Client-Side Web GIS

Web Data

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

WV VIEW

AmericaView
Empowering Earth Observation Education
AmericaView.org - Est. 2003

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Data

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Layers

- 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

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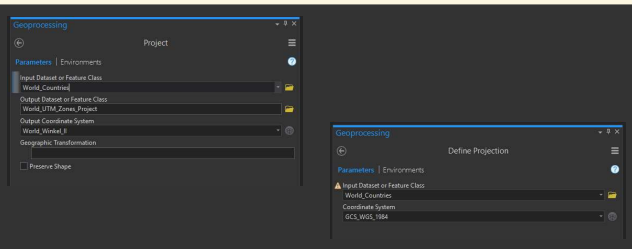
Transforming Datums/Projections in ArcGIS



*Should use WGS84 or Web Mercator

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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

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Map Image Layer

- 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

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Raster Tile Layer

- 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

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Understanding Tiling

- 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

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Zoom Levels

- 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

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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

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Vector Tile Layer

- 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

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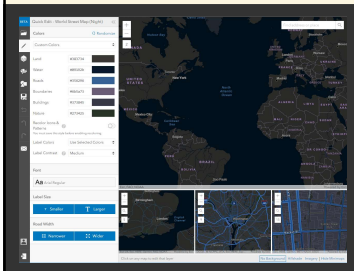
Vector Tile Basemaps



- Can edit ESRI basemaps as vector tile graphics
- Use ArcGIS for Developers: https://www.arcgis.com/apps/vtseditor/en/#/

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Other Layer Types

- 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

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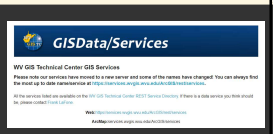
REST

- REST = Representational State Transfer
- Provides standards between computer systems on the web
- Makes it easier for systems to communicate with each other
- Server doesn't depend on client
- Client doesn't depend on server
- Implementation of the client and the implementation of the server can be done independently
- Code on client can be changed at any time without affecting the operation of the server
- Code on server can be changed without effecting the operation of the client
- https://www.codecademy.com/articles/what-is-rest



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Open Web Services

- WMS = Web Map Service
  - Georeferenced map images (JPEG or PNG)
- WMTS = Web Map Tile Service
  - Georeferenced, pre-rendered, multiscale images (JPEG or PNG)
- WFS = Web Feature Service
  - Access to vector geospatial data and attributes

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Web Content, Maps, and Scenes

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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

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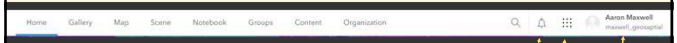
ArcGIS Online Layout



- 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

User info/links

ESRI links

Notifications

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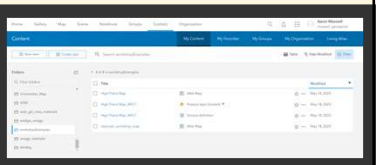
Your Content

- 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



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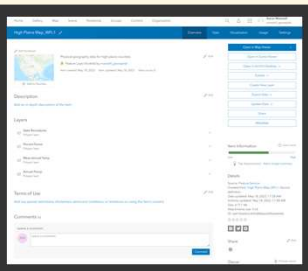
Your Content

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



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Maps vs. Scenes

- Map = 2D projected map (generally uses Web Mercator)
- Scene = 3D scene of a 3D globe

Image from ArcGIS API for JavaScript

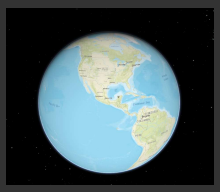

Image from ArcGIS API for JavaScript

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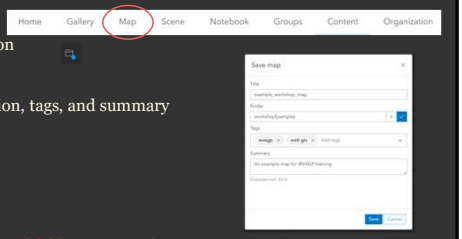
Create a Map

- Log into ArcGIS Online (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.

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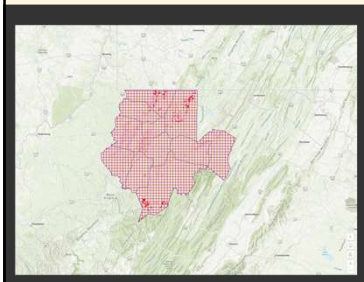
Create a Map



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

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Tour of Map Viewer

*Map Viewer Classic is being phased out.

- 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

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Tour of Map Viewer

*Tools on right are for data layers

- Layer properties
- Styles
- Filter
- Effects
- Pop-Ups
- Fields
- Labels
- Configure Charts
- Forms
- Analysis
- Edit
- Add Sketch
- Map tools

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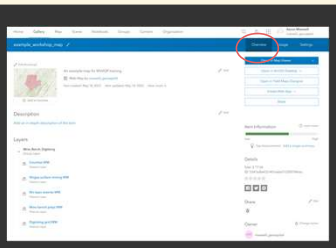
Web Map Editing and Settings

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



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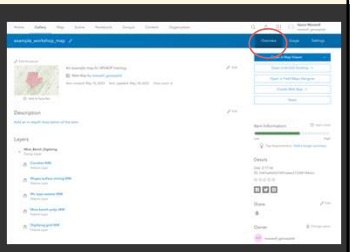
Web Map Editing and Settings

- 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



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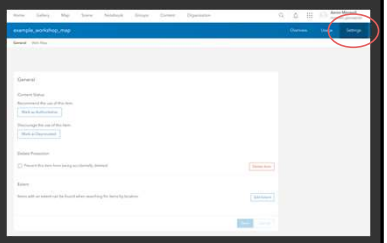
Web Map Editing and Settings

- Prevent item from being deleted by accident
- Change default map extent
- Allow for use in field maps
- Allow for copies to be made



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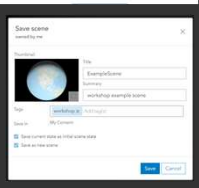
Create a Scene

- Log into ArcGIS Online (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



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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

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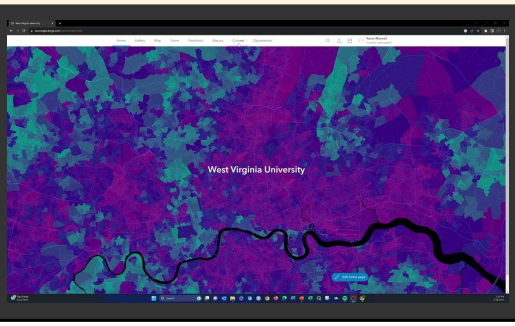
Video: Introduction to ArcGIS Online



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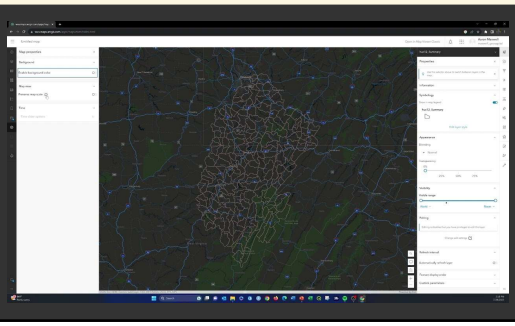
Video: AGOL Map Viewer



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Add Layers to Web Map

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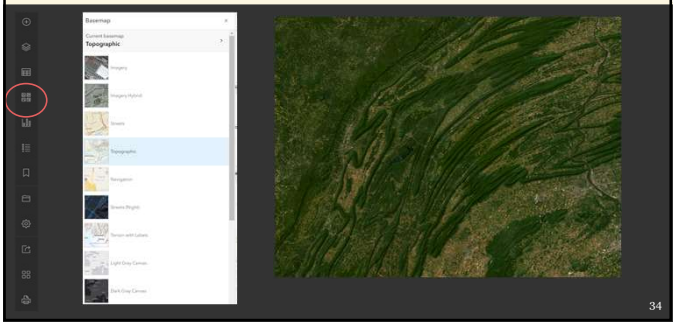
Change Basemap



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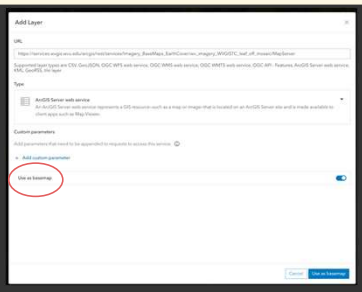
Basemap from Layer

- Some layers can be used as basemaps



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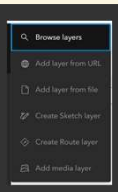
Adding Data

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

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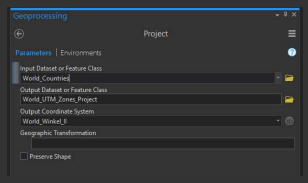
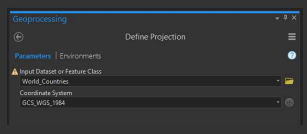
Transforming Projections and Datums in ArcGIS





*Should use WGS84 or Web Mercator

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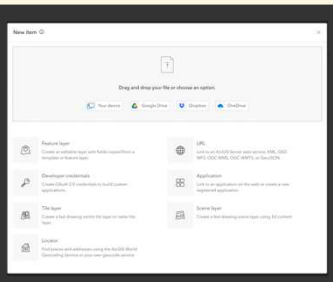
Adding Data

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

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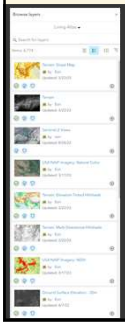
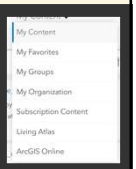
Browsing for Layers



- 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



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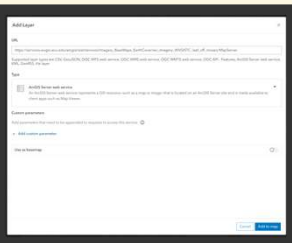
Add Layer from URL

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



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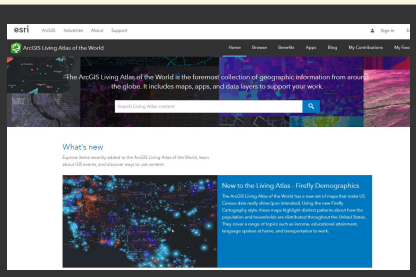
ArcGIS Living Atlas of the World



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

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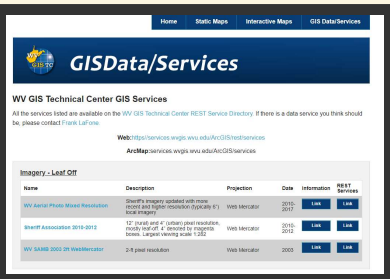
Map Services From the West Virginia GIS Tech Center



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

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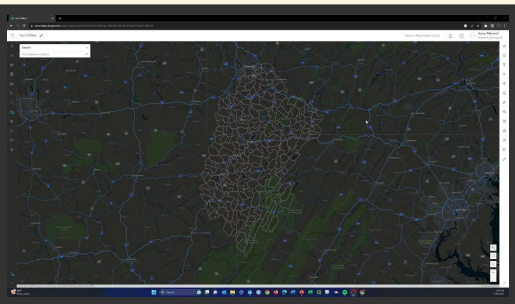
Video: Add Layer from Web



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From CSV

- 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 (	Bike shop	39.6416	-79.9632
1	1	0	Morgantor	Bike shop	39.64172	-79.9632
2	2	0	Pathfinder	Bike shop	39.6293	-79.9565
3	3	0	Gary's Cor	Comics an	39.6299	-79.9556
4	4	0	Vintage Vi	Comics an	39.62947	-79.9556
5	5	0	Comic Par	Comics an	39.63425	-79.9691
6	6	0	Four Horse	Comics an	39.62563	-79.997

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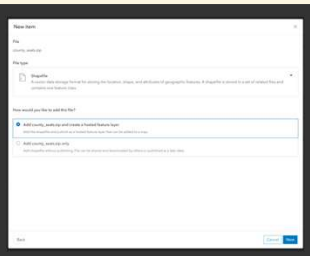
From Shapefile

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



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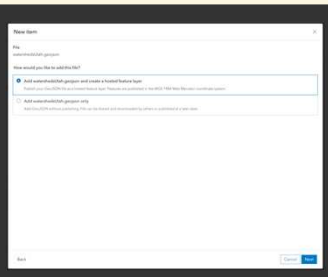
From GeoJSON

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



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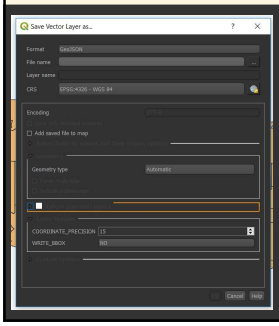
GeoJSON in QGIS



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

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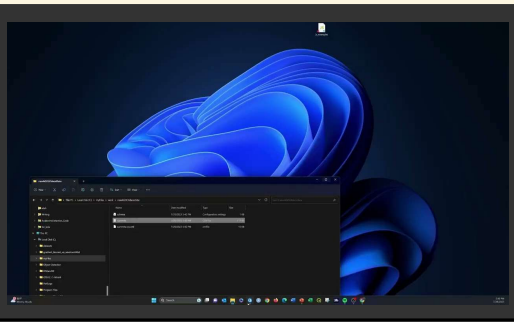
Video: Add Local Layers



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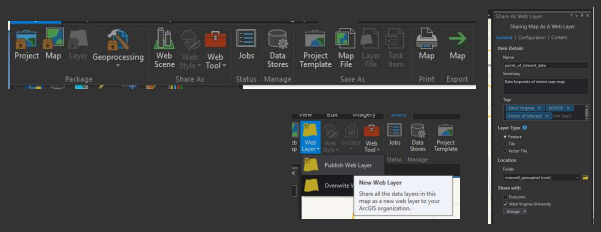
ArcGIS Pro to ArcGIS Online

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



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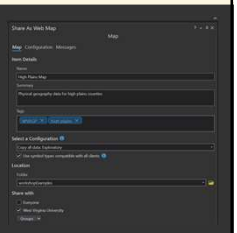
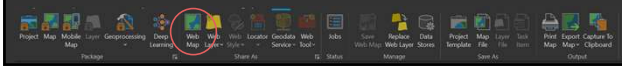
Publish Map and Layers

- 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





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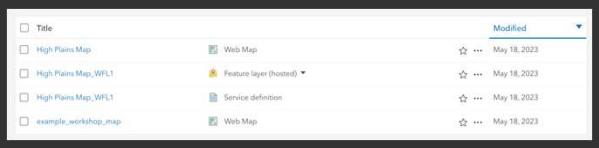
What is published?

- Map, Layers, Service definition



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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

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Publish Layers

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

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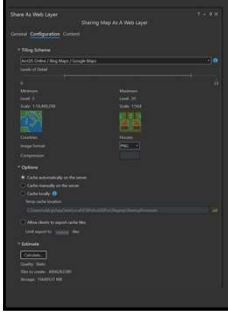
Exporting Data from ArcGIS Pro to Web Layer



- Can create web layers as:
  - Feature = Feature Layers
  - Tile = Raster Tile Layers
  - Vector Tile = Vector Tile Layers
- When exporting to raster tile layers:
  - Define a tiling scheme
  - Define levels of detail
  - Create cache on server
  - Cache locally
  - Can allow client to export cache tiles

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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

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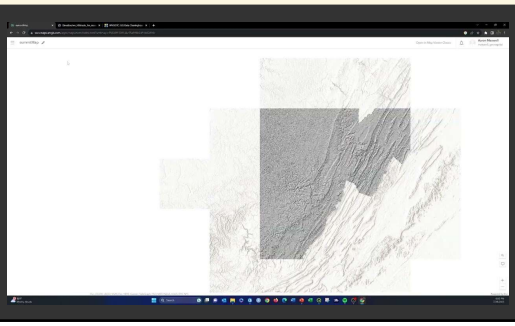
Video: Publish from ArcGIS Pro



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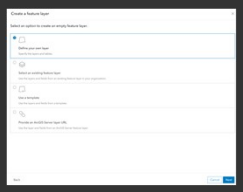
Create a New Hosted Feature Layer

- 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



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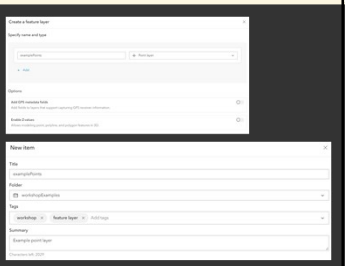
Create a New Hosted Feature Layer

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



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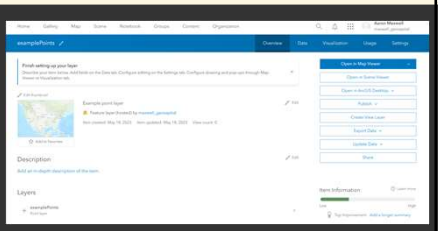
Layer Editing and Settings

- Find layer in Content
- Open drop page
- Information
  - Item Name
  - Thumbnail
  - Description
  - Layers
  - Owner
  - Keywords
  - Tags
  - Credits/attribution
  - Layer URL



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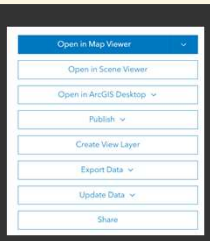
Layer Editing and Settings

- 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



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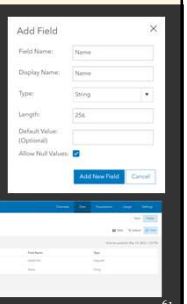
Add Fields

- Navigate to drop page for layer in Content
- Navigate to Data tab
- Switch to Fields view
- Click Add
- 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



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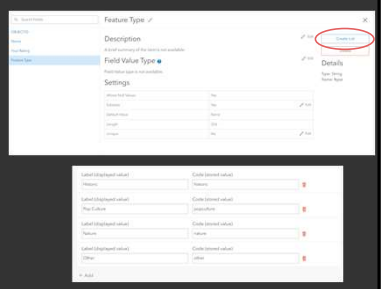
Domains (Coded Values)

- Navigate to drop page for layer in Content
- Navigate to Data tab
- Switch to Fields view
- Click on field name
- Coded values = Create List



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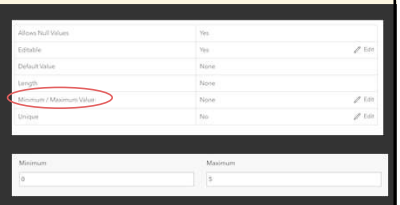
Domains (Range Values)

- Navigate to drop page for layer in Content
- Navigate to Data tab
- Switch to Fields view
- Click on field name
- Range values = Edit Minimum/Maximum Value



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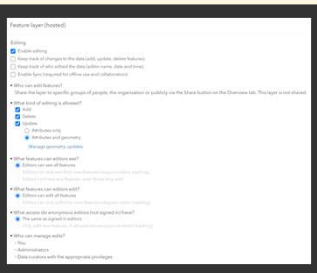
Make Layer Editable by Everyone

- Layer must be shared with your organization or everyone
- Layer must be enabled for editing
- Can also allow for attachments of files



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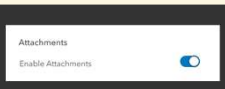
Attachments

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



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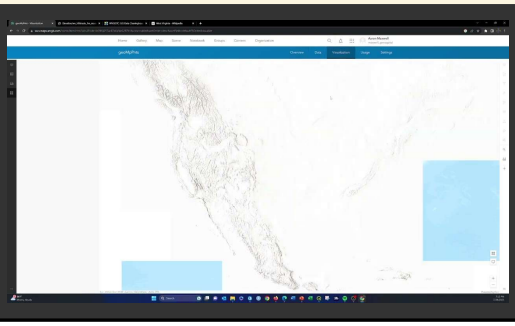
Video: Hosted Feature Layers



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This is the end of this lecture module.

Please return to the West Virginia View Webpage for additional content.

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