





Client-Side Web GIS

Web Data

Image from NASA:
https://commons.wikimedia.org/wiki/File:Earth_Western_Hemisphere_transparent_background.png#filelinks



This module will focus on web data and web maps.

Module Topics



1. Feature layers
2. Raster tile layers
3. Map image layers
4. Vector tile layers
5. Open alternatives
6. ArcGIS Online content, maps, and scenes
7. Adding data to web maps and scenes
8. New host feature layer configuration

These are the topics covered in this module.

Data

3

We will begin with a discussion of web data.

❖ Base Maps

- ❖ Raster-based background layer
- ❖ Provides context
- ❖ Not generally used for analysis
- ❖ Tiled layer
- ❖ Not interacting with raw data

❖ Operational Layers

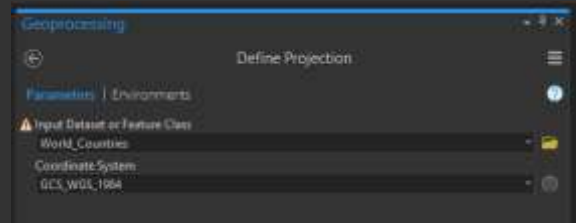
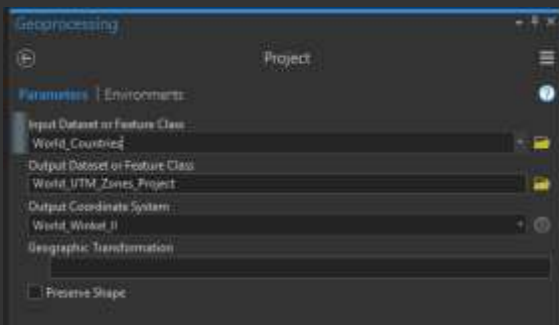
- ❖ Thematic layers
- ❖ Main information being presented on map
- ❖ Can be tiled layers or feature layers

Layers included in a map or scene can be grouped into two broad categories: base maps/layers and operational layers.

Base maps are used for context and are generally provided as raster-based or vector-based tile layers. The user does not have access to the raw or original spatial data and attributes.

In contrast, operational layers generally represent the central or highlighted map information and may require that the user have access to data attributes.

Transforming Datums/Projections in ArcGIS



*Should use WGS84 or Web Mercator

5

Data that will be use in a web map should be in the WGS84 geographic coordinate system or the Web Mercator projection. I prefer to use the Web Mercator projection.

If you need to transform data to a new projection, this can be accomplished in ArcGIS Pro using the Project tool available in the Data Management Toolbox.

◀...▶ Hosted Feature Layer/Feature Layer ▶...▶

- ❖ Stores vector data (points, lines, or polygons)
- ❖ Used for operational layers
- ❖ Properties can be set (style, transparency, visibility range, refresh interval, and labels)
- ❖ View, edit, analyze, and execute queries
- ❖ Access to features and attributes
- ❖ Can sometimes be downloaded
- ❖ Can have multiple layers grouped as single object

<https://doc.arcgis.com/en/arcgis-online/reference/layers.htm>

6

Feature layers allow you to store vector geospatial data for use in web maps and apps. A feature layer stored on ArcGIS Online is called a hosted feature layer. Feature layers allow for spatial data to be transferred between clients and a server. The user can also access attribute information, perform queries, and execute some analyses on the layer.

Symbology can be changed, pop-ups can be configured, and labels can be added or edited.

In short, feature layers provides web-based access to raw, vector geospatial data and are commonly used for operational layers.

- ❖ Pre-rendered tiles on **server**
- ❖ In compressed raster image format (**JPEG** or **PNG**)
- ❖ Cannot interact with raw data
- ❖ For **basemaps** and static **operational layers**
- ❖ Fast transfer
- ❖ Works well across a wide range of applications and devices

<https://doc.arcgis.com/en/arcgis-online/reference/layers.htm>

7

Raster tile layers are not raw geospatial data. Instead, pre-rendered tiles are uploaded to a server, and the server sends these tiles or “pictures” of the data to the client for viewing when requested.

Data are commonly transferred between the client and server in a compressed raster graphic format, such as JPEG or PNG.

Since raster tile layers are just “pictures” of the data, the user does not have access to the raw data or attributes. They are also not able to change the symbology.

If the data need to be presented with different symbology or layers need to be updated, then the tiles need to be re-rendered to the server.

Although this is more limiting than feature layers, it allow for faster data transfer.

This method is generally adequate for base maps or static operational layers where the user does not need to access attributes or change the data symbology.

- ❖ Individual image layers (JPEG or PNG)
- ❖ Set of pre-rendered images (256-by-256 pixels)
- ❖ Stored on server
- ❖ Spatially indexed
- ❖ Multiple zoom levels
- ❖ One zoom level active at a time
- ❖ Use tile layers produced by others
- ❖ Create your own tile layers

For raster tile layers, different tiles will be delivered to the client based on the viewing extent and map scale. For example, if the user is more zoomed out then less detailed, coarser tiles can be delivered. Detailed data will not be delivered until the user zooms in.

Tiles are commonly stored in a compressed raster graphic format, such as JPEG or PNG. Pre-rendered images measuring 256-by-256 pixels are stored on the server for different scales and extents.

The tiles are spatially index so that the server knows what tiles to send to the client based on the extent and scale. Data for a single scale or zoom level will be loaded until the scale and/or extent is changed and new tiles need to be sent. The goal is to provide the necessary data but limit the amount of information that must be transferred to the client.

Note that raster tile layers can be generated from your data using ArcGIS Pro and published to ArcGIS Online or a server for use in maps and applications.

- ❖ Different set of tiles displayed at different zoom levels
- ❖ Lower zoom level = more zoomed out, less detailed
- ❖ Higher zoom level = more zoomed in, more detailed

Example on following slide is for Open Street Map (OSM):
https://wiki.openstreetmap.org/wiki/Zoom_levels

A variety of tile sets are generated at different zoom levels.

Smaller numbers indicate more zoomed out, less detailed tiles.

Larger numbers indicate more zoomed in, more detailed tiles.

Level	# Tiles	Tile width (° of longitudes)	m / pixel (on Equator)	~ Scale (on screen)	Examples of areas to represent
0	1	360	156 412	1:500 million	whole world
1	4	180	78 206	1:250 million	
2	16	90	39 103	1:150 million	subcontinental area
3	64	45	19 551	1:70 million	largest country
4	256	22.5	9 776	1:35 million	
5	1 024	11.25	4 888	1:15 million	large African country
6	4 096	5.625	2 444	1:10 million	large European country
7	16 384	2.813	1 222	1:4 million	small country, US state
8	65 536	1.406	610.984	1:2 million	
9	262 144	0.703	305.492	1:1 million	wide area, large metropolitan area
10	1 048 576	0.352	152.746	1:500 thousand	metropolitan area
11	4 194 304	0.176	76.373	1:250 thousand	city
12	16 777 216	0.088	38.187	1:150 thousand	town, or city district
13	67 108 864	0.044	19.093	1:70 thousand	village, or suburb
14	268 435 456	0.022	9.547	1:35 thousand	
15	1 073 741 824	0.011	4.773	1:15 thousand	small road
16	4 294 967 296	0.005	2.387	1:8 thousand	street
17	17 179 869 184	0.003	1.193	1:4 thousand	block, park, addresses
18	68 719 476 736	0.001	0.596	1:2 thousand	some buildings, trees
19	274 877 906 944	0.0005	0.298	1:1 thousand	local highway and crossing details

This table provides an example of the tiling system used for OpenStreetMap.

A zoom level of 0 indicates a global scale while a zoom level of 12 would be appropriate for a city-level map.

The number of tiles, extent of each tile, and size of each pixel varies by zoom level.

Larger zoom levels will have more tiles, a smaller extent for each tile, and a smaller cell size; however, this is offset by the need to only send data for a smaller geographic extent to the client.

- ❖ Collection of map cartography based on vector data
- ❖ Map image layers are **dynamically rendered** image tiles
- ❖ Pictures or tiles of the data are sent to the client
- ❖ However, the vector data from which the tiles originate are still available so that data can be **visualized** and queried

<https://doc.arcgis.com/en/arcgis-online/reference/layers.htm>

11

Map image layers are a collection of map features and cartography based on vector data.

The raw vector data can be stored on a server; however, tiles are dynamically rendered to be sent to the client as opposed to sending the raw feature data.

Since the vector data from which the tiles originate are still available, data symbology can be changed and data can be queried; however, map image layers do not support editing of features from the client machine.

This is a “middle ground” between feature layers and raster tile layers.

- ❖ Map data delivered as **vector tiles** as opposed to raster tiles (PBF format)
- ❖ Layers are **rendered** on client machine based on a style delivered with the layer from the server
- ❖ Can **adapt** to the resolution of their display device and be restyled for multiple users
- ❖ Generally **smaller file size** than raster tiles
- ❖ **Faster** transfer and display
- ❖ More ability to edit style in comparison to raster tiles

Another option that has become available more recently is vector tile layers.

Note that vector tile layers are not raw, geospatial vector data. Instead, they are representations of the geospatial data stored in a vector graphic format as opposed to a raster graphic format.

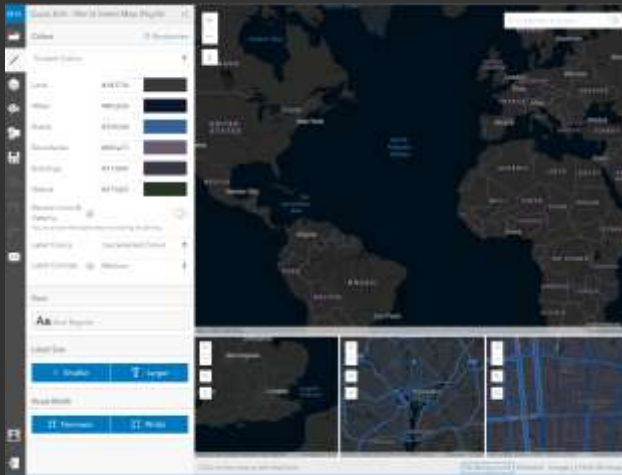
If you are a user of graphics editing software, this is analogous to storing a photograph as a JPEG or PNG file for editing as a raster graphic (for example, using Adobe Photoshop) vs. storing a graphic file as a vector graphic as a SVG or AI file for editing in a vector graphic software package (for example, Adobe Illustrator or InkScape).

Vector graphics store the font, vector, and color information and generally allow for more symbol editing than raster files.

Vector tile layers offer many benefits. Since they are vector graphics, they support the manipulation of data symbology without the need to store the raw geospatial data on the server and transfer the raw vector data to the client. File sizes are also generally smaller than raster tiles, and they support fast transfer and display. It is also easier to edit the style whereas raster tiles are pre-rendered images that do not allow for symbols and colors to be adjusted.

ArcGIS Pro currently supports the publication of vector tile layers to ArcGIS Online.

Vector Tile Basemaps



❖ Can edit ESRI **basemaps** as vector tile graphics

❖ Use ArcGIS for Developers:

<https://www.arcgis.com/apps/vtseditor/en/#/>

13

ESRI allows users to edit the provided ESRI basemaps as vector tile basemaps to generate customized base maps. Essentially, the user is specifying new styles to apply to the layers associated with the base map data. This requires that the data be stored as vector graphic data.

An edited base map can be saved to your ArcGIS Online account for use in your web apps and maps.

It can also be used in ArcGIS Pro if you are logged into your ArcGIS Online account to access your ArcGIS Online content.



- ❖ **Imagery Layer** = allows clients to access raw raster data
- ❖ **Scene Layer** = Collection of 3D feature objects and z-values for use in web scenes (points, 3D objects, integrated mesh, point cloud, and buildings)
- ❖ **Table** = collection of rows and columns (generally used to store aspatial or tabulated data)
- ❖ **Elevation Layer** = Special type for storing raster-based elevation data

There are some additional web layers that we will not discuss in detail here. For example, Image Layers allow for the transfer of raw raster data from the server to the client. Scene Layers allow for the storage of 3D features and include point clouds, 3D objects, integrated meshes, and 3D buildings. Tables allow aspatial or tabulated data to be transferred to the client. Elevation layers store raster-based elevation data.

-

15

REST is used in the ArcGIS Online environment so that data can be accessed without communication or compatibility issues.



❖ WMS = Web Map Service

- Client receives georeferenced map images
- JPEG, PNG, or GIF

❖ WMTS = Web Map Tile Service

- Client receives georeferenced, pre-rendered, multiscale images

❖ WFS = Web Feature Service

- Client receives the vector spatial data
- Access to vector geospatial data and attributes
- GML or GeoJSON

❖ WCS = Web Coverage Service

- Client receives raw raster data
- GeoTIFF, NetCDF, or HDF

❖ MVT = Mapbox Vector Tiles

- ❖ Client Receives vector graphic tiles
- ❖ PBF

Open data standards have been established for web-based geospatial data. A Web Map Service (WMS) is similar to a Map Image Layer in that raw data are stored on the server and images of these data, as tiles, are rendered and sent to the server. A Web Map Tile Service (WMTS) is similar to a Raster Tile Layer in which image tiles are pre-rendered and cached to the server. A Web Feature Service (WFS) is similar to a Feature Layer or Hosted Feature Layer in which raw geospatial data are stored on the server and provided to the client.

Web Coverage Services (WCG) allow for accessing raw raster data while Mapbox Vector Tiles (MVT) are used for vector-based graphic files, similar to Vector Tile Layers.

Web Content, Maps, and Scenes

17

We will now discuss web maps and scenes in the ArcGIS Online environment.



General Steps for Making a Web App using ArcGIS Online

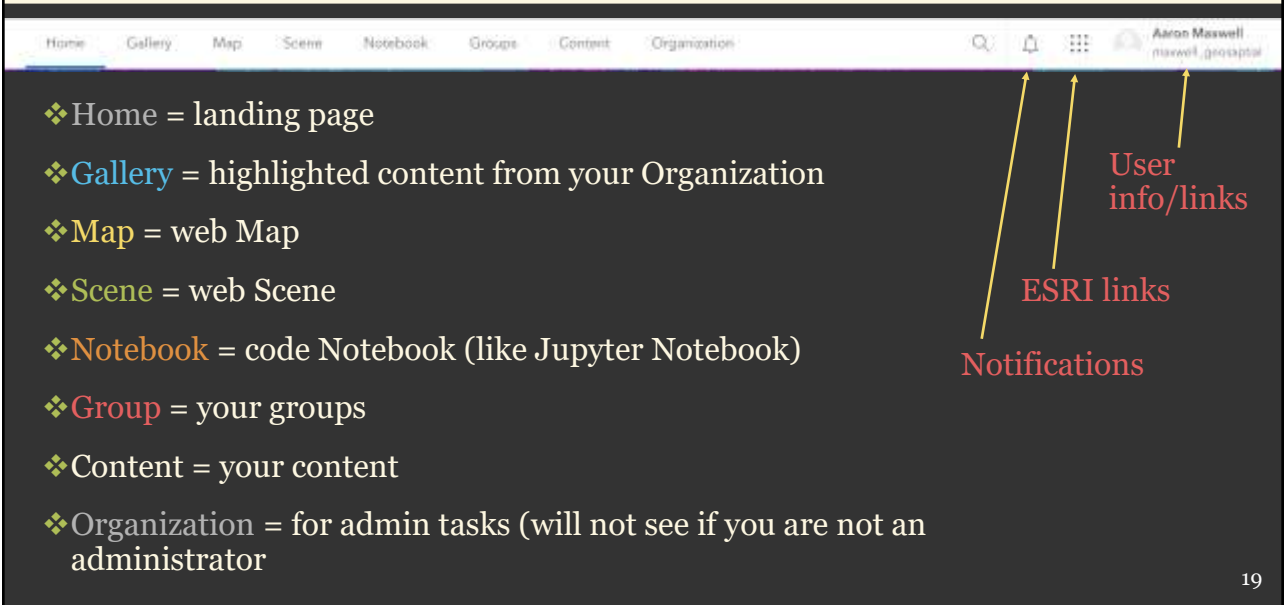


1. Find, prepare, publish, and/or create required layers/data
2. Configure layer(s) for editing if necessary
3. Create a web map or scene
4. Configure web map or scene
5. Add layers to map or scene
6. Edit layer symbology and/or visibility
7. Configure or disable pop-ups
8. Choose an app generation method
9. Configure and save app
10. Test app
11. Edit/update as needed

18

This slide outlines the common steps used to generate a web map and associated web apps using ArcGIS Online and associated technologies. We will begin to step through this process in this section. We will start with an overview of the ArcGIS Online web interface and the Map Viewer.

ArcGIS Online Layout



The screenshot shows the ArcGIS Online interface. At the top, there is a navigation bar with tabs: Home, Gallery, Map, Scene, Notebook, Groups, Content, and Organization. To the right of the tabs are icons for search, notifications, and user profile. Below the navigation bar, a list of features is shown with arrows pointing to the corresponding icons in the navigation bar:

- ❖ Home = landing page
- ❖ Gallery = highlighted content from your Organization
- ❖ Map = web Map
- ❖ Scene = web Scene
- ❖ Notebook = code Notebook (like Jupyter Notebook)
- ❖ Group = your groups
- ❖ Content = your content
- ❖ Organization = for admin tasks (will not see if you are not an administrator)

Annotations on the right side of the screenshot:

- Notifications (points to the bell icon)
- ESRI links (points to the grid icon)
- User info/links (points to the user profile icon)

This slide describes the main tabs on the ArcGIS Online landing page once a user is logged in. The Home tab represents the landing page while the Gallery tab highlights recent content generated within your organization. The Map tab opens the Map Viewer so that you can start building a web map while the Scene tab opens the Scene Viewer.

Notebooks allow for storing and working with code, such as Python code, to perform geoprocessing and spatial analysis operations. They function similar to a Jupyter Notebook and are designed specifically to work with the ArcGIS API for Python. You can save Notebooks created in ArcGIS Pro to your ArcGIS Online content. We will not explore notebooks in this course.

Groups list groups to which you belong.

The Content tab lists the content that you have saved within your ArcGIS Online account including maps, apps, hosted feature layers, and raster tile layers. I highly recommend organizing your content into folders since the content folder can get messy quickly.

The Organization tab has already been discussed and is only available to organization administrators.

If you have any notifications, there will be a small blue dot included with the bell symbol. Administrators can provide notifications to all members of the organization, for example to inform users of a system update or service outage.

Links are also provided for ESRI content/pages. Lastly, you can view your account information by clicking on your username.

◀▶ Your Content ▶◀

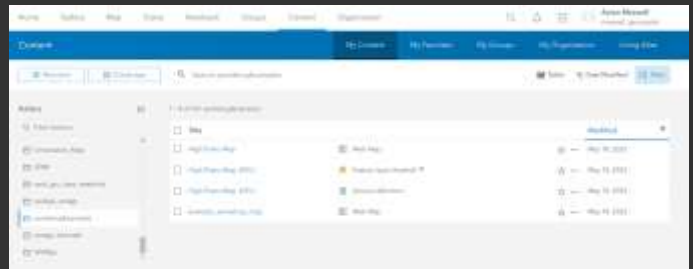


❖ Log into ArcGIS Online
(<https://www.arcgis.com/index.html>)

❖ Select Content

❖ Items

- ❖ Maps
- ❖ Scenes,
- ❖ Layers/data,
- ❖ Apps (Instant Apps, Storymaps, Dashboards, ExperienceBuilder)
- ❖ Tools
- ❖ Notebooks



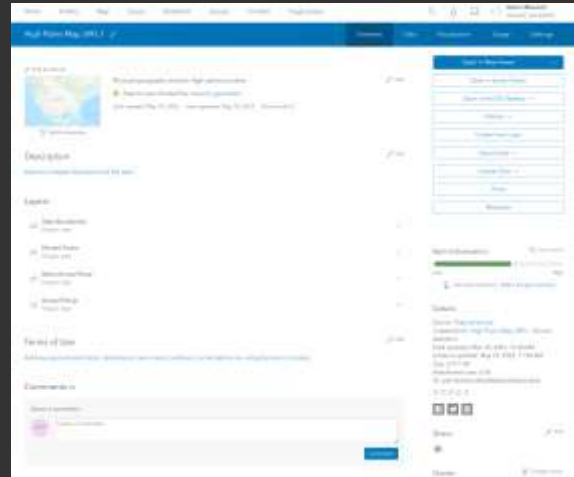
20

All of your content will be listed on your Content page. Again, I highly recommend organizing your content into folders. This slide lists some types of content that can be stored within your ArcGIS Online account.

◀⋯▶ Your Content



- ❖ All items have a drop page
- ❖ Page content will depend on item type
- ❖ Will make use of these pages throughout the workshop



21

Each item in your content will have a drop page, and the information displayed on this page will vary based on the item type. We will use these pages extensively in this course.

❖ **Map** = 2D projected map (generally uses Web Mercator)

❖ **Scene** = 3D scene of a 3D globe



Image from ArcGIS API for
JavaScript



Image from ArcGIS API for
JavaScript

Web maps are designed to represent your data in a 2D projected map space, generally Web Mercator.

In contrast, scenes allow for data to be displayed on a digital globe using 2D or 3D symbology.

◀▶ Create a Map ▶◀



❖ Log into [ArcGIS Online](https://www.arcgis.com/index.html) (<https://www.arcgis.com/index.html>)

❖ Click on Map

❖ Click Save and Open Icon

❖ Save as

❖ Provide title, save location, tags, and summary

❖ Click Save



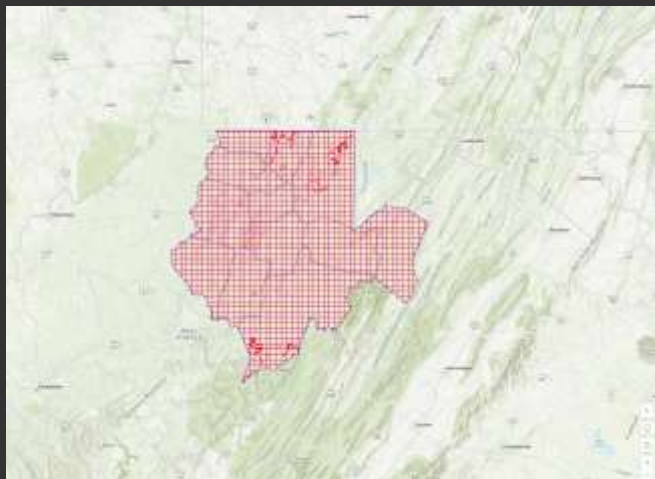
*I highly recommend using subfolders to organize your content.

23

Before generating a web app, you will need to create a web map. This can be accomplished in ArcGIS Online by selecting Create within the Content section. Alternatively, you can create a map using the Map tab, which opens the Map Viewer, then save the product to your Content.

When you generate a map, you will need to provide a unique title and some tags to make it searchable.

You can also provide a summary and save the map to a subfolder in your Content.



- ❖ Map designed to be viewed in web browser
- ❖ WGS84 Web Mercator projection used

Web maps make use of the WGS84 Web Mercator projection.

◀⋯▶ Tour of Map Viewer ▶⋯◀

- ⊕ Add data to Map
- 📁 List of Layers
- 📊 View tables
- 🗺️ Change Basemaps
- 📈 Build charts
- 📖 Map Legend
- 🔖 Add/access Bookmarks
- 💾 Save, Save as, Create new, or Open existing Map
- ⚙️ Change Map properties
- 🔗 Share Map or change share settings
- 📱 Create an App
- 🖨️ Print

25

This slide explains the icons on the left-side of the Map Viewer.

Generally, the icons on the left-side of the page relate to operations applied to the entire map while those on the right-side relate to layer-specific operations.

On the left-side of the page the icons allow for adding data to the map; viewing and selecting layers in the map; viewing tables; changing the base map; building charts; displaying the map legend; adding or accessing stored bookmarks; saving, saving a copy, creating a new, or opening an existing map; changing the map properties; changing the map share settings; creating an app from the map; and printing a map layout.

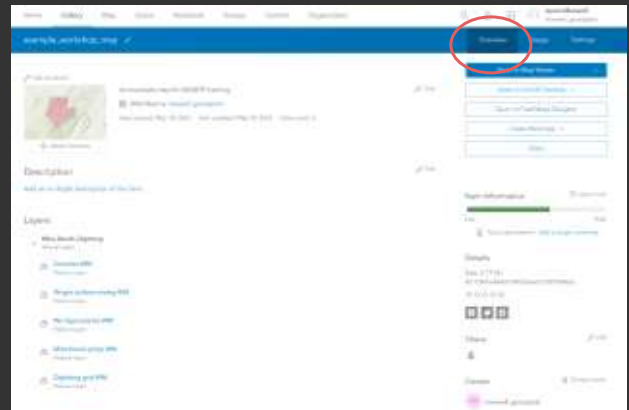
The screenshot shows a dark-themed interface. On the left is a vertical toolbar with icons and labels: Layer properties (green), Styles, Filter, Effects, Pop-Ups (blue), Fields (blue), Labels, Configure Charts, Forms, Analysis, Edit (red), Add Sketch, and Map tools. On the right, a red text note states: '*Tools on right are for data layers'. The page number '26' is in the bottom right corner.

*Tools on right are for data layers

The content on the right-side of the page generally relate to layer-specific operations such as viewing/editing layer properties; editing layer styles and symbology; applying data filters; adding display effects; configuring pop-ups; working with fields, labels, charts, and forms; performing analyses; editing data; and drawing and sketching into a temporary layer.

In this course, we will not focus on analysis operations available in ArcGIS Online.

- ❖ Find Map in **Content**
- ❖ Open drop page
- ❖ Information
 - Item Name
 - Thumbnail
 - Description
 - Layers
 - Owner
 - Keywords
 - Tags credits/attribution

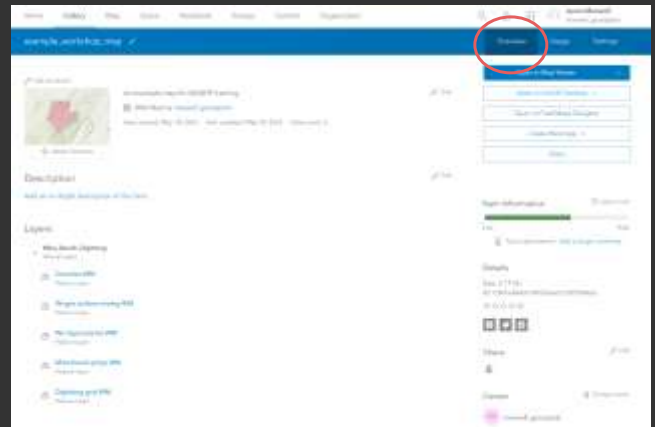


This slide highlights the information provided on the drop page for a map item in your ArcGIS Online content. Note that this information can be updated and edited. You can also go to the drop page to open the map and edit it further.

Web Map Editing and Settings



- ❖ Open in **Map Viewer** = open map and allows you to edit it
- ❖ Open in ArcGIS Desktop = open web map in ArcMap or **ArcGIS Pro**
- ❖ Create App = create **Web App** from Map
- ❖ Share = change share settings



28

From the drop page for the Map item, you can open it in the Map Viewer, open it in ArcGIS Pro, create an app, and change the share settings.

-
- The screenshot shows the AWS IAM console interface. The top navigation bar includes links for Home, History, Groups, Users, Groups and Users, Groups, Groups, and My Groups. The 'Groups' tab is currently selected. Below the navigation bar, the breadcrumb trail reads 'Groups > Your Group'. The main content area displays a 'Groups' table with columns for Name, Status, and Actions. The table is currently empty. At the bottom right of the table, there is a 'Create New Group' button. The overall layout is clean and professional, typical of AWS console interfaces.

Under the Settings tab, you can prevent the map item from being deleted, change the default map extent, allow for use in field maps, and allow for copies to be made.

◀▶ Create a Scene ▶◀



❖ Log into [ArcGIS Online](https://www.arcgis.com/index.html) (<https://www.arcgis.com/index.html>)

❖ Click on Scene



❖ Click Save and Open Icon

❖ Save as



❖ Provide title, save location, tags, and summary

❖ Click Save



30

You can also generate web scenes using ArcGIS Online. Scenes are viewed and created under the Scene tab. Similar to maps, they are saved as items to your ArcGIS Online content.

◀⋯▶ Tour of Scene Viewer



- ⊕ Add data to **Scene**
 - 📁 List of **Layers**
 - 🖥️ Access or capture **Slides**
 - ⚙️ Change **Scene** properties
 - 💾 Save
 - 📄 Create an app
- 🔍 Search
 - 📋 **Layer List** and **Legend**
 - 🗺️ **Basemap**
 - ☀️ Illumination and weather
 - 📊 Analyze/Measurement
 - 🔗 Share
 - ⚙️ Graphic settings



*Tools on right are for data layers

31

Scene are viewed in the Scene Viewer as opposed to the Map Viewer. The tools available for scenes are different from those for Maps.

The icons on the left-side allow for adding data to the scene, viewing the layer list and accessing layers, accessing or capturing slides, changing the Scene properties, saving the Scene, and creating an App from the Scene. Slides serve a similar purpose as Bookmarks in a 2D map. They store a camera position and view of the scene from a specific vantage point and scale.

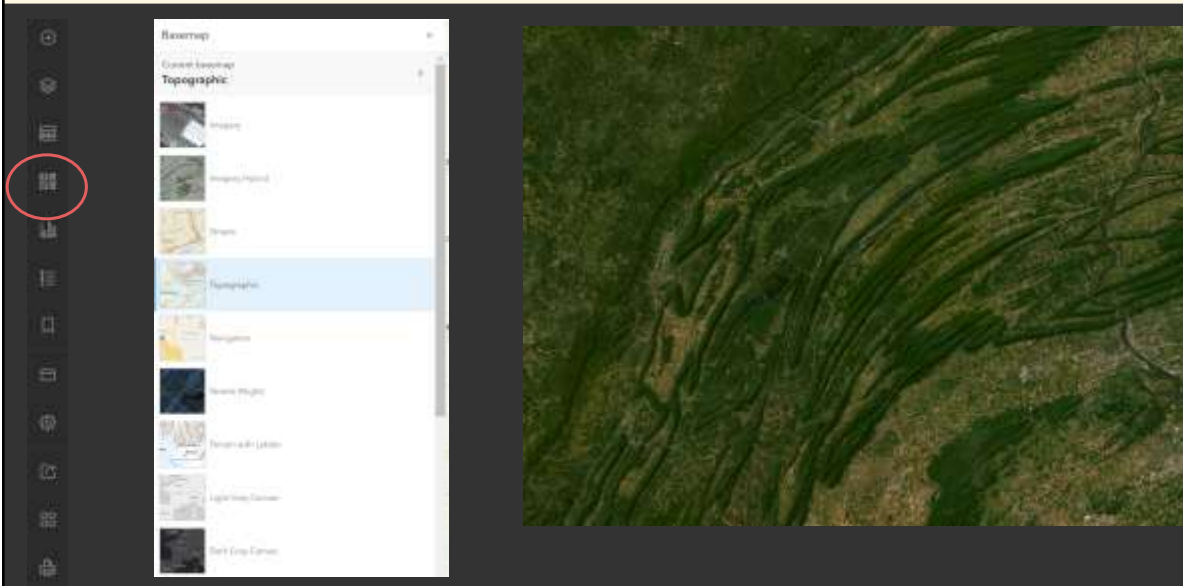
Tools on the right-side allow for searching, viewing, and manipulating the Layer List and Legend; changing the base map; changing the simulated illumination and weather conditions; performing analyses and measurements; and changing the share and graphics settings.

Add Layers to Web Map

32

We will now explore adding layers to a web map.

Change Base map

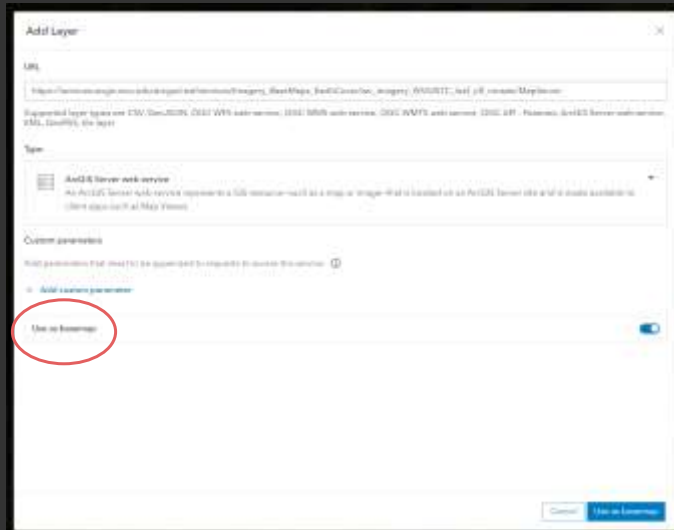


33

You can change the default base map to one of the other ESRI-provided base maps.

Base map from Layer

❖ Some layers can be used as
basemaps



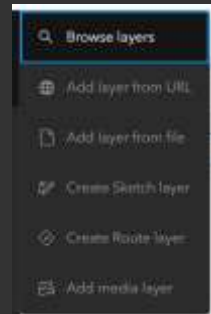
34

Alternatively, you can use another layer as a base map. This is generally accomplished by adding a layer and selecting the “Use as basemap” option. Base maps are generally Raster Tile Layers to allow for fast download and drawing speed.

Adding Data



1. Publish maps/data from **ArcGIS Pro**
2. Add existing layers by browsing content
3. Connect to data on a REST service
4. Upload data to ArcGIS Online as **CSV**, **shapefile**, or **GeoJSON**

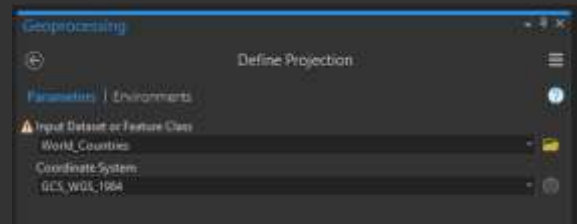
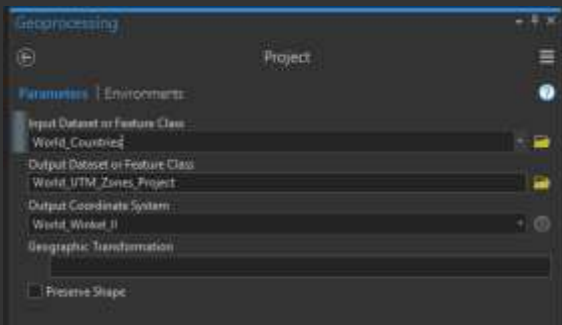


*Should use WGS84 or Web Mercator

35

There are many ways to add data to a map in ArcGIS Online. The next set of slides discuss how to link to or load data into an ArcGIS Online map using varying methods.

Transforming Projections and Datums in ArcGIS



*Should use WGS84 or Web Mercator

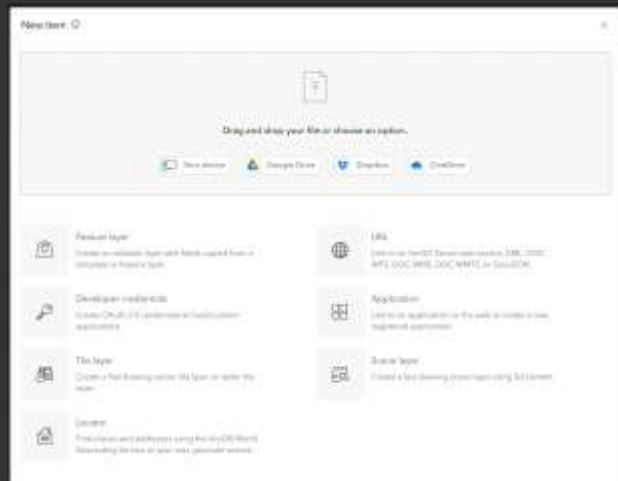
36

Data that will be used in a web map should be in the WGS84 geographic coordinate system or the Web Mercator projection. I prefer to use the Web Mercator projection.

If you need to transform data to a new projection, this can be accomplished in ArcGIS Pro using the Project tool available in the Data Management Toolbox.

Adding Data

1. From within web map
2. From Content → New Item
3. Can add data from local machine, Google Drive, Dropbox, and OneDrive
4. Can drag and drop in window



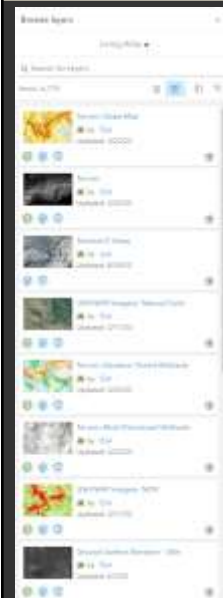
*Should use WGS84 or Web Mercator

37

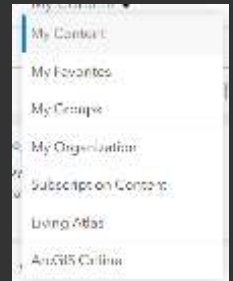
Data can be added to your ArcGIS Online content using a variety of methods and from a variety of locations within ArcGIS Online including from within the web map, creating a new item in your content, adding data from your local device or cloud storage, or dragging files into the New Item window.

The New Item window can be accessed from the Content tab.

⏮️ Browsing for Layers



- ❖ My Content = your ArcGIS Online content
- ❖ My Favorites = often or recently used layers
- ❖ My Groups = from group in which you are a member
- ❖ My Organization = shared within your organization
- ❖ Subscription Content (not free)
- ❖ Living Atlas = ESRI Living Atlas
- ❖ ArcGIS Online = shared publicly by others via ArcGIS Online



38

From within the web map, you can add data by browsing your content, content shared within groups to which you belong, content shared within your organization, and content shared via the Living Atlas or publicly via ArcGIS Online.

◀⋯▶ Add Layer from URL



❖ Includes CSV, GeoJSON, WFS, WMS, WMTS, ArcGIS REST, KML, GeoRSS, and tile layer



39

A variety of data layers can be added from a URL link including comma separated values (CSV) files, GeoJSON, WFS, WMS, WMTS, ArcGIS REST services, Keyhole Markup Language (KML) files, GeoRSS, and tile layers.

Note that some layers may fail to load if the connection is not secure (i.e., HTTPS).

◀▶ ArcGIS Living Atlas of the World ▶◀



<https://livingatlas.arcgis.com/en/>

40

ArcGIS Online allows for data to be streamed from the ArcGIS Living Atlas of the World. Note that this requires specific licensing and access rights. Data available via the Living Atlas may not be free and open-source.

Map Services From the West Virginia GIS Tech Center

WV GIS Technical Center GIS Services

All the services listed are available on the WV GIS Technical Center REST Service Directory. If there is a data service you think should be, please contact Frank LaRue.

Web: <https://services.wvgsi.wvu.edu/ArcGIS/rest/services/>
 ArcMap: services.wvgsi.wvu.edu/ArcGIS/rest/services/

Imagery - Leaflet

Name	Description	Projection	Date	Information	REST Services
WV Aerial Photo Web Resolution	Sherriff's imagery updated with more recent and higher resolution (typically 1") aerial imagery	Web Mercator	2010-2012	Link	Link
Sherriff Assessment 2010-2012	12" (urban) and 4" (rural) post-resolution, mostly built-up 4" detailed 50' imagery by towns. Largest viewing scale 1:250.	Web Mercator	2010-2012	Link	Link
WV Aerial 2002 25' Resolution Data	2-4' post-resolution	Web Mercator	2002	Link	Link

https://www.mapwv.gov/gis_services.html

41

You can also stream data from a web connection, such as an ArcGIS Server or data service. This slide provides a link to the data services provided by the WV GIS Technical Center.

- ❖ Can be used to add point data
- ❖ Need to provide **latitude** and **longitude** fields
- ❖ Can provide address to geocode locations
- ❖ Provide all fields

A	B	C	D	E	F	G
FID	FID_	Id	name	Type	lat	long
0	0	0	Wamsley C	Bike shop	39.6416	-79.9632
1	1	0	Morgantoi	Bike shop	39.64172	-79.9632
2	2	0	Pathfinder	Bike shop	39.6293	-79.9565
3	3	0	Gary's Cori	Comics an	39.6299	-79.9556
4	4	0	Vintage Vi	Comics an	39.62947	-79.9556
5	5	0	Comic Pari	Comics an	39.63425	-79.9691
6	6	0	Four Horse	Comics an	39.62563	-79.997

It is possible to import point data using a CSV (Comma Separated Values) or text (TXT) file. You will need columns that house the latitude and longitude coordinates relative to the WGS84 datum.

All other columns will be treated as attributes.

Note that you can export data tables to CSV or TXT from ArcGIS Pro and Microsoft Excel. This is also generally possible in most statistical and data analysis software packages.

From Shapefile

- ❖ Must be compressed first
- ❖ Works for **points**, **lines**, and **polygons**
- ❖ Should convert to WGS84 or WGS84 Web Mercator



43

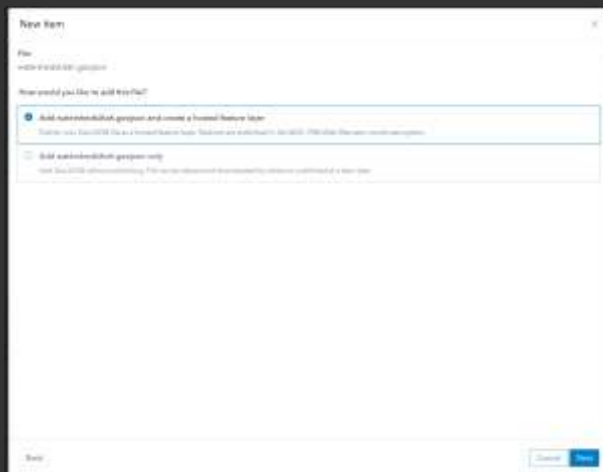
If you want to upload a shapefile, you need to place all the components of the file into a folder then compress the folder to a ZIP archive. You will then upload the compressed data.

If the data are complex (for example, there are many features and/or many vertices), you may want to consider generalizing the features for faster web display.

Again, the shapefile should be referenced to the WGS84 geographic coordinate system or the Web Mercator projection.

Using this method, you can upload point, line, or polygon geometries. Using the CSV method, you can only upload point features.

- ❖ Works for **points**, **lines**, or **polygons**
- ❖ Should convert to WGS84 or Web Mercator
- ❖ Can convert files to GeoJSON using QGIS

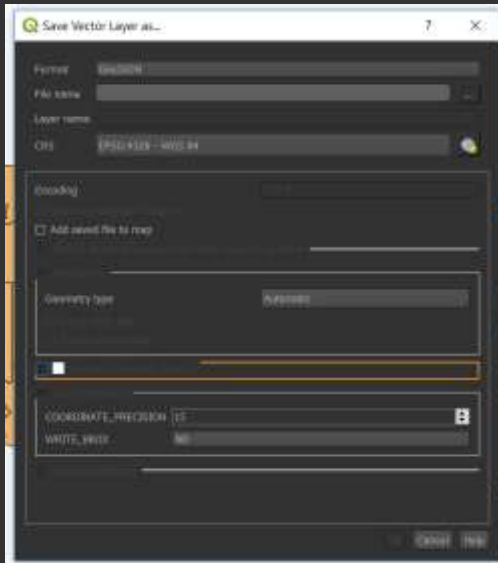


JSON stands for JavaScript Object Notation. JavaScript is capable of interacting with data provided in this format.

Since JavaScript is the primary client-side web programming language, JSON is often used to represent data on the web or transfer data between the client and server.

GeoJSON expands JSON to include geographic features and spatial reference information. This is one means to work with spatial data on the web using an open-source data format.

GeoJSON files can be uploaded to ArcGIS Online.

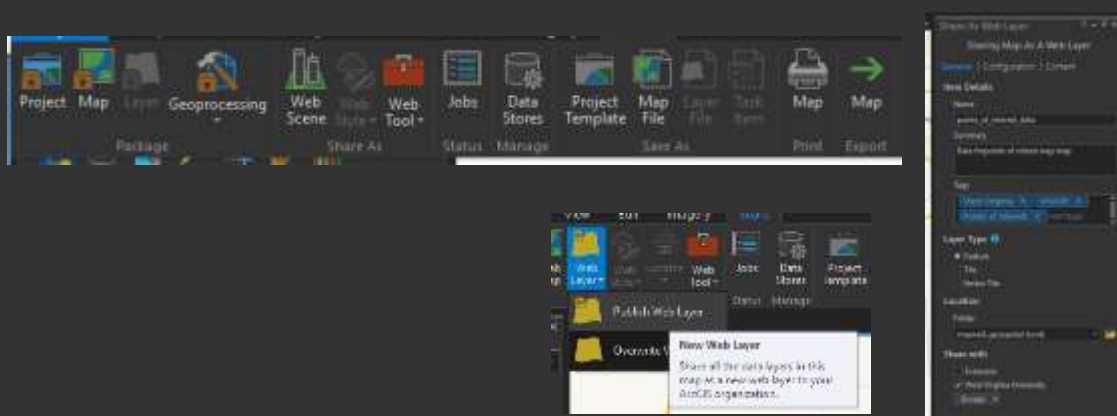


- ❖ Can export files to **GeoJSON** format
- ❖ Can create bounding box
- ❖ Can set coordinate precision
- ❖ **QGIS** can read and write many file types

GeoJSON files are directly readable in the free and open-source QGIS software. Data can be read in, and other data types can be saved to GeoJSON.

You can specify a bounding box as an extent and also the coordinate precision. One benefit of QGIS is that it can read in and convert a wide variety of data types. I often use QGIS as a data conversion tool for this reason.

- ❖ It is possible to create a map in **ArcGIS Pro** and create a service from it that can be used in a web map



46

You can also publish maps and/or data from ArcGIS Pro to your ArcGIS Online content.

This requires you be logged into your ArcGIS Online account in ArcGIS Pro and that you have the appropriate User Type and Role within your organization. For example, you would need to be a publisher to publish data. If you do not have these rights, you will need to talk with your administrator to update your User Type and/or Role.

Options for publishing a web map and/or data are available under the Share tab. As already mentioned above, web maps and all data layers should be in the WGS84 geographic coordinate system or Web Mercator projection for online use.

When you publish from ArcGIS Pro, you will be able to provide a name, tags, and a summary. You can also choose a subfolder in which to store the content on ArcGIS Online.

There are also different means to store data, such as hosted feature layers, raster tiles, and vector tiles.

❖❖ Publish Map and Layers ❖❖



- ❖ Must be logged in and have publishing rights
- ❖ Share → Web Map
- ❖ Must provide Name, Summary, and Tags
- ❖ Different Configurations are available: Copy all data, Editable, Visualization
- ❖ Can share with no one, everyone, organization, or specific groups
- ❖ Analyze to check for issues or errors
- ❖ Share to begin job



47

When a map is published from ArcGIS Pro to ArcGIS Online, the map object and the associated data will be published as items to your ArcGIS Online content. In order to publish content to ArcGIS Online, you will need to be logged into your account in ArcGIS Pro and have publishing rights within your organization. A map can be shared by selecting Web Map under the Share tab.

You will need to name the map and provide a summary and tags. Different configurations are available depending on whether or not data need to be editable. You can also choose to share the map and associated data with your organization, only specific groups in your organization, or with everyone (i.e., publicly).

You will need to analyze the content prior to publishing to make sure that there are no issues. Errors will not allow the map and data to be published while warnings will allow publishing to be performed; however, there may be issues.

When you click the Share button, the process of publishing the map will commence.

What is published?



❖ Map, Layers, Service definition



☐ Title		Modified
☐ High Plains Map	Web Map	May 18, 2023
☐ High Plains Map_WFL1	Feature layer (hosted)	May 18, 2023
☐ High Plains Map_WFL1	Service definition	May 18, 2023
☐ example_workshop_map	Web Map	May 18, 2023

48

Once a map is published, new items will be added to your ArcGIS Online content including the map object, the data layers, and a service definition file. A service definition file contains information about service properties, capabilities, and the service type, which is encapsulated into one portable file. This can be useful when you have limited internet access or speed and need to perform the upload at a later time.

Publish Layers

- ❖ Must be logged in and have publishing rights
- ❖ Share → Web Layer
- ❖ Provide Name, Summary, and Tags
- ❖ Define Type: Feature, Tile, or Vector Tile
- ❖ Can share with no one, everyone, organization, or specific groups
- ❖ Configuration options will depend on layer type
- ❖ Analyze to check for issues or errors
- ❖ Share to begin job



49

It is also possible to share just the data layers as opposed to the map and data layers. If data layers have already been saved to your ArcGIS Online content, they can be updated or overwritten.

◀▶ Publish Layers ▶◀



- ❖ Publish a new layer
- ❖ Overwrite an existing layer
- ❖ **Offline Service Definition File** = for publishing later if working offline



50

Again, you can choose to publish new layers or overwrite a prior upload. Overwriting can be used to update prior published layers. Maps and apps that reference these layers will automatically be updated to use the new version.



When data layers are rendered, you have the option of generating hosted feature layers, raster tiles, or vector tiles.

When you export to a raster tile layer, you can specify a tiling scheme, the level of detail or zoom levels to render, create a cache on the server or a local cache, and choose whether or not to allow the client to export cache tiles.

Other Items that can be published from ArcGIS Pro

- ❖ **Web Style** = save custom style for layer symbology
- ❖ **Locators** = share geocoding service
- ❖ **Web Tools** = tool or workflow as web service
- ❖ **Geodata Services** = access to file geodatabase or enterprise geodatabase remotely via ArcGIS Server



52

There are other items that can be published from ArcGIS Pro to ArcGIS Online that we will not discuss in detail. Web Styles allow for sharing layer style or symbology as opposed to the actual data. Locators allow for sharing custom geocoding services. Web tools allow for sharing geoprocessing or spatial analysis workflows for use as web-based tools. We will not discuss creating web-based tools in this course. Lastly, Geodata services allow for accessing file geodatabases or enterprise geodatabase remotely via ArcGIS Server.

◀...▶ Create a New Hosted Feature Layer ▶...▶

❖ Navigate to **Content**

❖ Select New Item



❖ Select Feature Layer



❖ Options to Create an empty feature layer

- ❖ Define your own layer
- ❖ Select an existing layer
- ❖ Use a template
- ❖ Provide an ArcGIS Server layer URL

❖ Name Layer and define geometry



53

If you need to create a layer in which to collect data, there are several options.

You could generate the data as a CSV file or shapefile and then upload it to ArcGIS Online as a template for the data collection. You could also publish a feature class from ArcGIS Pro.

Alternatively, you could generate a new layer from scratch as a hosted feature layer. A feature layer can store vector data with associated attribute information. It is a feature class that is available for use in web maps and apps. A hosted feature layer is a feature layer stored on ArcGIS Online.

When you create a hosted feature layer, you are able to edit it, allow others to edit it, and change the symbology. So, they are generally good options for collecting VGI data via the web and mobile apps.

ArcGIS Online provides a wide variety of templates to create hosted feature layers for common task. Alternatively, you can build a layer from scratch.

◀▶ Create a New Hosted Feature Layer ▶◀

- ❖ Add GPS metadata fields/Enable Z-values
- ❖ Provide item title, location, tags, and summary
- ❖ Click Save

54

When you define a hosted feature layer, you can choose to collect GPS metadata. This can be useful if data will be collected with field apps and to assess the positional accuracy of collected data. If you enable Z-values, this allows for storing elevation data with each vertex.

As with other ArcGIS Online content, you must provide a title and tags and can provide a summary. You can also save the hosted feature layer to a subfolder within your ArcGIS Online content. Again, I highly recommend using folders to organize your Content.

Layer Editing and Settings

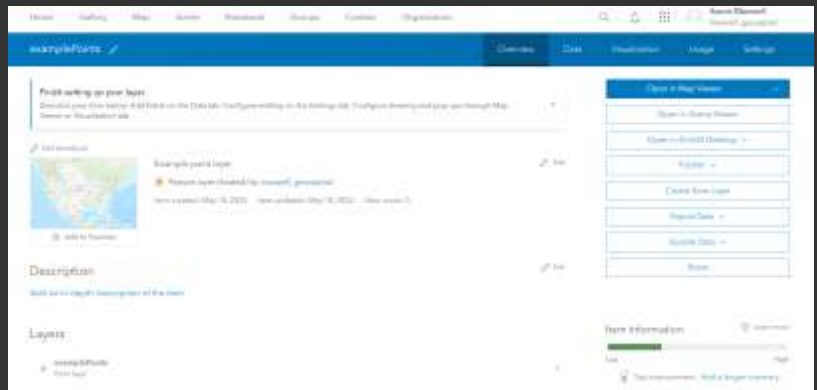


❖ Find layer in **Content**

❖ Open drop page

❖ Information

- Item Name
- Thumbnail
- Description
- Layers
- Owner
- Keywords
- Tags
- Credits/attribution
- Layer URL



55

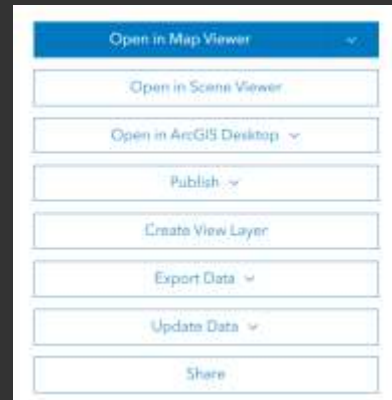
Once a hosted feature layer is created, it will have an associated drop page like all other ArcGIS Online content items.

Note that the layer will be assigned a URL. This URL can be used to link to the data in a web map or scene.

Layer Editing and Settings



- ❖ Open in Map Viewer = open layer in a new **map**
- ❖ Open in Scene View = open layer in new **scene**
- ❖ Open in ArcGIS Desktop = open in ArcMap or **ArcGIS Pro**
- ❖ Publish = convert and publish to new web format
- ❖ Export file for local use as shapefile, **CSV**, **KML**, **Excel**, **File Geodatabase**, **GeoJSON**, **Feature Collection**, or GeoPackage
- ❖ Share = change/update **share** settings



56

On the layer drop page, you can open the layer in the Map or Scene viewer, open it in ArcGIS Pro, convert or publish the layer to a different web format, and export the file to a different file format, potentially for download.

You can share the hosted feature layer with your organization, groups within your organization, or publicly.

➤ Add Fields

- ❖ Navigate to drop page for layer in **Content**
- ❖ Navigate to **Data** tab
- ❖ Switch to Fields view
- ❖ Click **Add Field**
- ❖ Field Name = actual field name
- ❖ Display Name = alias name (for cleaner display)
- ❖ Types = date, double, integer, or string
- ❖ Can specify default value
- ❖ Can choose to allow or not allow Null values



57

Fields can be added to a hosted feature layer under the Data tab on the layer's drop page. In this tab, you will need to switch to field view.

Field names represent the actual name stored in the table while the display name is a cleaner name used for display. This is comparable to an alias name for a field in a file geodatabase feature class.

You can define fields as either a date, double, integer, or string type. When using a string type, you can increase or decrease the allowed number of characters.

For a field, you can also specify a default value and choose whether or not to allow Null or empty entries.

Domains (Coded Values)



- ❖ Navigate to drop page for layer in **Content**
- ❖ Navigate to **Data** tab
- ❖ Switch to Fields view
- ❖ Click on field name
- ❖ Get started for **Domains** or Edit



☐ Label (displayed value)	Code (stored value)	
☐ Sandstone	etc. sandstone	...
☐ Limestone	etc. limestone	...
☐ Dolostone	etc. dolostone	...
☐ Shale	etc. shale	...
☐ Mudstone	etc. mudstone	...
☐ Conglomerate	etc. conglomerate	...
+ Add value		

58

You can also specify domains to only allow for certain values or a certain range of values to be entered into a field.

The Create List option allows for creating a coded values domain. This will allow for only a subset of categories or allowed values to be recorded in the field. For example, you could define a coded values domains for a buildings layer that only allows the building to be labeled into a set of pre-defined types (e.g., residential, commercial, industrial, or public). This can allow for much cleaner tables. Each allowed value is assigned a label, which serves as a clean and interpretable display name, and a code, which is the value or string actually stored in the table.

Domains (Range Values)



- ❖ Navigate to drop page for layer in **Content**
- ❖ Navigate to **Data tab**
- ❖ Switch to Fields view
- ❖ Click on field name
- ❖ Get started for **Domains** or Edit

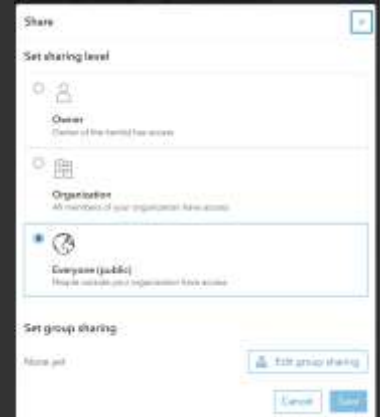
59

A range value domain can be specified for a double or integer field by specifying allowed minimum and maximum values. If a range value domain is set up, then the user will not be able to enter numbers outside of this range. This could be useful if only values within a certain range are valid. For example, a field that holds percentages may only allow values between 0 and 100 to be entered.

Make a Layer Editable



- ❖ Share with Group, Organization, or Everyone (public)
- ❖ Approve for public data collection
- ❖ Editing options
 - Add
 - Delete
 - Update (attributes only vs. attributes + geometry)
 - Which features editor can see/edit
 - Allow caching
 - Allow export



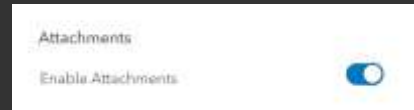
60

In order for a layer to be editable by others, it must be shared with either your organization or everyone. If it is shared with everyone, you must approve the layer for public data collection. You also have control over what can be edit. For example, a user could be allowed to only add features, as opposed to delete or edit existing features.

Attachments



- ❖ Navigate to layer in **Content**
- ❖ Navigate to Overview tab
- ❖ Turn on **Enable Attachments**



61

You can also allow attachments to be associated with records or features stored in a layer. For example, this could allow photos to be uploaded along with points collected in the field using a field or mobile app.



This is the end of this lecture module.

Please return to the [West Virginia View Webpage](#) for additional content.



Thanks! Hope you found this useful.