

Exercise 1: Access satellite data in ArcGIS Pro

i How can I print an exercise to PDF format?

Note: This course was developed with ArcGIS Pro 3.1 software.

Software Requirements:

- ArcGIS Pro 3.1

Introduction

Imagery analysis in ArcGIS extends beyond the capabilities of imagery web apps into desktop applications such as ArcGIS Pro, capable of advanced imagery analysis. With ArcGIS Pro, you can work with different types of data from multiple sources. This includes the dynamic image services found in the Landsat Viewer app, as well as ArcGIS Living Atlas of the World layers.

You previously accessed a Landsat imagery layer through a web app to view and assess vegetation areas. In this exercise, you will continue your analysis in ArcGIS Pro and access a Sentinel-2 Views imagery layer from ArcGIS Living Atlas. This multispectral imagery layer is similar to the Landsat imagery layer, but it has a higher spatial resolution. Spatial resolution is an aspect of remotely sensed data that is important to consider when selecting imagery for analysis. Features are more discernible in imagery with higher spatial resolution, which can further refine analysis results.

Scenario

In this exercise, you will continue researching the impact of changes to water policy through identifying vegetation areas around Paradise Valley, Arizona. You will use ArcGIS Pro to compare the vegetation area created with the Landsat imagery layer to the Sentinel-2 Views imagery layer.

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: 20 minutes

[Expand all steps](#) ▾

[Collapse all steps](#) ▲

- Step 1: Confirm that your computer can run ArcGIS Pro

In this step, you will run a test to confirm that your computer can support ArcGIS Pro. Even if you have ArcGIS Pro installed, you should confirm that it can support ArcGIS Pro 3.1.

Note: This test uses a third-party executable file. If you prefer, for security reasons, not to run this test, you can review the Common Questions or go to ArcGIS Pro Help: ArcGIS Pro 3.1 system requirements.

a In a web browser, go to Can You Run It? (<https://links.esri.com/CanYouRunIt>).

b Click the Run Tech Check button.

c Follow the steps to open and run the test.

The site generates a report that lists the minimum requirements and identifies whether your machine meets these requirements.

d If your computer does not meet the requirements, check the Common Questions to find links to complete the recommended updates, and then run the test again.

Note: If your computer does not meet the requirements, you may need to use a different computer or update your graphics card. For more information, go to ArcGIS Pro Help: Graphics adapter resources.

e If your computer meets the requirements, save the report.

The MOOC team may ask you to share the report if you need help in later ArcGIS Pro exercises.

- Step 2: Install ArcGIS Pro

This MOOC uses ArcGIS Pro 3.1. You will install ArcGIS Pro 3.1 from ArcGIS Online.

- a In a web browser, browse to the MOOC organization home page and, if necessary, sign in.

- Hint

Use the bookmark that you created in the previous section, or go to www.arcgis.com and use your MOOC credentials to sign in and access the MOOC organization home page.

- b In the upper-right corner, click your account, and then click My Settings.
- c On the left side of the page, under My Settings, click the Licenses tab.
- d Under Licensed Products, locate ArcGIS Pro.
- e To the right of the software name, click Download ArcGIS Pro.

[Download ArcGIS Pro](#)



When your download is complete, start the [installation program](#).

[View the installation process overview](#)

- > [File details](#)
- > [Need additional ArcGIS Pro downloads?](#)

[Step 2e***: Install ArcGIS Pro.](#)

The Download window opens.

Note: You can run ArcGIS Pro in a different language by clicking the down arrow next to English (Version 3.1) and choosing a different supported language. Keep in mind that this course is taught in English, which means that all screenshots and exercises will use the English version of ArcGIS Pro.

- f Click Download.
- g If the default download location does not have enough space, you can change the location by following the steps in this [How to Change the File Download Location in Your Browser](#) article (<https://links.esri.com/ChangeDownloadLocation> | www.lifewire.com/change-the-file-download-location-4046428).
- h After the download completes, double-click the .exe file.
- i Follow the installation instructions, accepting all defaults.

j When you are finished installing ArcGIS Pro, close your web browser.

- Step 3: Create the file structure

In this step, you will create the file structure that you will use throughout the entire MOOC to store exercise data.

a From your Windows taskbar, open File Explorer and browse to and select your C: drive.

b Click the Home tab, if necessary, and then click New Folder to create a new folder.

Note: You can also right-click in the white space, point to New, and choose Folder.

c For the folder name, type **EsriMOOC** and press Enter.

d Within this folder, create two more folders called **Data** and **Projects**.

The EsriMOOC folder should now contain two folders. These folders will be used to store the exercise data and any projects that you start in ArcGIS Pro and ArcGIS Drone2Map.

- Step 4: Sign in to ArcGIS Pro

In this step, you will use the course ArcGIS account to sign in to ArcGIS Pro. You will need to use your course ArcGIS account to license ArcGIS Pro and access other software applications used in the MOOC exercises.

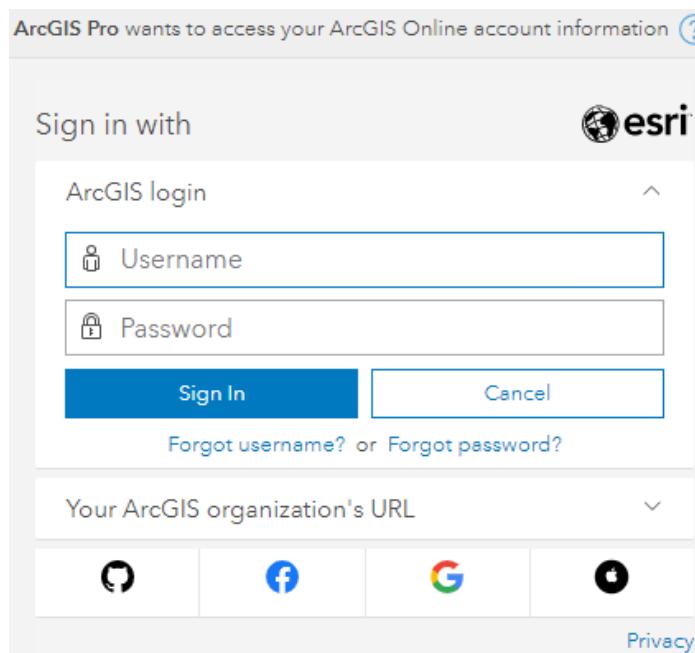
a If necessary, start ArcGIS Pro, and in the top-right corner of ArcGIS Pro, click Sign In.



*Step 4a***: Sign in to ArcGIS Pro.*

Note: If you are already signed in to ArcGIS Pro with a different account, click Sign Out, and then click Sign In.

b Sign in using the provided MOOC credentials that end in _iact.



*Step 4b***: Sign in to ArcGIS Pro.*

Note: The course ArcGIS account username and password are listed on the MOOC home page under Lessons. The username for this account ends with _iact (for example, jdoe_iact).

- c Click Sign In.
- d If you see an ArcGIS Pro Software Update Available notification, close the window.

Note: You will use ArcGIS Pro 3.1 for this MOOC.

- Step 5: Create an ArcGIS Pro project

In this step, you will create an ArcGIS Pro project. The project will allow you to save your work and organize your resources.

- a On the ArcGIS Pro Start page, under New Project, click Map to open a new map.

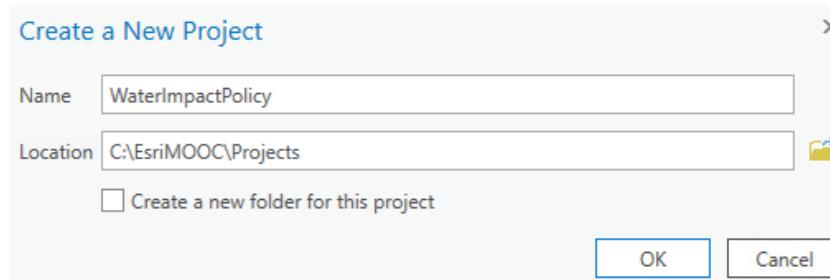
Note: If you have configured ArcGIS Pro to start without a project template or with a default project, you will not see the Start page. On the Project tab, click New, and then click Map.

- b In the Create A New Project dialog box, for Name, type **WaterImpactPolicy**.

- c For Location, click the Browse button .

- d Browse to the new C:\EsriMOOC folder that you created, click the Projects folder to select it, and then click OK.

- e Uncheck the option to create a new folder.



*Step 5e***: Create an ArcGIS Pro project.*

- f Click OK to create the new project.



*Step 5f***: Create an ArcGIS Pro project.*

Your ArcGIS Pro project opens with the World Topographic Map, used as a basemap.

At the top of the app is the ArcGIS Pro ribbon. ArcGIS Pro uses this horizontal ribbon to display and organize functionality into a series of tabs. On the Map tab is the Navigate group, which provides the tools that you need to navigate the map. The default tool is the Explore tool , which allows you to pan and zoom in and out of maps. To explore, you can pan by clicking and

holding the mouse button while moving the map. When you pan a map with the mouse, the pointer becomes a hand. You can zoom in or out of the map using the mouse wheel, or by using the Fixed Zoom In  and Fixed Zoom Out  buttons in the Navigate group.

To the left of the map is the Contents pane, which lists the layers that have been added to the map. To the right of the map is the Catalog pane, which lists the items associated with this ArcGIS Pro project—Maps, Toolboxes, Databases, Styles, Folders, and Locators.

- g If you do not see the Contents or Catalog panes, from the View tab, in the Windows group, either click Contents  or Catalog Pane .

To learn more about the ArcGIS Pro interface, go to ArcGIS Pro Help: ArcGIS Pro user interface, and to learn more about ArcGIS Pro projects, go to ArcGIS Pro Help: Projects in ArcGIS Pro.

- Step 6: Create a folder connection

In this step, you will create a folder connection in ArcGIS Pro. The folder connection will allow you to access data for the exercise.

- a In the Catalog pane, from the Project tab, right-click Folders and choose Add Folder Connection .
- b In the Add Folder Connection dialog box, browse to ..\EsriMOOC, click the Data folder to select it, and then click OK.
- c In the Catalog pane, expand Folders to see the new folder connection.
- d Right-click the Data folder and choose Add To New Projects.

This option will make the folder connection persist between different projects.

- Step 7: Add layers

Even though you performed your initial vegetation analysis through a web app, in ArcGIS Pro, you can still access and work with web-based layers through a connection to your online portal. In this step, you will add the study area layer, the vegetation mask layer from your previous analysis, and the Landsat imagery layer.

- a At the top of the Catalog pane, click the Portal tab.

Because you are signed in with the provided credentials, you will see the listing for My Content in the ArcGIS Online organization for the MOOC. To see the data available in ArcGIS Online, you will need to change the selection.

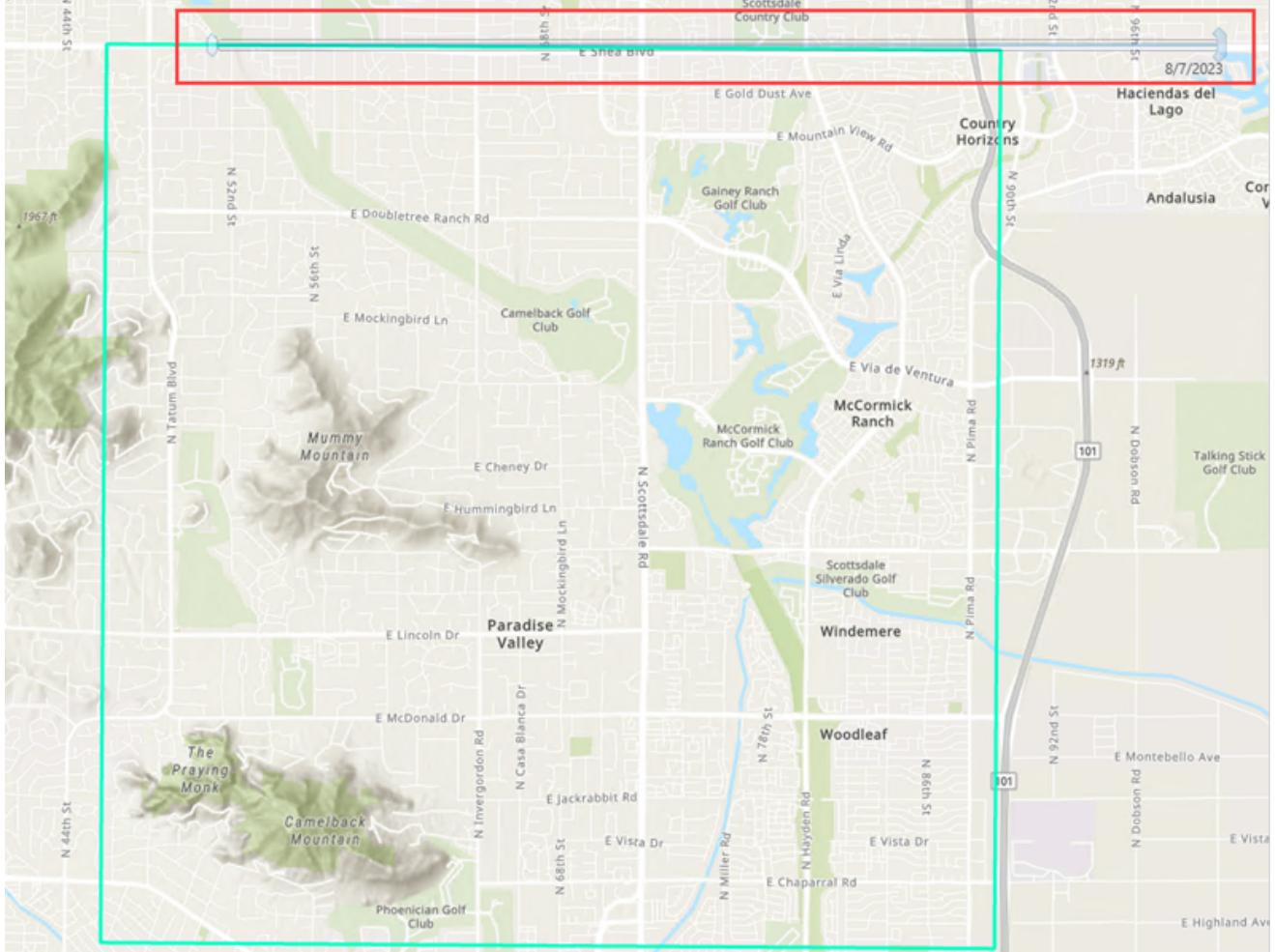
- b Click the ArcGIS Online button  to view items from ArcGIS Online.

Maps, layers, and other items are listed, along with an icon indicating the type of content.

- c In the Search ArcGIS Online field, type **potential water owner:esritrainingsvc** and press Enter.
- d Right-click the Potential Area For Water Policy feature layer  and choose Add To Current Map.

This layer is the study area polygon that you used to create the vegetation mask layer.

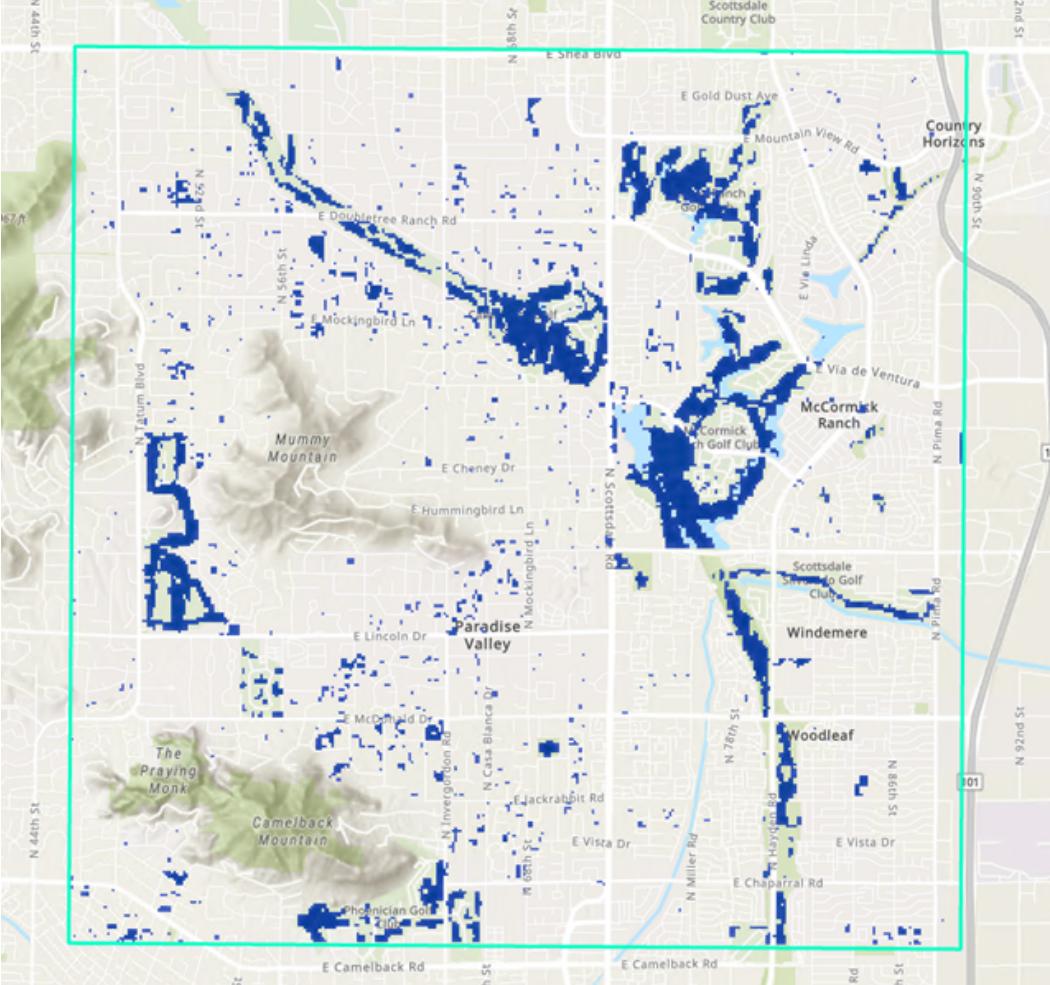
- e Click the My Content button , and then locate and add your NDVI Mask For Water Policy imagery layer  to the map.
- f In the map, click the time slider, as indicated in the following graphic.



- g In the top-right corner, click the up arrow to hide the time slider.

Note: The time slider will appear when adding time-enabled layers to the map; you may consider hiding the time slider as you work through the exercise.

- h In the Contents pane, confirm that the NDVI Mask For Water Policy layer is selected and click the Image Service Layer tab.
- i In the Rendering group, click Symbology.
- j In the Symbology pane, under Primary Symbology, click the drop-down list and choose Discrete.



Step 7j***: Add layers.

Note: This exercise uses a layer that was created in a previous exercise. If you did not complete the Section 1 exercise, then you can add the NDVI Mask For Water Policy Solution layer provided by clicking the ArcGIS Online button and searching for **ndvi mask owner:esritrainingsvc**. Remember to change the symbology from Colormap to Discrete.

In your initial analysis, you accessed a Landsat imagery layer through the Landsat Viewer web app; that layer was sourced from ArcGIS Living Atlas of the World. You can add layers from ArcGIS Living Atlas to ArcGIS Pro as well. You will now add a Landsat imagery layer to your map from ArcGIS Living Atlas.

- ↳ At the top of the Catalog pane, click the Living Atlas button to see the available layers.
- ↳ Click the Filter button , expand Categories and Imagery, and choose Multispectral Imagery.

Living Atlas

Search Living Atlas

Category: Sentinel USA Multi Build USA Lands Pansh USA Daily Land Sentin

Close Categories Clear

- ↳ Trending
- ↳ Basemaps
- ↳ Imagery
 - Basemap imagery
 - Multispectral imagery
 - Temporal imagery
 - Event imagery
- ↳ Boundaries
- ↳ People
- ↳ Infrastructure
- ↳ Environment

- > Item Type
- > Status
- > Tags

Land Cover Classification (Landsat 8)

Step 7l***: Add layers.

Note: Unlike the filter options found on the ArcGIS Living Atlas web page, you can only choose one of these four imagery options. On the ArcGIS Living Atlas web page, you could choose multiple options.

- m At the top of the drop-down list, click Close.

The filtered results reveal a list of imagery layers  , web maps  , and other items.

- n In the Search Living Atlas field, type **Landsat** and press Enter.
- o In the filtered results, right-click the Landsat GLS Multispectral imagery layer and choose Add To Current Map.



*Step 7o***: Add layers.*

Layers are displayed on the map in the order that they are listed in the Contents pane. In this case, the Landsat imagery layer is below the study area layer and above the NDVI Mask layer. You can drag a layer to change its order. You can also use the check box next to the layer to turn its visibility on and off.

You added the three layers that you used in your initial analysis. Now you are ready to look closer at some characteristics of the Landsat imagery.

- **Step 8: Examine the Landsat imagery layer**

Before you start the next phase of analysis using the Sentinel imagery, you will examine the characteristics of the Landsat imagery used in your initial study.

In ArcGIS Pro, you can change the way that an image is visualized by switching band combinations. One way to do this is by selecting a processing template.

 From your knowledge of band combinations, can you recall which renderer is being used?

- Answer

The Agriculture band combination of 5,4,1 is being used by default.

- Hint

This renderer was also used in the Landsat Explorer app from the previous exercise.

- a In the Contents pane, right-click the Landsat GLS Multispectral imagery layer and choose Properties.

Note: You can also double-click a layer or map to open its properties.

- b In the Layer Properties dialog box, click the Source tab, and then expand Raster Information.

? How many bands are reported?

- Answer
Three bands are reported.

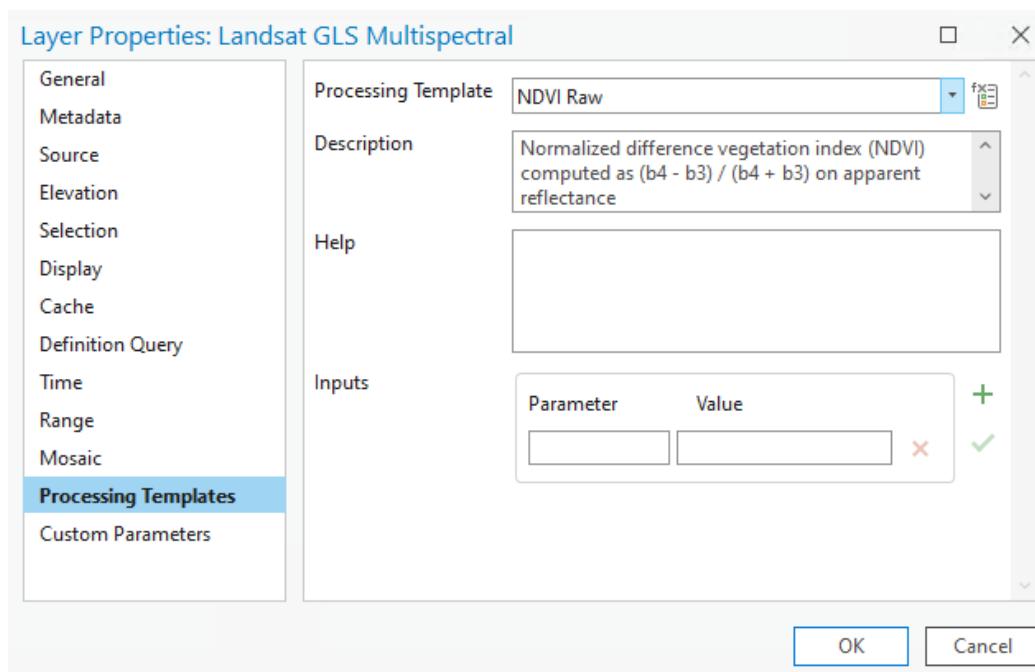
The imagery layer contains all the raster bands for the Landsat image, but it only returns the specific raster bands based on the selected processing template.

- c Click the Processing Templates tab.

Visualization for imagery layers in ArcGIS Pro is controlled by which processing template is selected. You can see that the Agriculture With DRA processing template has been selected for this imagery layer.

For more information about processing templates, go to ArcGIS Pro Help: Use processing templates.

- d Click the Processing Template down arrow to access the available options and choose NDVI Raw.



*Step 8d***: Examine the Landsat imagery layer.*

- e Click OK.

- f In the Contents pane, confirm that Landsat GLS Multispectral is selected and click the Imagery Service Layer tab.

- g In the Rendering group, click DRA.



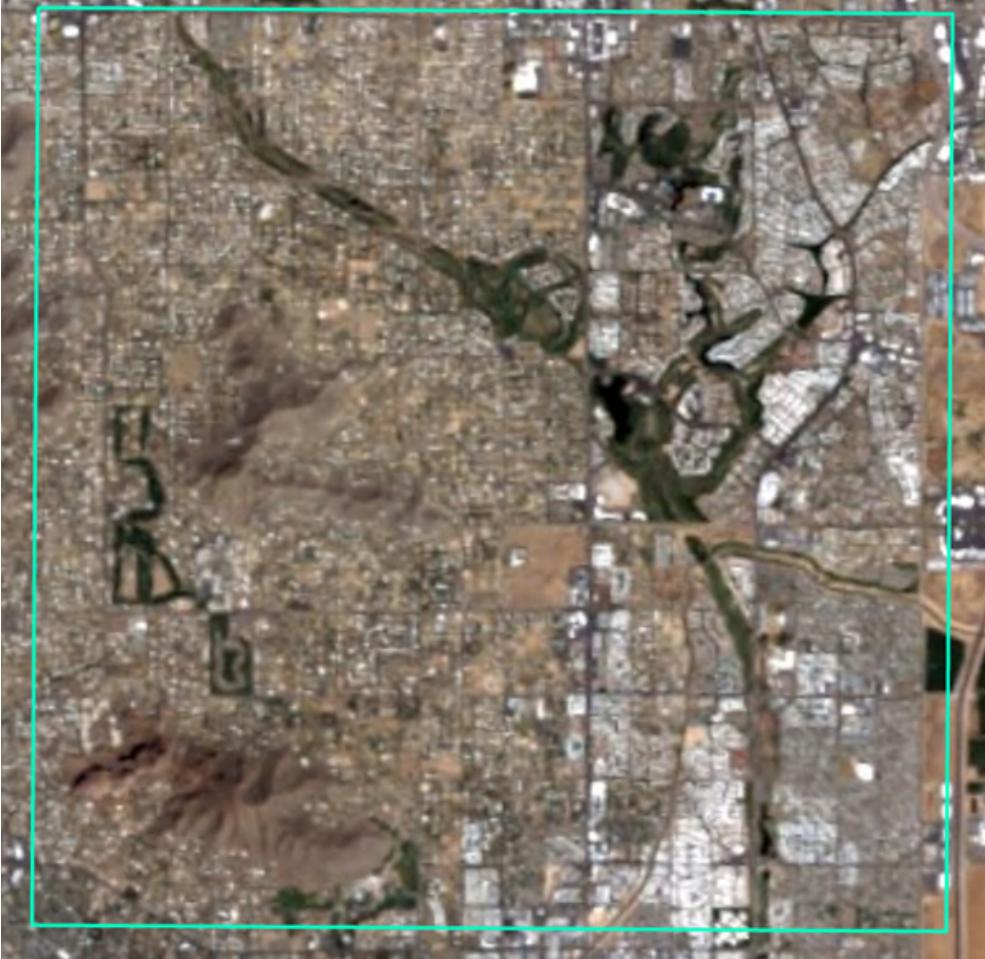
*Step 8g***: Examine the Landsat imagery layer.*

Dynamic Range Adjustment (DRA) adjusts the symbology of the imagery based on the viewing extent to create more contrast for more effective visualization.

This processing template is a visualization that indicates the NDVI values in a colormap, just like the Vegetation Index did in the Landsat Viewer app.

Note: You can also change the Processing Templates on the ribbon.

- h In the Contents pane, confirm that Landsat GLS Multispectral is selected and click the Data tab.
- i In the Processing group, click Processing Templates and choose Natural Color With DRA.



*Step 8i***: Examine the Landsat imagery layer.*

- j Reopen the Landsat GLS Multispectral imagery layer properties, and then from the Source tab, expand Raster Information.

 What is the cell size reported in the properties?

- Answer

The cell size is 30 meters.

Spatial resolution is measured by the size of a cell and represents an area covered on the ground. For instance, if a raster has a spatial resolution of 10 meters, that means that the area covered by the cell is 10 meters by 10 meters. Cell size affects the level of detail that can be seen within a raster. Spatial resolution can be considered high to low or coarse to fine. When the cell size number is small, the raster is considered to have a high spatial resolution.

These descriptions are used for comparison when selecting imagery for analysis or visualization. For example, when comparing two different imagery layers, a raster with a cell size of 1 meter is considered to have a high spatial resolution when compared to a raster with a cell size of 10 meters. However, both of these example rasters have a higher spatial resolution than a Landsat 9 multispectral imagery layer, which has a spatial resolution of 30 meters. It also may have a larger file size, which can affect performance. It is important to understand which level of resolution is the most appropriate to use in your analysis.

For more information about cell size and spatial resolution, go to ArcGIS Desktop Help: Cell size of raster data.

- k Click OK to close the layer properties.

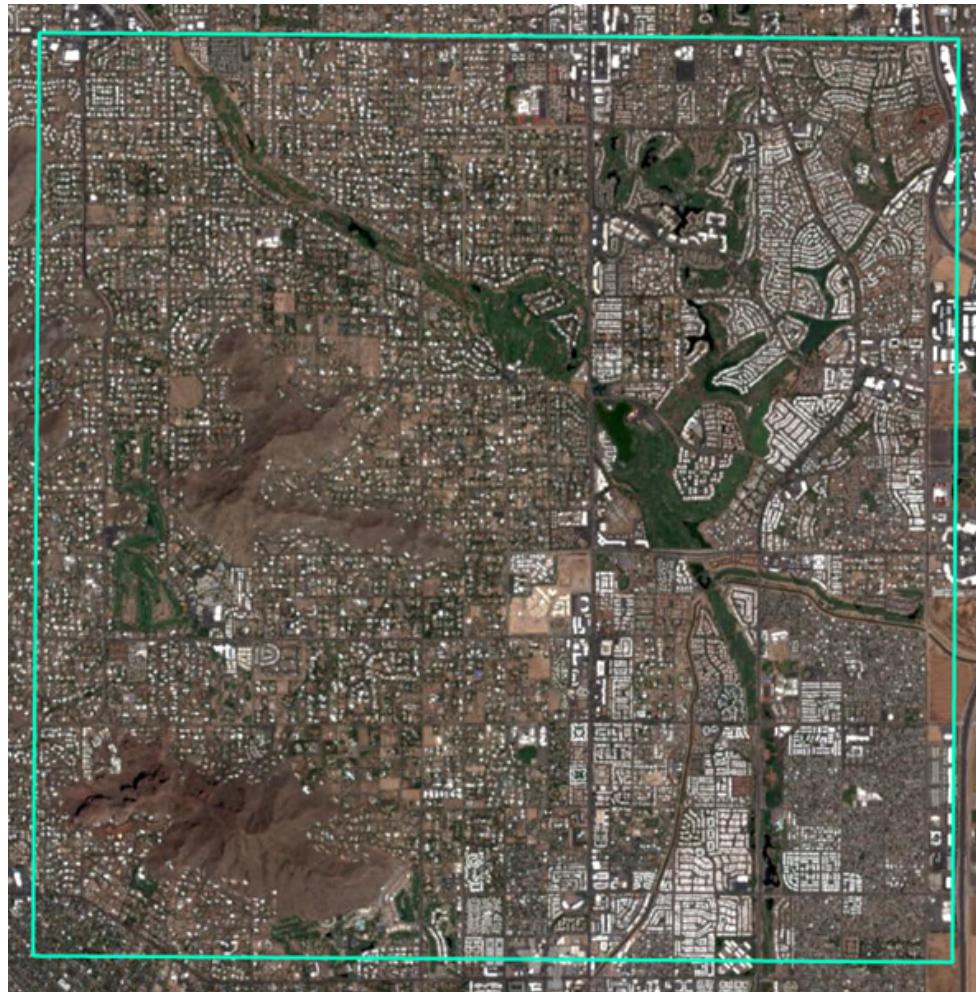
Now that you have reviewed the lower resolution imagery, you are ready to begin the process of refining the results using a higher resolution imagery layer.

- **Step 9: Add the Sentinel imagery layer**

In your initial analysis, you used Landsat imagery with a spatial resolution of 30 meters to find areas of high vegetation. In the next step of your analysis, you will add an imagery layer with a higher spatial resolution to further refine the estimate of

vegetation area. Using higher-resolution imagery can identify areas not previously found and remove areas that have been misidentified.

- a In the Catalog pane, view the available Living Atlas layers.
- b In the search field, delete your previous search term, type **sentinel**, and press Enter.
- c Right-click the Sentinel-2 Views imagery layer and choose Add To Current Map.



*Step 9c***: Add the Sentinel imagery layer.*

The Sentinel-2 Views imagery layer displays in Natural Color by default. You can see that the spatial resolution is much higher than the Landsat imagery layer.

The Sentinel-2 Views imagery layer is based on imagery data collected by the Sentinel-2 satellite. The Sentinel-2 satellite carries an optical instrument payload that samples 13 spectral bands: four bands at 10-meter, six bands at 20-meter, and three bands at 60-meter spatial resolutions. This imagery layer pulls directly from the Sentinel-2 on the Amazon Web Services collection and is updated daily with new imagery.

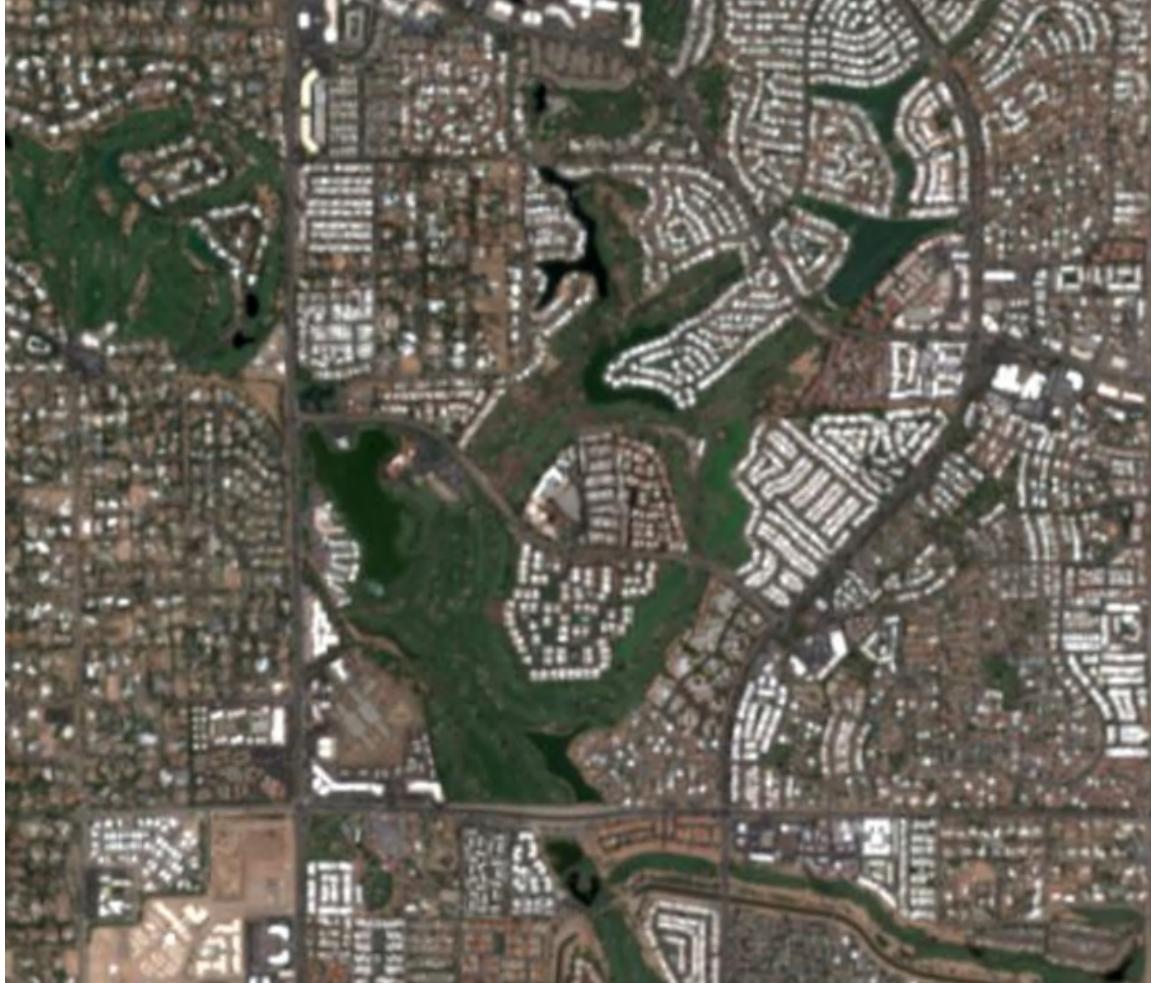
For more information about the Sentinel-2 Views imagery layer, review the item page on ArcGIS Online (<https://links.esri.com/Sentinel-2> | <https://arcgis.com/home/item.html?id=fd61b9e0c69c4e14beb50a9a968348c>) or right-click the Sentinel-2 Views imagery layer in the Contents pane and choose View Metadata to see the same information.

You added the higher-resolution Sentinel imagery layer and will now compare it to the Landsat imagery layer.

- Step 10: Compare imagery layers

In this step, you will visually compare the Landsat and Sentinel imagery layers to get a better understanding of the impact of spatial resolution for your vegetation analysis.

- a Zoom in to the middle of the study area and focus on the lakes in the middle, as shown in the following graphic.



- b In the Contents pane, select the Sentinel-2 Views imagery layer, if necessary.
- c Click the Image Service Layer tab.
- d In the Compare group, click Swipe .

Your pointer will change in the map to a triangle, indicating that the Swipe tool is active.

- e Click the left side of the map and drag your pointer to the right side.



Step

*10e***:*

*Compare
imagery
layers.*

The Landsat GLS Multispectral imagery layer will appear in contrast to the Sentinel-2 Views imagery layer.

The difference in spatial resolution is noticeable, as the Landsat layer looks much blurrier than the Sentinel layer. Due to the higher spatial resolution of the Sentinel imagery layer, the differences in vegetation is more visible.

- f In the Contents pane, right-click WaterPolicyStudyArea and choose Zoom To Layer.
- g Select the NDVI Mask For Water Policy layer and drag it above the Sentinel-2 Views imagery layer.
- h Open the Sentinel-2 Views imagery layer properties, and then from the Source tab, expand Raster Information.

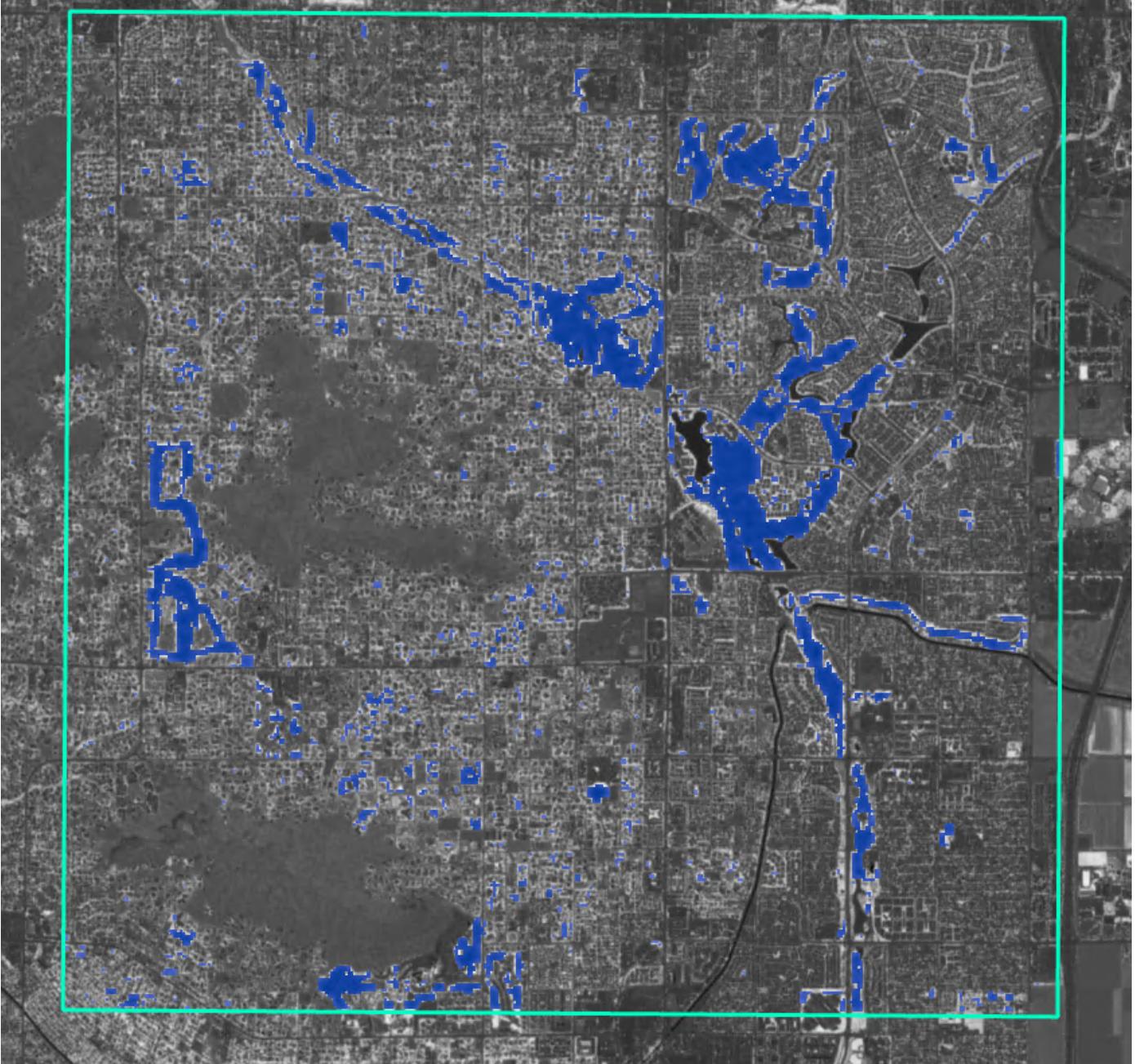


What is the cell size reported for the layer?

- Answer

The cell size is 10 meters.

- i Update the processing template for the Sentinel-2 Views imagery layer to NDVI Raw.
- j Apply the DRA.

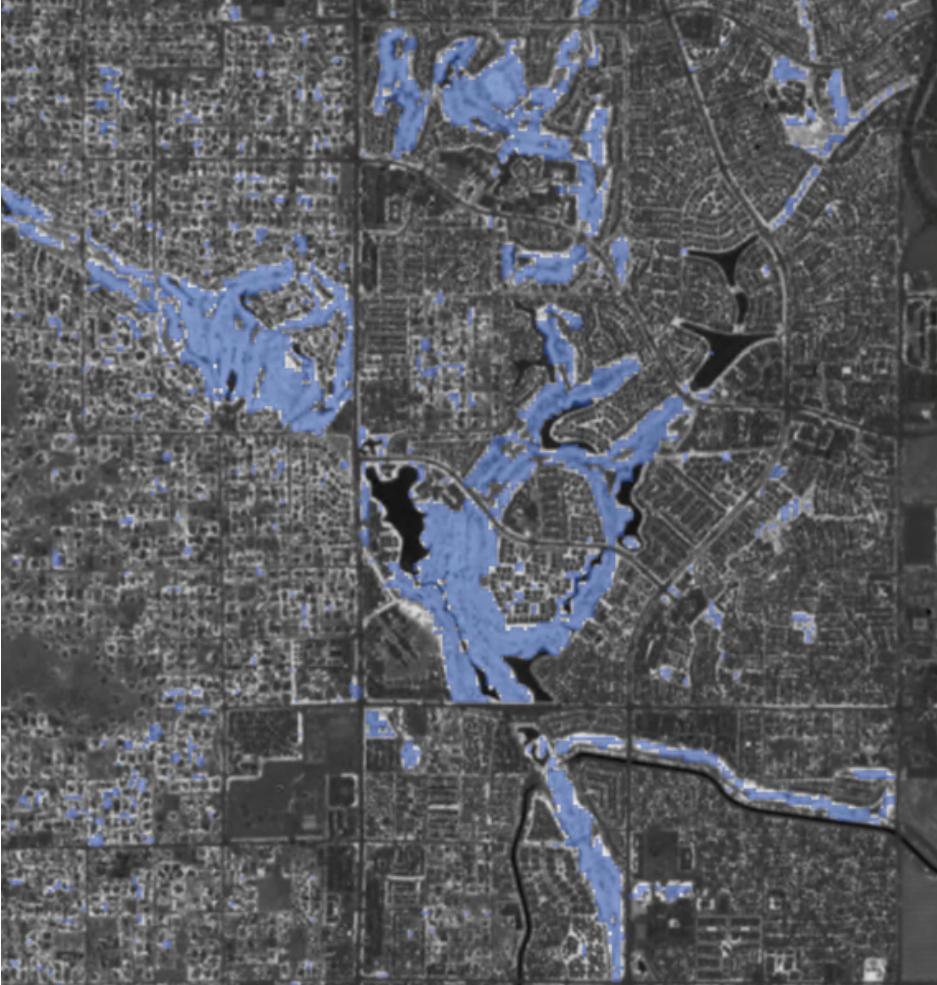


*Step 10j***: Compare imagery layers.*

- Hint

In the Contents pane, select the Sentinel-2 Views imagery layer, if necessary, and then from the Image Service Layer tab, in the Rendering group, click DRA.

- k Zoom in to the middle of the map to view the overlap of the mask from the Landsat imagery with the Sentinel-2 Views imagery layer.
- l In the Contents pane, select the NDVI Mask For Water Policy layer.
- m From Image Service Layer tab, in the Effects group, change the Transparency to **50%** and press Enter.



*Step 10m***: Compare imagery layers.*

The NDVI mask layer shows areas of high vegetation detected using the lower-resolution Landsat imagery layer. In the higher-resolution Sentinel imagery layer, areas of high vegetation are displayed in lighter shades of gray and white. At a quick glance, it appears that if you use the Sentinel imagery layer for your analysis, you will find more vegetation areas.

You will now compare the Landsat and Sentinel imagery layers using the NDVI processing template to get a better look at how the difference in spatial resolution affects detection of vegetation.

- n In the Contents pane, turn off the visibility of the NDVI Mask For Water Policy layer.
- o Update the processing template for the Landsat GLS Multispectral imagery layer to NDVI Raw and apply DRA.

- Hint

In the Contents pane, select the Landsat GLS Multispectral layer, and then from the Image Service Layer tab, in the Rendering group, click DRA.

- p Select the Sentinel-2 Views imagery layer, and then use the Swipe tool to compare the two layers.



*Step 10p***: Compare imagery layers.*

In this comparison, you can see that because the Landsat imagery layer (left side of graphic) has a lower spatial resolution, features are not as well-defined, meaning that certain areas of high vegetation may be missed. With the higher resolution Sentinel imagery layer (right side of graphic), features are more defined and smaller areas of high vegetation are more likely to be detected.

- q From the Map tab, in the Navigate group, click the Explore tool to deactivate the Swipe tool.
- r Save the project and keep ArcGIS Pro open for the next exercise.