Introduction to ArcGIS 10x: Working with Historical Maps

http://guides.library.upenn.edu/georeferencing
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Contents

Introduction

Goals

Through a hands-on exercise in creating georeferencing a digitized map and creating and editing vector data, participants will gain experience in working with digitized historic maps in ArcGIS.

Learning Outcomes

Upon completion of this tutorial the student will be able to:
- Georeference an image using reference data.
- Create a new feature class in a geodatabase.
- Edit feature class features and attributes.

Requirements

- The tutorial is self-contained and should take no longer than 90 minutes to complete.
- All data used during the exercise will be included.
- No previous experience with ArcGIS is assumed.
- 10MB of disk space is required to store data during the exercises.

Tutorial

Navigating ArcMap

Toolbars

Tools you need for navigating and manipulating your data, at the top of the window. To choose which to display, go to Customize > Toolbars.
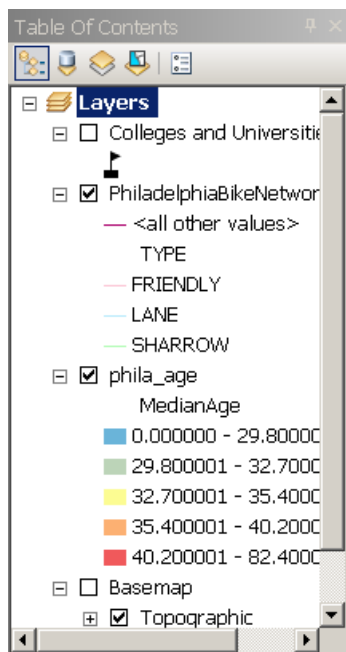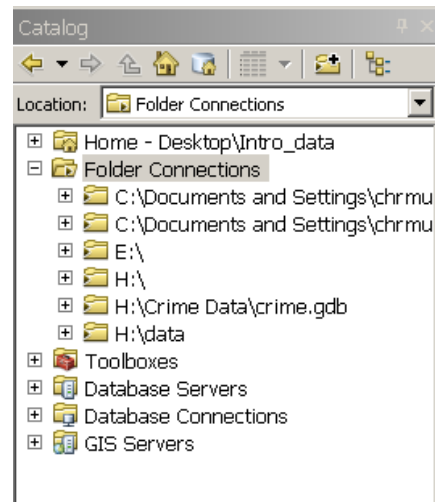

Table of Contents

Shows you which data files have been added to your map and lets you control how the layers will be displayed.

Catalog Window

Allows you to navigate and organize the folders that contain your data. Also exists as a separate application, ArcCatalog.
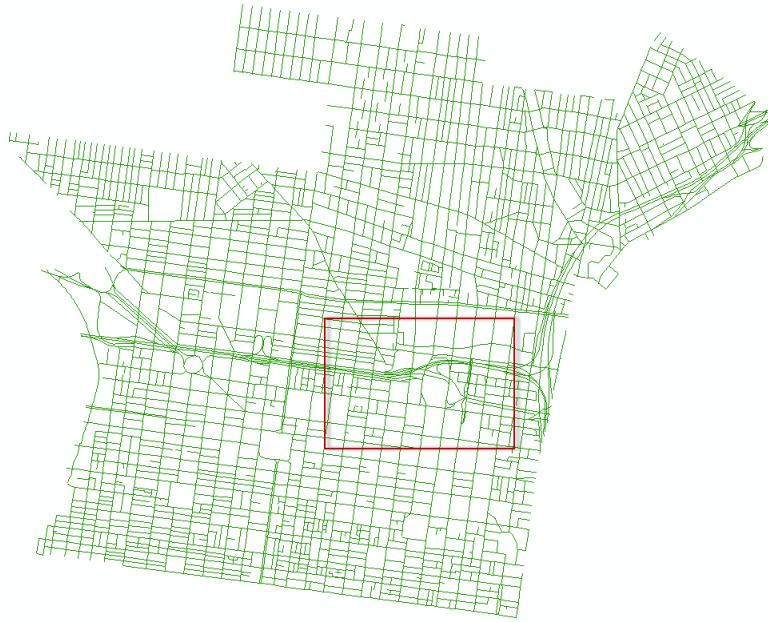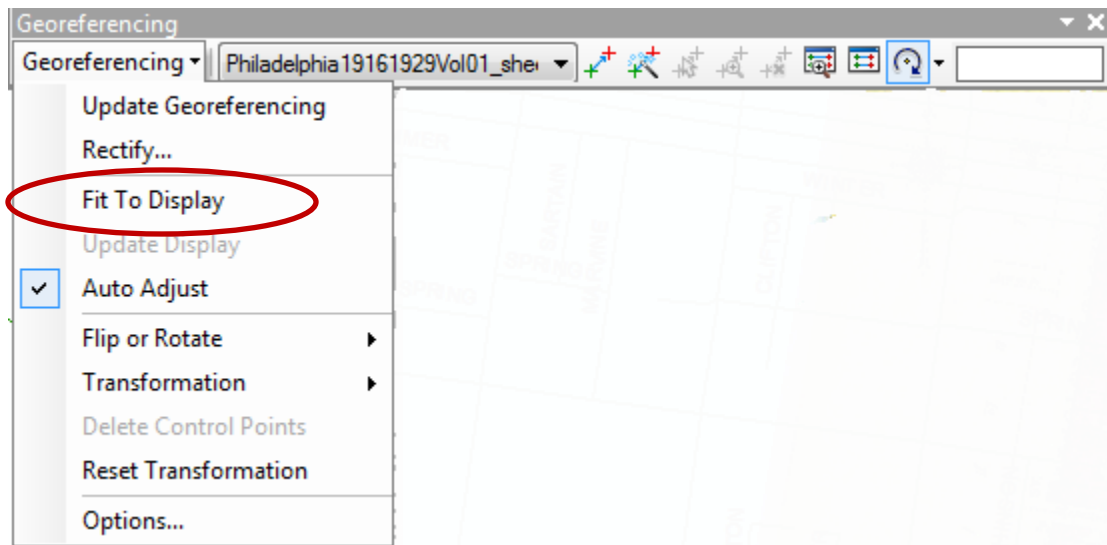
Georeferencing

1. Download georeferencing.zip from the workshop website to your Desktop and unzip. (In Windows, right-click on the zipped folder and select Extract all.) This should create a new folder called **georeferencing**. Then, in your web browser visit the Penn State University Libraries digital collection at http://collection1.libraries.psu.edu/cdm/compoundobject/collection/maps1/id/160 55/rec/1, and find the digital map entitled "Philadelphia-19161929-Vol01_sheet01," listed at the right. Open the map and click on Download > Large. Also save this in the same georeferencing folder.

2. From ArcMap, open a blank map. Click on the Add Data button.
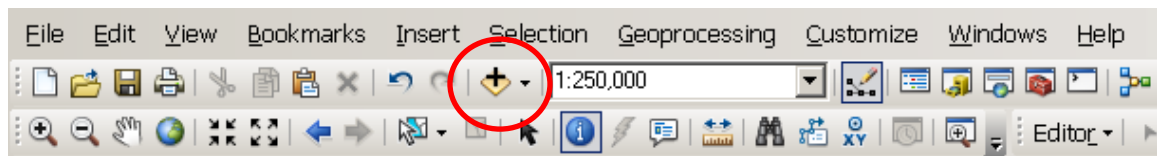
3. Select the Connect to Folder button and navigate to the unzipped georeferencing folder; click OK. Now within the georeferencing folder you should find a file called streets.shp; add it. This is our reference data: a vector representation of street centerlines in Philadelphia.

4. Next do the same for the digitized map and add it to your map. Click Yes if it asks to build pyramids. It should also give you a warning that this file has "Unknown Spatial Reference." This is exactly the problem we will solve.

5. The streets layer should show up in the Table of Contents. Right-click on the layer name streets, and select "Zoom to layer." Then, use the Zoom In (magnifying glass) tool in the tool bar to enlarge in the east side of the map, as shown below. Once you are zoomed in, right-click on the layer name again and select Label Features, so we can tell which street is which.

6. Next, activate the Georeferencing Toolbar by selecting Customize > Toolbars > Georeferencing from the menu bar. From the Georeferencing drop-down menu, select Fit to Display, as shown below. Now the digitized map and the reference data should appear together.

7. Also in the Georeferencing Toolbar, you can use the Rotate, Shift and Scale options so that the digitized map and the reference data roughly align. Keep in mind that the Sanborn map contains the intersection of 12th and Race Streets.
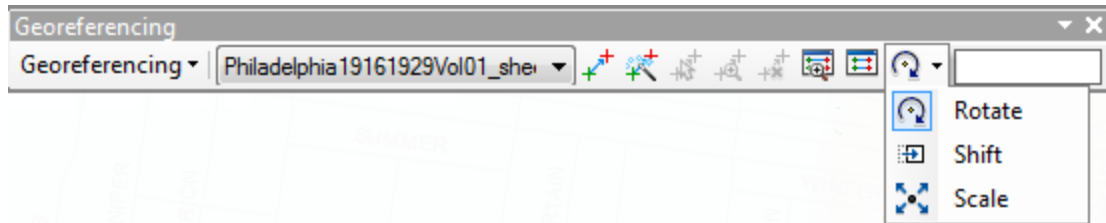
8. The next step is to add control points. These are pairs of points that link recognizable features in both the digitized map and the reference data. The more precise the placement of the points, the better the georeferencing output, so it's a good idea to zoom in closely. You can also use the Magnifying Window, which you can activate from the Windows menu. Start with an easily identified intersection like N. 12th and Race Street. First, click on the exact center of the intersection in the Sanborn map. Next, click on the same intersection in the reference data. A link will form.

9. Repeat throughout the map. For best results, distribute the control points in different areas of the map. You will need at least three sets of control points

10. After practicing with the control points, click on the View Link Table button on the Georeferencing Toolbar to check on the results. The Residual column will tell you if any control points are off the mark relative to the other sets of control points; if one link has an unusually high residual; you can delete it here and try again.

    The Transformation tells you what kind of mathematical formula is used to transform the pixels in the georeferenced digitized map. For most purposes, the 1st Order Polynomial transformation is fine, but for more distorted maps, a second- or third-order polynomial may be used, which require a greater number of control points.

Link	X Source	Y Source	X Map	Y Map	Residual_x	Residual_y	Residual
1	1556.961772	-4986.130978	2694752.063690	237398.990006	0.0929583	0.685711	0.691983
2	1555.119494	-4163.136025	2694770.235093	237535.054650	-0.0928647	-0.685021	0.691287
3	4192.298519	-6966.561464	2695149.513060	237011.575420	-0.0163317	-0.120471	0.121573
4	4196.951547	-2271.313996	2695256.820925	237795.572607	0.0162381	0.119781	0.120877

Total RMS Error: Forward:0.496515

Auto Adjust   Transformation: 1st Order Polynomial (Affine)
Degrees Minutes Seconds   Forward Residual Unit : Unknown

11. When you are satisfied with your georeferencing, you can save your work by selecting Georeferencing > Update Georeferencing from the Georeferencing toolbar. This will create an auxiliary file that is stored alongside the original

digitized map, so that when you open the file again in ArcGIS, it will be aligned with other layers. You can also create a new georeferenced file by selecting Georeferencing > Rectify.

Creating New Vector Data

You may have noticed that the digitized map (a raster dataset) is fundamentally different from the streets layer (a vector dataset). If you want to create a vector dataset from the digitized Sanborn map, you will have to create a new file. This section of the tutorial covers how to create and edit that new dataset.

1. First, create a new geodatabase. You can do this in the Catalog window; open the Catalog window by either clicking on the tab n the right-hand side of the map, or click Windows > Catalog. Find the Georeferencing folder where your downloaded data resides, right-click on the title of the folder, and select New > File Geodatabase. When the new geodatabase appears, click on the placeholder title and enter **sanbornmap**. It should look something like the following:
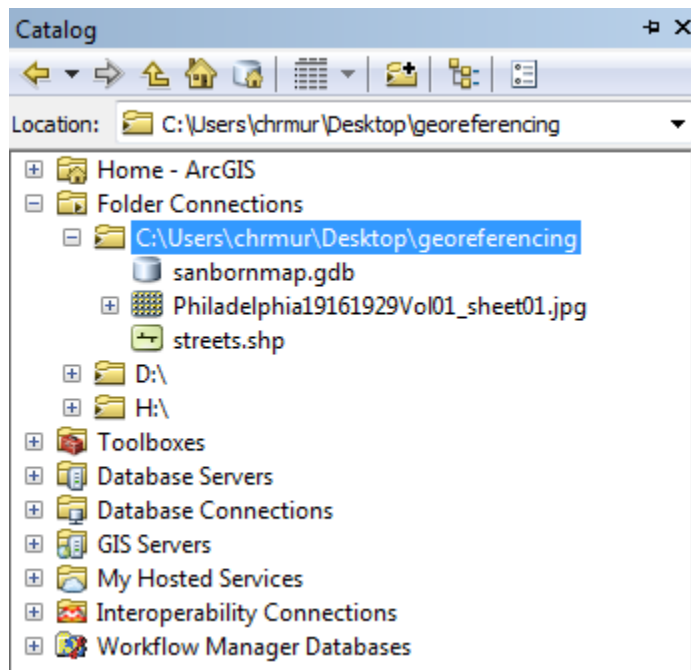
2. The geodatabase is a container for other data. We need a new feature class to contain the features we will create by hand. Right-click on sanbornmap.gdb and select New > Feature Class…

3. A series of dialog boxes will lead you through the process of creating a new feature class. The first is to give it a name—enter **structures**, and give it an optional alias of Structures in Sanborn Map. Select Polygon Features as the type of feature.

You must also select a coordinate system. You will want to select the same coordinate system as the digitized map we will use as a guide; you should find it (NAD 1983 State Plane Pennsylvania South FIPS 3702 Feet) in the Layers folder, but you can also search for it by name.
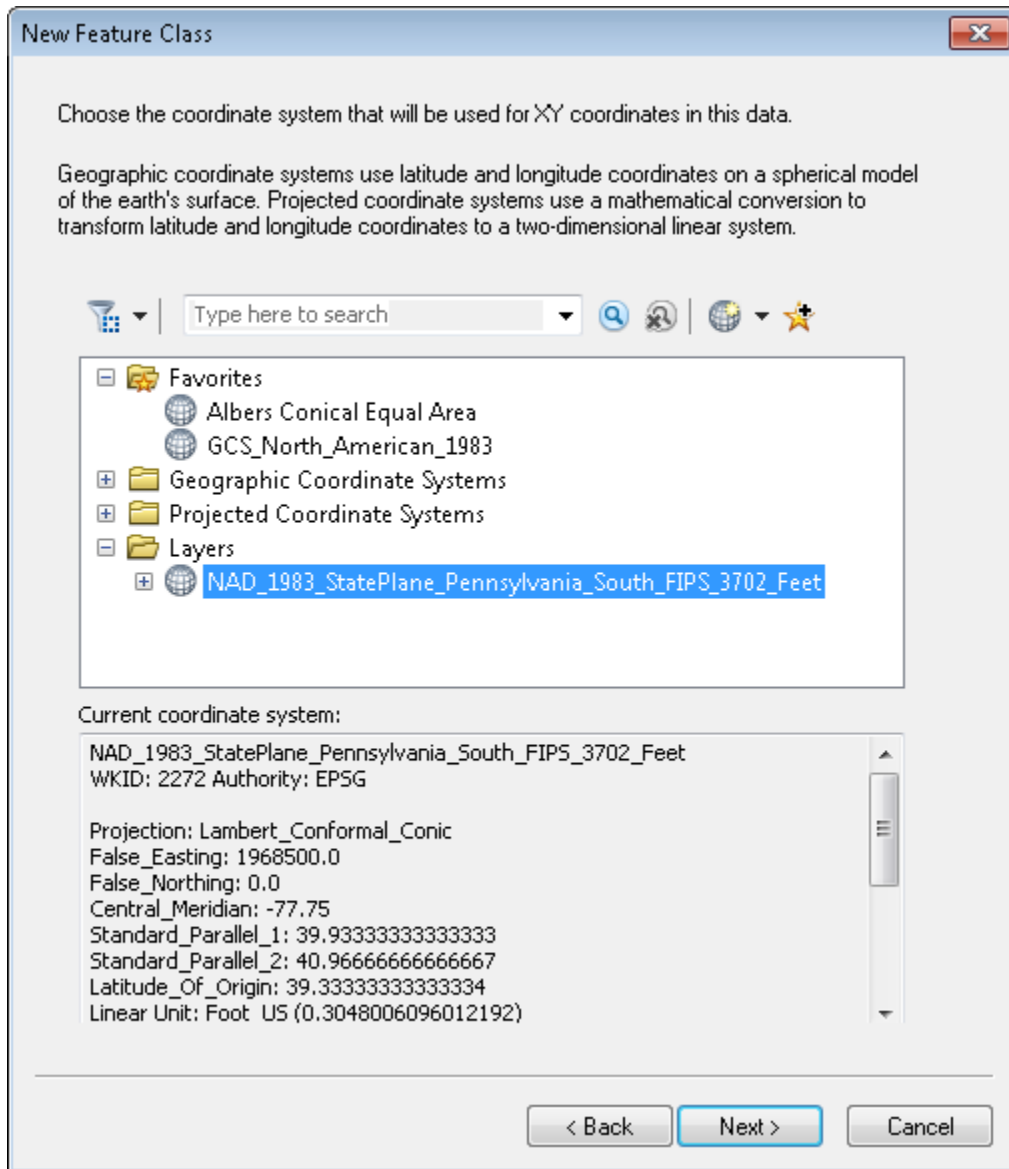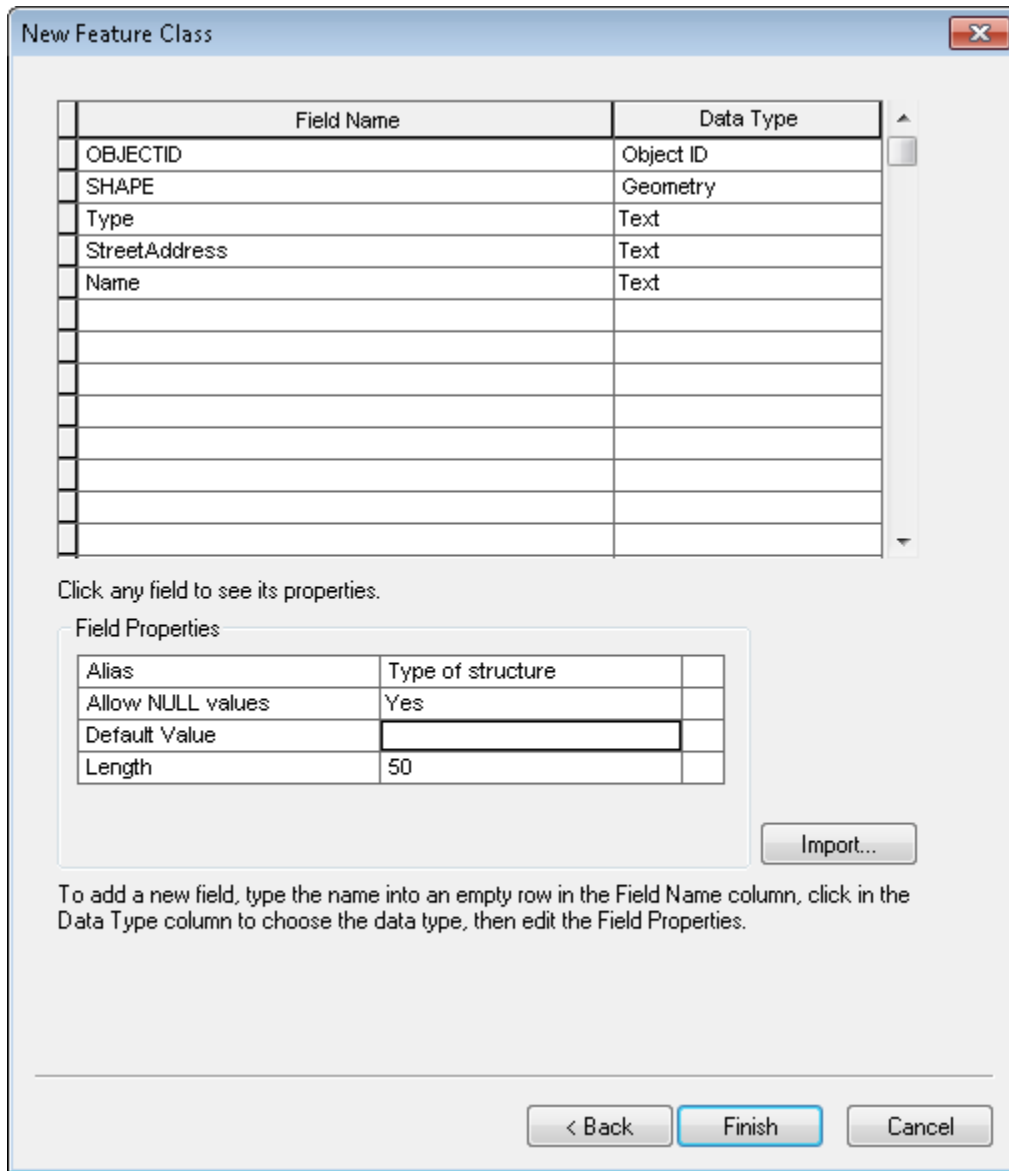
Click Next two additional times, accepting XY tolerance and configuration keyword defaults.

The next screen allows you to define fields for the features you create. To add a new field, click on an empty row. Enter fields named Type, StreetAddress, and Name, and give them the data type of Text. Under the Field Properties, make sure they allow null values. Click Finish.

New Feature Class ✕

	Field Name	Data Type	▲
	OBJECTID	Object ID	
	SHAPE	Geometry	
	Type	Text	
	StreetAddress	Text	
	Name	Text	
			▼

Click any field to see its properties.

Field Properties

Alias	Type of structure	
Allow NULL values	Yes	
Default Value		
Length	50	

[Import...]

To add a new field, type the name into an empty row in the Field Name column, click in the Data Type column to choose the data type, then edit the Field Properties.

[< Back] [Finish] [Cancel]

4. When the feature class is created, it should show up in the Table of Contents on the left-hand side. To create features, we must activate the Editor Toolbar; from the menu bar, click on Customize > Toolbars > Editor. Within this new toolbar, click on Editor > Start Editing; if it asks you to choose a layer or workspace to edit, select the new structures data. Next select Editor > Editing Windows > Create Features, then Editor > Editing Windows > Attributes.
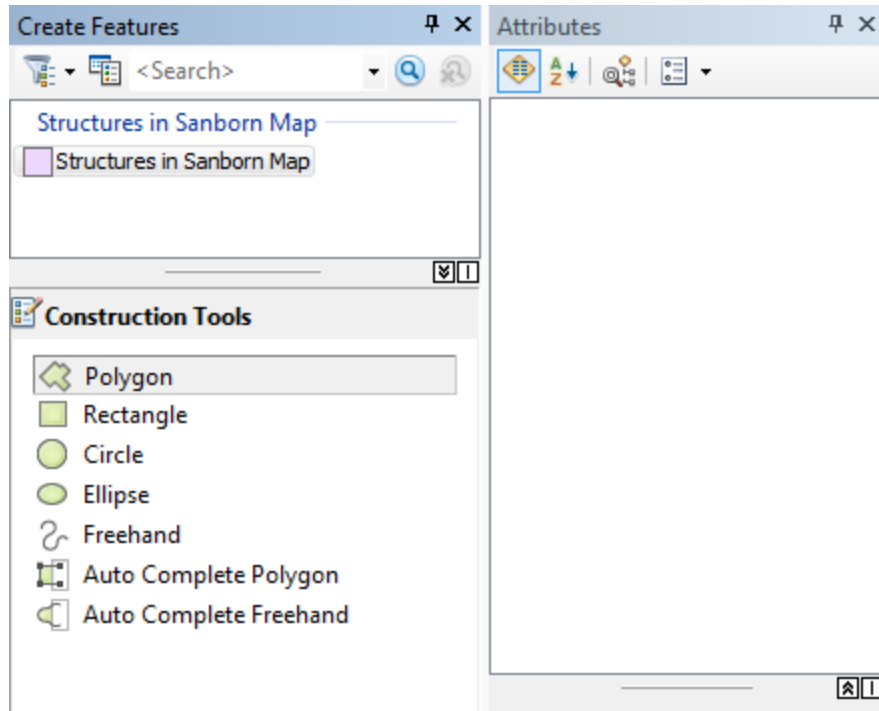
5. Now we can create structures. Click on the structures layer in the Create Features window, and you should see a several options under Construction Tools. Start with the Polygon, and we can switch to Auto Complete Polygon later. Zoom in close to the digitized map, then trace the outlines of one of the buildings. Double-click to complete the feature. (Note: it will help to change the symbology of the new layer to hollow fill, so you can see the map underneath.)

6. After the first feature is created, you can change the attributes of the features in the Attributes window. The fields OBJECTID, StreetAddress, and Name will be filled in automatically, but you can enter information into the other fields by clicking the empty fields. In the example below, I've entered information for 220 Marvine Street. This particularly structure has no name (only the some factories and stores do), but it has a type of D—for dwelling.
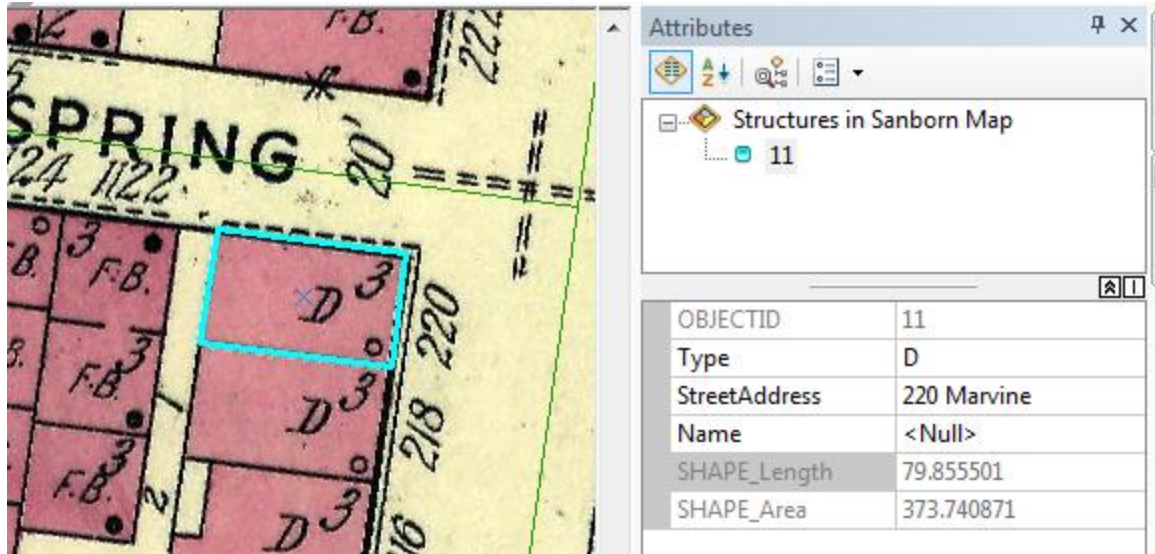
7. For subsequent features, use the Auto Complete Polygon tool; it allows you to create features that share a side, so that you won't accidently make features that overlap. This can be controlled more formally using feature datasets and topologies within geodatabases. (see "Topology in ArcGIS," http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Topology_in_ArcGIS/00620000003000000/ .)

8. In order to preserve these newly created features, you will have to save your edits: from the Editor Toolbar, select Editor > Save Edits. When you have finished creating features, select Editor > Stop Editing.

You have now successfully created new features based on a scanned and georeferenced map.