Setting up the viewshed geoprocessing service

Introduction

The CreateViewshed analysis tool of ArcGIS Online and Portal for ArcGIS requires a backend viewshed service to work. This document explains how to set up this service on your own in-house server using the viewshed script tool available in this repository.

Setting up the viewshed service involves the following steps:

1. Organize the elevation source rasters
2. Create mosaic datasets and boundary feature classes from the elevation source rasters
3. Update the viewshed script tool to with your data
4. Publish the viewshed service to ArcGIS Enterprise

Data requirement

The viewshed tool requires Digital Elevation Model (DEM) data and a few other supporting components. Following are details on the list of required datasets.

1. The **DEM source rasters**, which provides the elevation values for the viewshed calculation. If you don't already have the elevation datasets you wish to use, various other elevation data products are available for this purpose, such as the National Elevation Dataset (NED) and the Shuttle Radar Topography Mission (SRTM) data. Multiple resolutions can be available in a data product. For example, the NED data provides elevation data at 1 arc second (approximately 30 meters) and 1/3 arc second (approximately 10 meters).
   If your organization has the Data Appliance for ArcGIS from Esri, then the world elevation data from it—which includes SRTM and NED data at various resolutions—can be used as the data source for the viewshed tool.

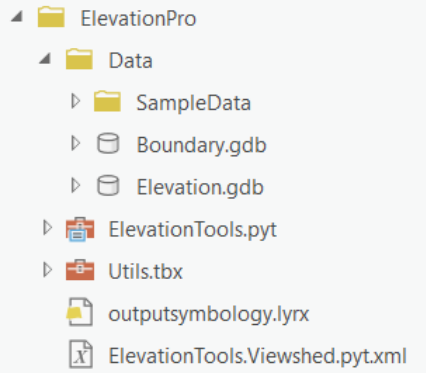
2. A **mosaic dataset** for each DEM resolution. The individual elevation raster datasets for each resolution need to be added to a mosaic dataset. This mosaic dataset will be used as the input raster to the viewshed tool.
3. A **data boundary** feature class which describes the coverage of each DEM resolution. The data boundary features support the viewshed service in the following scenarios:
   - When the user specifies 'Finest' for the DEM Resolution parameter, the tool will query the data boundaries to find the best resolution available and use it to calculate the viewshed.
   - When the user selects a resolution other than 'Finest' for the DEM Resolution parameter, the tool will query the data boundary features to determine whether that particular resolution is available for the input area before calculating the viewshed. If the resolution is not available, the tool will return an error and will not execute.

- During the calculation, the tool gets the metadata information from the data boundary features and returns it as attribute fields—such as Product Name, Source and Source URL—in the output viewshed feature class.

Preparing the mosaic datasets and data boundary feature class

Folder structure and data organization

Once the elevation-gp-python repo is cloned to local machine, you will need to unzip the Data.zip to the ElevationPro folder, so that the folder structure looks like the following.



The content of the ElevationPro folder are as follows.

- Under the Data folder, the file geodatabase Elevation.gdb is used to store the DEM mosaic datasets (which will be created in later steps). Boundary.gdb is used to store the data boundary feature class. The SampleData folder contains a few sample DEM data, which will be used to create the mosaic datasets in this help document.
- The ElevationTools.pyt is a python toolbox that contains the viewshed script tool, which will be published to your ArcGIS Enterprise as a geoprocessing service.
- The Utils.tbx contains a utility tool (Dissolve Footprint) to help create the data boundary feature class.
- The outputsymbology.lyrx is used by the viewshed script tool to set up the tool output symbology.

To use this workflow with your own DEM data, the source DEM datasets should be organized by resolutions. Each resolution should have the same cell size and spatial reference and put under the same workspace (see the sample datasets under the SampleData folder for example).

Create the mosaic datasets

For each data resolution in your DEM source data, a mosaic dataset is created from the individual rasters.

Note: you need Standard or Advanced license to perform this task.

Steps:

1. In ArcToolbox, open the *Create Mosaic Dataset* tool under Data Management Tools » Raster » Mosaic Dataset, and specify the following parameters:

Output Location	Save it to ElevationPro\Data\Elevation.gdb
Mosaic Dataset Name	Provide a descriptive name, such as 'dem30m'.
Coordinate System	Enter '102100' *(Note: This is the EPSG code for the WGS 1984 Web Mercator Auxiliary Sphere coordinate system.)*

2. Leave the remaining parameters as default, then click OK to run the tool.
3. If you have more than one elevation resolution, repeat steps 1 – 2 for each resolution to create a new mosaic dataset for each of the resolutions.

Next, add the individual rasters to the mosaic dataset.

Steps:

1. In ArcToolbox, open the *Add Rasters to Mosaic Dataset* tool under Data Management Tools » Raster » Mosaic Dataset, and specify the following parameters:

Mosaic Dataset	Select one of the mosaic datasets that you created above.
Raster Type	Accept the default setting (Raster Dataset).
Input Data	Select the Folder option. Then, browse to and add the following workspaces: 1) The folder (such as ElevationPro\Data\SampleData\dem30m) that contains all the source DEM rasters for the current resolution. 2) The OceanSurface folder that stores the ocean surface elevation raster (located under ElevationPro\Data\SampleData\background).

2. Leave the remaining parameters as default, then click OK to run the tool.
3. In the resultant mosaic dataset layer in the TOC, right-click the Footprint layer, then select Open Attribute Table. Click Add Field. For the new field, specify 'Best' for the Name and select Float for the Type, then click Save on the Fields ribbon. Close the fields view.
4. Use the Field Calculator to calculate the value of the new field (Best) to !LowPS! * 10, then close the attribute table.
5. In the Catalog window, navigate to the mosaic dataset that you created above. Right-click it and select Properties to open the Mosaic Dataset Properties dialog.
6. Click on the Defaults tab. In Image Properties, locate the Allowed Mosaic Method setting, then click on the pencil icon to open the Configure Allow List dialog. Set the Default Method field to By Attribute. Set the Order Field to Best. Leave all other settings as default. Click OK to close the dialog.
7. Still on the Defaults tab, in the Image Properties section, set the following properties according to the values in the table, then click OK to close the Mosaic Dataset Properties dialog.

Property	**Value**
Maximum Size of Requests - Rows	24000

Maximum Size of Requests - Columns	24000
Default Compression Method (*Note: this is under Allowed Compression Methods*)	LZ77
Default Resampling Method	Bilinear Interpolation
Maximum Number of Rasters per Mosaic	50
Always Clip the Raster to its Footprint	Unchecked
Footprints May Contain NoData	Checked
Always Clip the mosaic dataset to its Boundary	Checked

8. Click on the General tab. Under Raster Information, set Source Type to Elevation. Click OK to close the dialog.
9. If you have more than one mosaic dataset, repeat steps 1 to 7 for each one to add rasters to them.

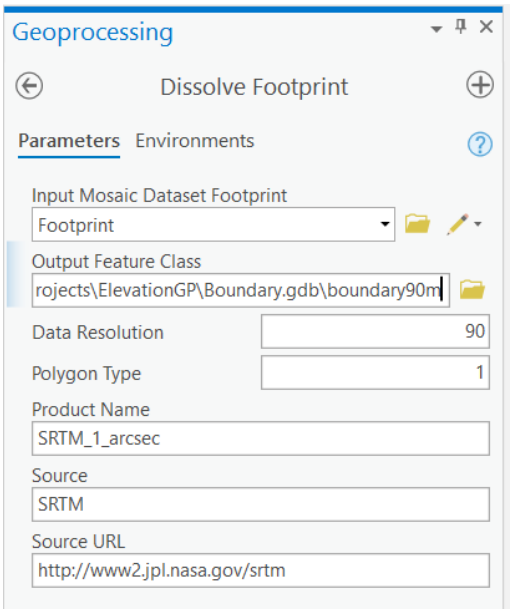
Create the data boundary feature class

The coverage of each data resolution is described by a data boundary feature, which follows the outline of the footprints of the mosaic dataset. The data boundary features are created by dissolving the footprints of the mosaic datasets. A utility geoprocessing tool is provided to facilitate this process.

Steps:

1. In ArcGIS Pro, load the mosaic dataset to the Table of Contents.
2. Open the geoprocessing tool *Dissolve Footprint* under ElevationPro\Utils.tbx.
3. Specify the following parameters for the tool and click OK to run the tool.

Input Mosaic Dataset Footprint	Select the footprint layer in the mosaic dataset. For example, dem90m\Footprint.
Output Feature Class	Save it to ElevationPro\Data\Boundary.gdb using a descriptive name, such as boundary90m.
Data Resolution	Enter the resolution of the mosaic dataset. For example, 90.
Polygon Type	1
Product Name, Source, and Source URL	Specify some descriptive text for them. See the following screen capture for an example. *Note: These are the metadata strings that describe your DEM data. They can be any text. However, it is recommended to use descriptive text that is meaningful for the DEM data.*



4. If there is more than one mosaic dataset, repeat steps 1 to 3 for each of them and create a boundary feature class for each of them.
5. In ArcToolbox, open the *Merge* tool under Data Management Tools » General and specify all of the individual boundary feature classes created above to merge them into one. Set the Output Dataset location to ElevationPro\Data\Boundary.gdb and name it 'databoundary' or some other descriptive name. Click OK to run the tool.

   Note: The output boundary feature class has the following fields:

Field name	Field type	Field length	Description
res	Short	n/a	Resolution in meters
polytype	Short	n/a	Polygon type (0, 1, or 2)
prd	String	50	Product name
src	String	50	Source name
srcurl	String	100	Source URL

The following is an example of the data boundary feature class attribute table:

OBJECTID *	Shape *	dissolveid	res	polytype	prd	src	srcurl	Shape_Length	Shape_Area
1	Polygon	1	30	1	NED_13_arcsec	NED	https://catalog.data.g...	201113917.2048	2.423815e+15
2	Polygon	1	60	1	SRTM_1half_arcsec	SRTM	http://www2.jpl.nasa.g...	201113917.2048	2.423815e+15
3	Polygon	1	90	1	SRTM_1_arcsec	SRTM	http://www2.jpl.nasa.g...	201113917.2048	2.423815e+15

Fig 4. A sample attribute table of the data boundary feature class

Updating the viewshed tool script

Once the data is ready, you can update the viewshed tool script to point to the data. The viewshed tool is implemented as a python toolbox ElevationTools.pyt. To update the tool, you may edit ElevationTools.pyt in any python IDE. All the edits are in the function __init__(self).

1. **Update DEM resolutions list**

   Go to line 55 and update the dictionary `self.dictDEMSources`. This dictionary is the source of the DEM resolution dropdown on the tool dialog. Replace the key-value pairs in this dictionary with your own DEM resolutions. The keys are descriptive names for the DEM data (such as '30m'). The values represent the data resolution (such as 30).

   The `self.defaultDEMResolution` and `self.defaultDEMMetadata` variables also need to be updated. The `self.defaultDEMResolution` variable defines the default resolution to use when the user omits the DEM resolution parameter. The `self.defaultDEMMetadata` variable is a list that defines the metadata for the default DEM resolution. The first string in the list represents the product name, the second string represents the source, and the third string represents the source URL. (Technically, these metadata strings can be any text. They won't affect the tool execution.
   However, it is recommended to use descriptive text that is meaningful for the DEM data.)

```
#-----------------------------------------
#DEM resolutions
#-----------------------------------------
self.dictDEMSources = {"30m":"30", "60m":"60", "90m":"90"}
self.defaultDEMResolution = '90'
self.defaultDEMMetadata = ["SRTM", "USGS, NASA, CGIAR", "http://www.cgiar-csi.org/"]
```

2. **Data source layers**

   Go to line 61 and update the dictionary `self.dictMosaicLayers`, which provides the mosaic dataset pathnames for each of the resolutions. Replace the key-value pairs in this dictionary with your DEM resolutions and the corresponding dataset pathnames. The DEM resolutions should be specified as integer values in meters (same as the resolution values in `self.dictDEMSources`).

   The `self.resolutionCoverage` variable should be assigned with the data boundary feature class. During execution, the tool will check this data to determine which DEM resolution(s) are available in the input area.

```
#-----------------------------------------
#Data source layers
#-----------------------------------------
self.dictMosaicLayers = {'30':r'C:\git\ElevationPro\Data\Elevation.gdb\dem30m',
                         '60':r'C:\git\ElevationPro\Data\Elevation.gdb\dem60m',
                         '90':r'C:\git\ElevationPro\Data\Elevation.gdb\dem90m'}
self.resolutionCoverage = r'C:\git\ElevationPro\Data\Boundary.gdb\databoundary'
```

3. **Default and maximum radiuses**

   Go to line 68. The variable `self.dictDefaultRadius` defines a default viewing distance for each resolution when the user omits the maximum distance parameter (the 2nd parameter on

the tool). The variable `self.dictMaxRadius` defines a maximum viewing distance for each resolution when the input DEM resolution parameter is a value other than 'Finest', and the `self.dictMaxRadiusFinest` variable defines a maximum viewing distance for each resolution when the input DEM resolution parameter is 'Finest'. Update these variables with your DEM resolutions and desired distance values. (Technically, these radius or distance values can be any integer values. The tool will execute with the values you assign to them. However, the values should meet the requirements of your application. You may use the default values below as a guideline.)

```
#----------------------------------------
#default and maximum radiuses
#----------------------------------------
self.dictDefaultRadius = {'30':5000, '60':15000, '90':15000}
self.dictMaxRadius = {'30':15000, '60':30000, '90':50000}
self.dictMaxRadiusFinest = {'30':5000, '60':15000, '90':50000}
```

Publishing the viewshed tool to ArcGIS Enterprise

Once the data and tool script are ready, the viewshed script tool can be published to ArcGIS Enterprise as a geoprocessing service.

Copy the Data folder to the server machine

The Data folder containing the mosaic datasets and data boundary feature class need to be shared with the server machine. This can be done by copying the Data folder to the server machine.

Steps:

1. Log onto the server machine, create a Data folder which mirrors the same path as on the local machine. For example, create a folder 'C:\git\ElevationPro\Data' on the server machine if that's the path for the Data folder on your local machine.
2. Copy everything in the Data folder from your local machine to the Data folder on the server machine.
   Note: if the Data folder path on the server is different than the local machine, the mosaic dataset may not function properly on the server and you may need to run the Repair Mosaic Dataset Path tool to repair the mosaic dataset paths.

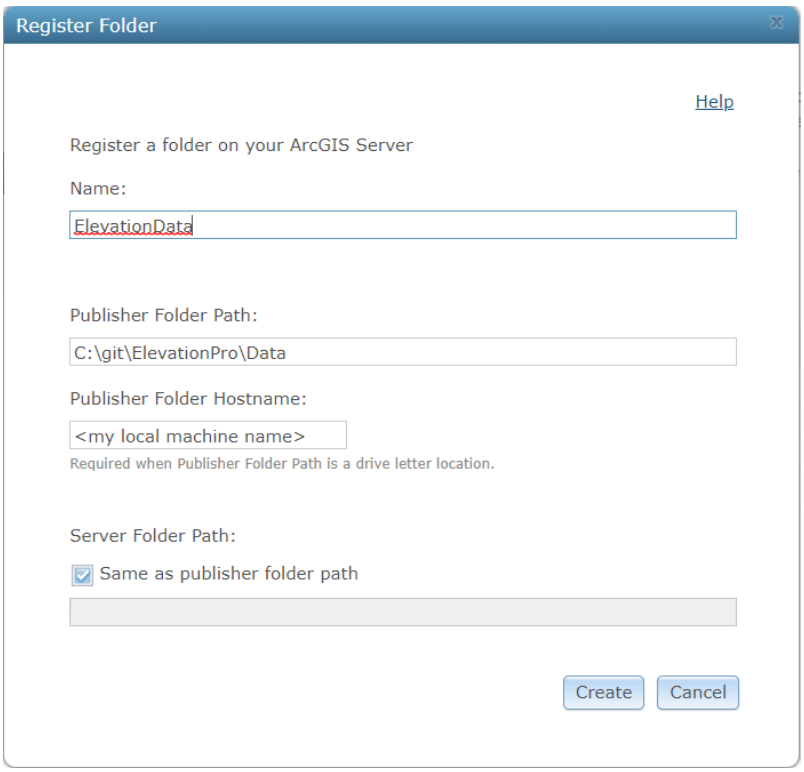
Register the Data folder on server

The Data folder needs to be registered on server, so that the publisher can use referenced data instead of copying data to the server during publishing.

Steps:

1. On the server machine, open web browser and log onto the server manager (https://localhost:6443/arcgis/manager).
2. Go to Site -> Data Stores.
3. In the Register dropdown, click Folder.
4. Fill in the fields as follows:
   a. Name: give it a descriptive name (e.g., ElevationData)
   b. Publisher Folder Path: Enter path to the Data folder on server
   c. Publisher Folder Hostname: your local machine name
   d. Same as publisher folder path: checked

5. Click the Create button.

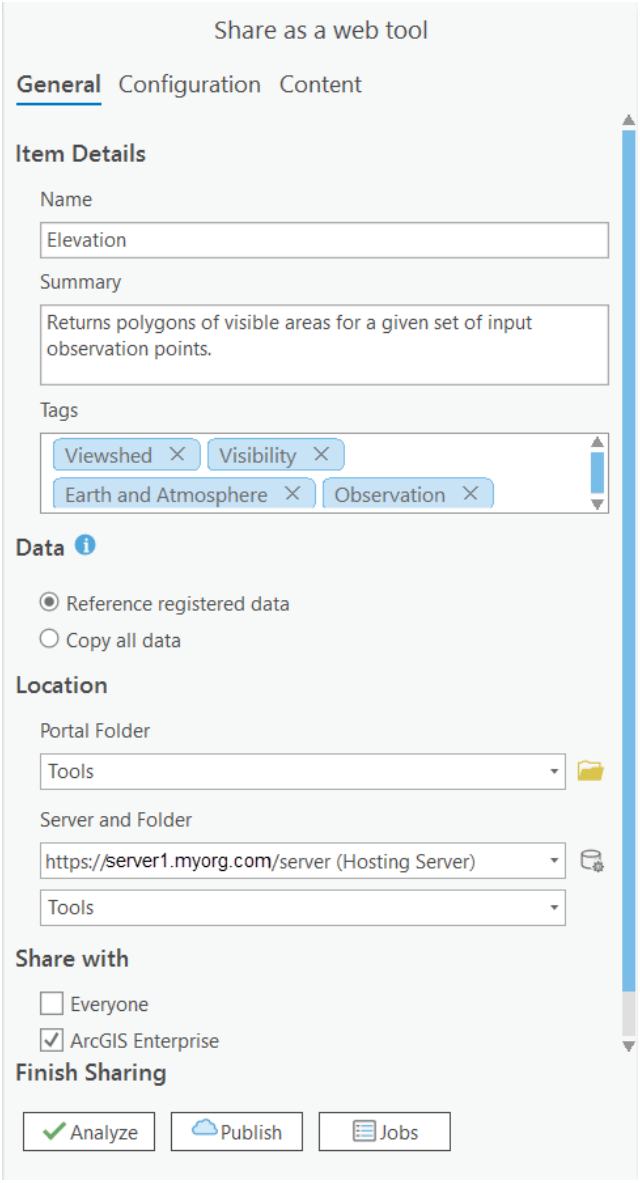


Publish the viewshed script tool

The viewshed script tool is now ready to be published.

Steps:

1. Open ArcGIS Pro with a new map project.
2. Sign into the portal with which the server is federated, and make it the active portal.
3. In the Pro catalog window, make folder connection to the ElevationPro folder.
4. Locate the Viewshed tool under ElevationPro->ElevationTools.pyt, click to open the tool.
5. Run the Viewshed tool by specifying an input observer feature layer (leave all other parameters as default).
6. Open the History window, and locate the latest tool history for Viewshed. Right click it and select Share As -> Share Web Tool.
7. In the Share as a web tool dialog:
    a. Specify the service name as Elevation.
    b. Check Reference registered data.
    c. In Portal Folder, select Create new folder…, and specify Tools as the new folder name
    d. In Server and Folder, select Create new folder…, and specify Tools as the name
8. Click Publish to start the publishing.


Share as a web tool
General
Configuration
Content
Item Details
Name
Elevation
Summary
Returns polygons of visible areas for a given set of input observation points.
Tags
Viewshed
Visibility
Earth and Atmosphere
Observation
Data
Reference registered data
Copy all data
Location
Portal Folder
Tools
Server and Folder
https://server1.myorg.com/server (Hosting Server)
Tools
Share with
Everyone
ArcGIS Enterprise
Finish Sharing
Analyze
Publish
Jobs