Exercise 1: Measure land cover change over time

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Software Requirements:

- ArcGIS Pro 3.1
- ArcGIS Image Analyst

Introduction

Discovering and understanding change over time is essential to land use planning. Knowing where and how land has changed can help policymakers understand the impact of past decisions and plan for the future.

An efficient method of determining change is to analyze imagery of the same area over several years, which is often done through image classification. With image classification, each pixel in an image is assigned a class. These classes are defined through a land cover and land use system known as a classification schema. Classes can be broad (for example, water) or precise (for example, freshwater tidal marsh). The schema and classes that you use depend on various factors, including the size of the study area and the level of precision that is required for your analysis.

One of the most popular classification schemas is the National Land Cover Database (NLCD). The NLCD is created by the Multi-Resolution Land Characteristics (MRLC) consortium, which classifies areas based on their land cover. For more information about the NLCD schema, see the USA NLCD Land Cover layer item page (https://links.esri.com/USANLCD | https://www.arcgis.com/home/item.html?id=3ccf118ed80748909eb85c6d262b426f).

The resulting product from image classification is a thematic raster. With this raster, you can measure the type and amount of change over time. There are several methods of measuring change. In this exercise, you will determine the amount of land developed over a period of time.

Scenario

In this exercise, you will analyze how land cover around Dallas, Texas, in the United States has changed from 2001 to 2016. To measure the change, you will use two classified thematic rasters that display aggregated land cover classes. Both rasters were classified with the same schema. Using the Change Detection Wizard in ArcGIS Pro, you will determine which types of land have changed, as well as the scope of change.

Note: This exercise provides a simplified starting point for what is often a much more in-depth workflow. The data and parameters that are used in this exercise are not intended to be a comprehensive list of what might be required for this type of analysis.

Note: The exercises in this course include View Result links. Click these links to confirm that your results match what is expected.

Estimated completion time in minutes: 35 minutes

Expand all steps | Collapse all steps

- Step 1: Open the ArcGIS Pro map package

In this step, you will open and explore the ArcGIS Pro map package from ArcGIS Online. The map package includes two classified thematic rasters that you will use in your analysis. To aid in change detection, the two rasters have the same modified classification scheme.

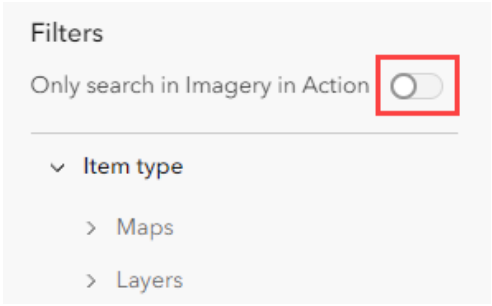
a In a web browser, go to www.arcgis.com and sign in with your MOOC credentials.

b At the top of the page, to the left of your profile icon, click the Search button, and then type **dallas land cover evaluation**.

*Step 1b***: Open the ArcGIS Pro map package.*

c Press Enter.

d On the left side, under Filters, turn off the Only Search In Imagery In Action option, as shown in the following graphic.



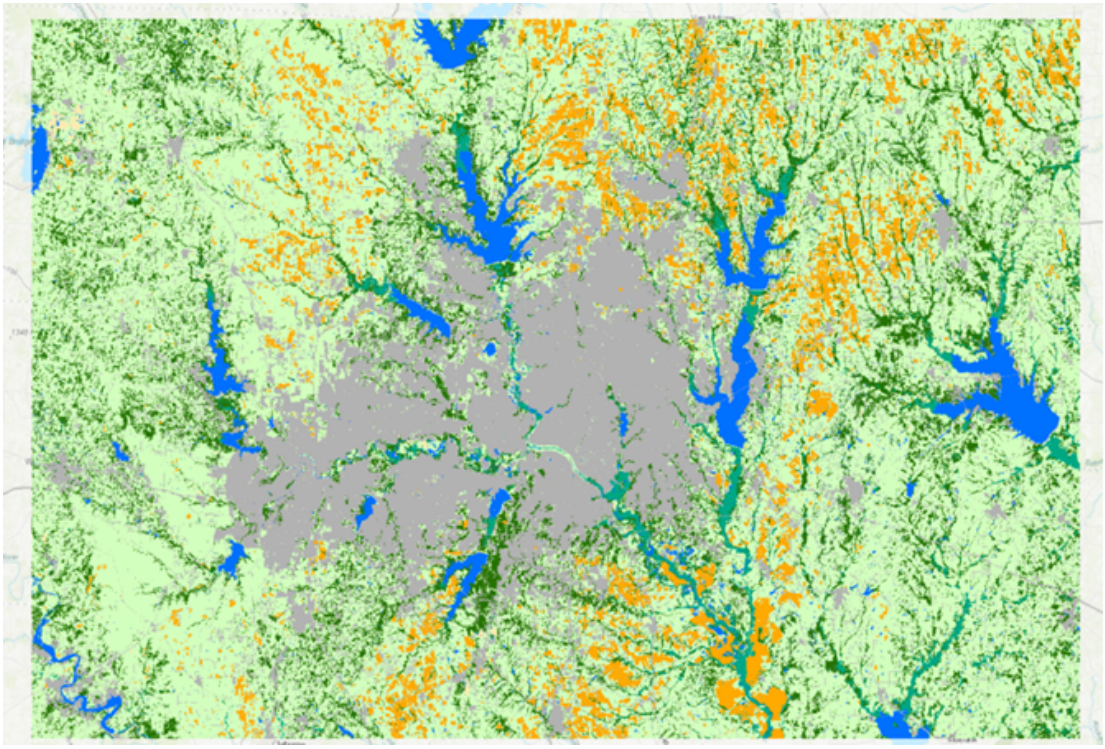
e Locate the Dallas Landcover Evaluation map package by Esri Training Services, and then in the bottom-right corner, click Download.

f If prompted, save the Dallas_Landcover_Evaluation.mpkx map package in your Downloads folder.

g In File Explorer, browse to your Downloads folder.

h Double-click the Dallas_Landcover_Evaluation.mpkx map package to start ArcGIS Pro.

i If prompted, sign in to ArcGIS Pro.



*Step 1i***: Open the ArcGIS Pro map package.*

The map displays the two classified thematic rasters with eight classes based on the NLCD classification schema. The eight classes are condensed and slightly modified from the original NLCD classification, as outlined in the following table:

Condensed Class	Original NLCD Class
Agriculture	• Cultivated Crops
Barren Land	• Barren Land
Developed	• Developed Open Space • Developed Low Intensity • Developed Medium Intensity • Developed High Intensity
Forest	• Deciduous Forest

	• Evergreen Forest • Mixed Forest
Grassland	• Grassland/Herbaceous • Pasture
Open Water	• Open Water
Shrub/Scrub	• Shrub/Scrub
Wetlands	• Woody Wetlands • Emergent Herbaceous Wetlands

Based on the rasters in the map, reference the legend below each layer in the Contents pane to answer the following question.

? Which land cover class in the NLCD2001_Dallas_Condensed.tif layer appears to be the most prominent?

- Answer

The Grassland class is the most prominent.

j In the Contents pane, open the NLCD2001_Dallas_Condensed.tif attribute table and, if necessary, resize the window to see the complete raster attribute table.

- Hint

Right-click the NLCD2001_Dallas_Condensed.tif layer and choose Attribute Table or press Ctrl and double-click the layer.

k In the attribute table, right-click the Count column and choose Sort Descending to sort the table by the class with the highest count.

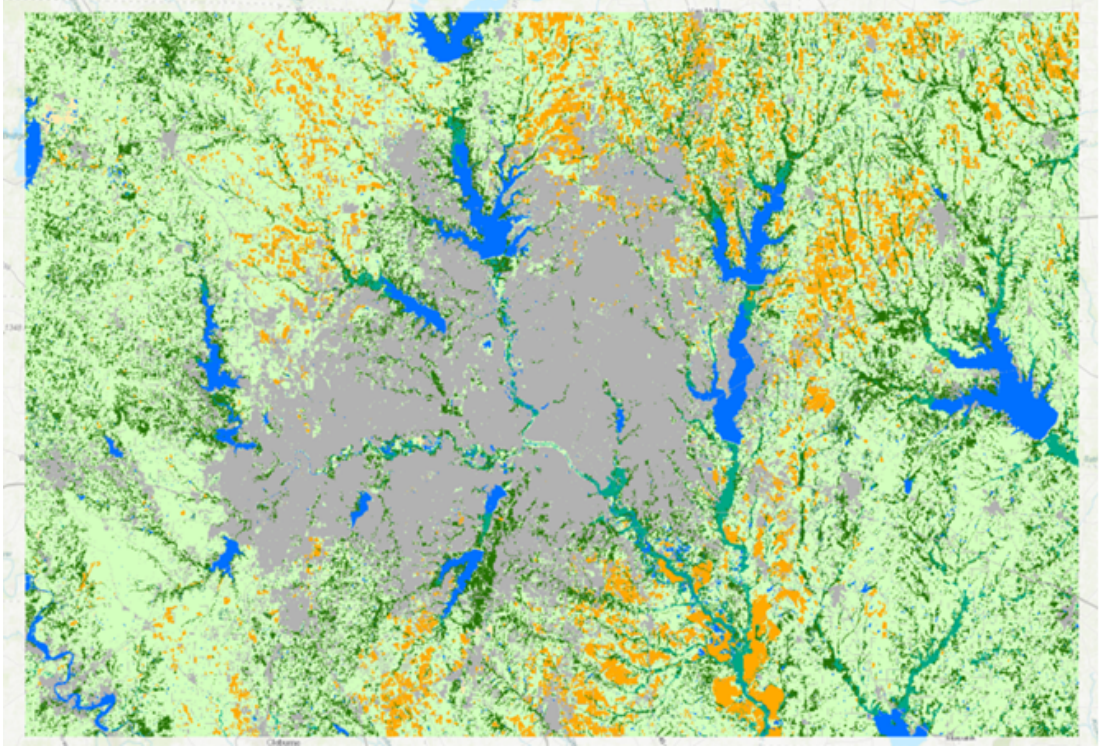
The Count column indicates how many cells of a particular class are present in the layer. This cell count can be used to calculate areas based on the number of cells and the size of each cell.

? What is the count for the Developed class in 2001?

- Answer

There are 5,152,043 cells in the Developed class in 2001.

l In the Contents pane, turn off the visibility of the NLCD2001_Dallas_Condensed.tif layer.



*Step 1l***: Open the ArcGIS Pro map package.*

- Hint

  Uncheck the box next to the NLCD2001_Dallas_Condensed.tif layer.

m Open the NLCD2016_Dallas_Condensed.tif attribute table.

n In the attribute table, right-click the Count column and choose Sort Descending to sort the table by the class with the highest count.

? What is the count for the Developed class in 2016?

- Answer

  There are 6,115,902 cells in the Developed class in 2016.

? How does the count for the Developed class of the 2016 NLCD layer compare to the 2001 NLCD layer?

- Answer

  The 2016 layer contains 963,859 more cells than the 2001 layer.

o Close both attribute tables.

While this simple comparison shows that change has occurred, you will investigate the type and scope of change using the Change Detection Wizard.

- Step 2: Configure the Change Detection Wizard

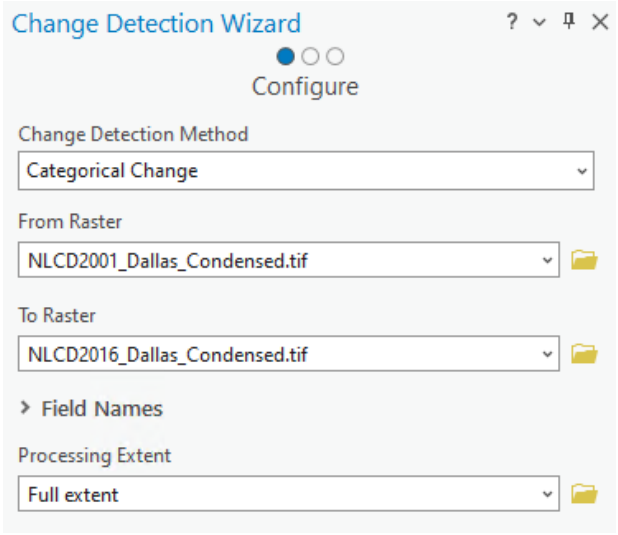
The Change Detection Wizard is a guided workflow to detect and quantify change. You will configure the Change Detection Wizard to identify the land cover classes that converted to the Developed class between 2001 and 2016.

a On the Imagery tab, in the Analysis group, click Change Detection and choose Change Detection Wizard.

b In the Change Detection Wizard, for the Configure step, set or confirm the following parameters in the precise order that is listed:

- Change Detection Method: Categorical Change
- From Raster: NLCD2001_Dallas_Condensed.tif

- To Raster: NLCD2016_Dallas_Condensed.tif
- Processing Extent: Full Extent

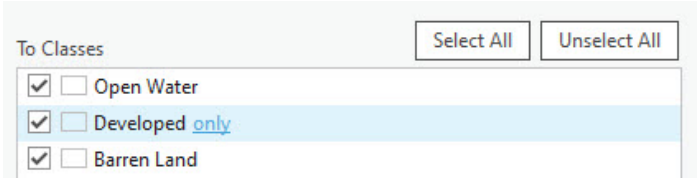


*Step 2b***: Configure the Change Detection Wizard.*

c Click Next.

In the Class Configuration step, for Filter Method, the default selection is set to Changed Only.

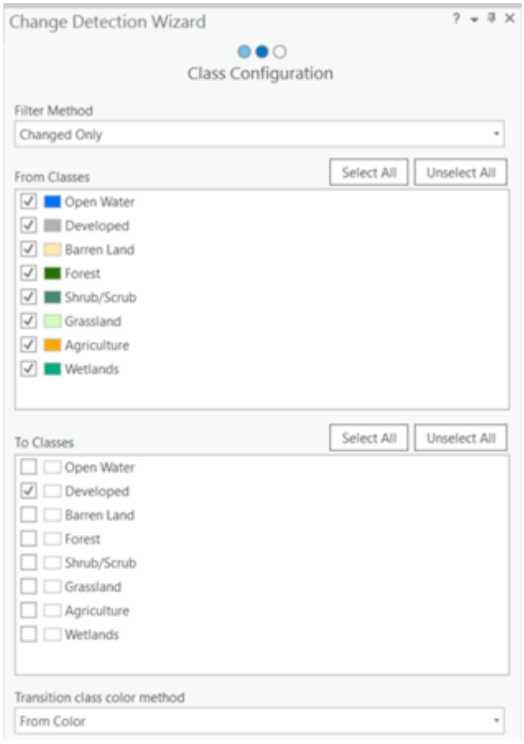
d In the To Classes section, point to the Developed class and notice the blue Only link, as shown in the following graphic.



e Next to the Developed class, click the blue Only link.

This action will clear the other check boxes, and Developed will be the only option that is selected.

f For Transition Class Color Method, choose From Color.



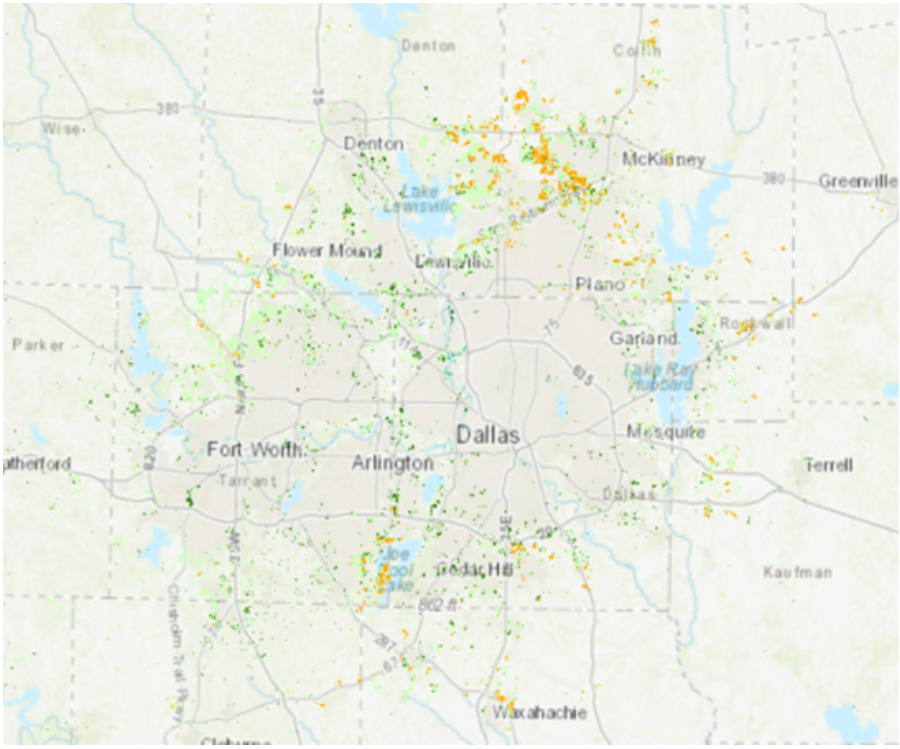
*Step 2f***: Configure the Change Detection Wizard.*

- Hint

  If you do not see this option, you may need to scroll down in the Change Detection Wizard.

g At the bottom of the Change Detection Wizard, click Preview.

h In the Contents pane, turn off visibility of the NLCD2016_Dallas_Condensed.tif layer.



*Step 2h***: Configure the Change Detection Wizard.*

Only the changed area is displayed in the map.

i Observe the preview layer legend.

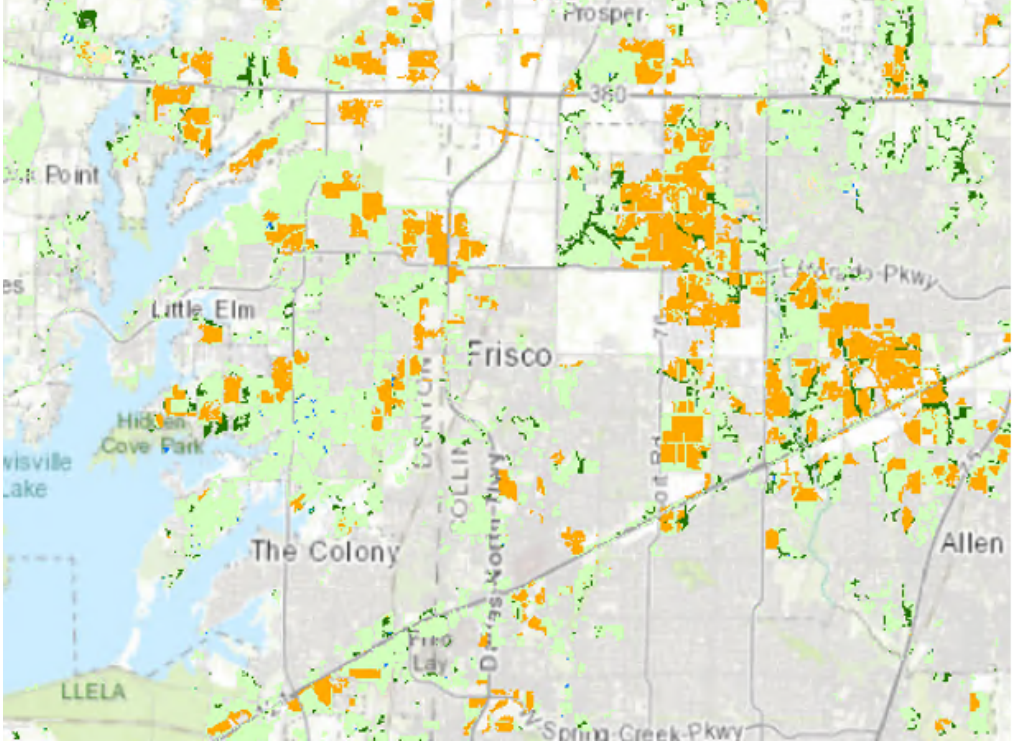
*Step 2i***: Configure the Change Detection Wizard.*

The legend indicates the area with classes that changed, as well as the class to which they changed.

j Open the Preview_ComputeChange attribute table.

The preview layer has a Class_name field that indicates the previous class and the new class. Two additional fields list the previous class and the new class separately.

k On the Map tab, in the Navigate group, click Bookmarks and select the Frisco, TX bookmark.



*Step 2k***: Configure the Change Detection Wizard.*

> What are the primary classes that have converted to the Developed class?
>
> - Answer
> Agriculture and Grassland classes were the primary classes that changed to Developed.

l Close the attribute table.

The preview allows you to see what your final results will look like. If you wanted to make any changes to the parameters, you could do so at this point. The results in the preview appear satisfactory, so you will save them.

m In the Change Detection Wizard, click Next.

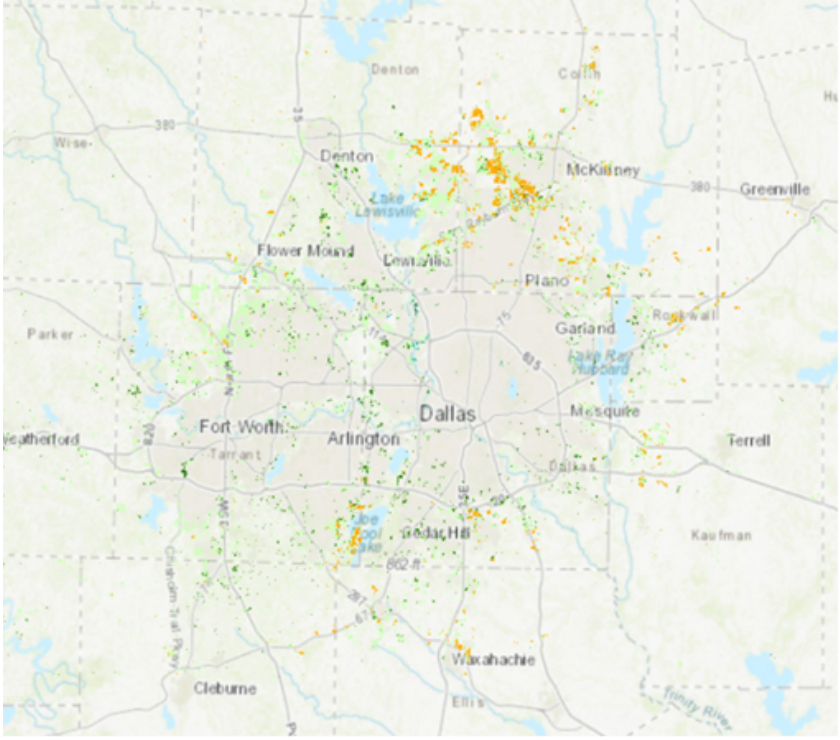
n In the Output Generation step, ensure that Smoothing Neighborhood is set to None and confirm that Save Result As is set to Raster Dataset.

o For Output Dataset, click the Browse button and browse to **C:\EsriMOOC\Data**.

p For Name, type **DallasDevelopedChange.tif**, and then click Save.

q At the bottom of the Change Detection Wizard, click Run.

r In the Contents pane, right-click DallasDevelopedChange.tif and choose Zoom To Layer.



*Step 2r***: Configure the Change Detection Wizard.*

The raster output shows all the areas in the raster that have changed and the classes from which they have changed. Developed areas have expanded from 2001 to 2016, and this analysis indicates where the growth has occurred.

s At the bottom of the Change Detection Wizard, click Finish.

- Step 3: Determine the change in developed areas

In this step, you will determine the amount of change that occurred with the classes that converted to the Developed class.

a In the Contents pane, open the DallasDevelopedChange.tif attribute table.

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy

	OID	Value	Classvalue	Class_name	Class_From	Class_To	Red	Green	Blue	Alpha	Count	Area
1	0	0	9	Open Water->Developed	Open Water	Developed	0	112	255	255	3900	3510000
2	1	1	10	Barren Land->Developed	Barren Land	Developed	255	235	175	255	7751	6975900
3	2	2	11	Forest->Developed	Forest	Developed	38	115	0	255	109657	98691300
4	3	3	12	Shrub/Scrub->Developed	Shrub/Scrub	Developed	68	137	112	255	2302	2071800
5	4	4	13	Grassland->Developed	Grassland	Developed	211	255	190	255	725324	652791600
6	5	5	14	Agriculture->Developed	Agriculture	Developed	255	170	0	255	111374	100236600
7	6	6	15	Wetlands->Developed	Wetlands	Developed	0	168	132	255	3551	3195900
8	7	7	16	Other	Other	Other	255	255	255	0	18303606	16473245400
9	8	8	17	No Change	Same	Same	255	255	255	0	5152043	4636838700

*Step 3a***: Determine the change in developed areas.*

b Right-click the Count field and choose Sort Descending.

The Count field displays the number of cells that converted or changed from one class to another. In the Class_name field, there are two classes named Other and No Change. Although they have the highest count values, you will ignore these two because you are only interested in specifically named classes that converted to Developed.

? Which class has the highest number of cells which converted to Developed?

- Answer

The Grassland class had the most cells change to developed area.

How many cells changed from Agriculture to Developed?

- Answer

111,374 cells changed from Agriculture to Developed.

The results indicate that areas classified as Grassland and Agriculture have been converted to Developed land more than other land classes.

c In the Contents pane, open the DallasDevelopedChange.tif layer properties.

- Hint

Right-click the DallasDevelopedChange.tif layer and choose Properties.

d In the Layer Properties dialog box, on the Source tab, expand Raster Information.

What are the units of measurement in the raster?

- Answer

The units are meters.

- Hint

Expand the Spatial Reference section to find the units.

What is the cell size reported?

- Answer

The cell size is 30.

The cell size is related to the area covered by each pixel. By squaring the cell size, you can measure the area covered by each pixel.

e Close the Layer Properties dialog box.

To determine the square area of one cell, you will multiply the cell size by itself because the cells are square. For this calculation, a cell is 900 square meters (30 x 30).

Based on the cell size, what is the total area classified as Agriculture that has converted to developed area?

- Answer

The total area of the Agriculture class that converted to the Developed class is 100,236,600 square meters (111,374 x 900).

This simple calculation was intended to show you the parameters that are used to measure an area of change. However, the Change Detection Wizard does this work for you. If you look at the DallasDevelopedChange.tif attribute table, you will see an Area field containing the total converted area for each class.

f On the Quick Access Toolbar, click the Save Project button and save the project as **DallasDevelopment** in the **..\EsriMOOC\Projects** folder.

g Leave ArcGIS Pro open.

With the Change Detection Wizard, you discovered which classes converted to the Developed class from 2001 to 2016. You also determined the total area that was converted for each class.

h If you would like to continue your analysis, complete the stretch goal; otherwise, continue to the next exercise.

- Step 4: Stretch goal (optional)

a Continue working in the DallasDevelopment ArcGIS project and complete the following task:

- Using the same data, perform another change detection. This time, focus on a different class than Developed.

b Use the Lesson Forum to post your questions and observations and be sure to include the **#stretch** hashtag in the posting title.