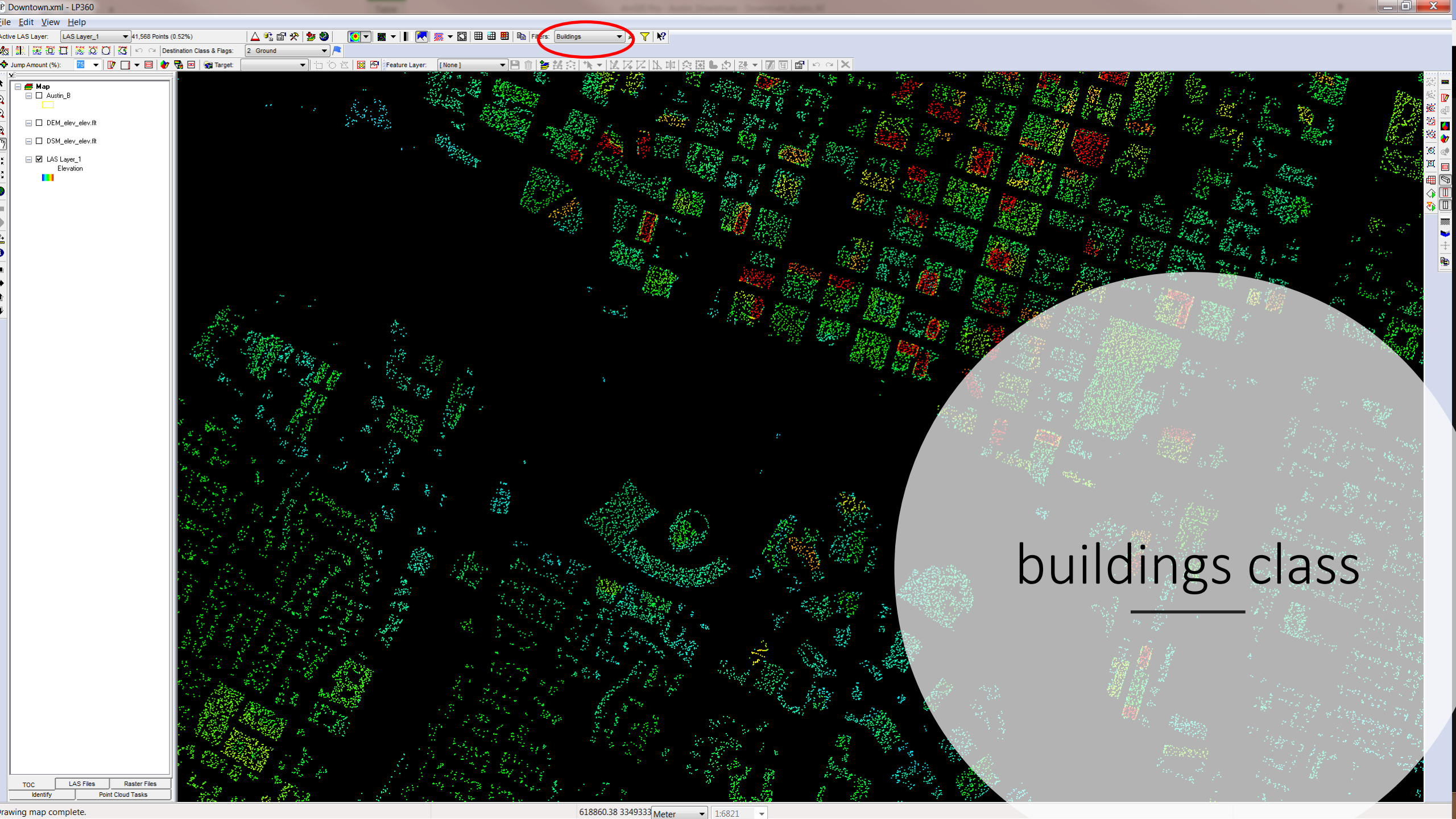
# 10 Step AGENDA

1. Check that the lidar collection has “buildings” as one of the classifications of the point cloud (LP360)
2. Create building footprint polygons (LP360)
3. If Digital Elevation Model is not available create it using “ground” classified points (LP360)
4. Create a Digital Surface Model using “ground” and “building” classified points (LP360)
5. Create a new raster mosaic for DEM if DEM tiles available from vendor (ArcGIS Pro)
6. Create a normalized Digital Surface Model (nDSM) subtracting the DEM from the DSM to get object heights (ArcMap or ArcGIS Pro)
7. Using DEM, DSM, nDSM and building footprints extract the roof forms for buildings and Create 3D buildings (ArcGIS Pro)
8. Enable and symbolize 3D buildings in a 3D Scene (ArcGIS Pro)
9. Review buildings and QA/QC the attributes, fix incorrect roof forms (ArcGIS Pro)
10. Next Steps



Check that the lidar  
collection has  
"buildings" as a class



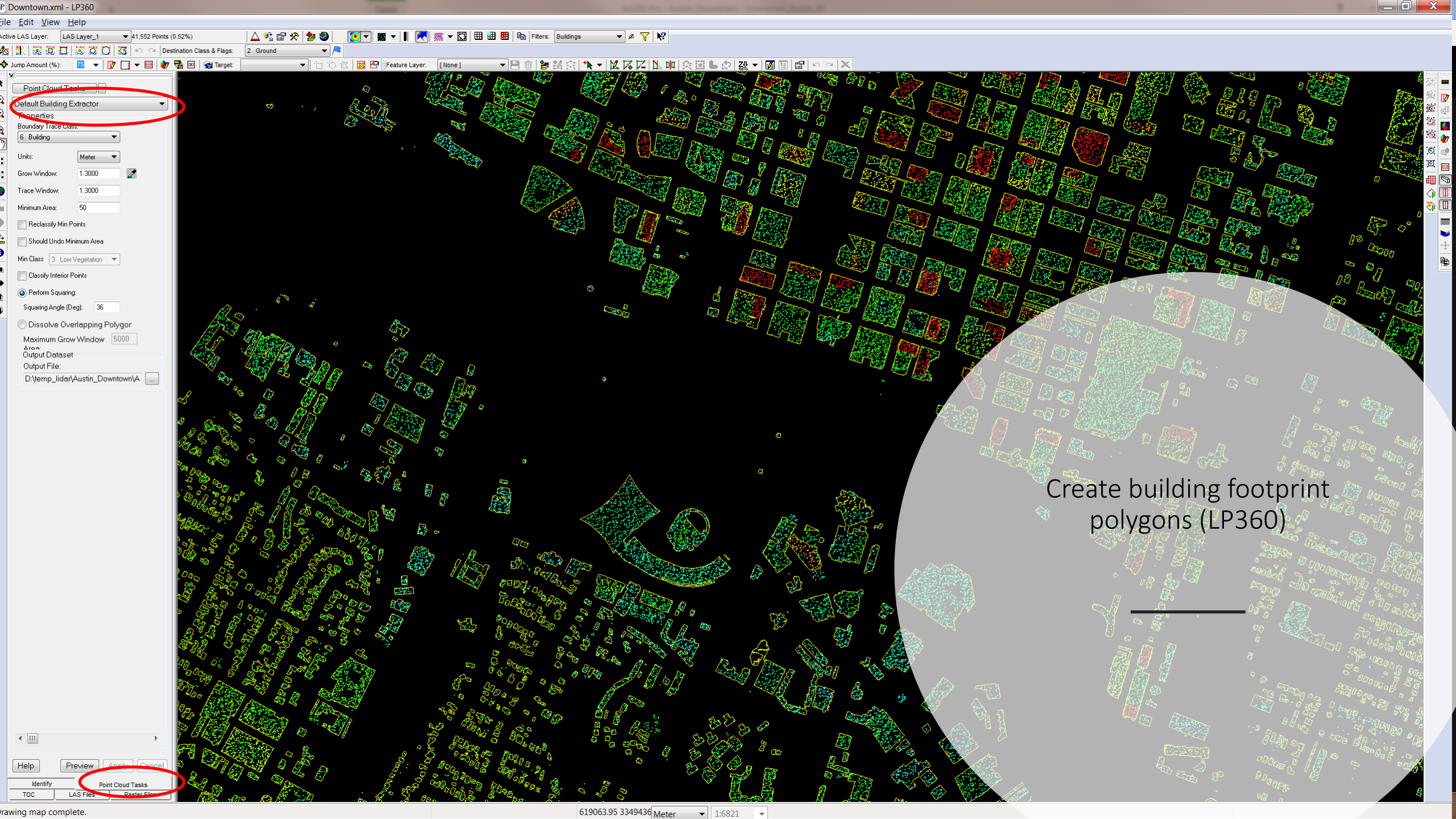


Buildings

- Map
- Austin\_B
- DEM\_elev\_elev.flt
- DSM\_elev\_elev.flt
- LAS Layer\_1  
Elevation

buildings class

---



Create building footprint polygons (LP360)

Point Cloud Tasks

Default Building Extractor

Boundary Trace Class: 6 Building

Units: Meter

Grow Window: 1,300

Trace Window: 1,300

Minimum Area: 50

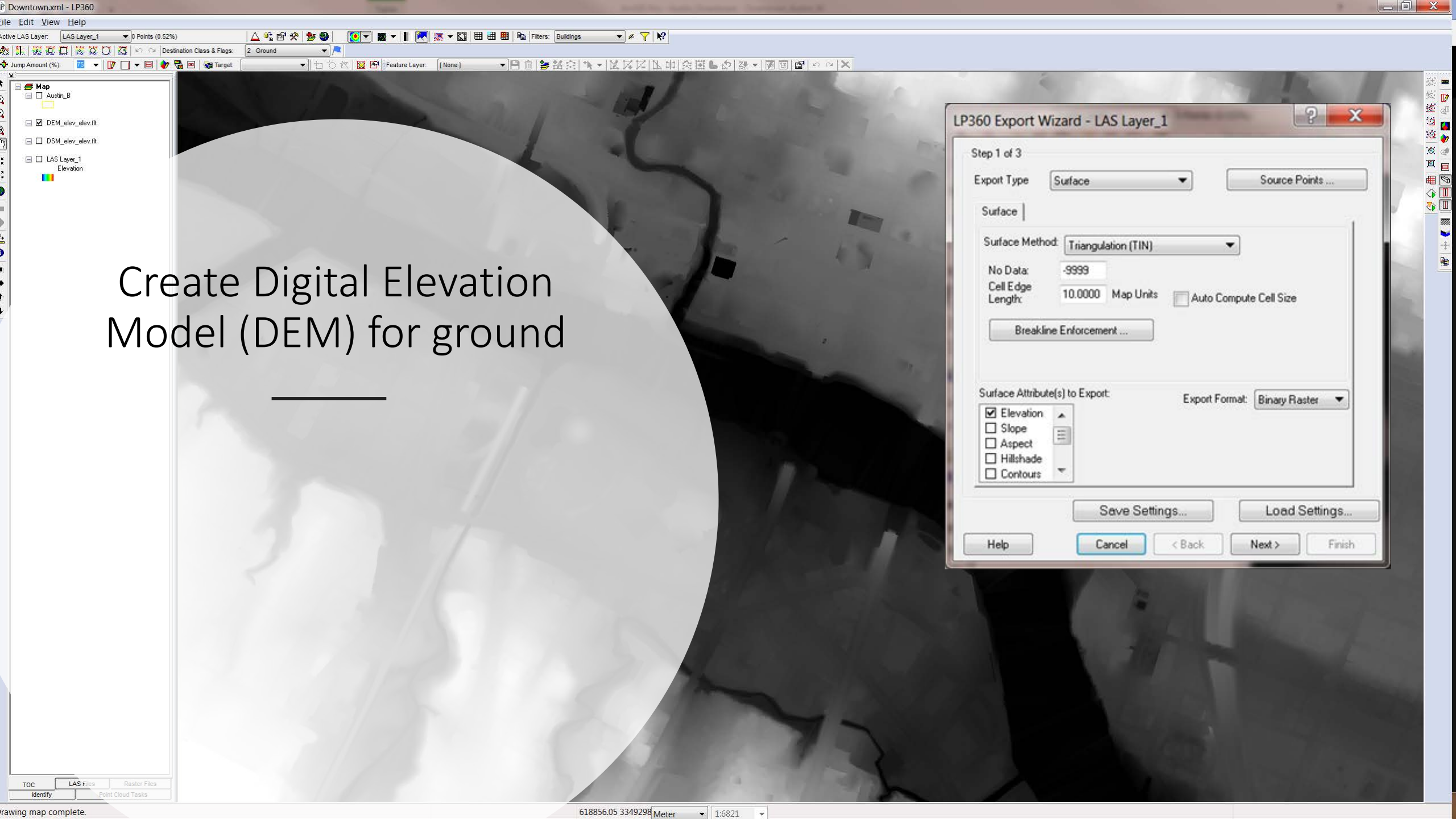
Min Class: 3 Low Vegetation

Squaring Angle (Deg): 36

Maximum Grow Window: 5000

Output Dataset: D:\temp\_lidar\Austin\_Downtown\A

Point Cloud Tasks



# Create Digital Elevation Model (DEM) for ground

LP360 Export Wizard - LAS Layer\_1

Step 1 of 3

Export Type: Surface [Source Points ...]

Surface

Surface Method: Triangulation (TIN)

No Data: -9999

Cell Edge Length: 10.0000 Map Units  Auto Compute Cell Size

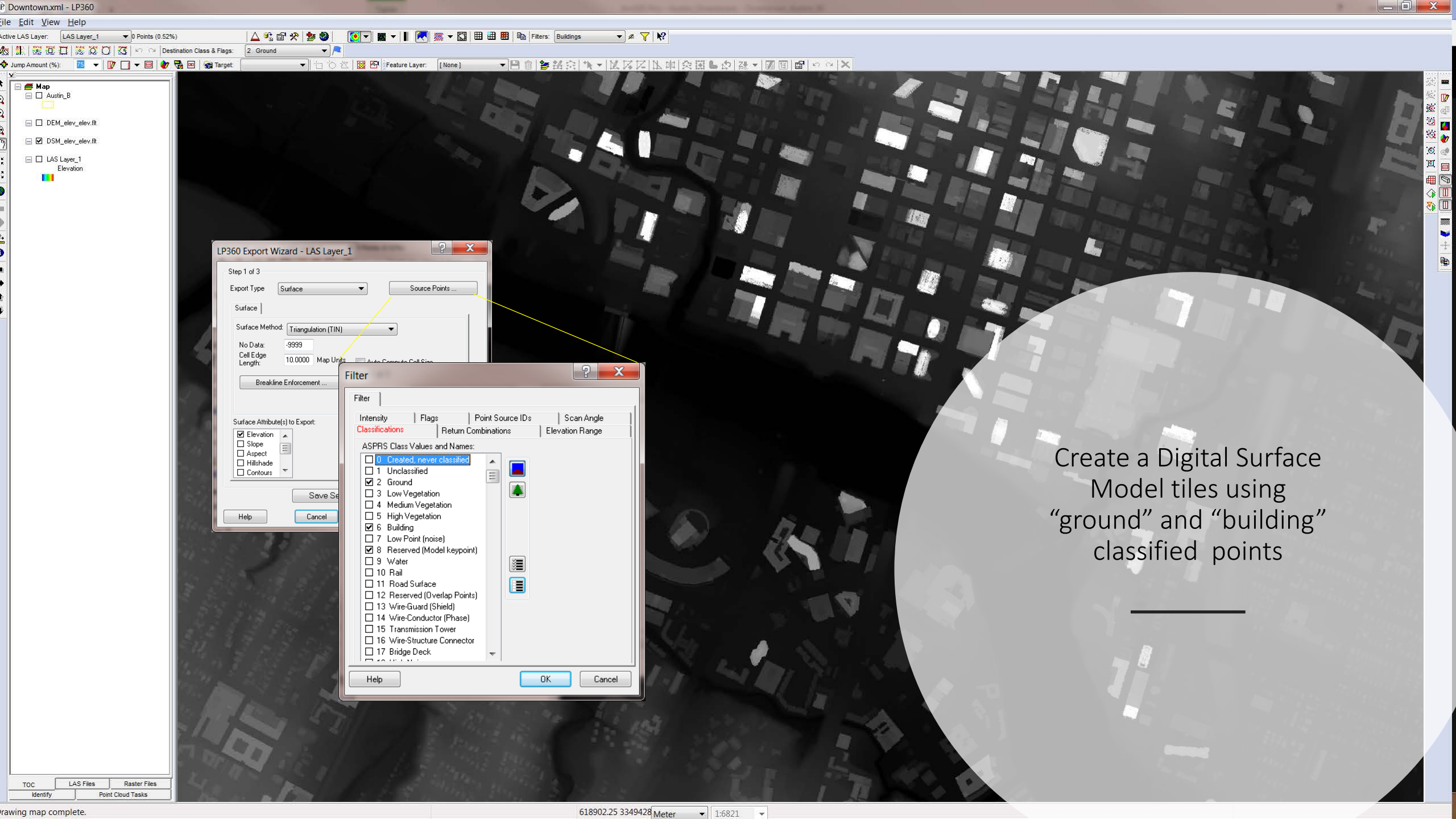
Breakline Enforcement ...

Surface Attribute(s) to Export:  Elevation  Slope  Aspect  Hillshade  Contours

Export Format: Binary Raster

Save Settings... Load Settings...

Help Cancel < Back Next > Finish



Create a Digital Surface Model tiles using "ground" and "building" classified points

File Edit View Go Geoprocessing Customize Windows Help

F:\Buildings\_Footprints\Austin\_West.gdb\nDSM

Catalog Tree

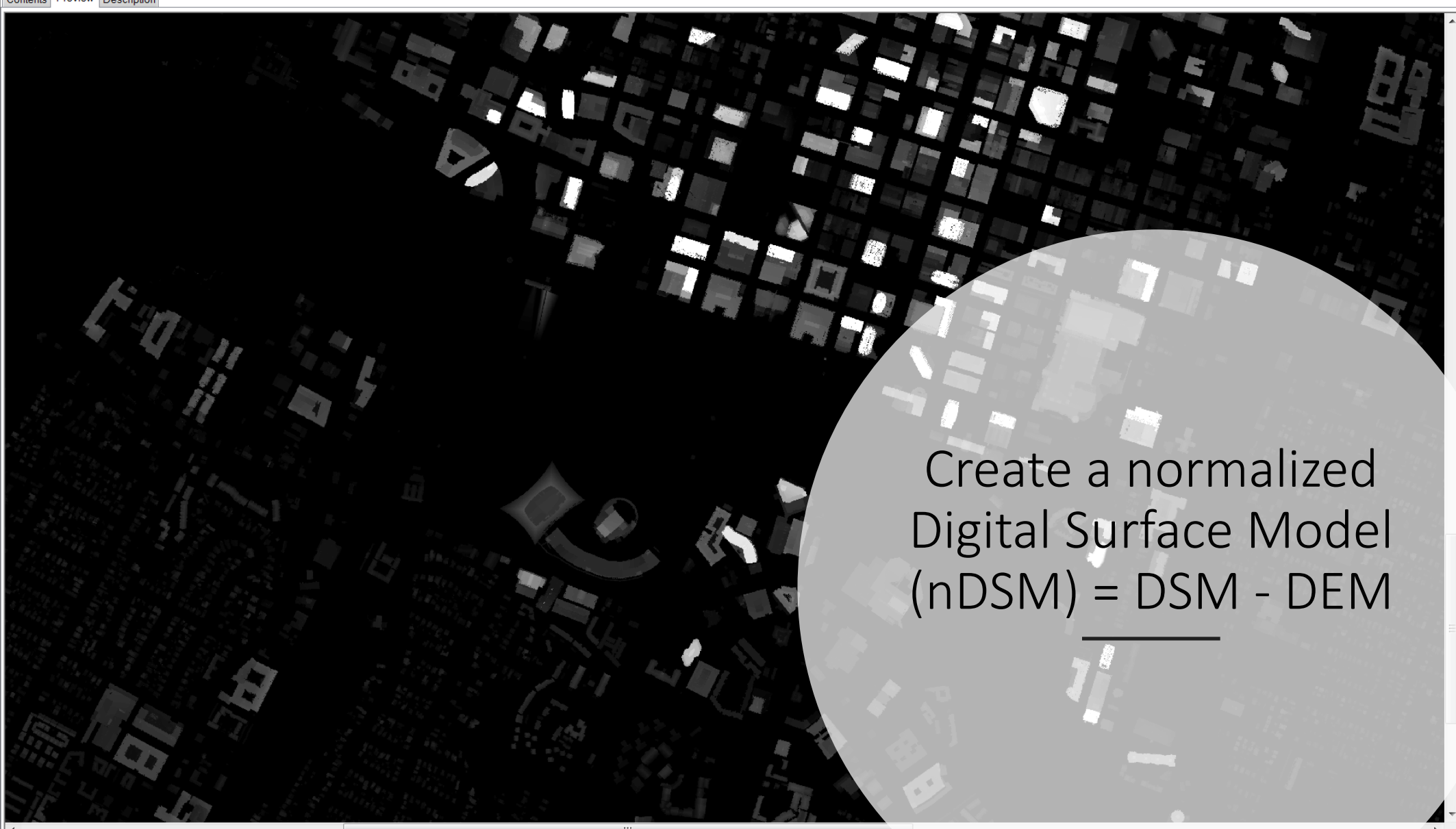
- Buildings\_Footprints
  - ImportLog
  - Index
  - Roof\_Form\_Extraction
  - Solution
  - Stratmap11\_Austin\_and\_Others
  - Stratmap11\_Bell\_McLennan\_Burn
  - Stratmap11\_Denton\_Collin\_Cooke
  - Stratmap11\_Gonzales\_Caldwell
  - Stratmap11\_Kaufman
  - Stratmap11\_Kendal\_Kerr
  - Stratmap11\_Newton\_Sabine\_Shel
- Austin\_West.gdb
  - DEM\_elev\_elev
    - Downtown\_Austin\_RF
    - Downtown\_B
  - DSM\_elev\_elev
  - nDSM
- CityOfGrandPrairie09gdb.gdb
- EL\_PasoIBWC\_BorderAreaNorth.g
- FarEastArea.gdb
- Fort\_Bend.gdb
- IBWC11\_Border\_North.gdb
- McLennanCoTX\_9\_19\_2016.gdb
- Stratmap09\_Dallas.gdb
- Stratmap09\_Goliad.gdb
- Stratmap09\_La\_Salle.gdb
- Stratmap09\_Zapata\_County\_Area
- Stratmap10\_Grayson.gdb
- Stratmap10\_Wize\_Montague\_Coc
- Stratmap11\_Austin\_and\_Others\_Sc
- Stratmap11\_Bell\_McLennan\_Burn
- Stratmap11\_Kaufman.gdb
- Stratmap11\_Kendal\_Kerr\_RawBuil
- Stratmap11\_Newton\_Sabine\_Shel
- Stratmap11\_Original\_Denton\_Coll
- Stratmap12\_Callahan.gdb
- Stratmap12\_Dewitt.gdb
- Stratmap12\_Hood\_Johnson.gdb
- Stratmap13\_Navarro\_Hill\_Ellis\_Jot
- Stratmap13\_Willson\_Karnes.gdb
- Stratmap14\_Bandera\_Read\_Uvald
- Stratmap14\_Dallas.gdb
- Stratmap14\_Ellis\_Kaufman.gdb
- Stratmap14\_Fort\_Bend.gdb
- Stratmap14\_FreeStone\_Anderson
- Stratmap14\_Lampasas\_Mills.gdb
- Stratmap14\_VanZandt\_Hendersor
- Stratmap15\_Brazos.gdb
- Stratmap17\_Jefferson.gdb
- Fort\_Bend.tbx
- Local\_Scene.tbx
- Roof\_Form\_Extraction.tbx

- EARS

Contents Preview Description

Preview: Geography

File Geodatabase Raster Dataset selected



Create a normalized  
Digital Surface Model  
(nDSM) = DSM - DEM

---

Tasks

Extract the...

1. Extract the...

1. Under **Buildings**...

2. Under **DSM, DTM**...

3. If necessary, ch...

**Minimum Slope R**...

values large enough...

included, but not...

values are in feet...

change the values...

4. Choose the name...

**Polygons.**

5. If you want, check **Simplify**...

vertices from the building...

6. If necessary, choose a **Simplify**...

maximum degree of simplification...

Pending edits. Save edits to complete.

Parameters | Environments

\* Buildings

\* DSM

\* DTM

\* nDSM

Minimum Flat Roof Area 250

Minimum Slope Roof Area 75

Minimum Roof Height 8

\* Output Building Polygons

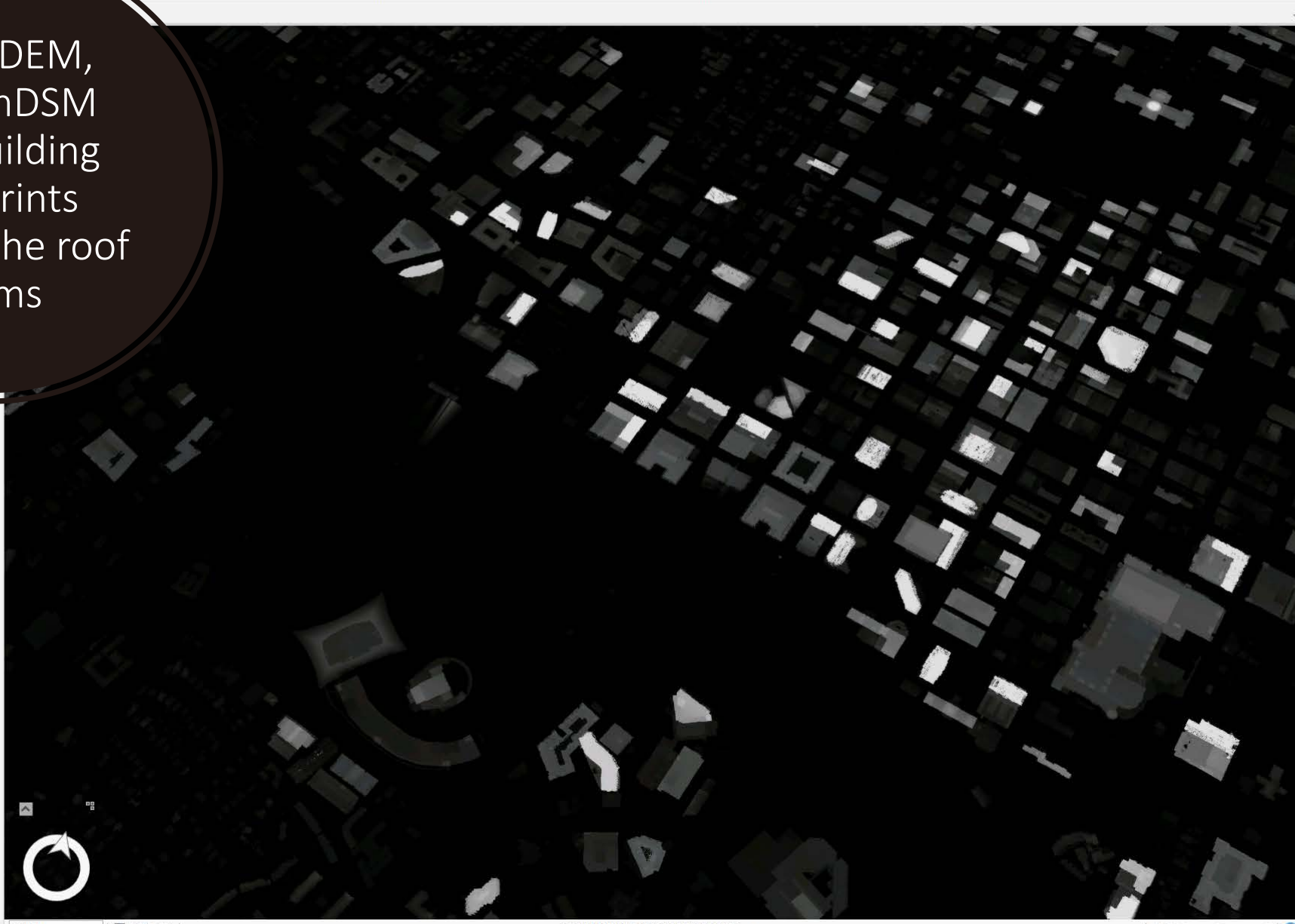
Simplify Buildings

Simplify Tolerance

Progress (1/1)

Finish

Using DEM, DSM, nDSM and building footprints extract the roof forms



Geoprocessing

Find Tools

Favorites | Toolboxes | Portal

- Calculate Field (Data Management Tools)
- Buffer (Analysis Tools)
- Near (Analysis Tools)
- Spatial Join (Analysis Tools)
- Intersect (Analysis Tools)

Recent Tools

- Copy Features (Data Management Tools)
- Apply Symbology from Layer (Data Management Tools)
- Extract Roof Form (RoofFormExtraction)**

2,354 m 91.7615499°W 30.2705649°N 3.683 m Selected Features: 0

Symbology Geoprocessing

Enable and symbolize 3D buildings in a 3d Scene

Contents

Search

Drawing Order

Scene

3D Layers

- Downtown
- Downtown
- Downtown\_B

2D Layers

- txdot\_2015\_county\_detailed
- World Light Gray Reference
- nDSM

Value

209.73

-21.3024

- DSM\_elev\_elev

Value

353.538

114.285

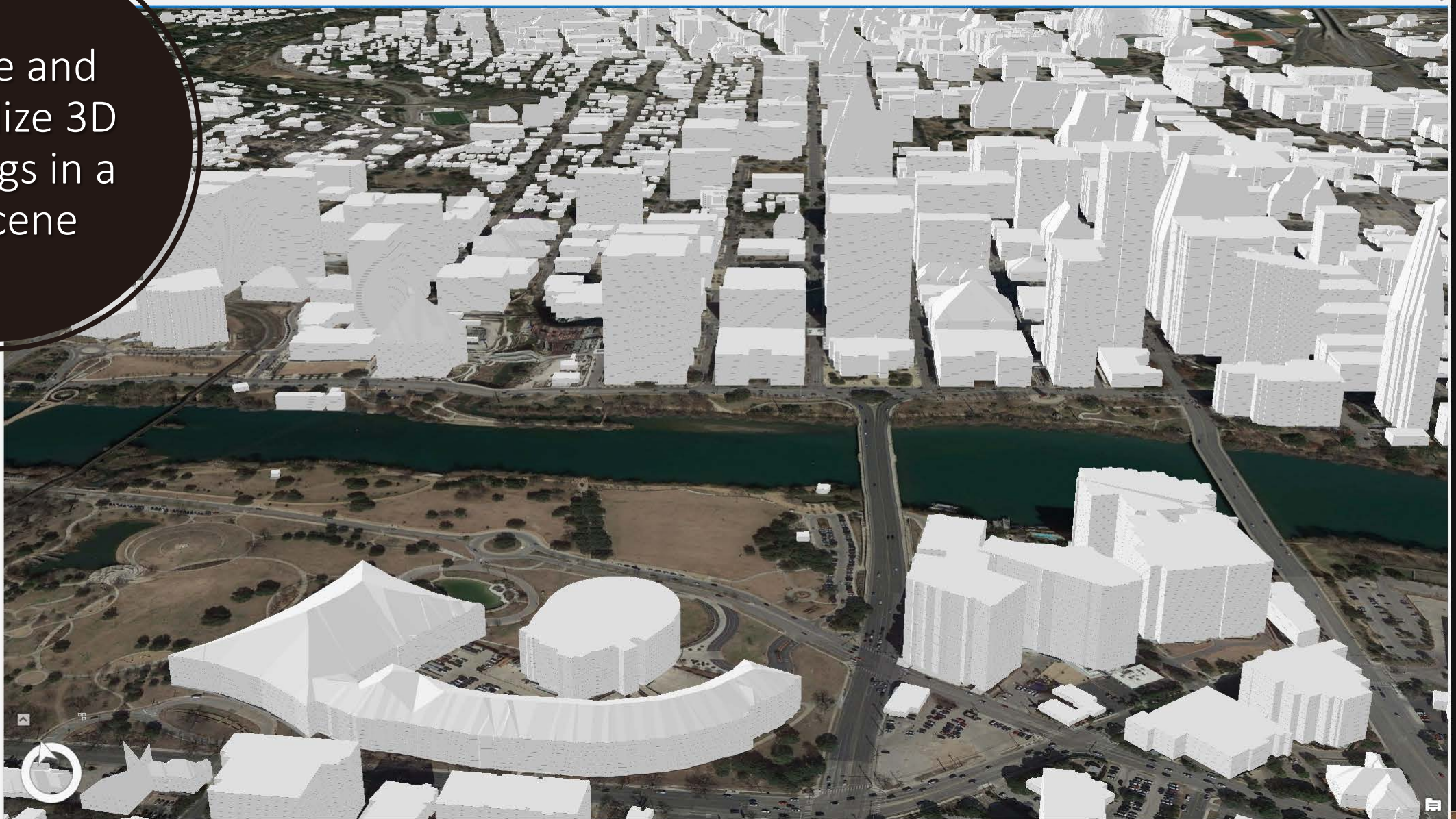
- DEM\_elev\_elev

Value

208.505

114.285

- Texas
- World Light Gray Canvas Base



Project Map Insert Analysis View Edit Imagery Share View Appearance Labeling Data

Cut Copy Paste Copy Path Explore Bookmarks Add Select Select By Attributes Select By Location Attributes Clear Infographics Measure Locate Pause View Unplaced More Convert To Annotation Download Map Sync Remove

Contents

Search

Drawing Order

Scene

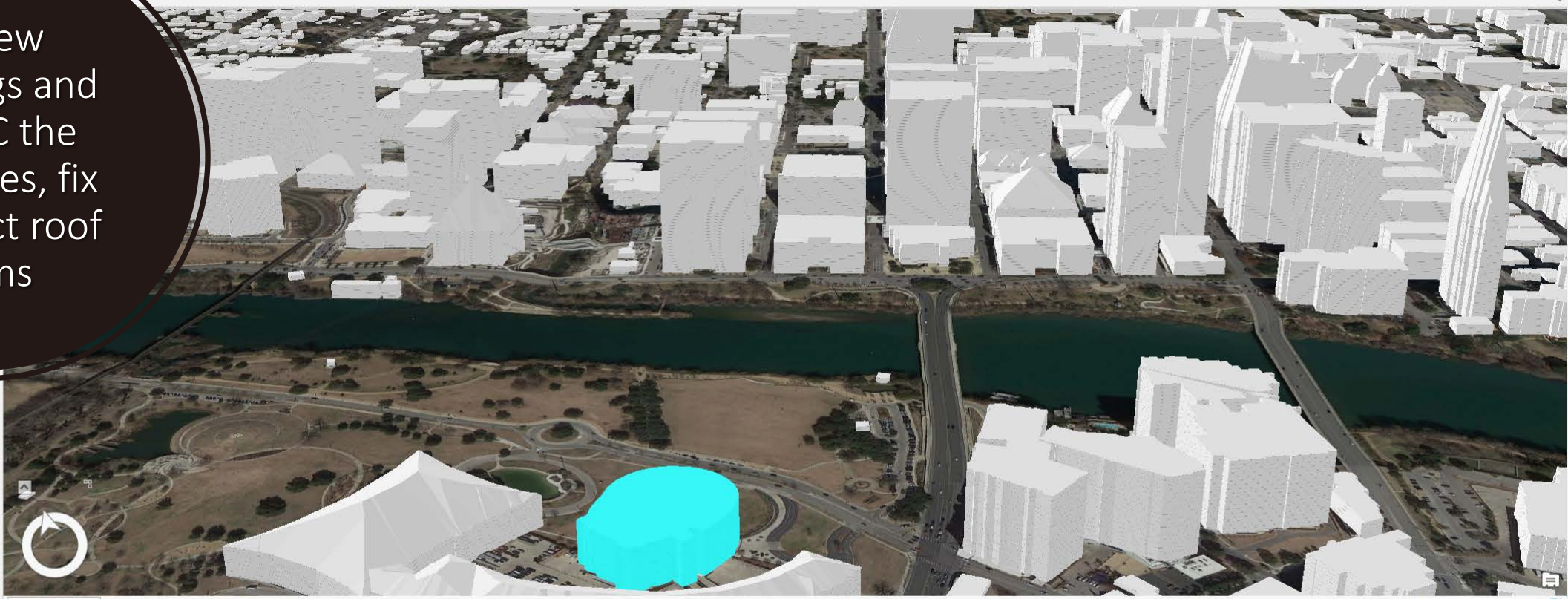
3D Layers

- Downtown\_Austin\_RF
- Downtown\_Austin\_RF
- Downtown\_Austin\_RF

2D Layers

- txdot\_2015\_county\_details
- World Light Gray Reference
- nDSM
  - Value: 209.73 to -21.3024
- DSM\_elev\_elev
  - Value: 353.538 to 114.285
- DEM\_elev\_elev
  - Value: 208.505 to 114.285
- Texas
- World Light Gray Canvas Base

Review buildings and QA/QC the attributes, fix incorrect roof forms



501 m 97.7435081°W 30.2656746°N 217.976 m Selected Features: 1

Downtown\_Austin\_RF

Field: Add Delete Calculate Selection: Zoom To Switch Clear Delete

OBJECTID	Shape	Shape_Length	Shape_Area	BLDGHEIGHT	EAVEHEIGHT	ROOFORM	BuildingFID	BASEELEV	ROOFDIR	RoofDirAdjust
23752	Polygon M	62.512923	162.447888	6.2765	<Null>	Flat	Building_23752	139.4542	<Null>	0
23753	Polygon M	550.417078	15754.480573	29.5984	<Null>	Flat	Building_23753	164.2857	<Null>	0
23754	Polygon M	1241.905208	29864.513593	22.9098	<Null>	Hip	Building_23754	136.6866	<Null>	0
23755	Polygon M	375.385079	8126.423513	32.6285	<Null>	Flat	Building_23755	135.2196	<Null>	0
23756	Polygon M	737.519646	9541.908656	63.5947	<Null>	Flat	Building_23756	134.878	<Null>	0
23757	Polygon M	1447.426177	19921.688289	55.0999	<Null>	Hip	Building_23757	155.7147	<Null>	0
23758	Polygon M	174.637081	937.42655	15.3075	<Null>	Gable	Building_23758	159.4721	0	0
23759	Polygon M	262.218994	4280.417255	30.1136	<Null>	Flat	Building_23759	159.1924	<Null>	0

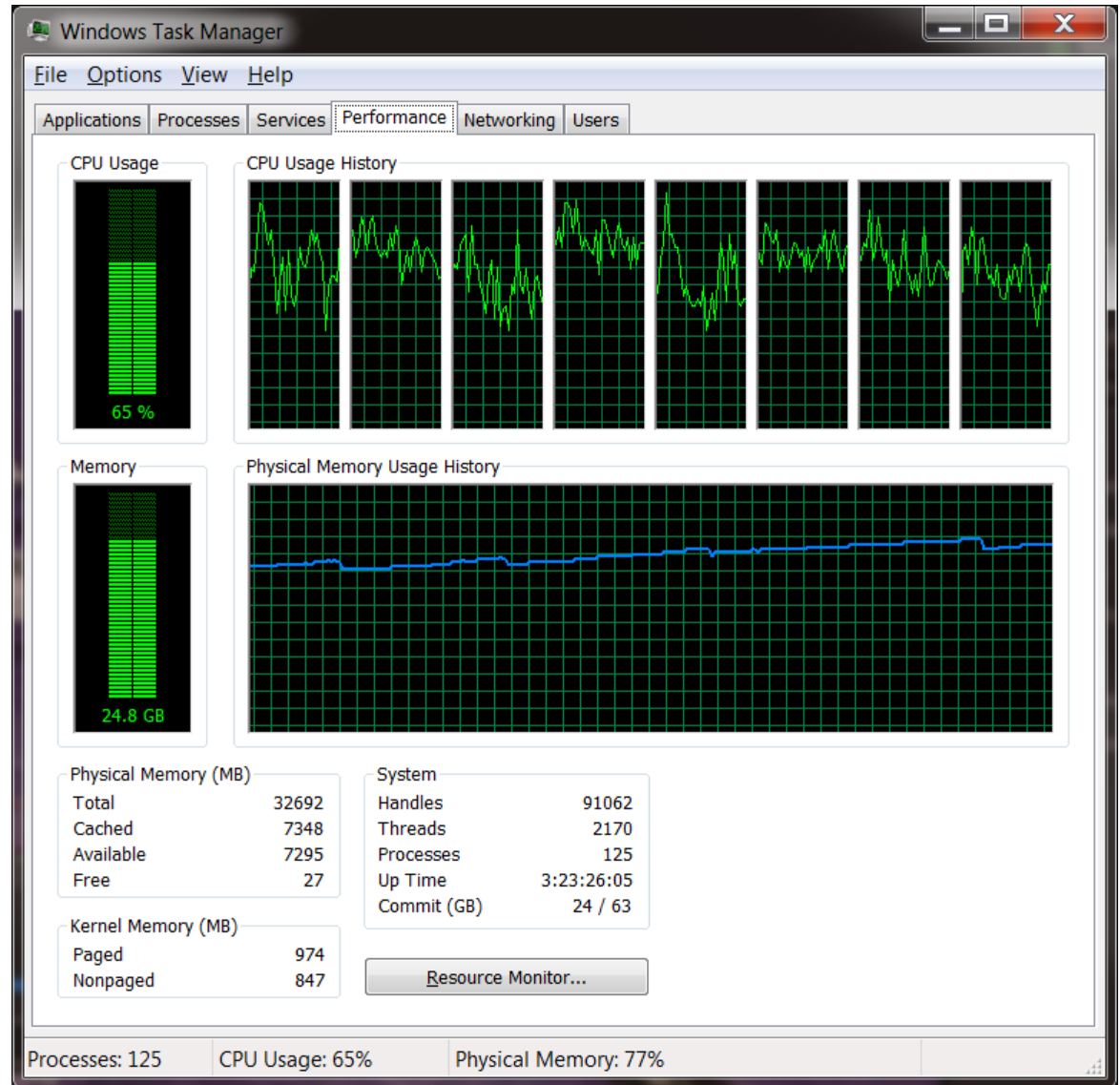
Click to add new row.



# Extracting Information ...

takes time and  
resources . . .

but is very useful in  
emergency situations and  
many other scenarios.



So, how long it will take?

- Consider billions of points as a portion of one collection (T2995 is one portion, Stratmap\_2018\_Upper\_TX\_Coast has 10 portions)
- Get a Desktop computer with resources to process thousands of points a second for i.e.: 2D Buildings footprint delineation.
- $1\text{B points} / 1\text{K points/s} = 1\text{ M seconds}$
- $1\text{M Seconds} / 60\text{ s/min} = 16,660\text{ minutes}$
- $16,660\text{ min.} / 60\text{ min/hr} = 277\text{ hours}$
- $277\text{ hr.} / 24\text{ hr/day} = 12\text{ days}$

LP Add Files

L... Rast... Featu...

LAS Files: ( Total: 3252 )

File	Points	Size (MB)	Map Layer	Message	Version	PDRF
stratmap18-50cm_2995011a1_1.las	15,085,517	452.57	LAS Layer_1		1.4	6
stratmap18-50cm_2995011a2_1.las	16,384,797	491.55	LAS Layer_1		1.4	6
stratmap18-50cm_2995011a3_1.las	14,695,685	440.87	LAS Layer_1		1.4	6
stratmap18-50cm_2995011a4_1.las	16,174,016	485.22	LAS Layer_1		1.4	6
stratmap18-50cm_2995011b1_1.las	15,775,119	473.26	LAS Layer_1		1.4	6
stratmap18-50cm_2995011b2_1.las	15,156,537	454.70	LAS Layer_1		1.4	6
stratmap18-50cm_2995011b3_1.las	15,779,517	473.39	LAS Layer_1		1.4	6
stratmap18-50cm_2995011b4_1.las	15,315,803	459.48	LAS Layer_1		1.4	6
stratmap18-50cm_2995011c1_1.las	15,178,798	455.37	LAS Layer_1		1.4	6
stratmap18-50cm_2995011c2_1.las	16,085,329	482.56	LAS Layer_1		1.4	6
stratmap18-50cm_2995011c3_1.las	14,890,038	446.70	LAS Layer_1		1.4	6
stratmap18-50cm_2995011c4_1.las	15,206,346	456.19	LAS Layer_1		1.4	6
stratmap18-50cm_2995011d1_1.las	16,061,627	481.85	LAS Layer_1		1.4	6
stratmap18-50cm_2995011d2_1.las	15,552,405	466.58	LAS Layer_1		1.4	6
stratmap18-50cm_2995011d3_1.las	15,208,025	456.24	LAS Layer_1		1.4	6
stratmap18-50cm_2995011d4_1.las	15,424,848	462.75	LAS Layer_1		1.4	6
Sum: 42,927,629,474		Total: 1,287.43 GB				

Open Setting

Open Read-Only  
 Open Read-Write

Load Setting

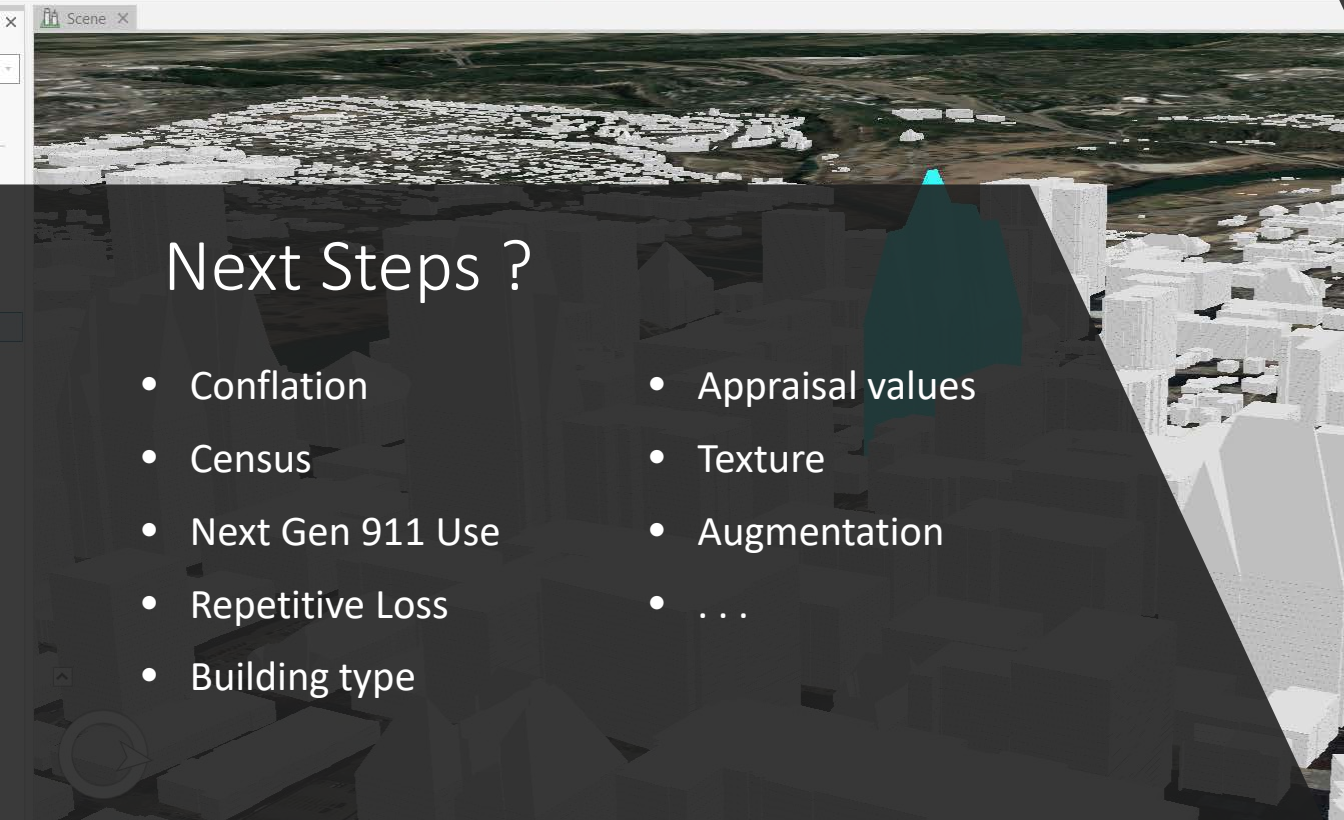
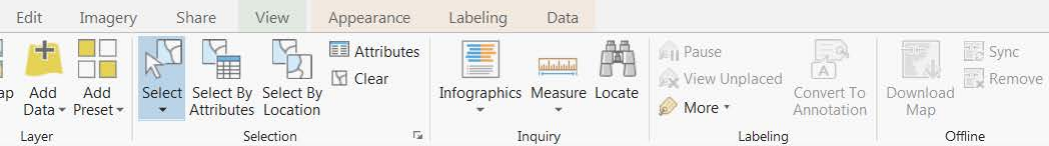
Load Files  
 Load Footprints Only

Options

Append to Compatible Layers  
 Ignore Incompatible CRS  
 Pyramid

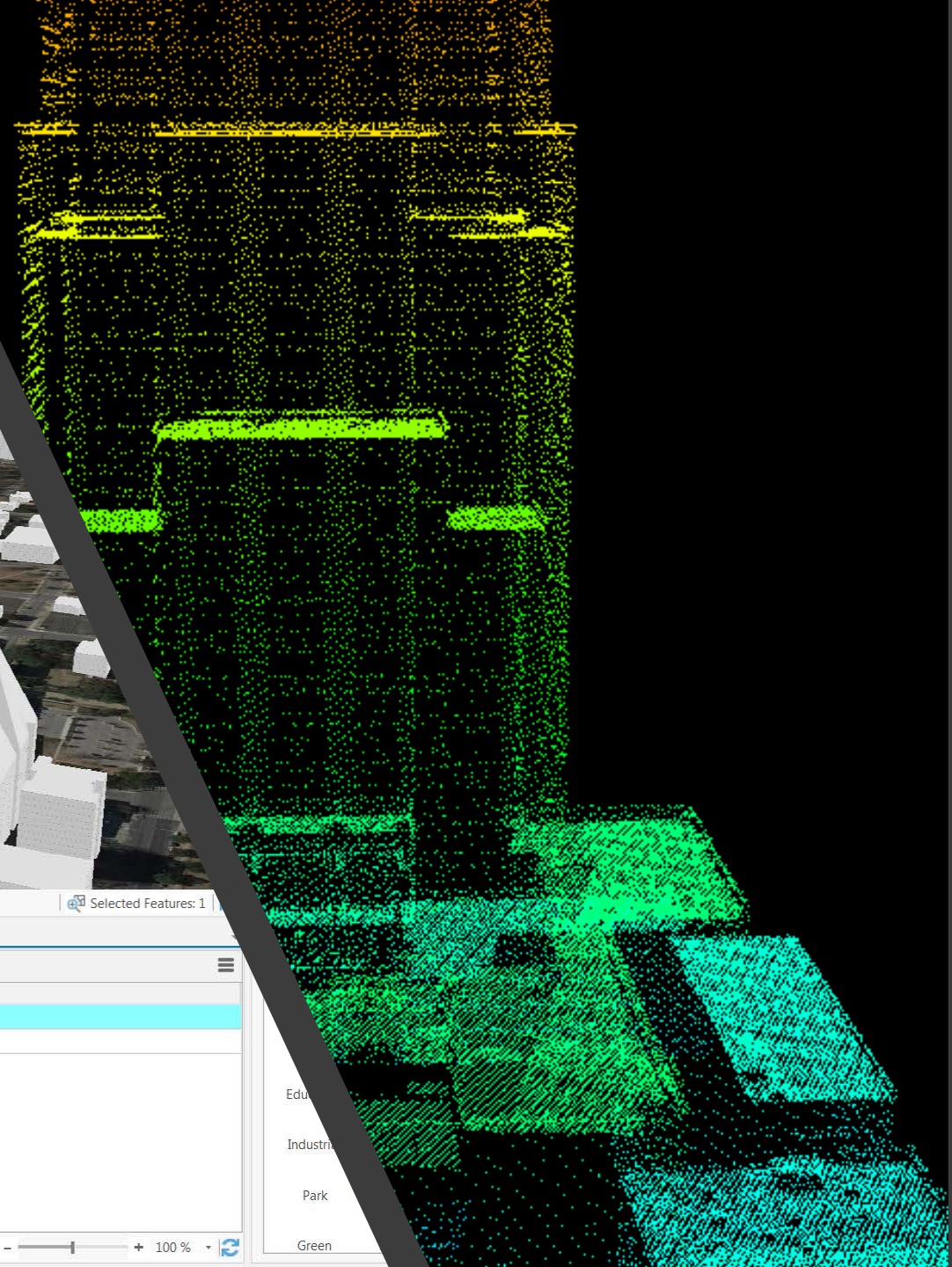
Thinning: 16

OK Cancel



## Next Steps ?

- Conflation
- Census
- Next Gen 911 Use
- Repetitive Loss
- Building type
- Appraisal values
- Texture
- Augmentation
- ...



316 m 97.8563880°W 30.2741383°N 228.755 m Selected Features: 1

OBJECTID	Shape	Shape_Length	Shape_Area	BLDGHEIGHT	EAVEHEIGHT	ROOFFORM	BuildingFID	BASEELEV	ROOFDIR	RoofDirAdjust
16686	Polygon M	429.987034	6707.690968	100.5281	<Null>	Gable	Building_16686	150.98	90	0

Click to add new row.

1 of 23759 selected

Filters: 100%

A promotional graphic for the Texas GIS Forum. The top text reads "TEXAS GIS FORUM" in white, with "GIS" in a stylized font. Below this is a collage of photos from the forum, including speakers, attendees, and GIS maps. The text "Stay Tuned" is prominently displayed in the center, and "Save the Dates October 21 - 25, 2019" is at the bottom. The entire graphic is framed by blue curtains on the sides.

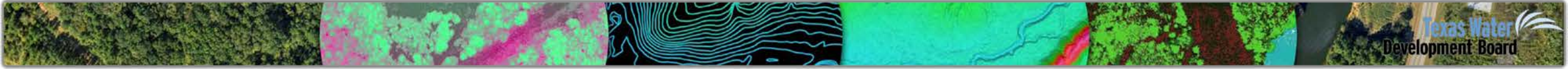
TEXAS GIS FORUM

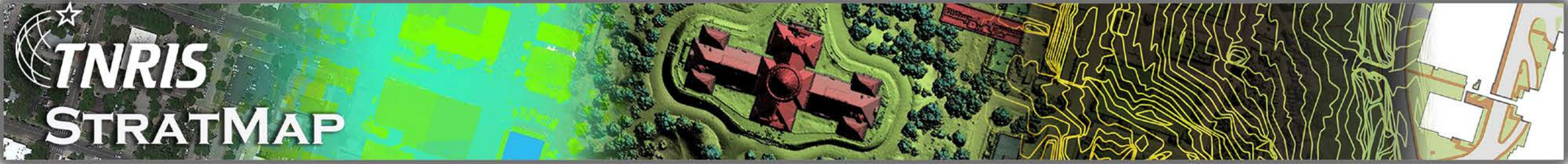
Stay Tuned

Save the Dates October 21 - 25, 2019

Texas GIS Forum – October 21-25, 2019  
Commons Learning Center at the JJ Pickle Center

More at <https://tnris.org/texas-gis-forum/2019/>





# Thank you!

**Joey Thomas**

RDC Team Lead & Elevation Data Specialist/Project Manager

[joey.thomas@twdb.texas.gov](mailto:joey.thomas@twdb.texas.gov)

512.463.8851

**Miguel Pavon**

Data Mapping Services/Special Projects Lead

[Miguel.Pavon@twdb.texas.gov](mailto:Miguel.Pavon@twdb.texas.gov)

512.463.8399

