Watershed Index Online (WSIO) Web Service Guide

1   Introduction

Watershed Index Online (WSIO) is a free, publicly available data library of watershed indicators and a decision-support tool developed by EPA to assist resource managers, citizens, and other users with comparing and prioritizing watersheds for restoration and protection. The indicators in the WSIO measure a wide variety of watershed characteristics (e.g., percent forest cover, number of impaired waters, or area of protected lands). Indicator data can be accessed by downloading Microsoft Excel or ESRI geodatabase files from the WSIO website or through the WSIO web service.

Web services provide users with access to data without needing to download and store the dataset on a laptop or desktop computer. Web services are particularly useful for web-based applications, such as mapping or data analysis tools. These applications can be programmed to retrieve targeted pieces of a dataset using web services and then format and display the data according to the needs of users.

The following sections are intended to support users that are interested in accessing watershed indicator data through the WSIO web service:

- *Section 2 - The Basics* provides basic information about the WSIO web service.
- *Section 3 - Getting Started: Viewing the HUC12 Feature Layer* is primarily intended for **beginner-level users** of web services and provides step-by-step instructions for viewing maps of indicator data using ArcGIS Online or ArcGIS Pro software.
- *Section 4 - Querying the WSIO Web Service* is primarily intended for **application developers** and contains examples of how to query the WSIO web service to retrieve indicator data.

2   The Basics

The WSIO web service provides access to a database of indicators for 12-digit Hydrologic Unit (HUC12) subwatersheds in the contiguous United States. HUC12 boundaries are based on topographic drainage patterns and are delineated by the US Geological Survey (USGS) and Natural Resources Conservation Service (NRCS) as part of the national Watershed Boundary Dataset[1]. HUC12s average approximately 35 square miles in size. The WSIO contains indicator data for 82,915 HUC12s and uses the February 2015 version of HUC12s produced for EPA's EnviroAtlas mapping tool.

The WSIO web service is published as a map service on EPA's ArcGIS Server. The base URL for the WSIO web service is: https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer. The WSIO web service is comprised of three items: the *HUC12 Feature Layer*, the *Indicator Data Table*, and the *Indicator Information Table*. A diagram of these components is provided in Figure 1. Key characteristics of each item are listed below.

1. *HUC12 Feature Layer* (https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/0)
   - Includes polygons depicting HUC12 boundaries and an attribute table that stores indicator values.

---

[1] Refer to the USGS Watershed Boundary Dataset website for additional background information on HUC12 subwatersheds.

- o Each row of the attribute table contains indicator values for one HUC12. Different indicators are stored in the table's columns.
- o The layer name is "NHDPlusV2_HUC12" and the coordinate system is WGS 1984 Web Mercator (Auxiliary Sphere), EPSG code 3857.

2. *Indicator Data Table* (https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/1)
   - o A standalone table of indicator values for HUC12s.
   - o Contains the same data as the attribute table of the *HUC12 Feature Layer*.
   - o The table name is "Indicator_Data".

3. *Indicator Information Table* (https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/2)
   - o A table of supplemental information for indicators, including the full name of each indicator, category, subcategory, and description.
   - o The "Field_Name" column contains indicator names exactly as they are stored in the *HUC12 Feature Layer* and *Indicator Data Table*. Therefore, the "Field_Name" column can be used to look up supplemental information for specific indicators of interest.
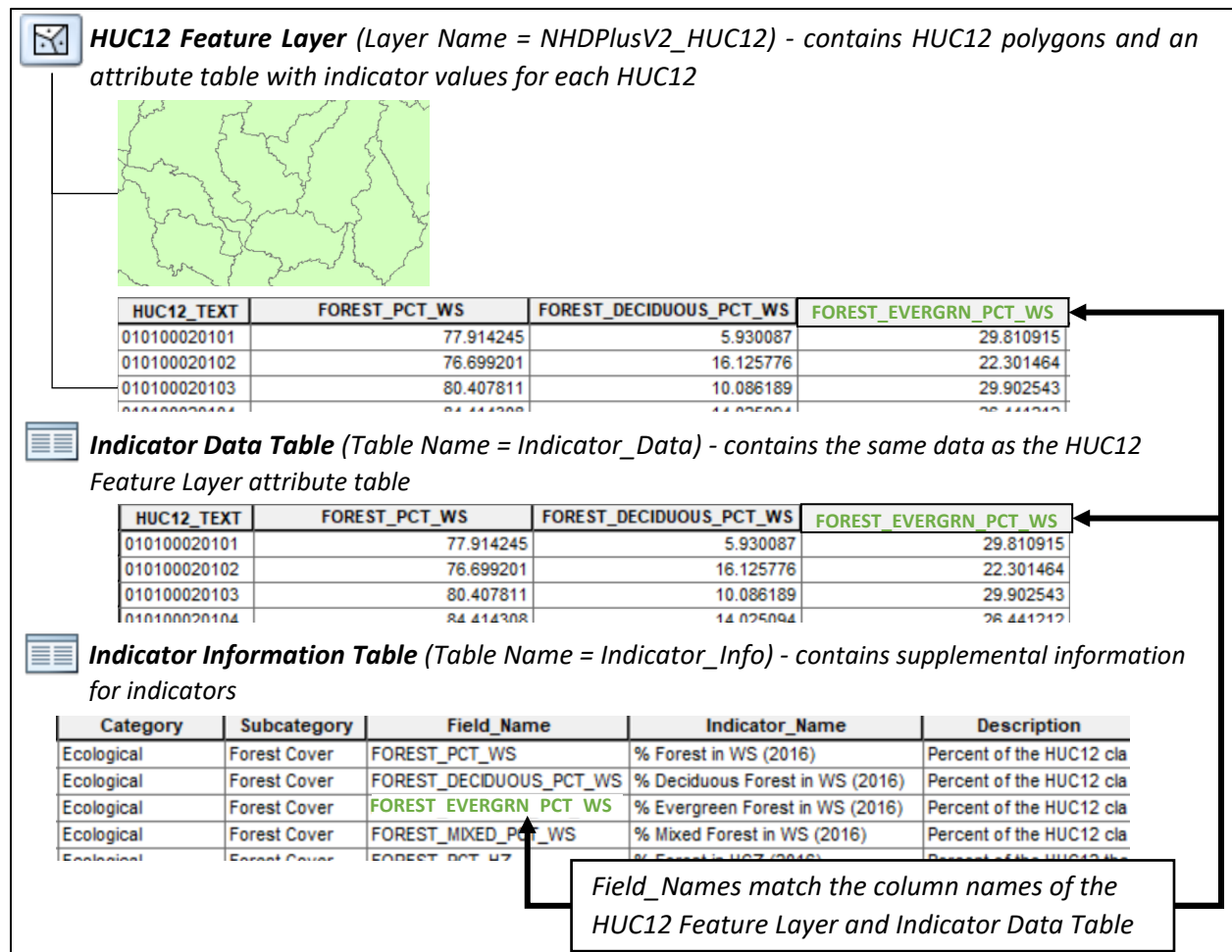   - o The table name is "Indicator_Info".

Figure 1. Diagram of elements in the WSIO web service.

3   Getting Started: Viewing the HUC12 Feature Layer

3.1   Viewing the HUC12 Feature Layer with ArcGIS Online

This section is provided for beginner users of web services that may be interested in viewing the WSIO indicator data with ArcGIS Online and creating basic maps. Note that the ArcGIS Online Map Viewer provides limited options to symbolize, filter, or otherwise interact with WSIO indicator data. Desktop GIS software, such as ArcGIS or QGIS, offers expanded options for creating maps using the WSIO indicator data. Section 3.2 of this guide describes how to add the HUC12 Feature Layer to ArcGIS Pro software.

3.1.1   *How to Open the ArcGIS Online Map Viewer*

Click the ArcGIS Online Map Viewer link at the top of the WSIO web service landing page to open the *HUC12 Feature Layer* in ArcGIS Online (Figure 2).

Figure 2. Link to the ArcGIS Online Map Viewer on the WSIO web service landing page.

The Contents pane of the Map Viewer displays the *HUC12 Feature Layer* from the WSIO web service (the layer name is "NHDPlusV2 HUC12"). The *Indicator Information Table* and the *Indicator Data Table* are also shown in the Contents pane (Figure 3).
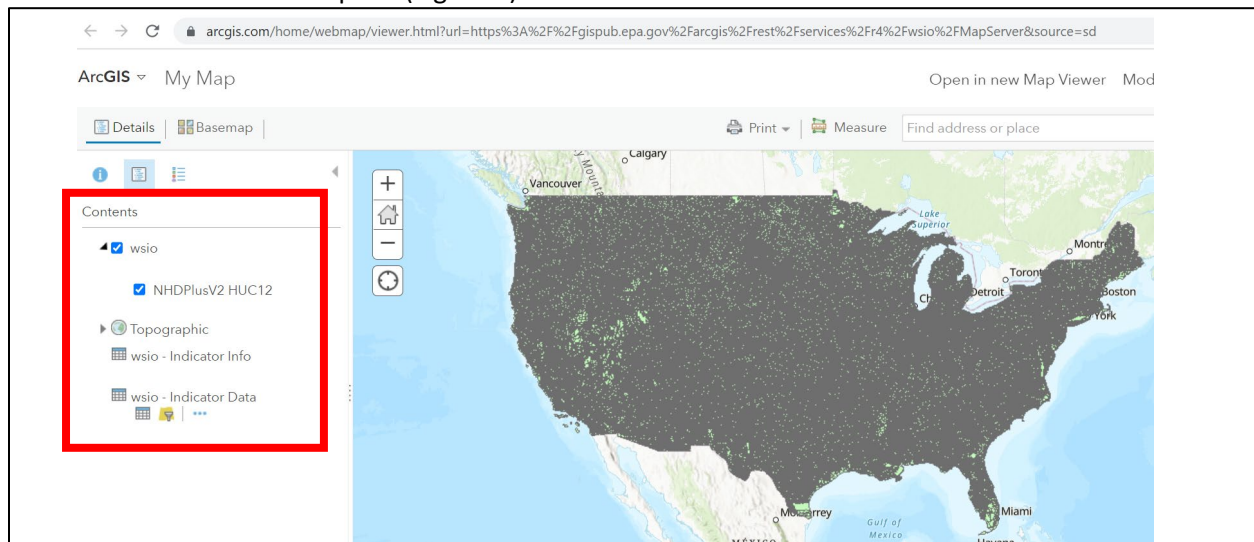

Figure 3. Initial view of the *HUC12 Feature Layer* in the ArcGIS Online Map Viewer with the Contents pane highlighted.

3.1.2 *How to Create an Indicator Map in the ArcGIS Online Map Viewer*

The steps below can be used to create a basic map of indicator data within the ArcGIS Online Map Viewer.

1. In the Contents pane, click on the symbology button for the HUC12 Feature Layer to display the "Change Style" menu.
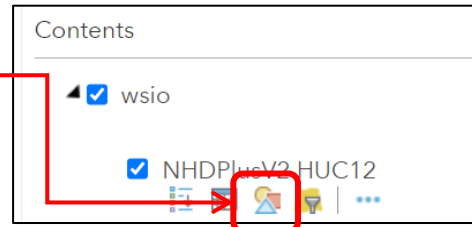
2. Use the drop-down menu to pick an indicator of interest. Note: a description of the available indicators can be viewed by opening the *Indicator Information Table* from the Contents pane.
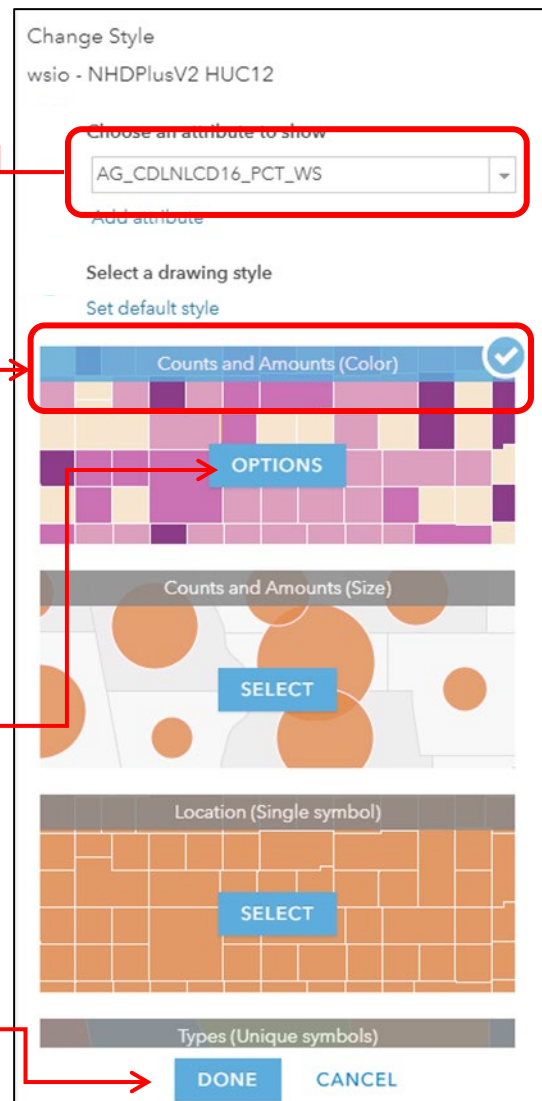
3. Pick a symbology method. The "Counts and Amounts (Color)" option is recommended.

4. Click the "Options" button to customize the color scheme and select other display options. Or skip this step to use the default color scheme.

5. Click "Done" to view a national map of the selected indicator.

Figure 4 contains an example map created from the steps described above. The map displays values of the percent agricultural cover indicator. Refer to the ArcGIS Online help page for style settings for more information on customizing the display of a map.

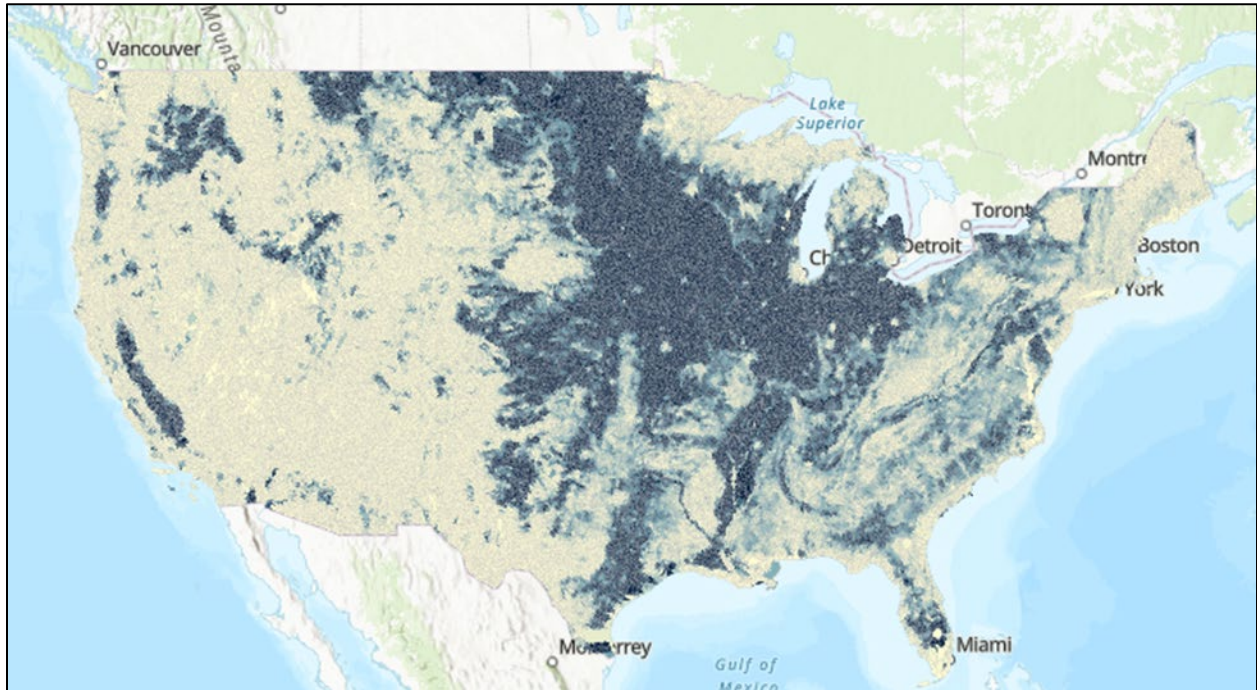**Figure 4. Example map of percent agricultural cover in HUC12s created in the ArcGIS Online Map Viewer with the WSIO web service.**

### 3.1.3 *How to Filter HUC12s in the ArcGIS Online Map Viewer*

The filter option within the ArcGIS Online Map Viewer can be used to display a subset of HUC12s that meet one or more user-defined selection criteria. To apply a filter, follow the instructions below.

1. In the Contents pane, click the filter button for the *HUC12 Feature Layer* to display the filter menu.
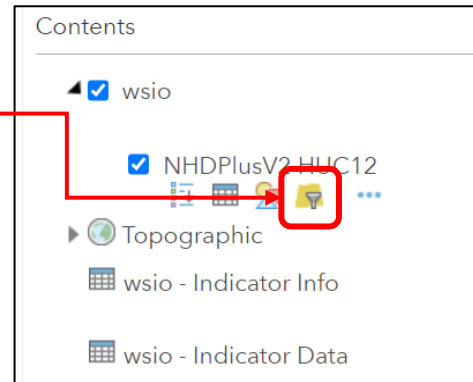
2. The filter menu contains drop-down boxes for creating a filter expression. In this example, the map will be filtered to only display HUC12s that are located in Arkansas.

In the first drop-down menu, type or select the "STATES2013"column. This column lists the states that each HUC12 intersects using 2-letter state abbreviations.
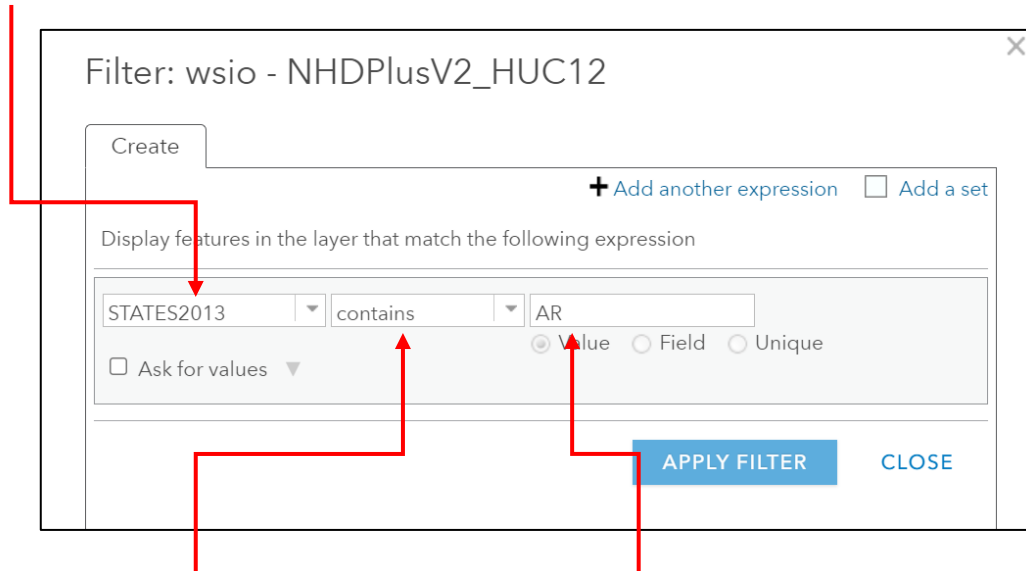
3. Select "contains" from the second drop-down box and type "AR" for Arkansas in the third box.

4. Click the "Apply Filter" button. With these settings, the filter will only display Arkansas HUC12s on the map by searching for HUC12s that contain "AR" in the "STATES2013" column.

Figure 5 contains an example filtered map created from the steps described above. The map displays values of percent agricultural cover in Arkansas HUC12s. The filter menu can also be applied to only display HUC12s that meet a numeric expression, such as HUC12s with greater than 25% agricultural cover. Refer to the ArcGIS Online help page for applying filters for additional details on using the filter menu.
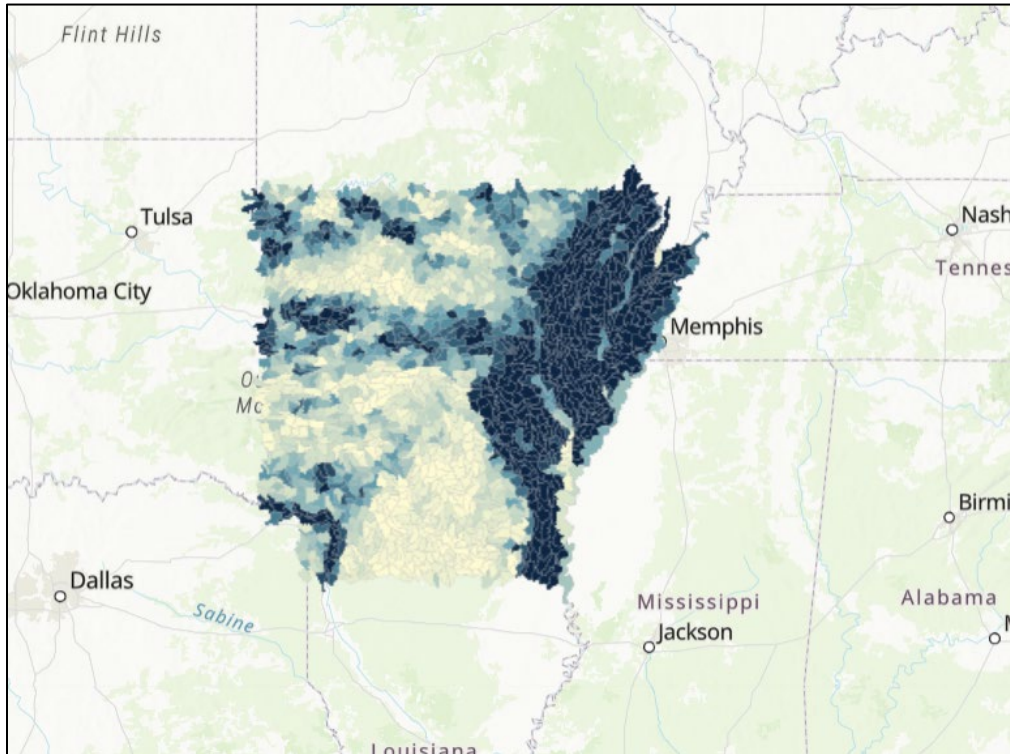

Figure 5. Example map of percent agricultural cover in Arkansas HUC12s created in the ArcGIS Online Map Viewer with the WSIO web service.
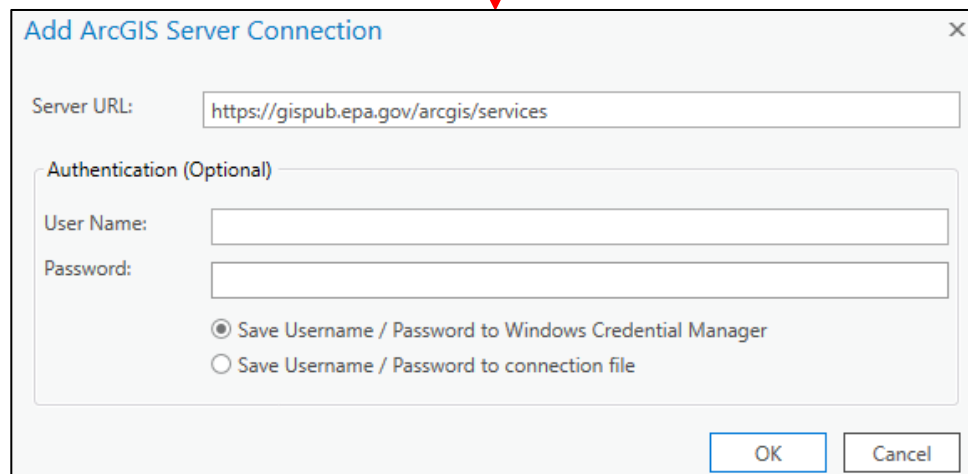
3.2   Viewing the HUC12 Feature Layer in ArcGIS Pro

ArcGIS Pro software provides users with additional options for creating custom indicator maps. This section describes steps for adding the WSIO web service to ArcGIS Pro. Depending on internet connection speed, users may experience long loading times when opening and viewing the *HUC12 Feature Layer*. In these cases, users may instead download a geodatabase of HUC12 polygons and data tables from the WSIO website for use in ArcGIS Pro or other GIS software.

1. In ArcGIS Pro, open the Catalog pane and select the Project tab. Right-click anywhere in the grey pane and select "New ArcGIS Server Connection."
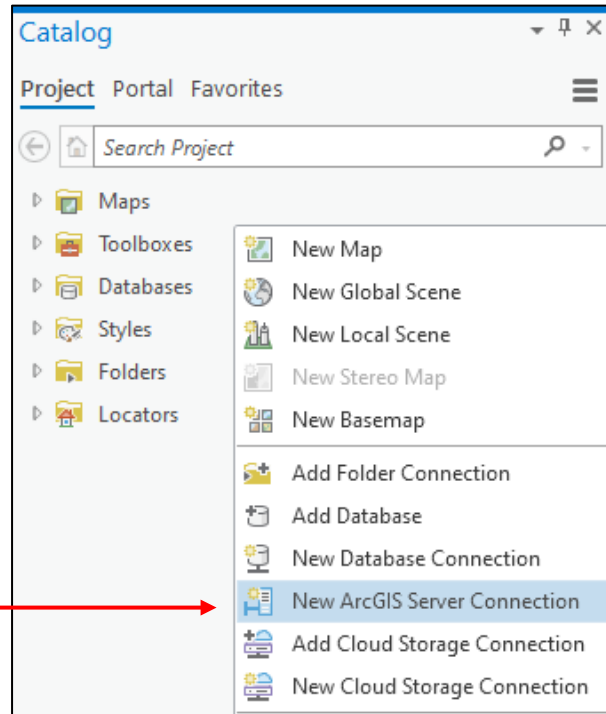
2. In the dialog box, enter the Server URL: https://gispub.epa.gov/arcgis/services and click OK. A username and password are not required.

3. A new "Servers" item will automatically be added to the Catalog pane. Click the arrow next to the "services on gispub.epa.gov" server icon to display a list of folders.

4. Click the arrow next to the "r4" folder to display a list of map services in the folder.

5. Click the arrow next to the "wsio" service icon to display a list of layers in the WSIO web service.

6. Right-click on the "NHDPlusV2_HUC12" layer and click "Add to Current Map."
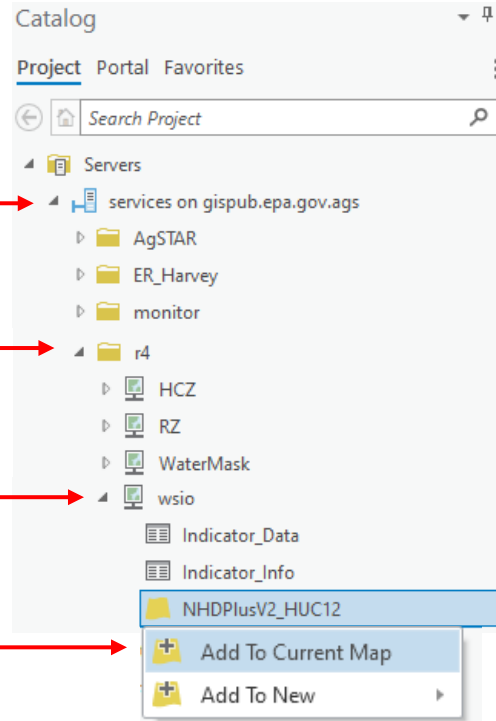
The HUC12 Feature Layer will now appear in the Contents pane and HUC12s will display in the viewer window. The symbology of HUC12s can be customized to display any indicator and HUC12s can be filtered to only display HUC12s that meet user-defined selection criteria. Users can also run geoprocessing tools on the HUC12 polygons to complete additional analysis.
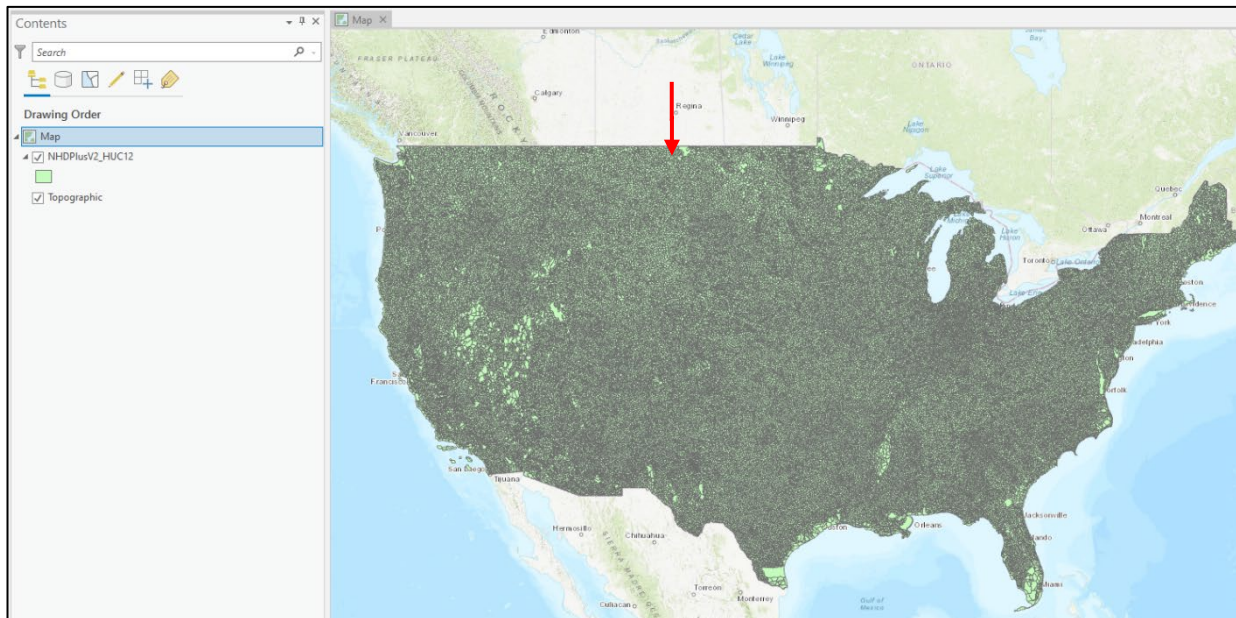
4 Querying the WSIO Web Service

Watershed indicator data can be retrieved by querying the WSIO web service. A query is a string of text that contains user-supplied search parameters for retrieving data from a dataset. When a web service receives the query, the data that meet the search parameters are identified and returned to the user. For example, the *HUC12 Feature Layer* can be queried to retrieve indicator data for any user-defined geographic area of interest. The data returned by the query can then be used by application developers in desktop, mobile, or web-based applications to visualize or analyze HUC12 conditions.

The base URLs for querying the *HUC12 Feature Layer*, *Indicator Data Table*, *Indicator Information Table* are listed in Table 1. Users of the WSIO web service can develop custom queries to define their desired outputs and the format of outputs. This section describes commonly used parameters for creating a custom query and example queries. The [ArcGIS reference page for querying a map service](#) contains a full list of query parameters that are available to map service users and descriptions of each parameter.

The example queries in this section return outputs in "html" format to facilitate viewing in a web broswer. The output format is specified in the query with the Format parameter (f=html). Readers can change the Format parameter to view alternative formatting options (for example, f=json will return the results in JavaScript Object Notation (JSON) format).

Table 1. Base URLs for querying the *HUC12 Feature Layer*, *Indicator Data Table*, and *Indicator Information Table*.

Item	Base URL
HUC12 Feature Layer	https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/0/query
Indicator Data Table	https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/1/query
Indicator Information Table	https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/2/query

Table 2. Example query parameters for retrieving data from the *HUC12 Feature Layer*.

Query Parameter	Description	Example Queries
Where	A clause for filtering the *HUC12 Feature Layer* using the layer's attribute table. Results are returned for any HUC12s that meet the user-specified criteria.	**Query 1.** Returns all indicators for a specific HUC12 ID. The HUC12 ID of interest is 020600040203. The query uses the Where parameter and the "HUC12_TEXT" field of the attribute table to limit the output to the single HUC12 of interest. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/0/query?where=HUC12_TEXT='020600040203'&outFields=*&f=html
Input Geometry & Geometry Type	A geographic filter for the query. Results will only be returned for HUC12s that meet the geographic filter.	**Query 2**. Returns all indicators for a HUC12 that intersects a specific point location. The point is defined using the Input Geometry and Geometry Type parameters. The horizontal (x) coordinate of the point is −8515000 meters and the vertical (y) coordinate of the point is 4720000 meters. The geographic coordinates are in the same coordinate system as the *HUC12 Feature Layer*. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/0/query?geometry=-8515000,4720000&geometryType=esriGeometryPoint&outFields=*&f=html **Query 3**. Returns all indicators for HUC12s that intersect a rectangular geographic area of interest. The rectangular area is defined using the Input Geometry and Geometry Type parameters. The coordinates of the rectangular area are: • Minimum horizontal (xmin) coordinate = -8515000 meters • Minimum vertical (ymin) coordinate = 4720000 meters • Maximum horizontal (xmax) coordinate = -8510000 meters • Maximum vertical (ymax) coordinate = 4728000 meters https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/0/query?geometry=-8515000,4720000,-8510000,4728000&geometryType=esriGeometryEnvelope&outFields=*&f=html
Out Fields	A list of fields from the attribute table of the *HUC12 Feature Layer* to be included in the query results. Using an asterisk (outFields=*) will return all fields.	**Query 4**. Returns three indicator values for a specific HUC12 ID: the HUC12 name, percent impervious cover, and percent forest cover in the HUC12. The query uses the Out Fields parameter to limit the output to the three indicators. The HUC12 ID of interest is 020600040203. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/0/query?where=HUC12_TEXT='020600040203'&outFields=NAME_HUC12, IMP_COV_PCT_HUC12,FOREST_PCT_HUC12&f=html

Table 3. Example query parameters for retrieving data from the *Indicator Data Table*.

Query Parameter	Description	Example Queries
Where	A clause for filtering the *Indicator Data Table*. Results are returned for any HUC12s that meet the user-specified criteria.	**Query 5.** Returns all indicators for a specific HUC12 ID. The HUC12 ID of interest is 070900020702. The query uses the Where parameter and the "HUC12_TEXT" field to limit the output to the single HUC12 of interest. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/1/query?where=HUC12_TEXT= '070900020702'&outFields=*&f=html **Query 6**. Returns all indicators for HUC12s in Wisconsin. The query uses the Where parameter and the "STATE_MAJ" field to limit the output to HUC12s that have the majority of their area in Wisconsin. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/1/query?where=STATE_MAJO RITY='WI'&outFields=*&f=html
Input Geometry & Geometry Type	Not used in queries of the *Indicator Data Table.* The *Indicator Data Table* is not linked to HUC12 polygons.	
Out Fields	A list of fields from the *Indicator Data Table* to be included in the query results. Using an asterisk (outFields=*) will return all fields.	**Query 7**. Returns three indicator values for a specific HUC12 ID: the HUC12 name, the county where the HUC12 is located, and percent protected lands in the HUC12. The query uses the Out Fields parameter to limit the output to those three indicators. The HUC12 ID of interest is 070900020702. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/1/query?where=HUC12_TEXT= '070900020702'&outFields=NAME_HUC12, COUNTY_MAJORITY_HUC12, PROT_LAND_PCT_HUC12&f=html **Query 8**. Returns HUC12 IDs in the contiguous US with at least 75% natural land cover. The query uses the Out Fields parameter to limit the output to the HUC12 ID and percent natural land cover fields. The Where parameter is used to limit the output to HUC12s with at least 75% natural land cover. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/1/query?where=N_INDEX_PCT _HUC12>75&outFields=HUC12_TEXT,N_INDEX_PCT_HUC12&f=html

Table 4. Example query parameters for retrieving data from the *Indicator Information Table.*

Query Parameter	Description	Example Queries
Where	A clause for filtering the *Indicator Information Table*. Results are returned for any indicators that meet the user-specified criteria.	**Query 9**. Returns the entire *Indicator Information Table*. The query uses the Where parameter and the "OBJECTID" field to return all rows. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/2/query?where=OBJECTID>0&outFields=*&f=html **Query 10**. Returns all columns for a specific indicator of interest: road density in the HUC12. The query uses the Where parameter and the "Field_Name" column to limit the output to the road density indicator. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/2/query?where=Field_Name='ROADS_ALL_DENSITY_HUC12'&outFields=*&f=html **Query 11**. Returns all columns for indicators in the "Ecological" category. The query uses the Where parameter and the "Category" column to limit the output to Ecological indicators. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/2/query?where=CATEGORY='Ecological'&outFields=*&f=html
Input Geometry & Geometry Type	Not used in queries of the *Indicator Information Table.* The *Indicator Information Table* is not linked to HUC12 polygons.	
Out Fields	A list of fields from the *Indicator Information Table* to be included in the query results. Using an asterisk (outFields=*) will return all fields.	**Query 12**. Returns indicator names and descriptions for all indicators. The query uses the Out Fields parameter to limit the output to the name and description fields. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/2/query?where=OBJECTID>0&outFields=Indicator_Name,Description&f=html **Query 13**. Returns indicator names and descriptions for indicators in the "Forest Cover" subcategory. The query uses the Out Fields parameter to limit the output to the name and description fields. The Where parameter is used to limit the output to indicators in the Forest Cover subcategory. https://gispub.epa.gov/arcgis/rest/services/r4/wsio/MapServer/2/query?where=SUBCATEGORY='Forest Cover'&outFields=Indicator_Name,Description&f=html