

ArcGIS Pro: Loading and Manipulating Data

Presented By: Cole White, GIS Analyst
Map and Data Library

Download the workshop data:

<https://uoft.me/ProDataDownload>

Get these slides:

<https://uoft.me/ProDataSlides>



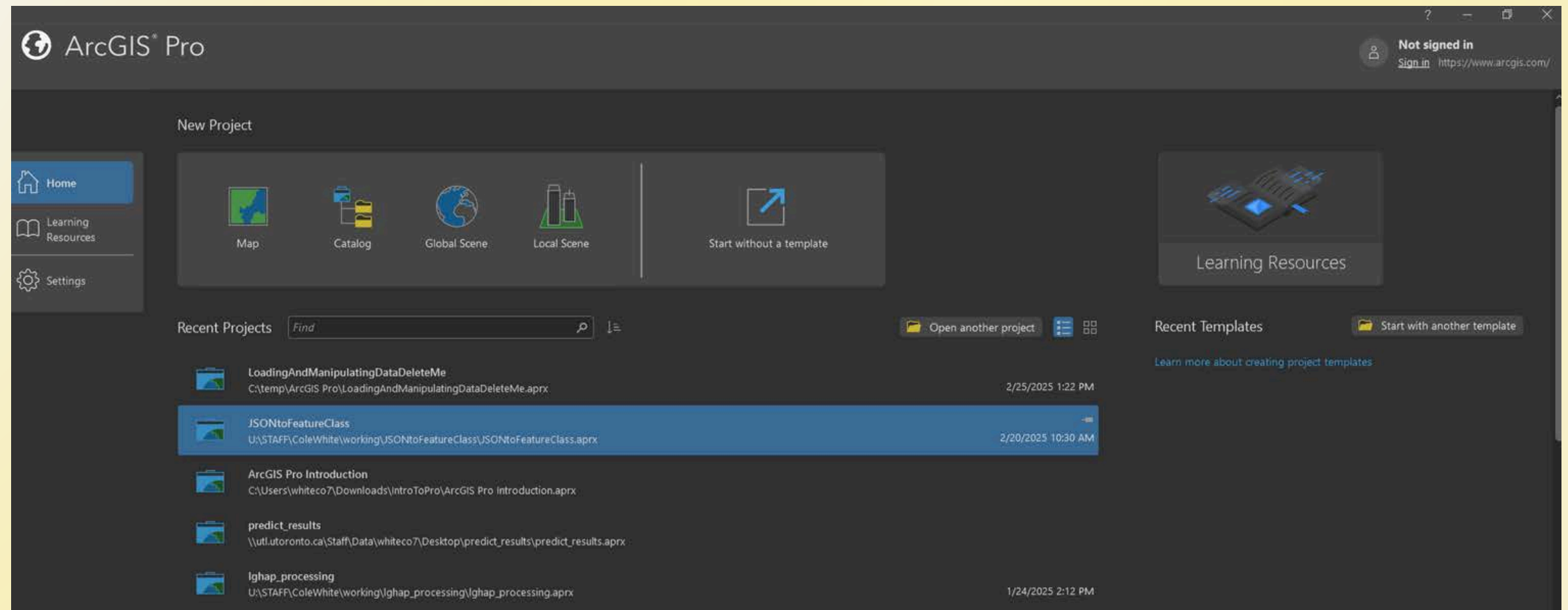
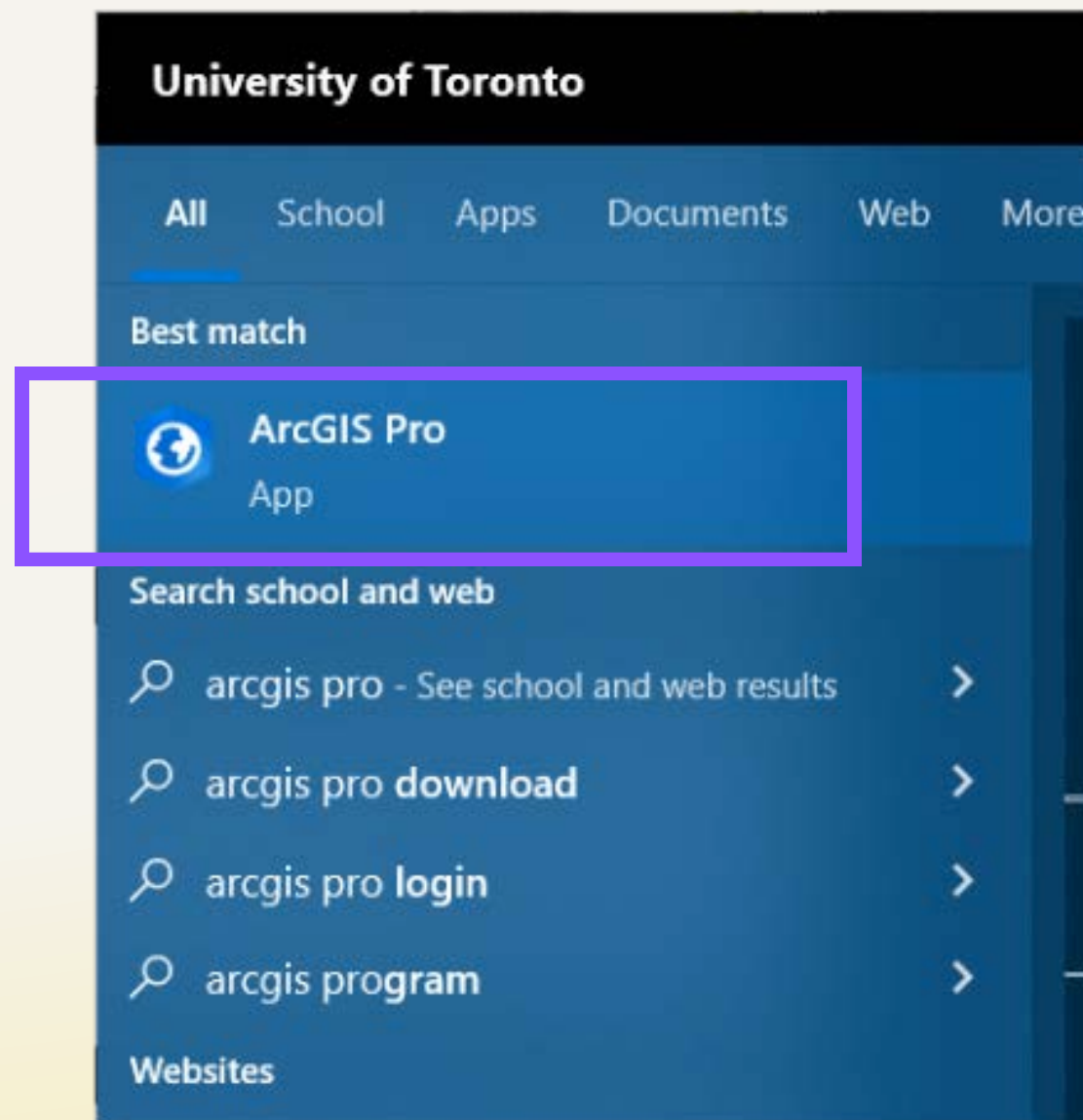
Please choose a lab computer with this sticker:



Agenda

- | | | | |
|----|-----------------------------|----|---------------------------------|
| 01 | Introduction | 05 | Filtering Data |
| 02 | Project Creation | 06 | Geoprocessing |
| 03 | Adding Vector Layers | 07 | Working With Raster Data |
| 04 | Vector Symbology | 08 | Getting Help |

But first, some troubleshooting





Introduction

The Map and Data Library

- Access data collections
- Workshops and training
- One-on-one consults
- Appointment-only until summer 2025 (?)

<https://mdl.library.utoronto.ca/>
mdl@library.utoronto.ca
[416-978-5589](tel:416-978-5589)

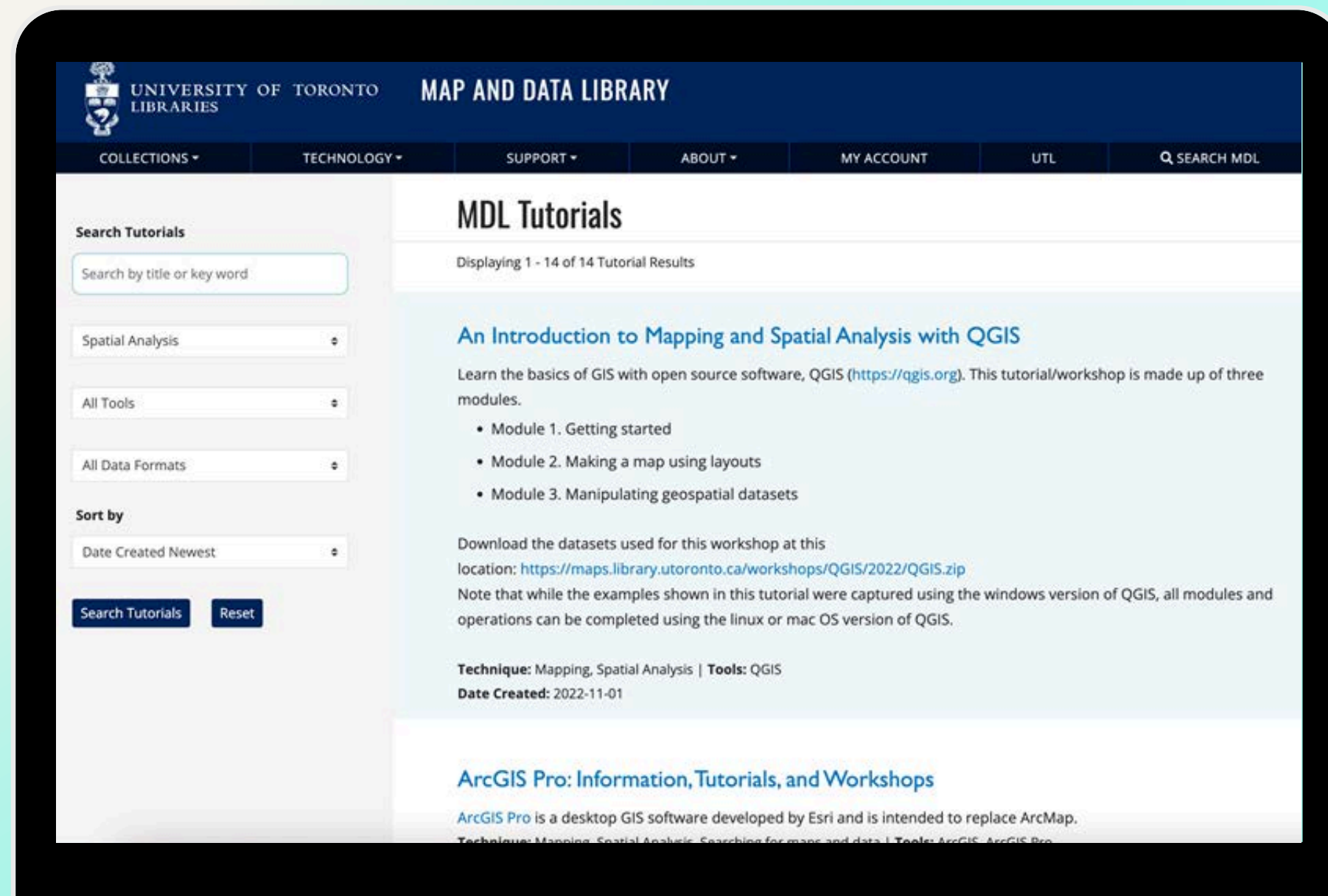
11am - 5pm, Monday - Friday

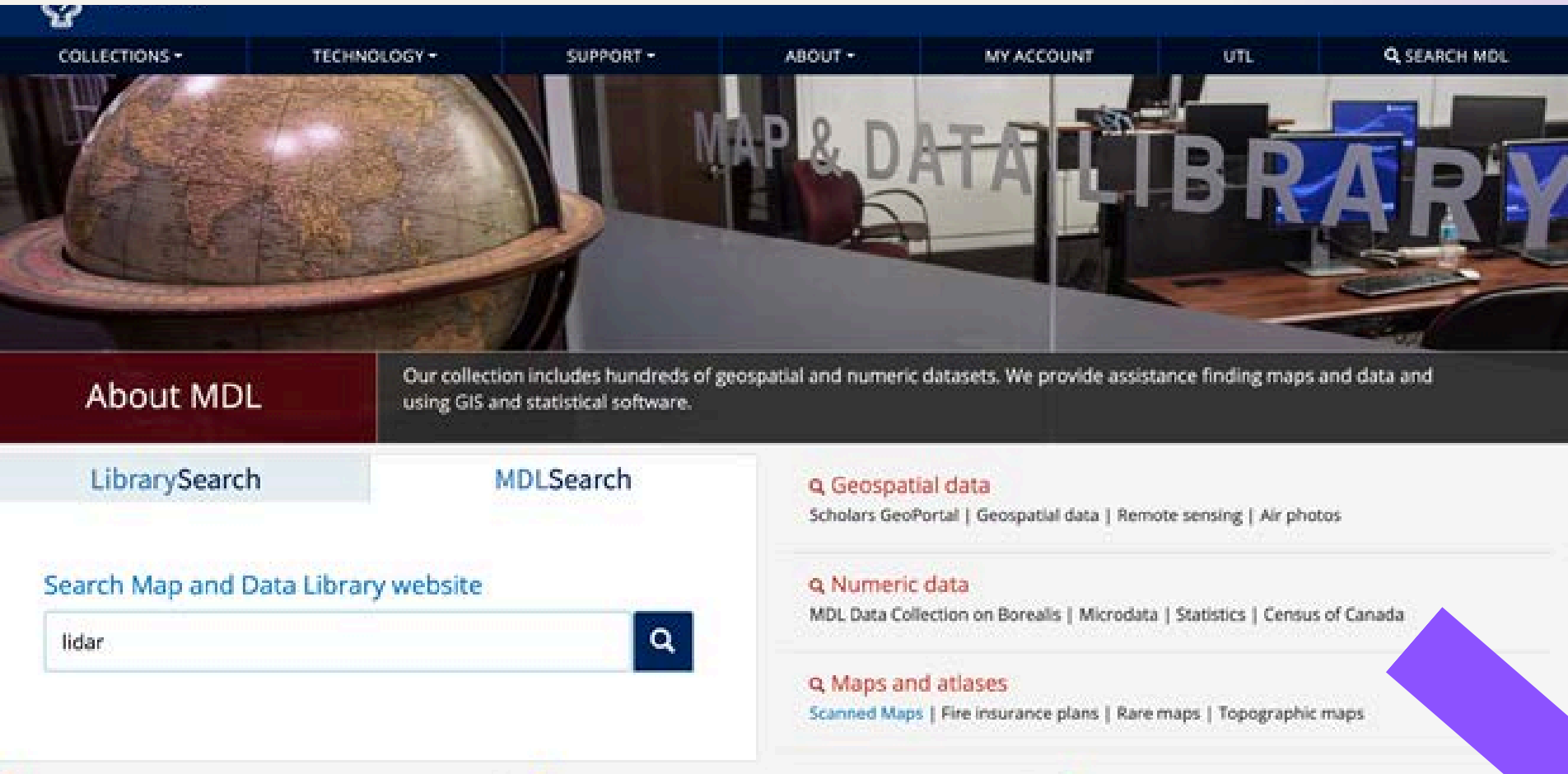
Map and Data Library

Tutorials and Workshops

<https://mdl.library.utoronto.ca/support/tutorials>

<https://mdl.library.utoronto.ca/support/workshops-and-training>

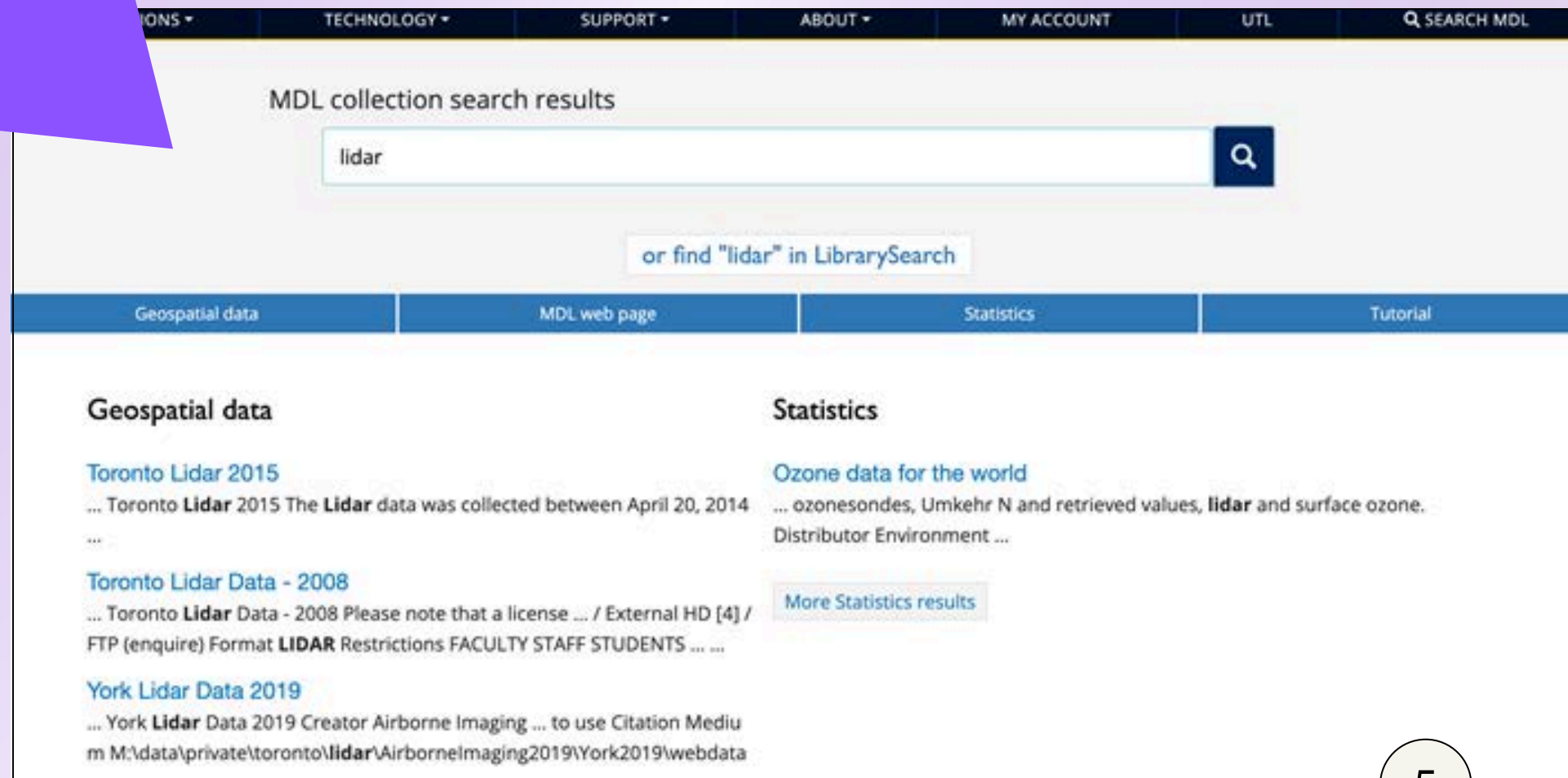




Finding Data

Map and Data Library
collection:

<https://mdl.library.utoronto.ca/>



Scholars Geoportal

<https://geo2.scholarsportal.info/>

The screenshot displays the Scholars Geoportal interface. On the left, a search bar contains the text 'parks' and a dropdown menu is set to 'Anywhere'. Below the search bar, there are options for 'Downloadable content only' and a 'Back To Browse' button. The search results section shows 'Found 96 results showing results 1 to 10' and a 'Sort by: Relevance' dropdown. A 'Refine: Topics' list includes categories like 'Environment and conservation (16)', 'Census and administrative boundaries (12)', and 'Imagery, base maps, and land cover (10)'. Below the topics, there are sections for 'Keywords' and a list of search results. The map on the right shows the Greater Toronto Area with green markers indicating park locations. The map includes labels for various cities and towns such as Aurora, Richmond Hill, and Mississauga. The interface also features a top navigation bar with options like 'Share', 'Print', 'Export', 'Data Table', 'Base Maps', 'Contact', and 'Français'.

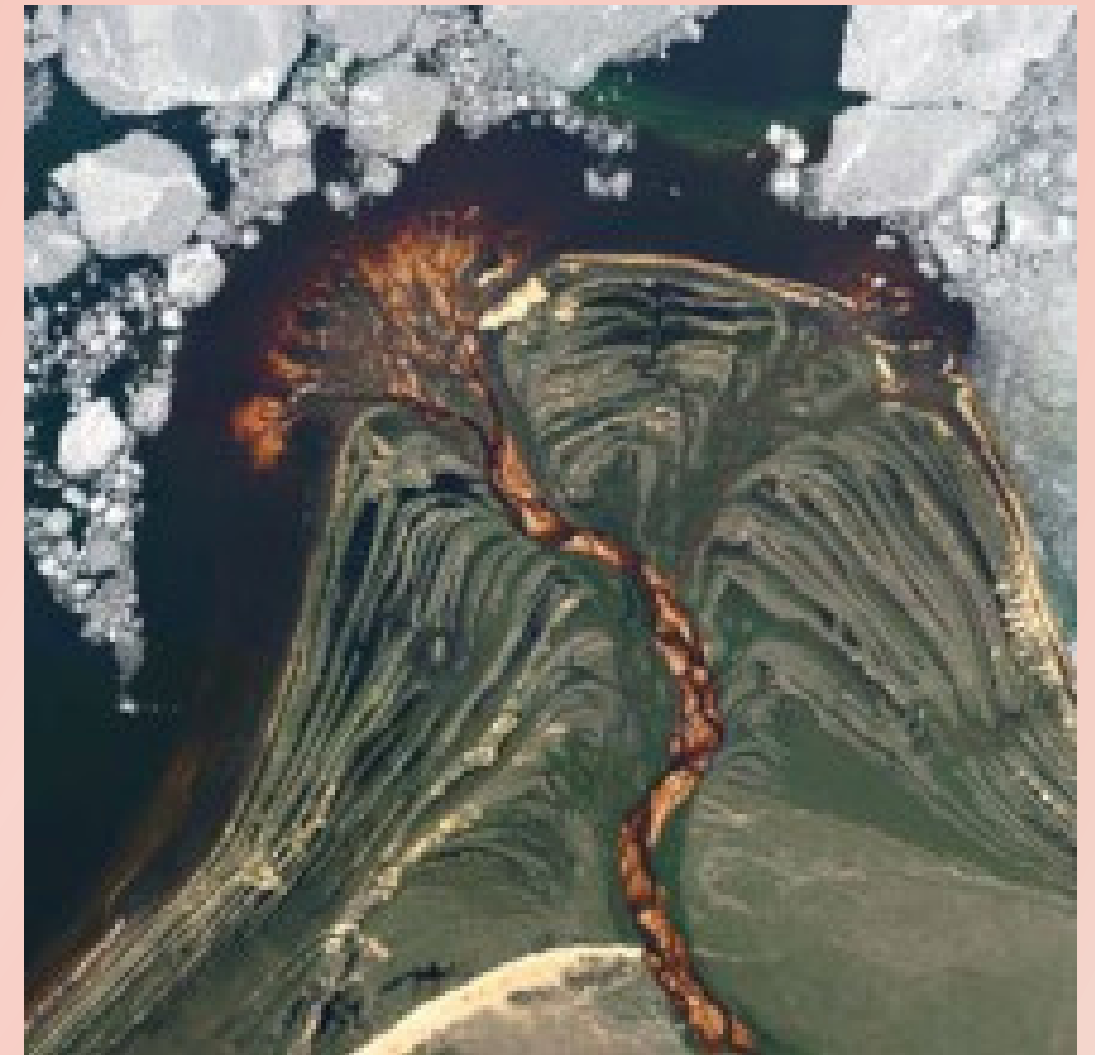
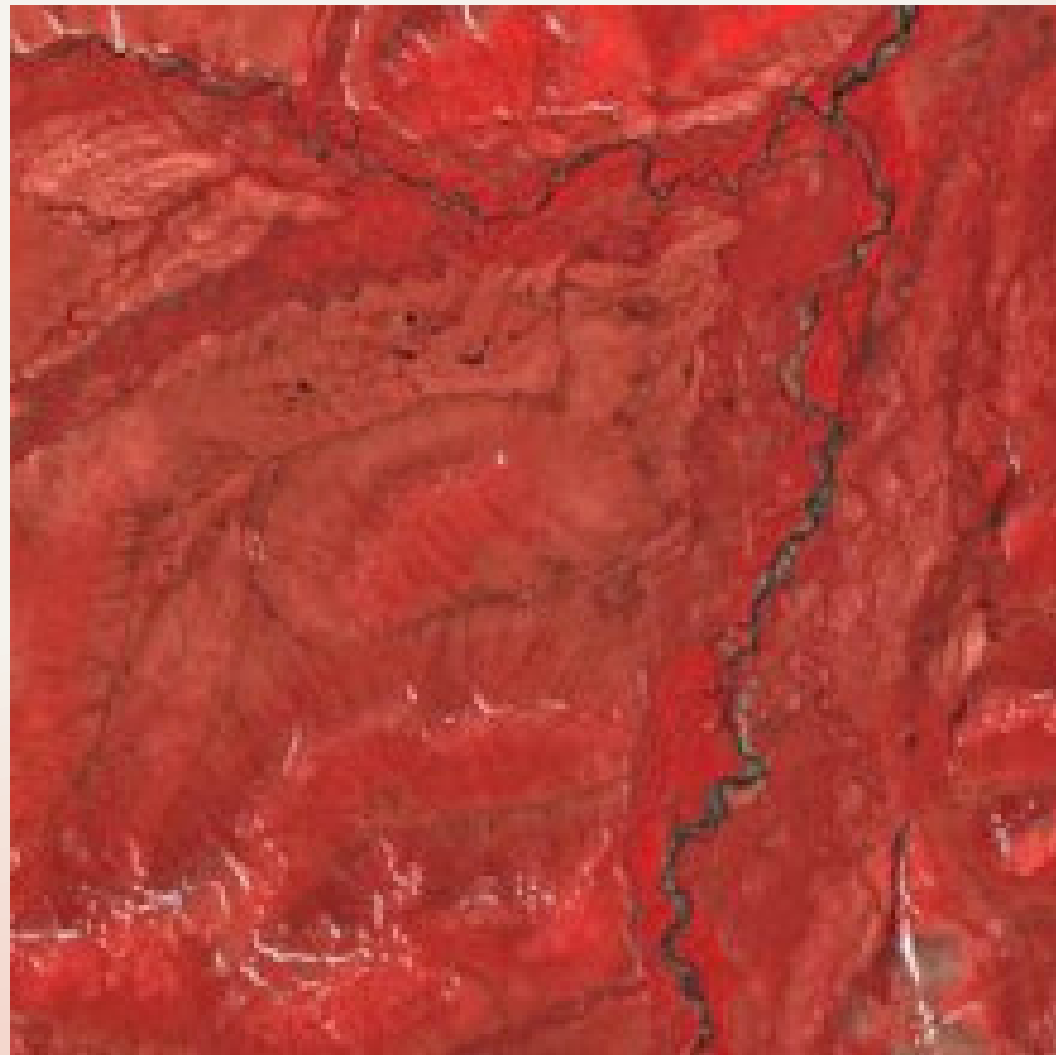
Search Results:

- Park Sports Field Region**
Add - 1/7 Details
Producer: DMTI Spatial Inc.
Date published: 2015-04-01 (publication), 2021-09-15 (revision)
Type of data layer: Vector
- Park Sports Field Point**
Add - 0/7 Details
Producer: DMTI Spatial Inc.
Date published: 2015-04-01 (publication), 2021-09-15 (revision)
Type of data layer: Vector
- Federal Protected Area**
Add Details
Producer: Ontario Ministry of Natural Resources
Date published: 2008-07-09 (creation), 2008-07-09 (revision)
Type of data layer: Vector
- Municipal Park**
Add Details
Producer: Ontario Ministry of Natural Resources
Date published: 2000-01-01 (creation), 2000-01-01 (revision)
Type of data layer: Vector
- Canadian Heritage River System**
Add Details
Producer: Ontario Ministry of Natural Resources
Date published: 1986-01-02 (creation), 2004-01-05 (revision)

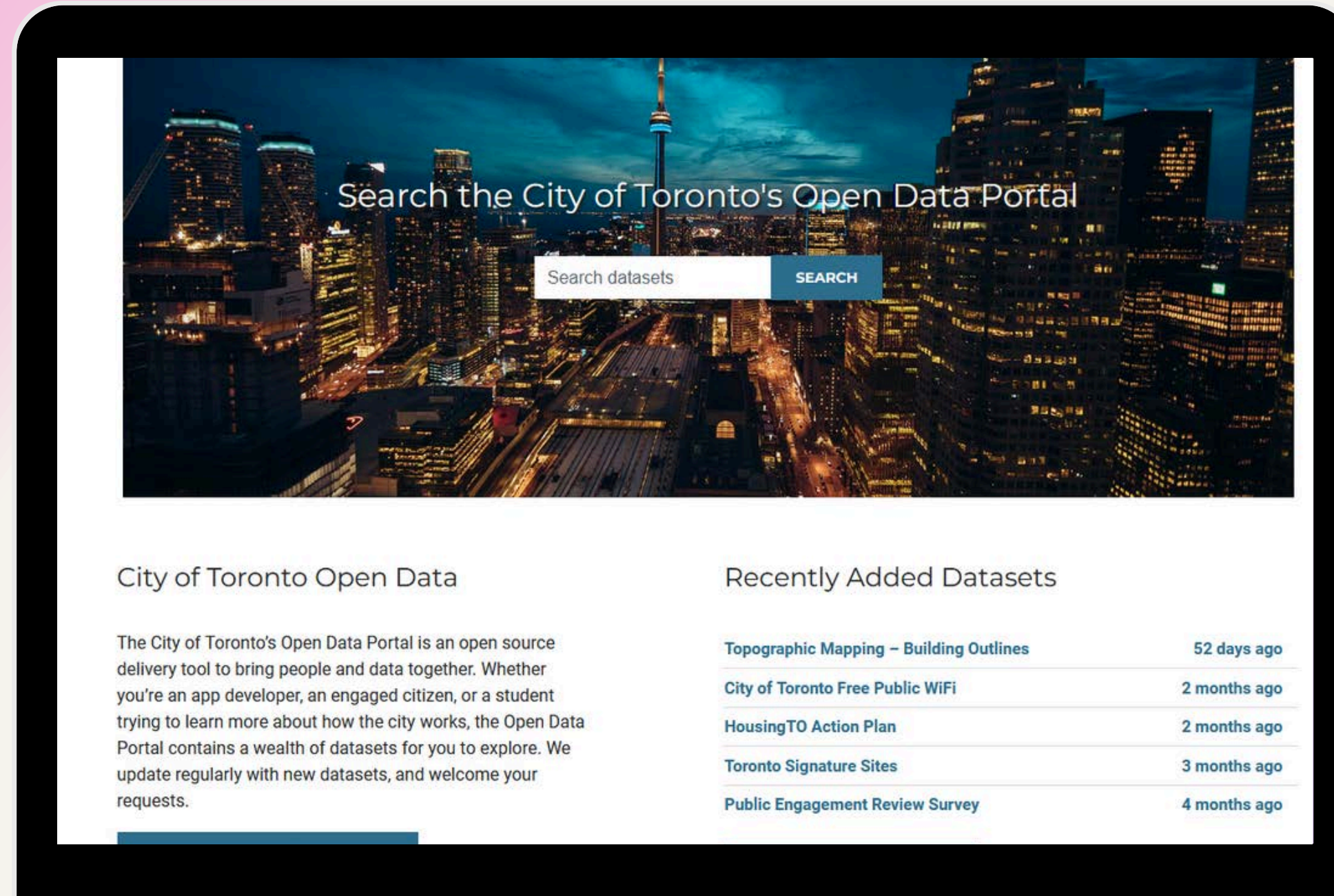
Planet.com

Access instructions:

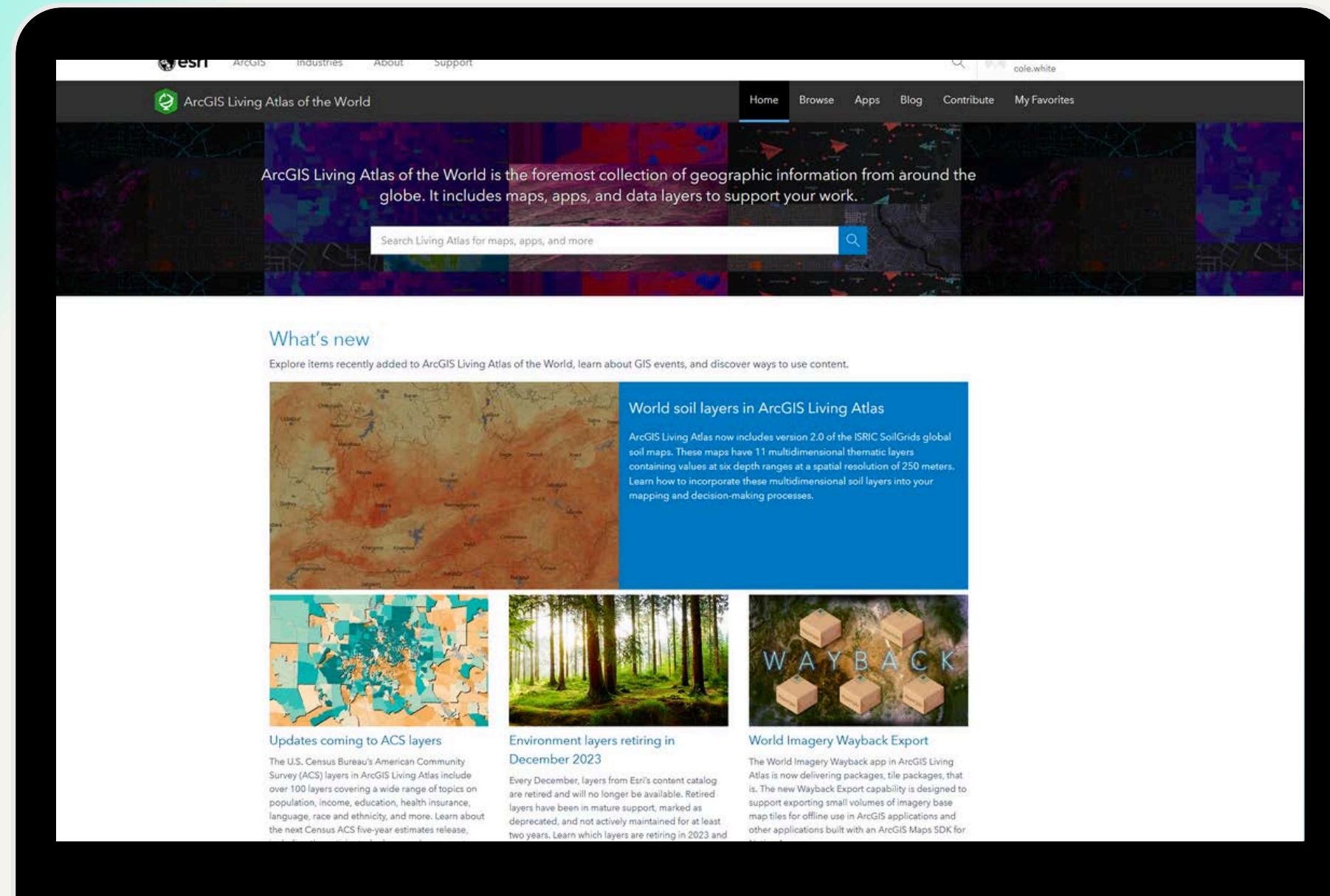
<https://mdl.library.utoronto.ca/collections/data-portal/planetcom>



Open data

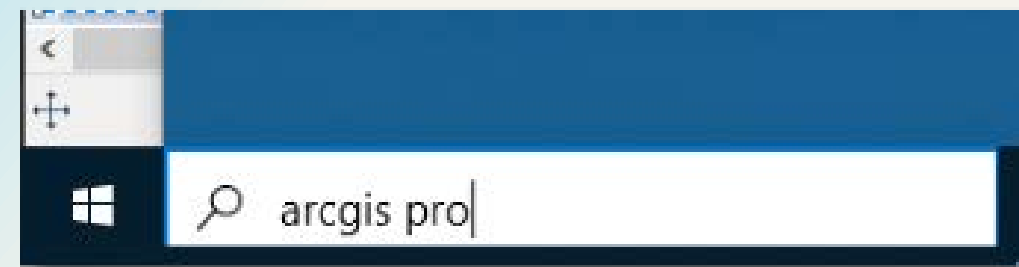
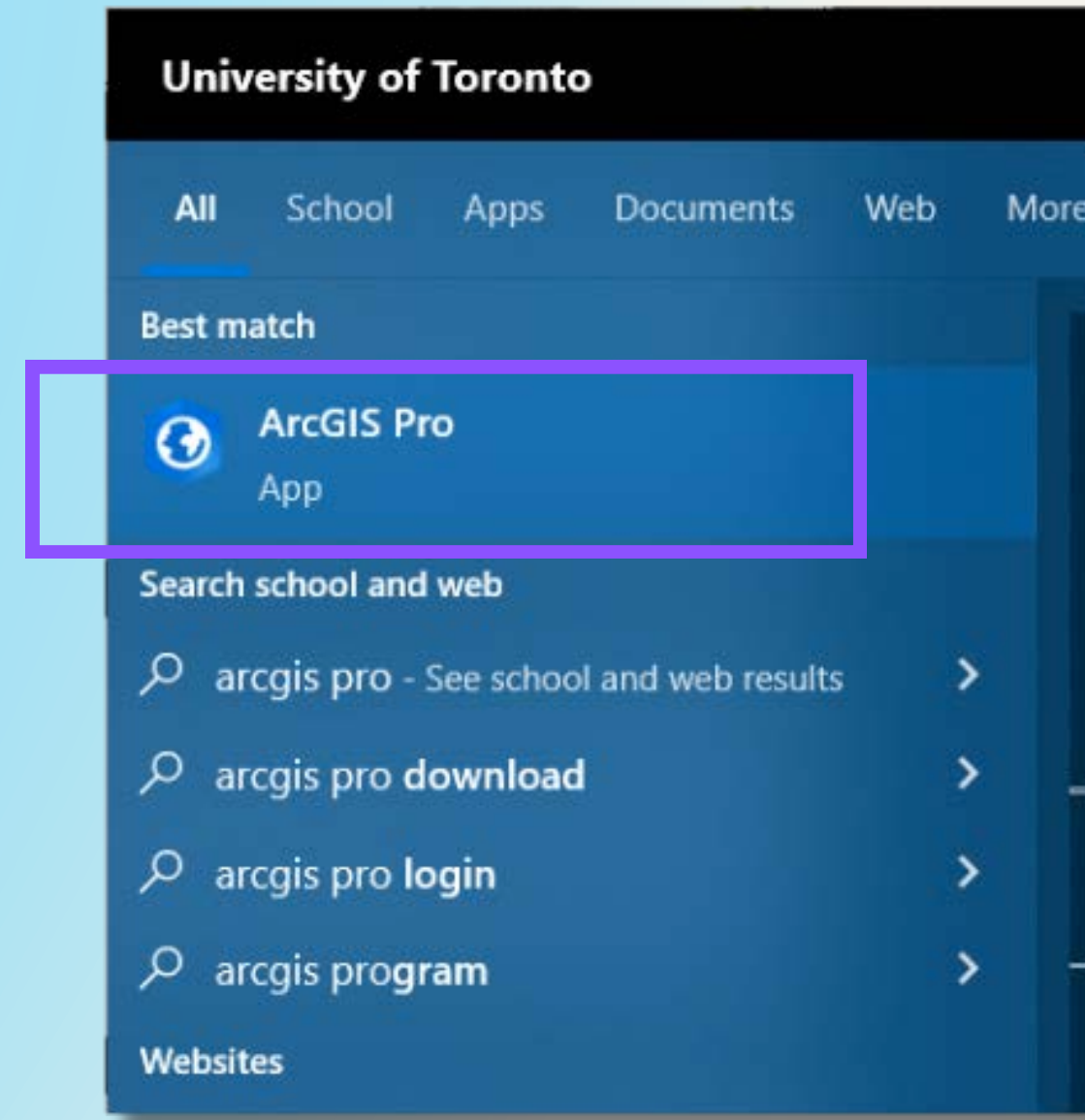


ArcGIS Online and Living Atlas

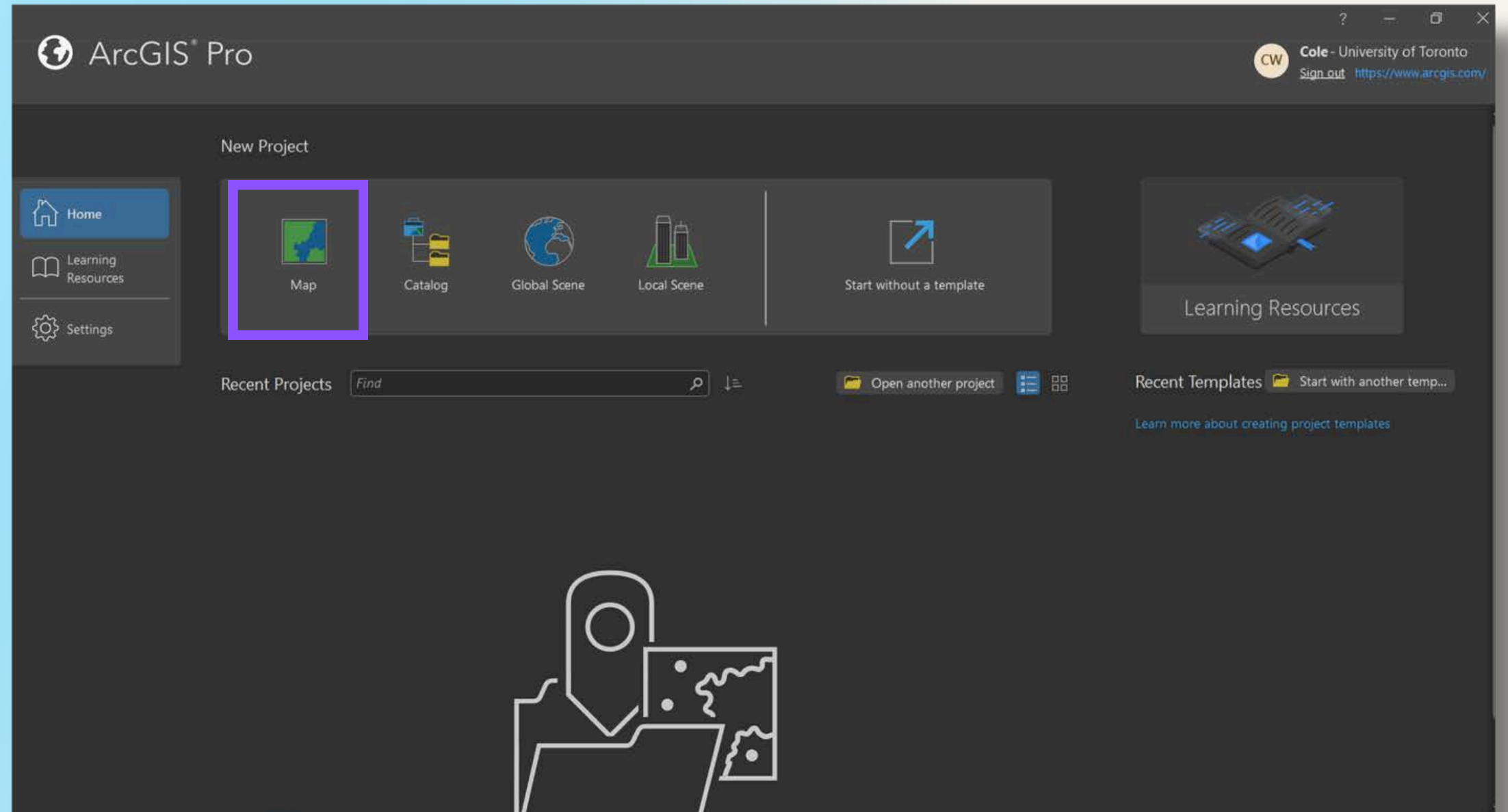


Creating a New Project

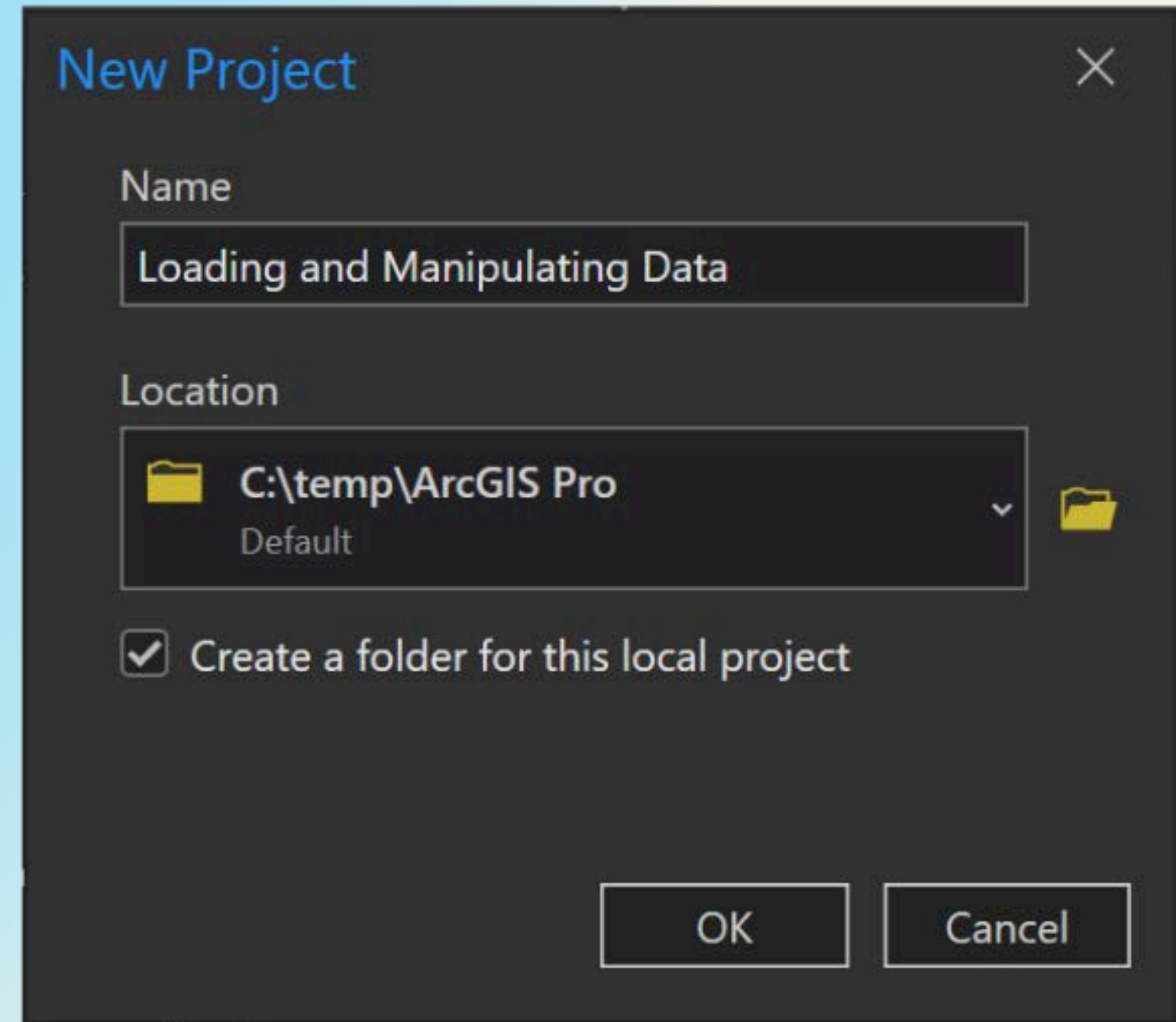
- Launch Pro from the Windows Start Menu



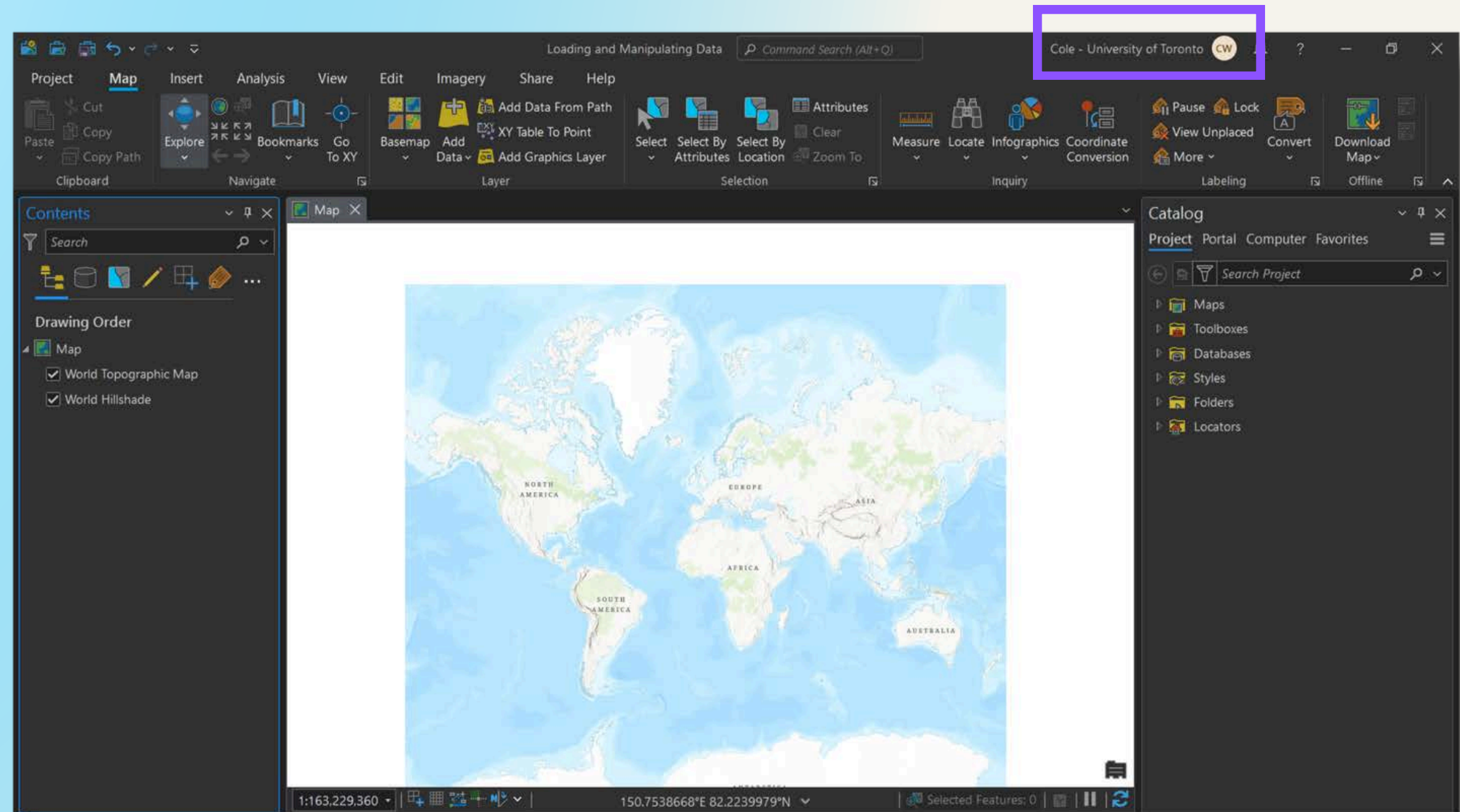
- From the intro screen, create a new project using the **Map** template.



- Give your new project a name.
- Choose a location on your filesystem to save the project.
- Check the box to create a new folder for the project.
- Click **OK**.



- A new project containing a **map view** will open.
- The map will be empty except for a default **basemap**.
- Make sure you're signed in with your U of T credentials.



Working with Vector Data:

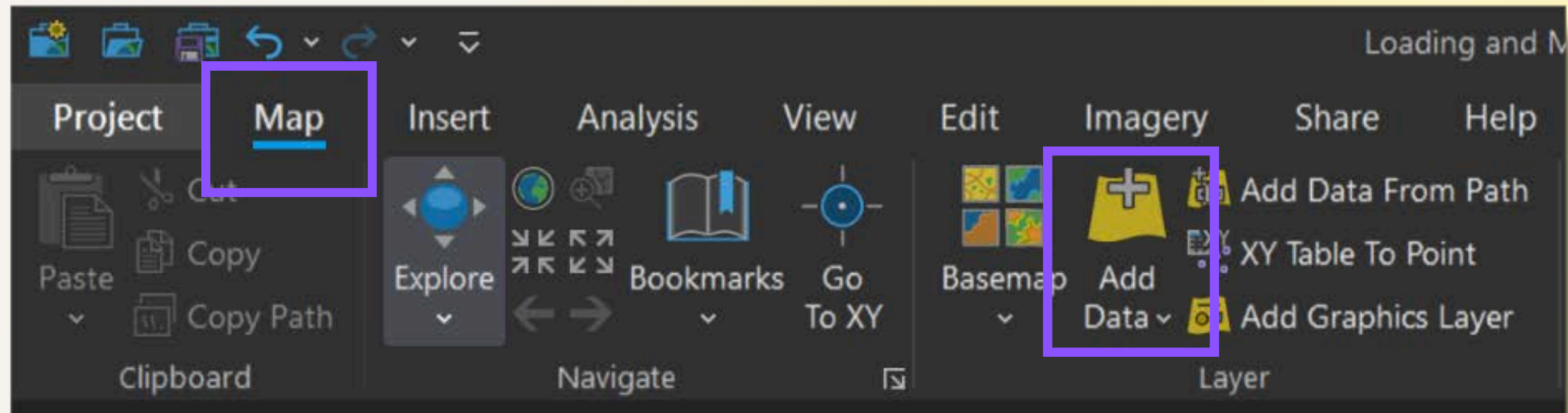
Add a data layer from a shapefile

Shapefile (.shp) - a very common GIS vector file format.

- **Other GIS-compatible vector formats:**
 - **.dwg, .dxf** - CAD drawings (*survey plans often use this format*)
 - **.kml, .kmz** - Google Earth file
 - **.geojson** - GeoJSON (*often used in web mapping*)



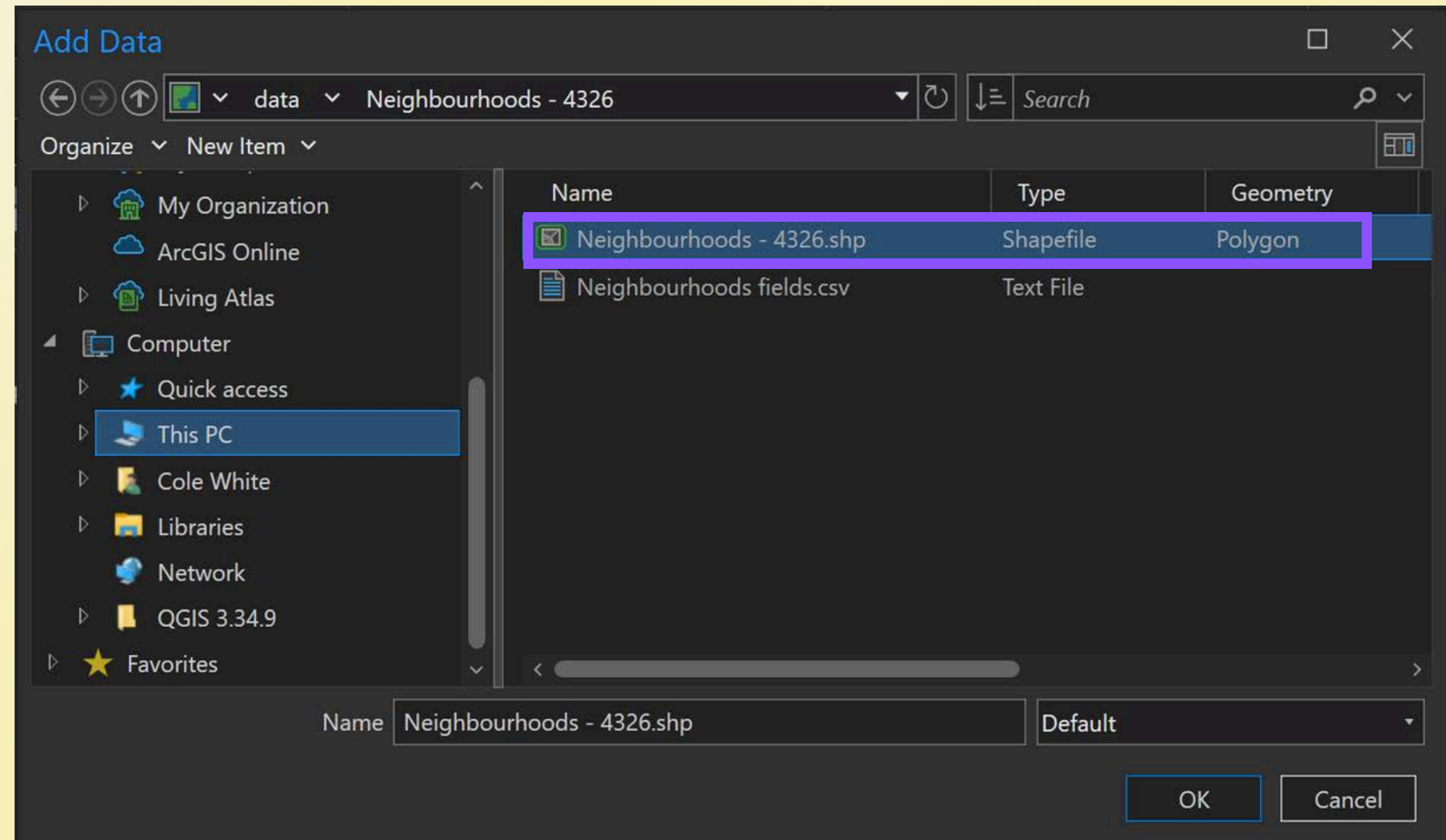
Add a data layer from a shapefile



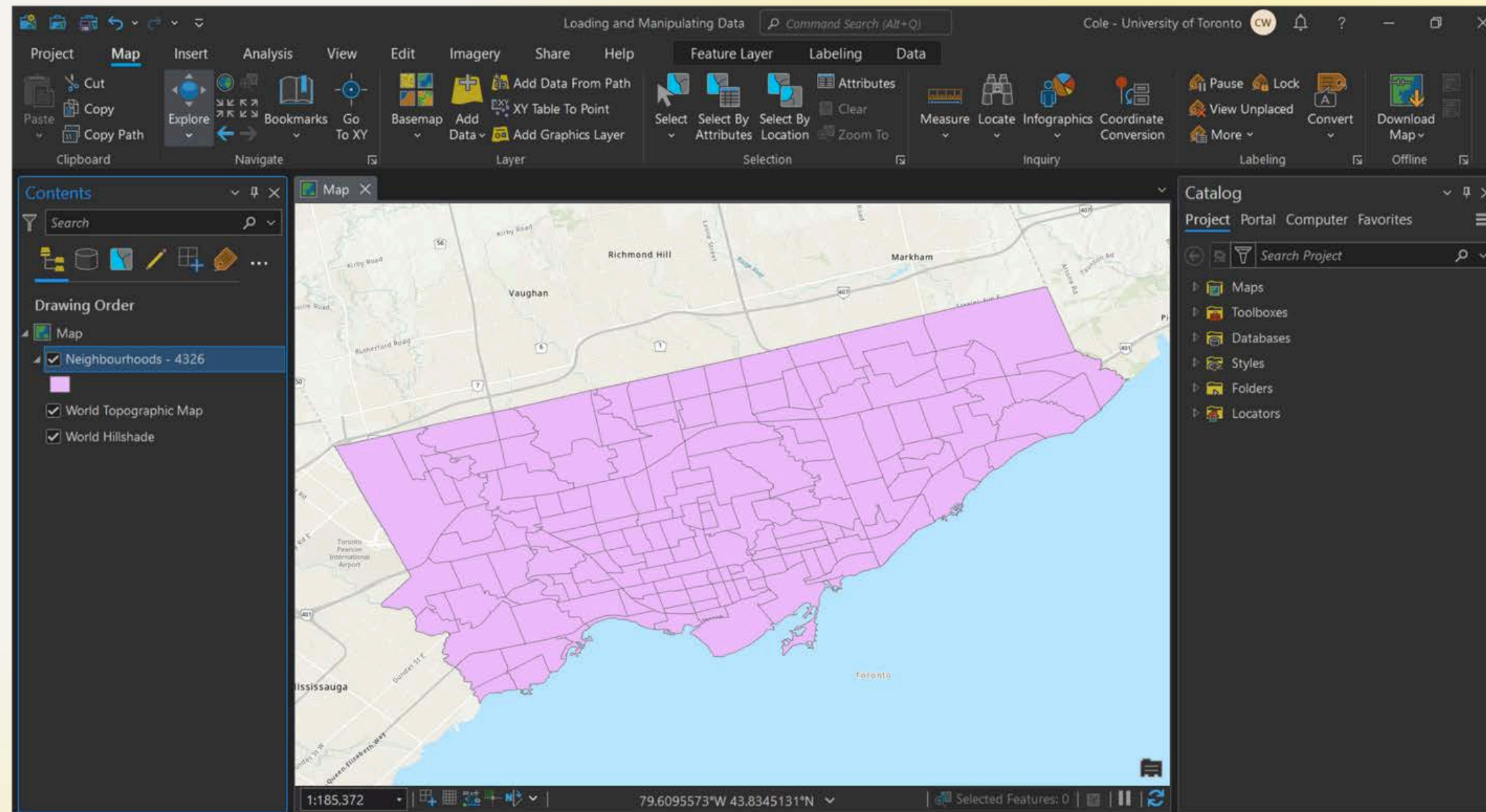
- From the **Map** tab, click the **Add Data** button.

Add a data layer from a shapefile

- Navigate to the location where you've saved the sample data.
- Select **Neighbourhoods - 4326.shp** and click **OK**.



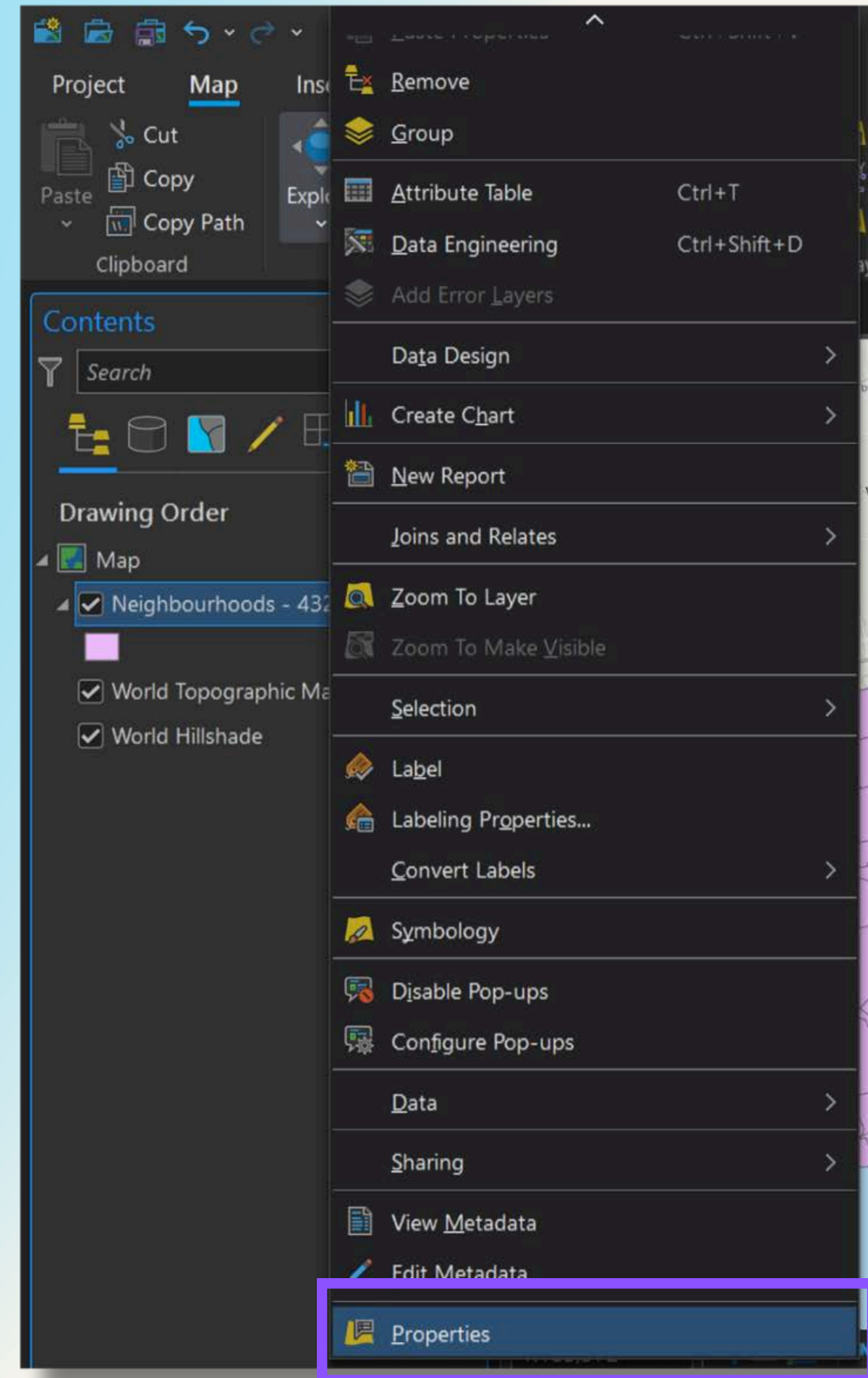
Add a data layer from a shapefile



- The layer will be added to your map view.
 - **Note:** This dataset was acquired from the City's open data portal website: <https://open.toronto.ca/dataset/neighbourhoods/>

Projections

- Right-click the Neighbourhoods layer and select **Properties** from the contextual menu. (Or, double-click the layer name.)



Projections

- Click on the **Source** tab.
- Take a look at the information in the **Spatial Reference** section.
- Note that this layer uses the **WGS 1984** geographic coordinate system.
- Click **OK**.

Layer Properties: Neighbourhoods - 4326

General
Metadata
Source
Elevation
Selection
Display
Cache
Definition Query
Time
Range
Indexes
Joins
Relates
Page Query

Set Data Source...

▼ Data Source

Data Type	Shapefile Feature Class
Shapefile	U:\STAFF\ColeWhite\workshops\ProLoadingAndManipulatingData\
Geometry Type	Polygon
Coordinates have Z value	No
Coordinates have M value	No

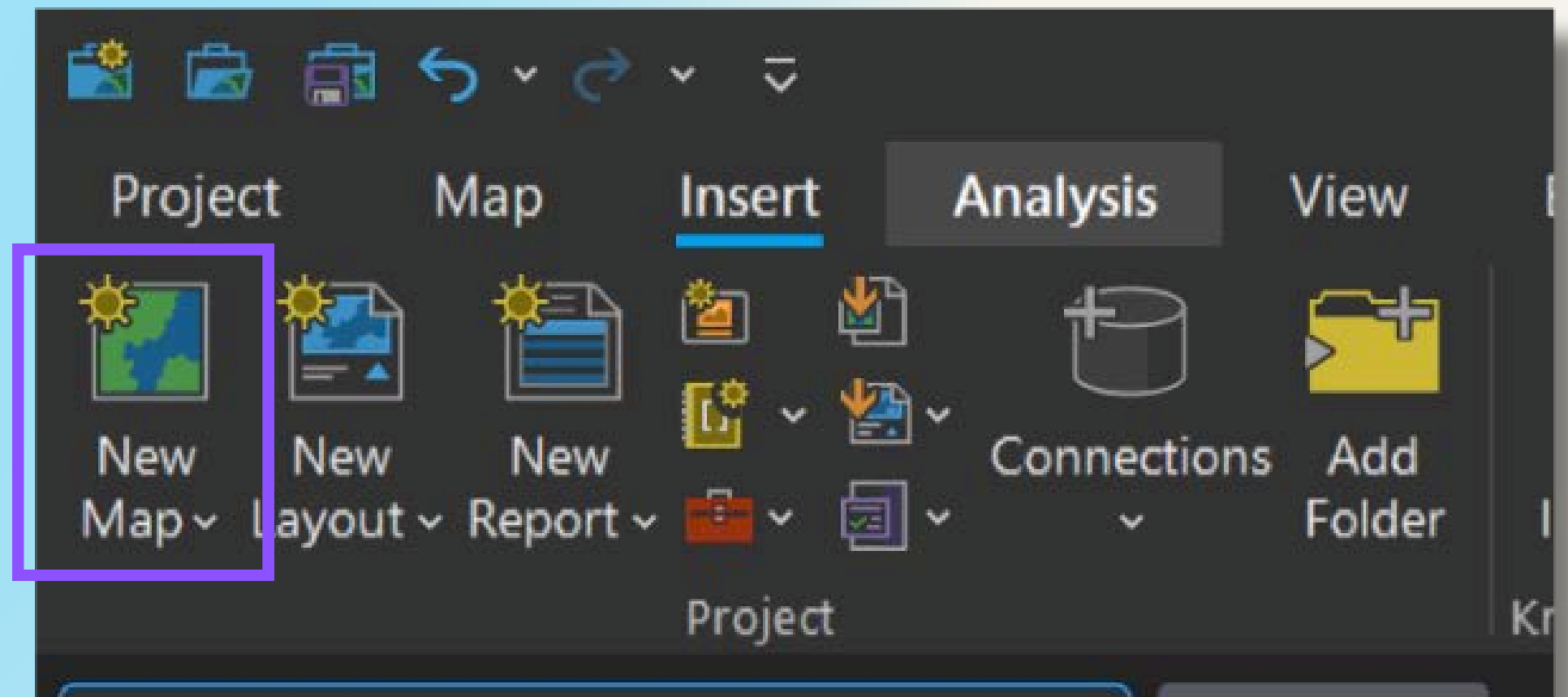
> Extent

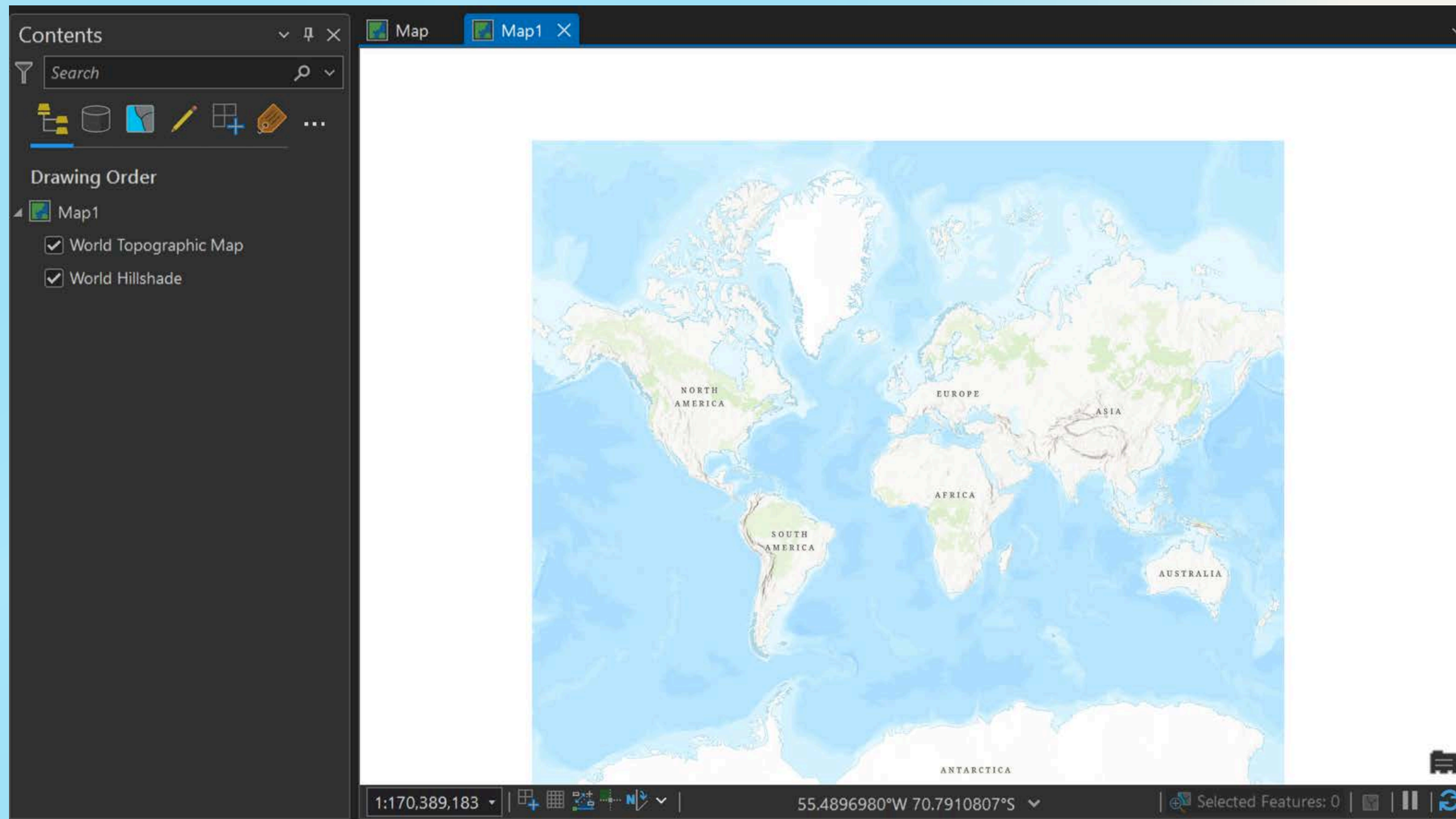
▼ Spatial Reference

Geographic Coordinate System	WGS 1984
WKID	4326
Authority	EPSG
Angular Unit	Degree (0.0174532925199433)
Prime Meridian	Greenwich (0.0)
Datum	D WGS 1984
Spheroid	WGS 1984
Semimajor Axis	6378137.0
Semiminor Axis	6356752.314245179
Inverse Flattening	298.257223563

OK Cancel Apply

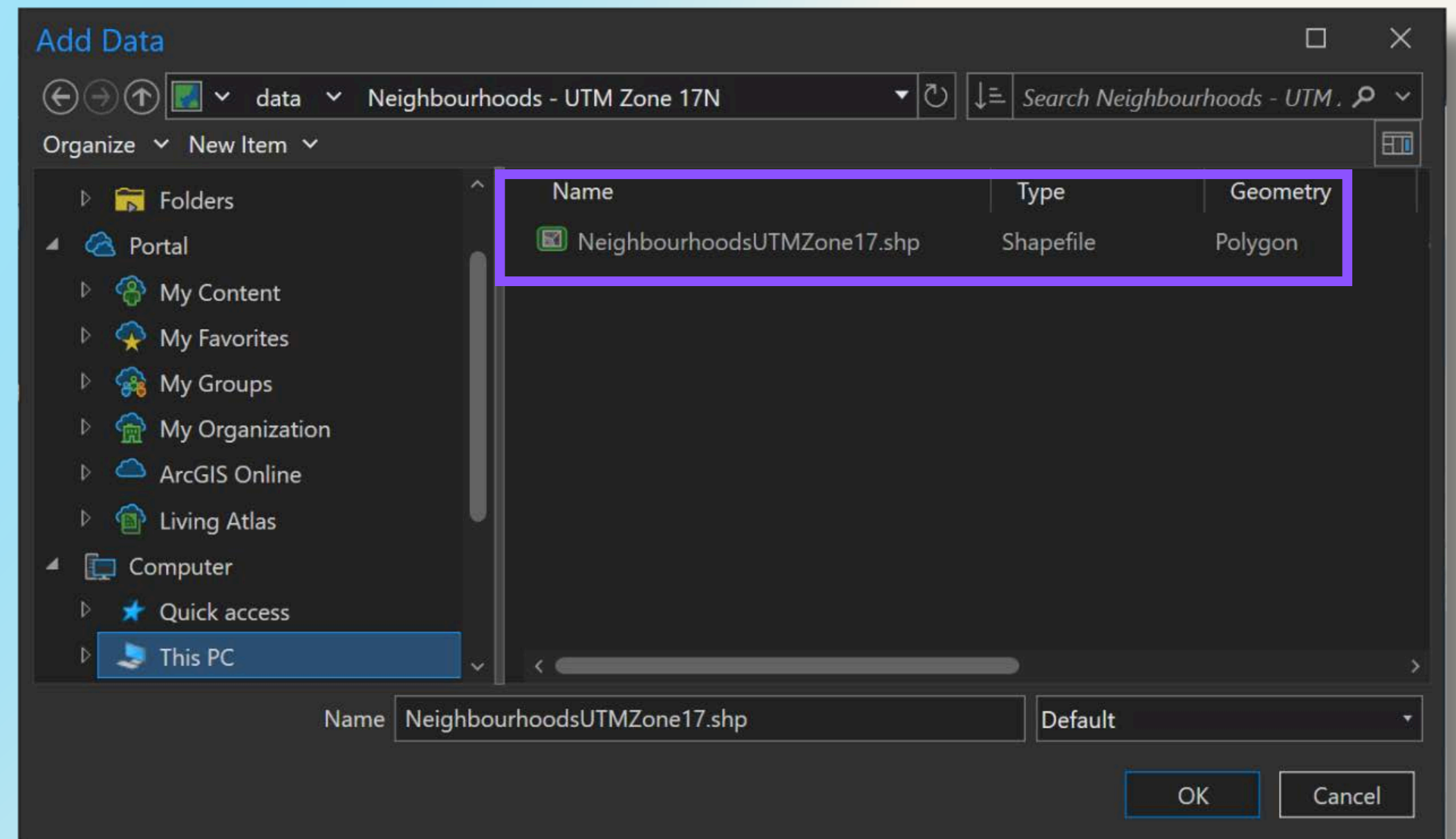
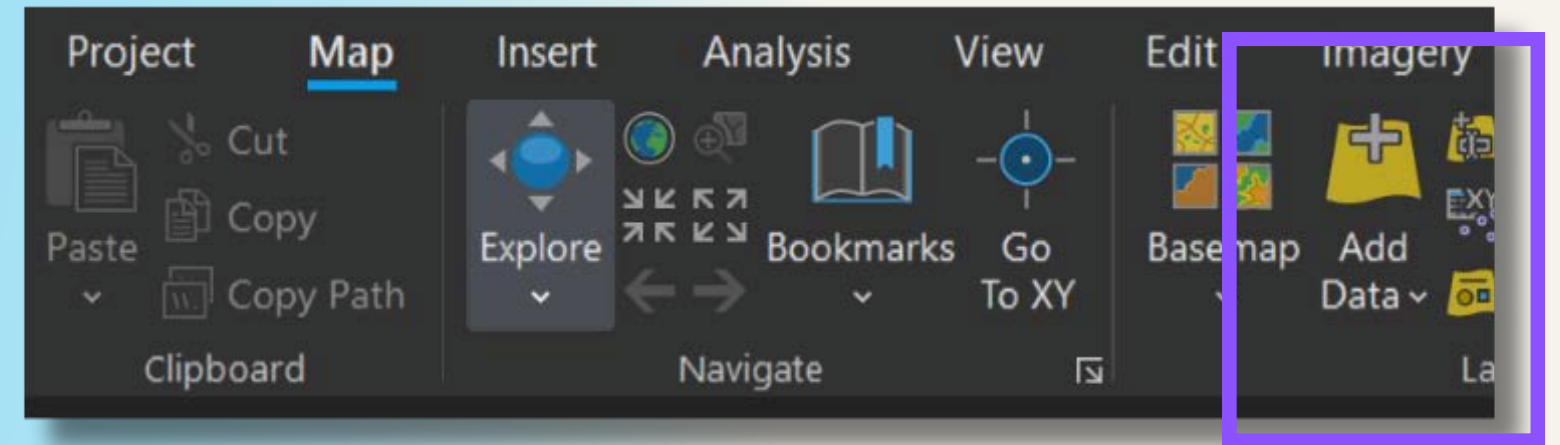
- From the Insert tab on the Pro Ribbon, click **New Map**.

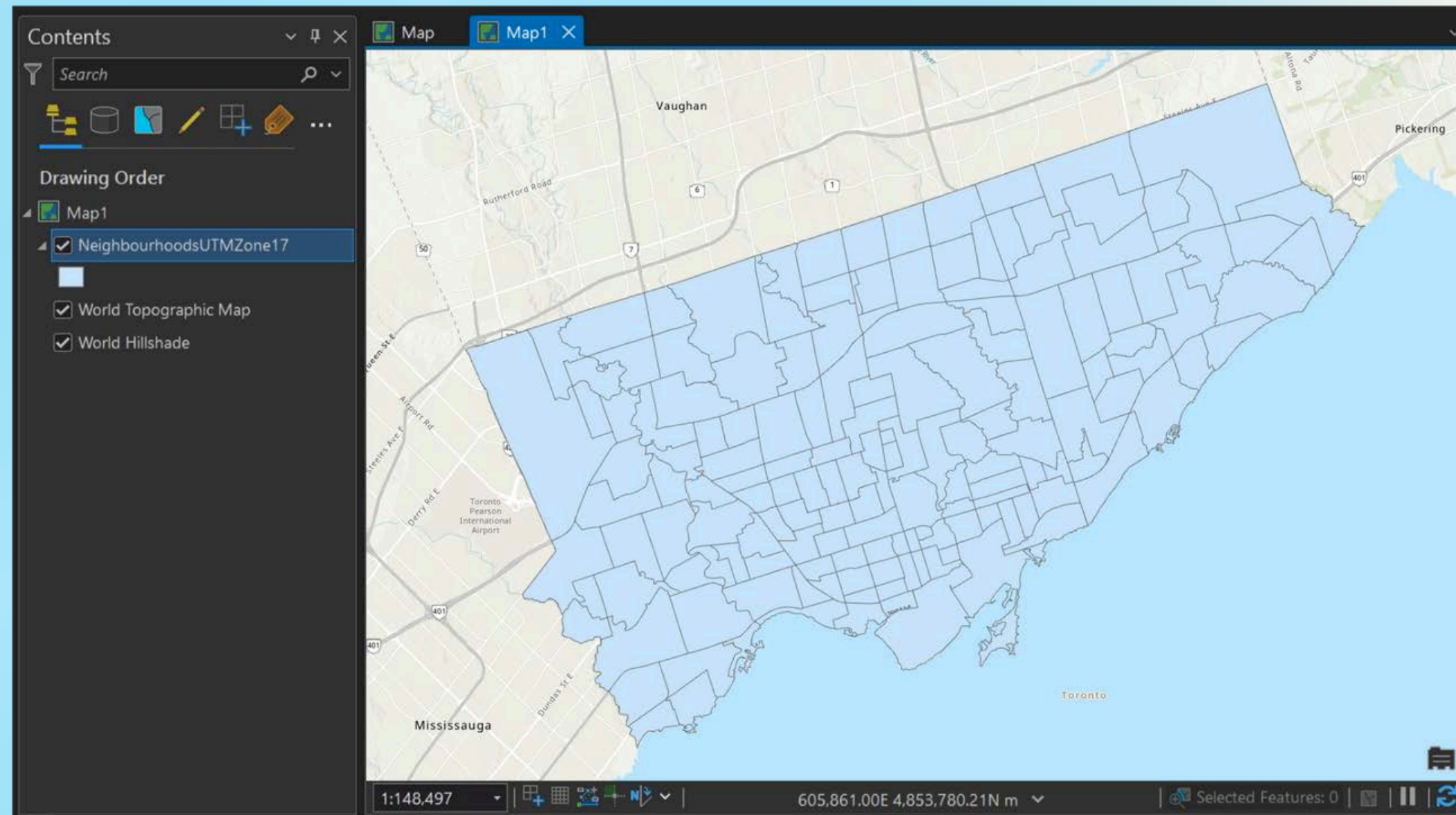




- A new, blank map will be added to your project.

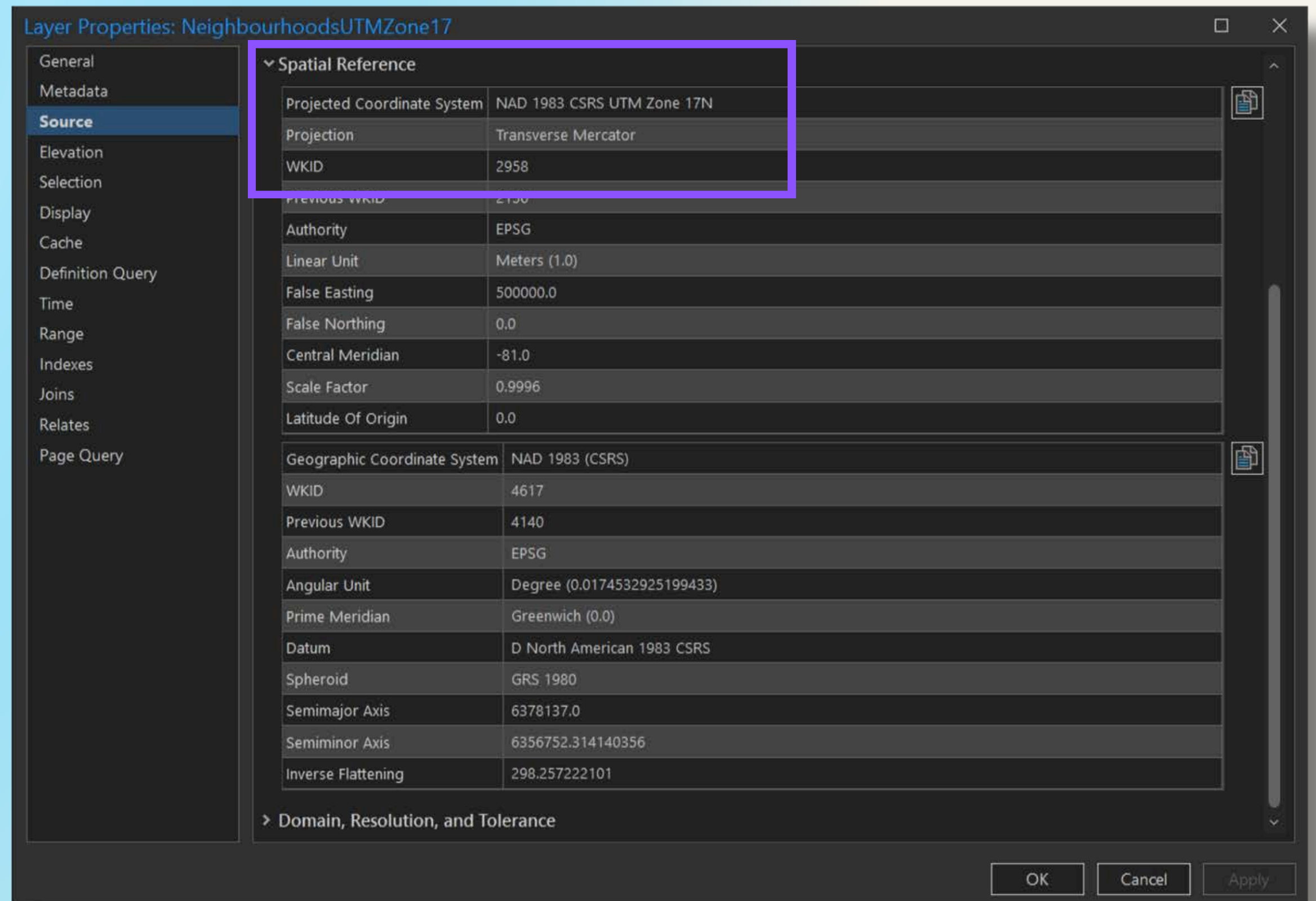
- Click the **Add Data** button.
- Navigate to and open **NeighbourhoodsUTM Zone17.shp**





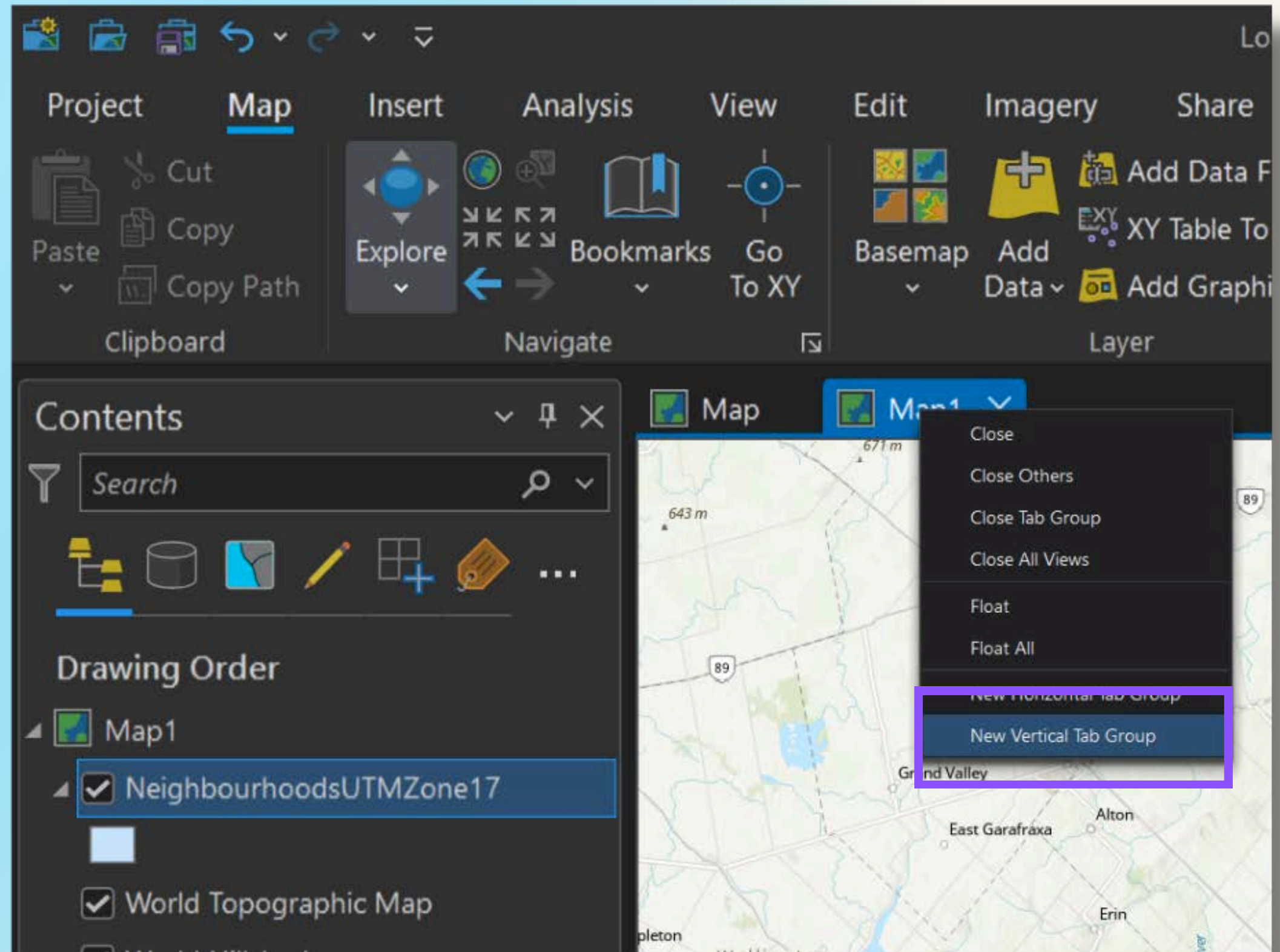
- A second version of the **Neighbourhoods** layer will be added to your new map.

- Open the **Properties** pane for this version of the Neighbourhoods layer.
- Note the **Spatial Reference** details.
- Click **OK**.



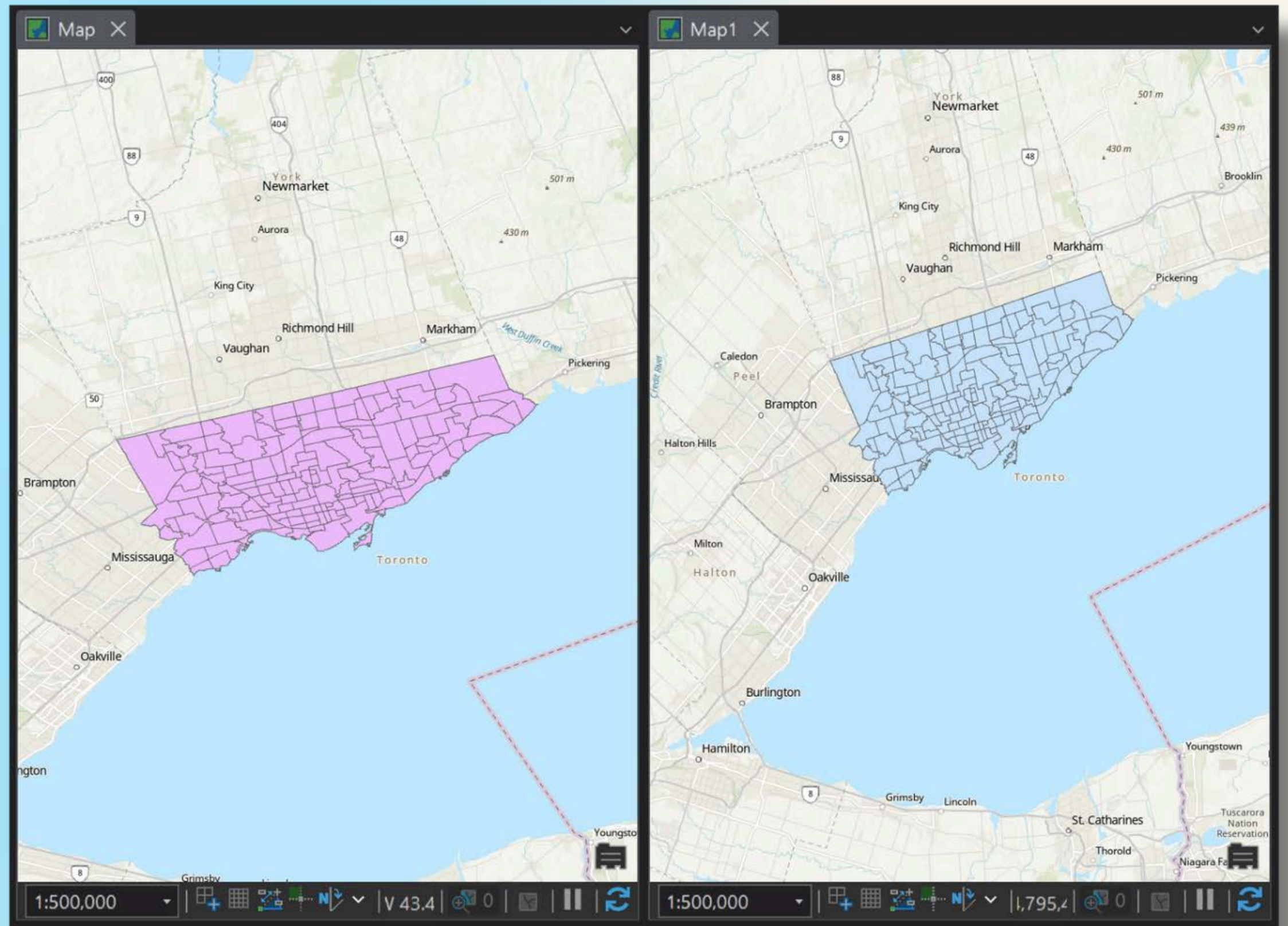
Projections

- Right-click the **Map1** tab.
- Select **New Vertical Tab Group**.



Projections

- Compare the two map views side by side
- Note that the shape of the neighbourhoods layer is quite different between the two maps.
- This is due to two different **spatial reference systems** being used.

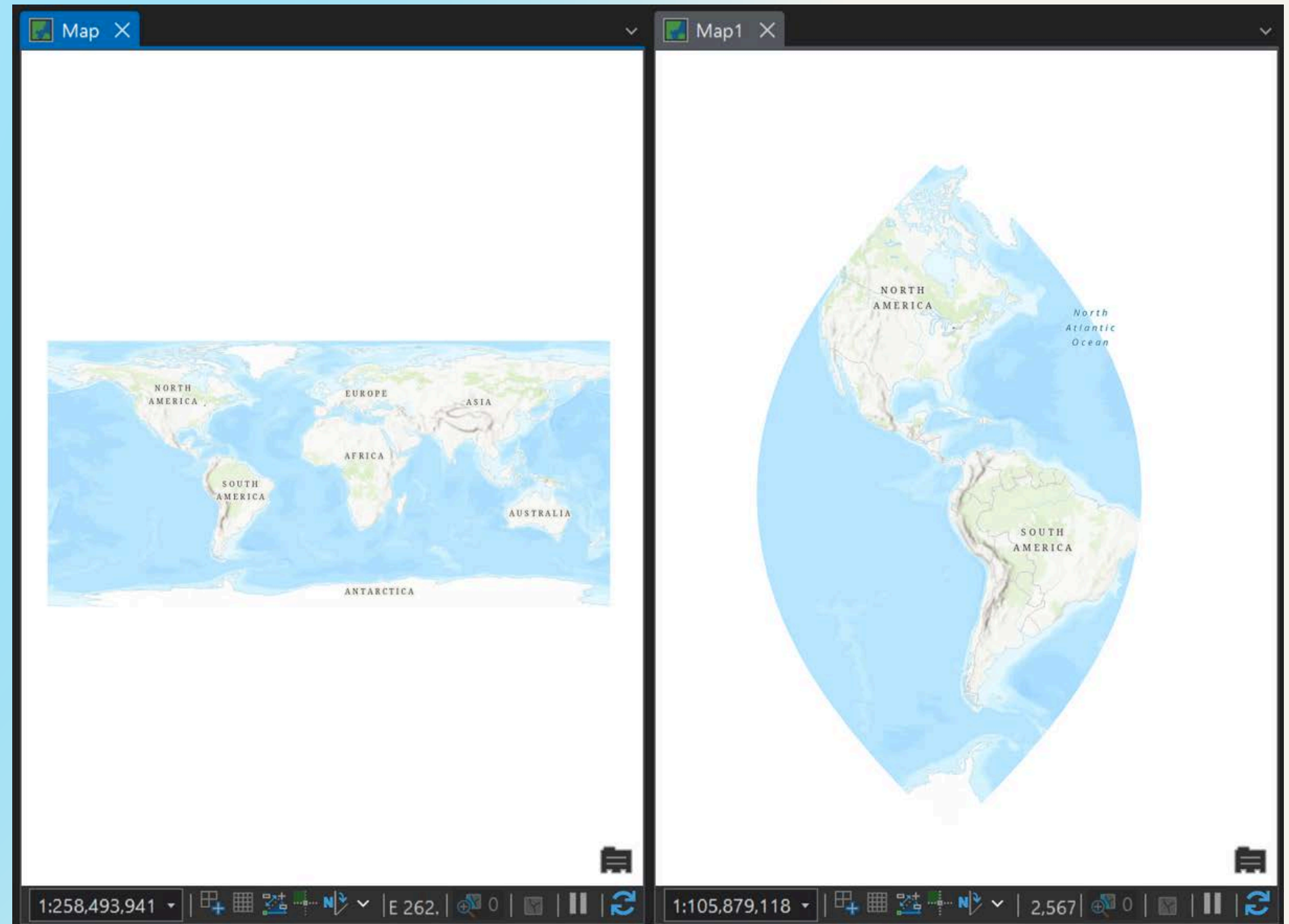


WGS84 Geographic
Coordinate System

Universal Transverse
Mercator (UTM) Zone
17N Projection

Projections

- **Zoom out** to view the entire world on each map view.



**WGS84 Geographic
Coordinate System**

**Universal Transverse
Mercator (UTM) Zone
17N Projection**

World Geodetic System 1984 (WGS84)

- **Scope:** Worldwide
- **Units:** Degrees (latitude and longitude)

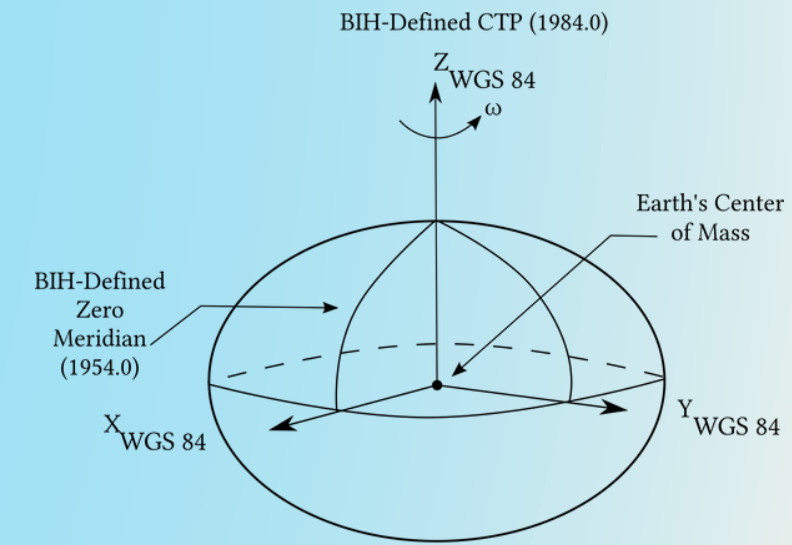
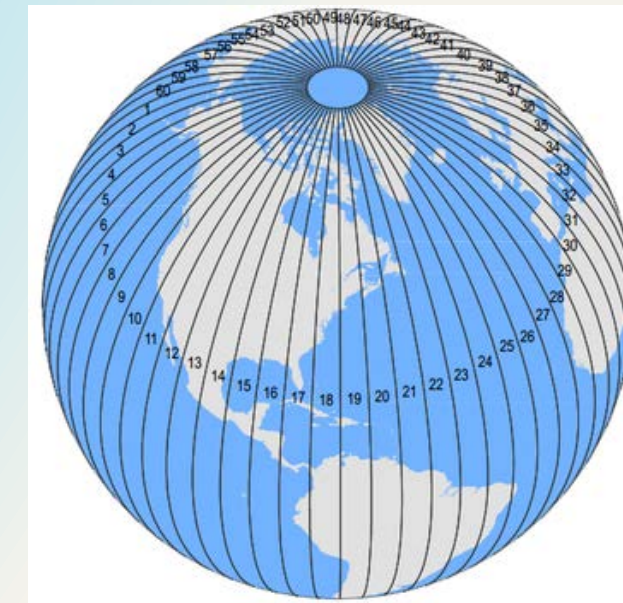


Figure 1.1 WGS 84 Reference Frame

NAD83 CSRS UTM Zone 17

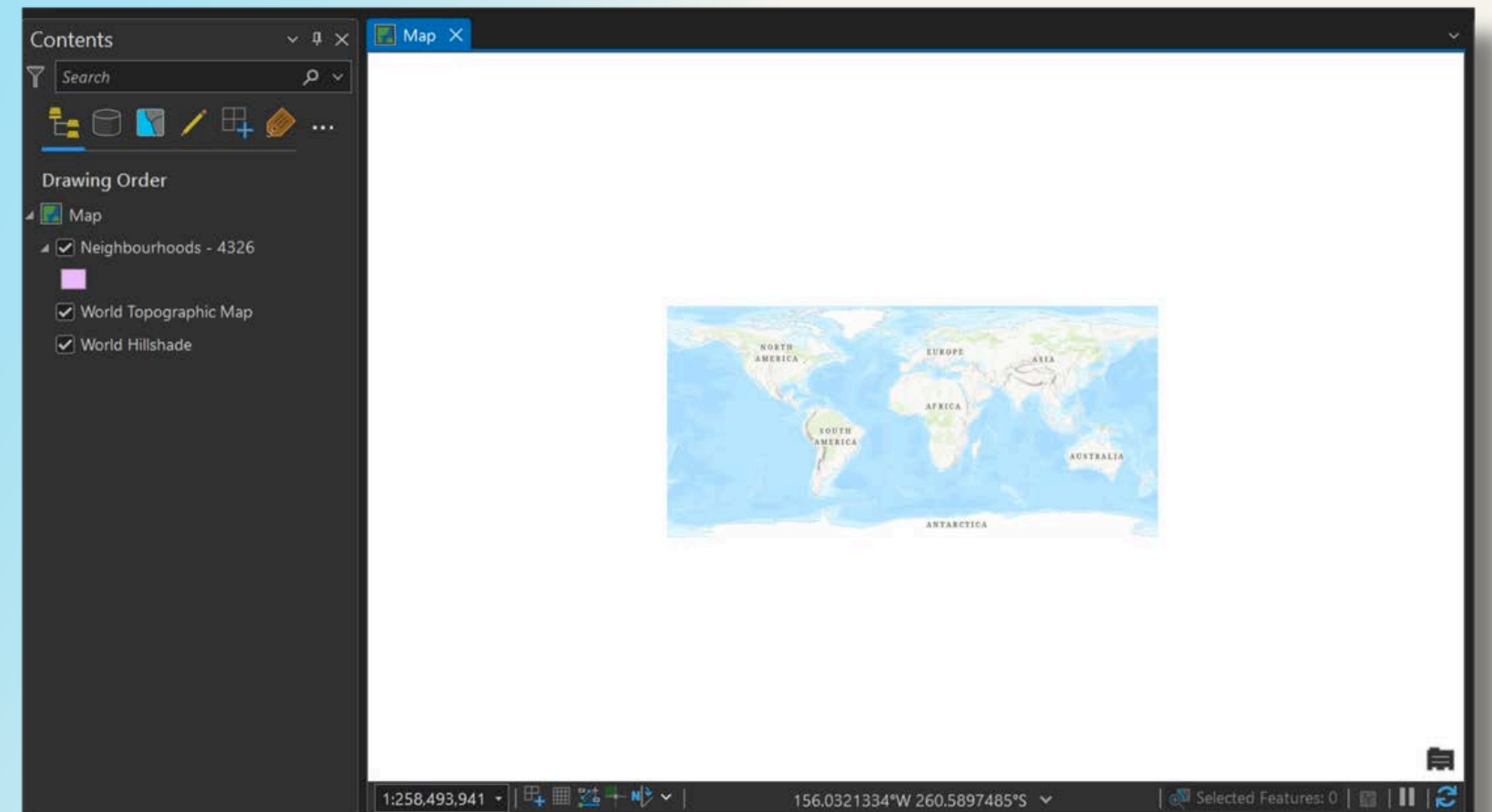
- **Scope:** Centered on -81 degrees longitude
 - Allows Southern Ontario to be mapped quite accurately on a flat surface
- **Units:** Metres



More information: <https://gisgeography.com/map-projections/>

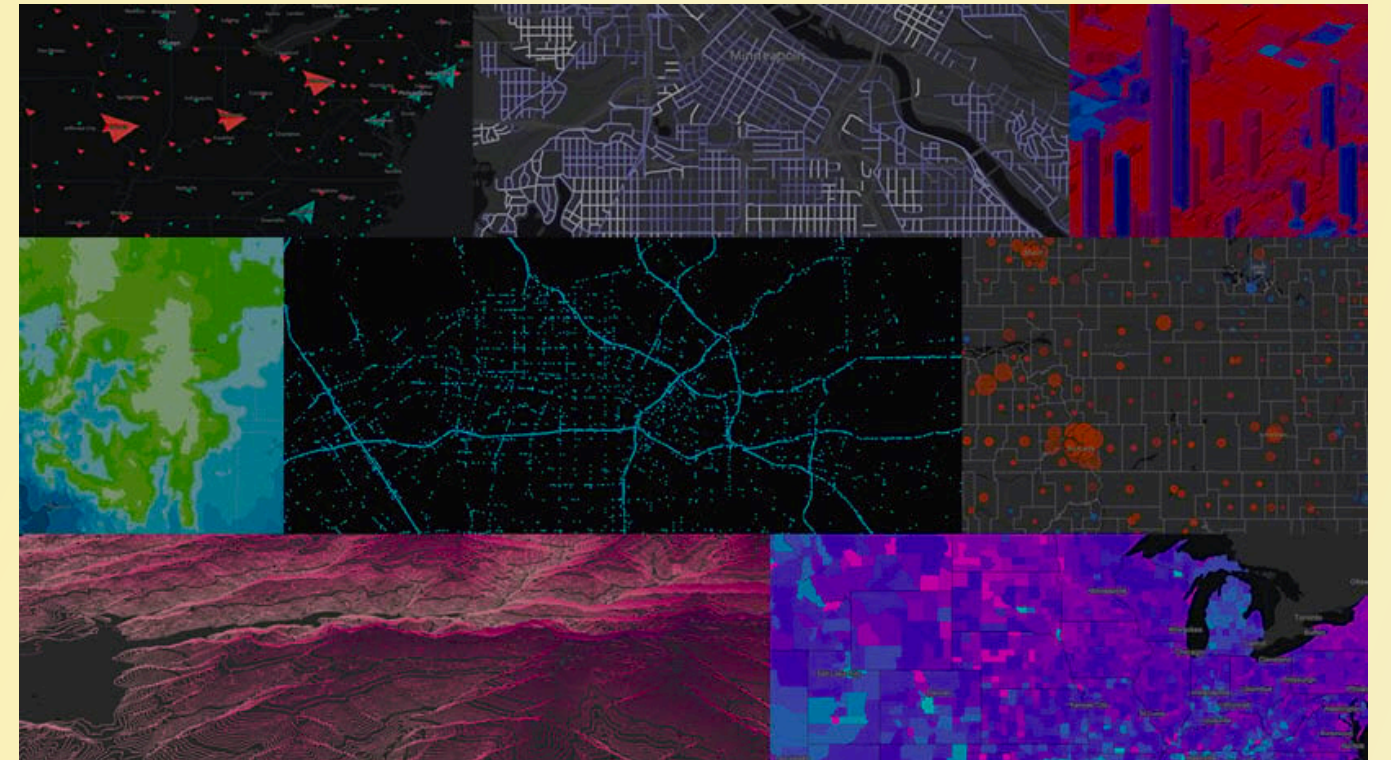
Projections

- To maintain spatial consistency and accuracy, as well as avoid potential data issues, it's best for all layers within a map to use the same spatial reference.
- Data can be **reprojected** using ArcGIS Pro's geoprocessing tools if necessary.
- **Close the Map1 tab.** We will continue working with the WGS84 map.



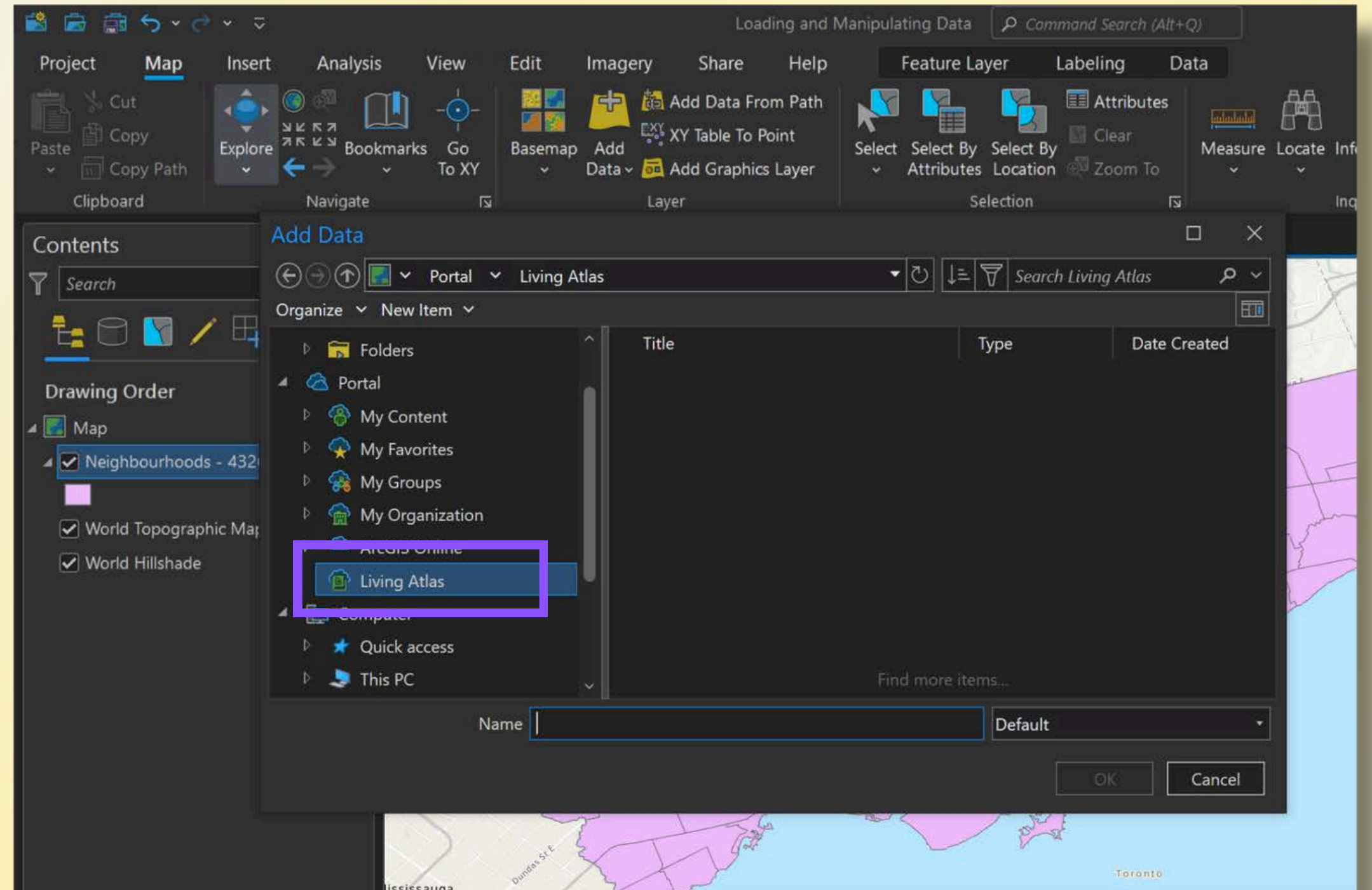
Add data from Living Atlas or ArcGIS Online

- **Living Atlas** is a curated selection of authoritative spatial datasets provided by Esri via the **ArcGIS Online** platform.
- Living Atlas content can be added to ArcGIS Pro maps as **Web Services** (more info about those later).

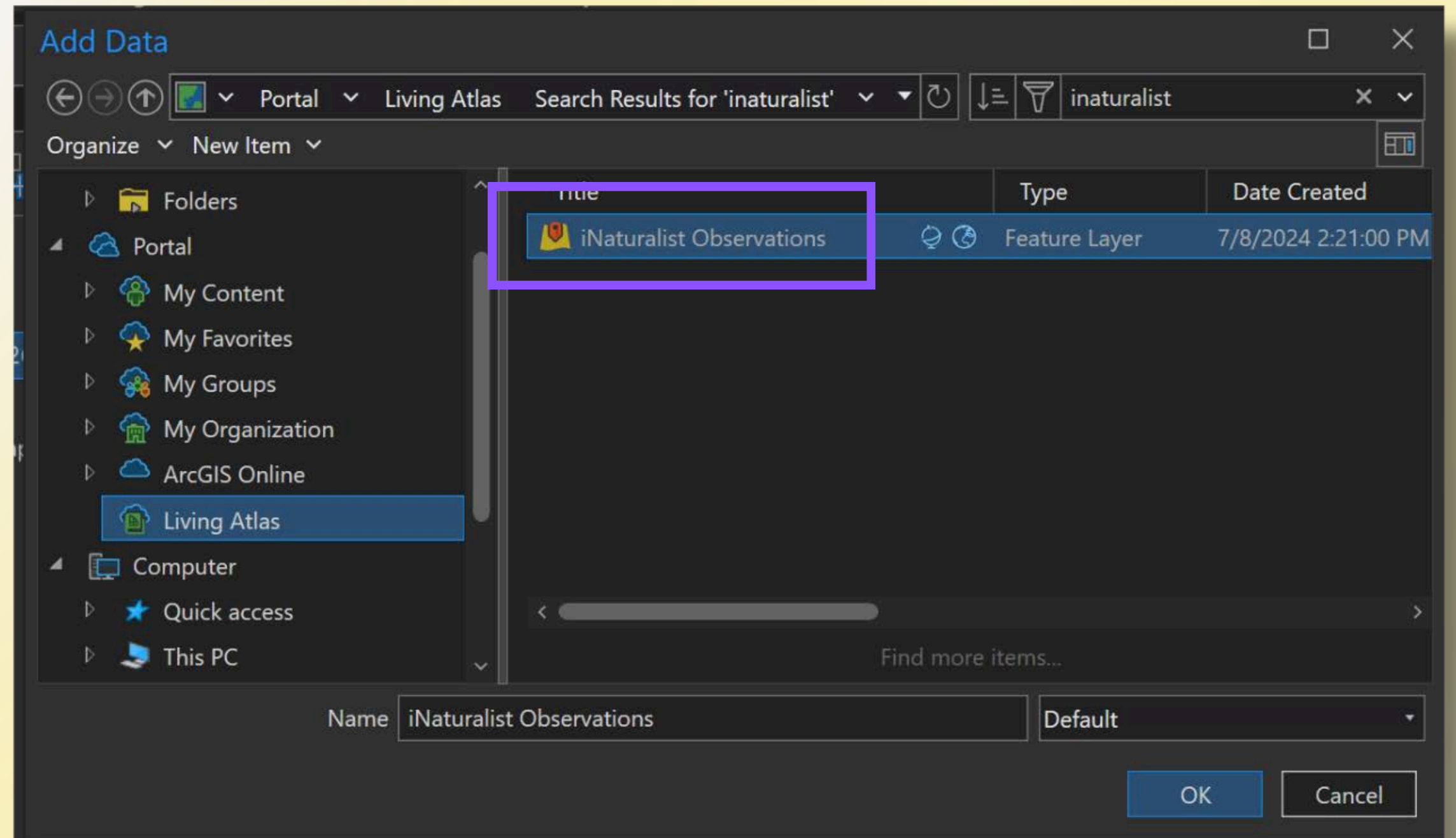


<https://livingatlas.arcgis.com/>

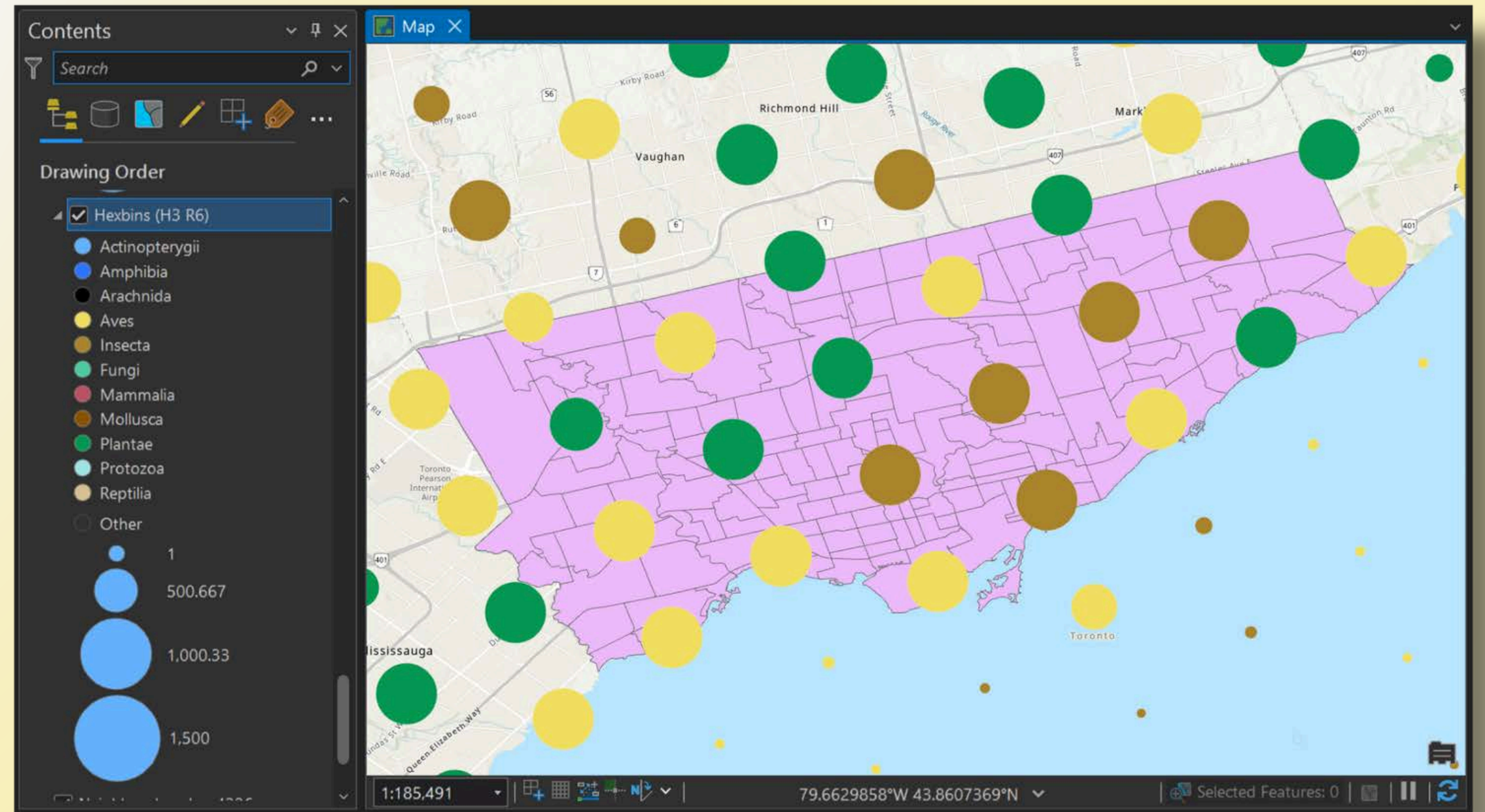
- Click the **Add Data Button**.
- Select the **Living Atlas** tab.



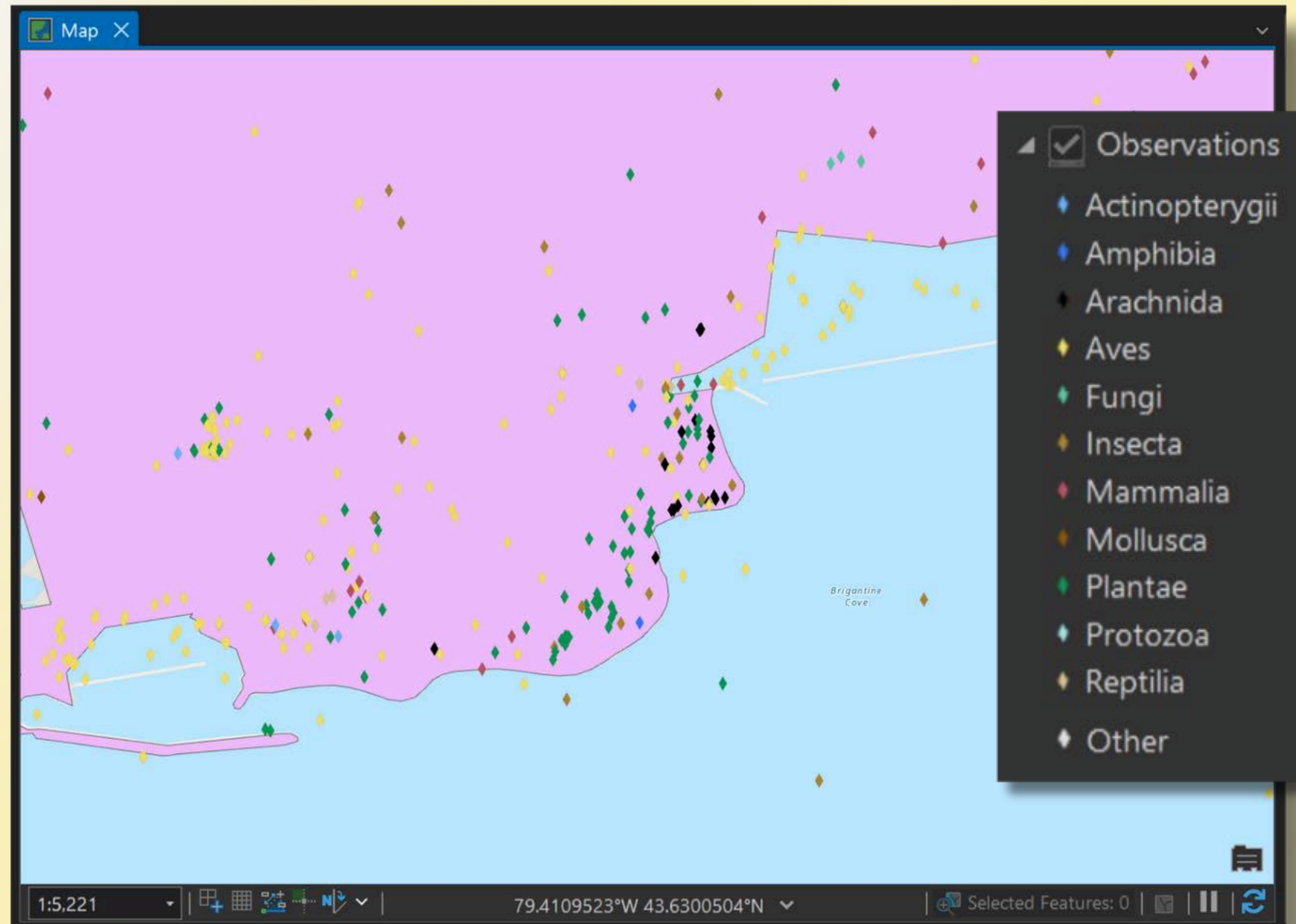
- Type **iNaturalist** in the search box and press Enter.
- Select the **iNaturalist Observations** Feature Layer and Click **OK**.



- This dataset contains crowdsourced wildlife observations.
- When zoomed out, the individual observations are **aggregated** into bins denoting the number of observations per area.

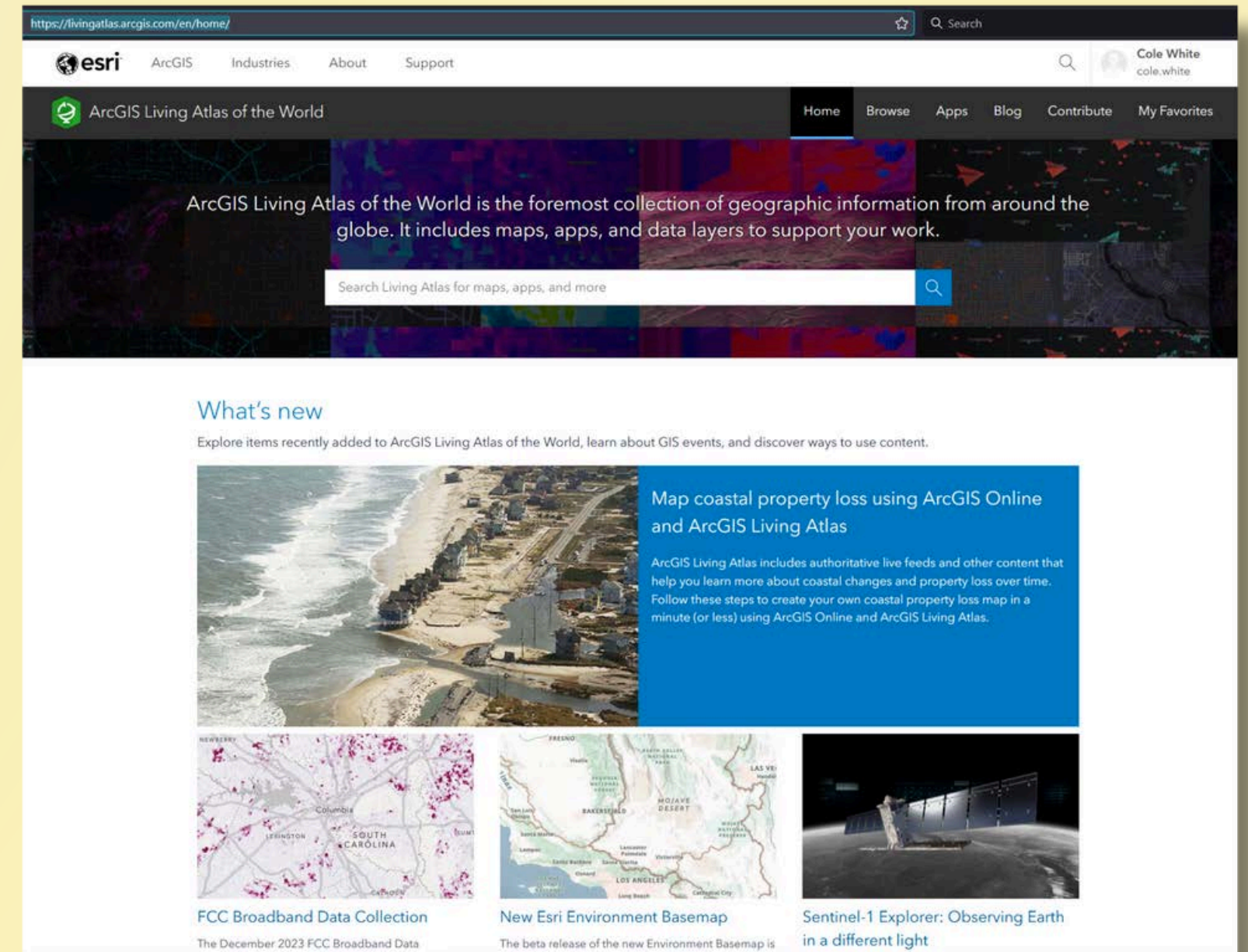


- Zoom in to display individual observation points.
- Note that the points have been symbolized by **category** (taxonomic class)

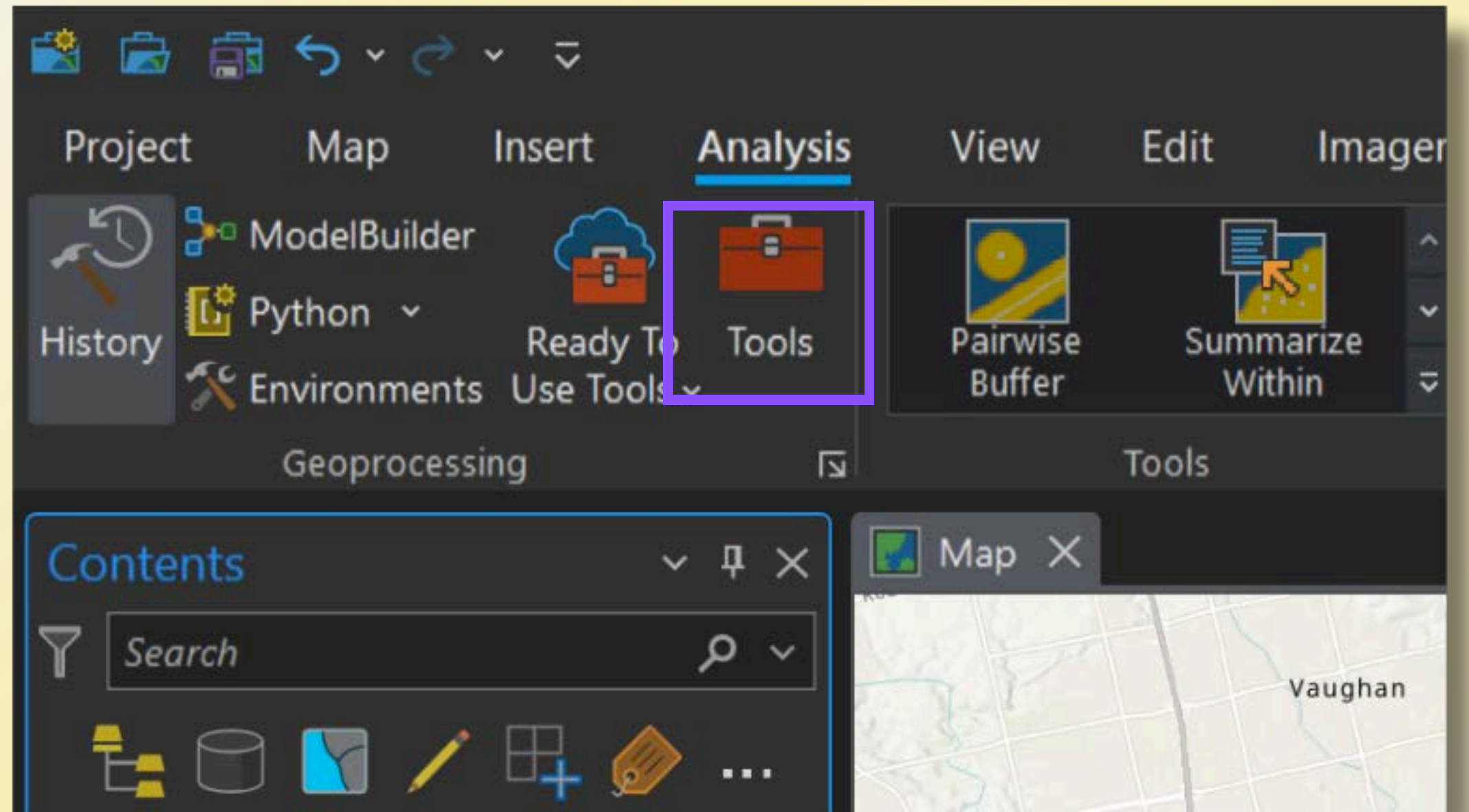


Visit the Living Atlas website to browse other available datasets:

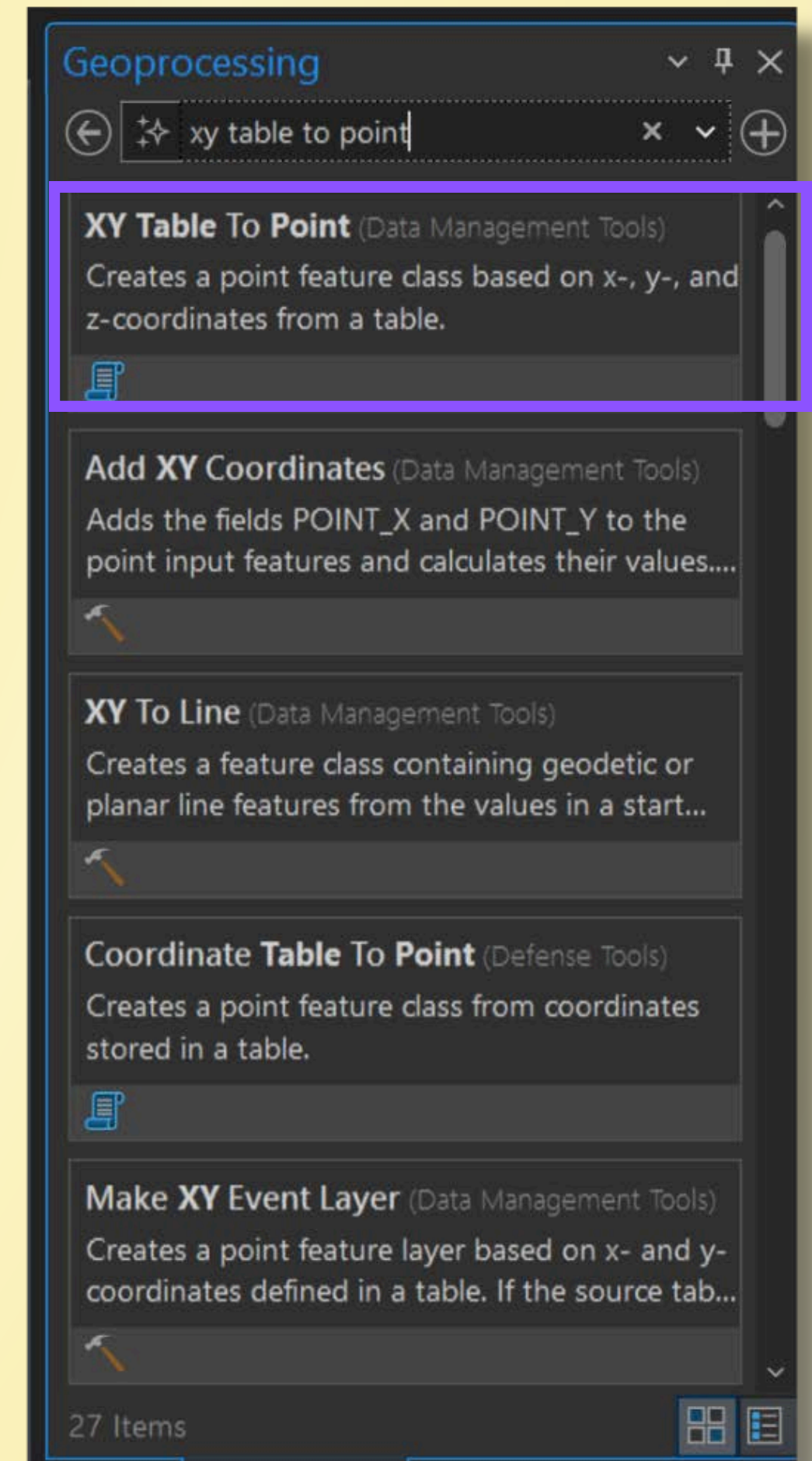
<https://livingatlas.arcgis.com/en/home/>



- From Pro's **Analysis** tab, click **Tools**.

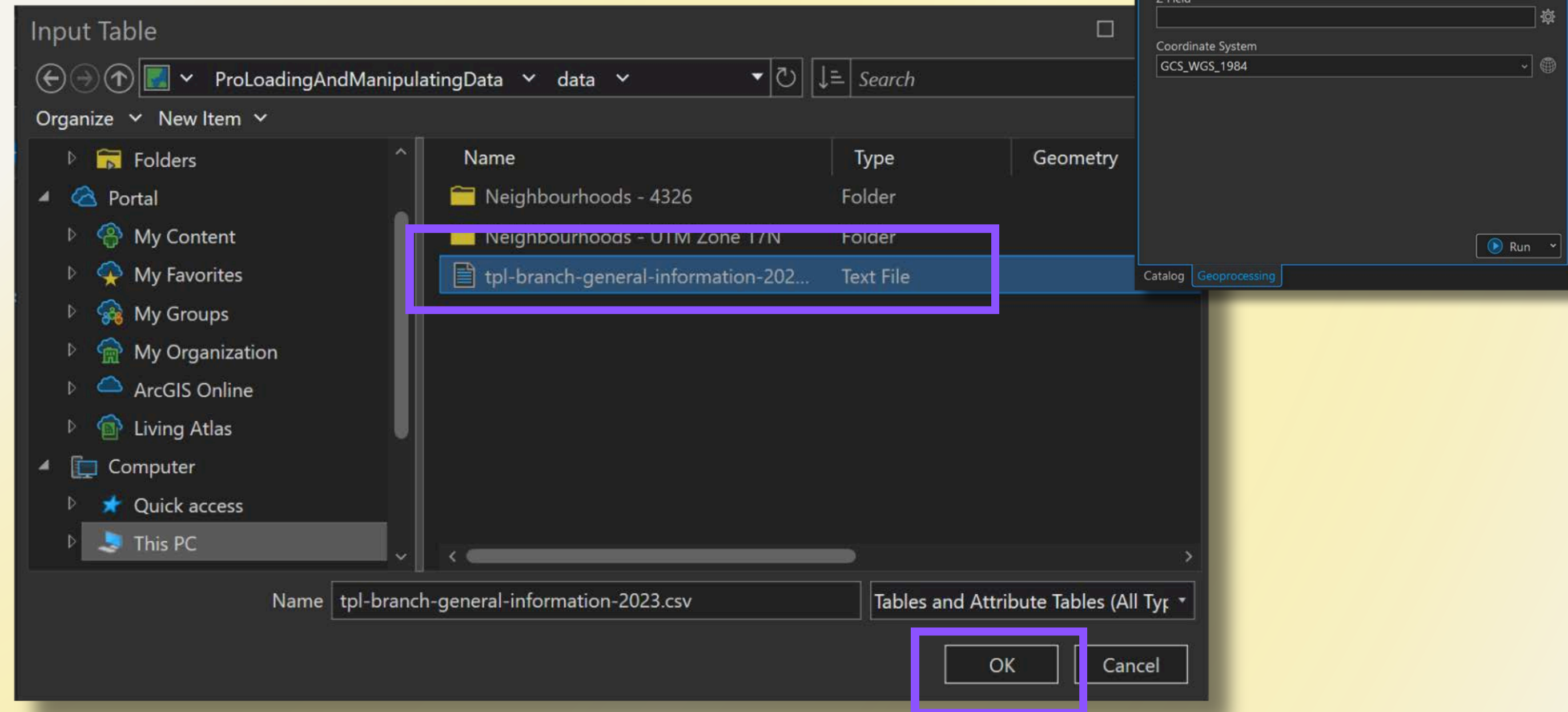


- The **Geoprocessing** pane will open.
- In the search bar, start typing '**xy table to point**'.
- Click the first search result to open the tool.

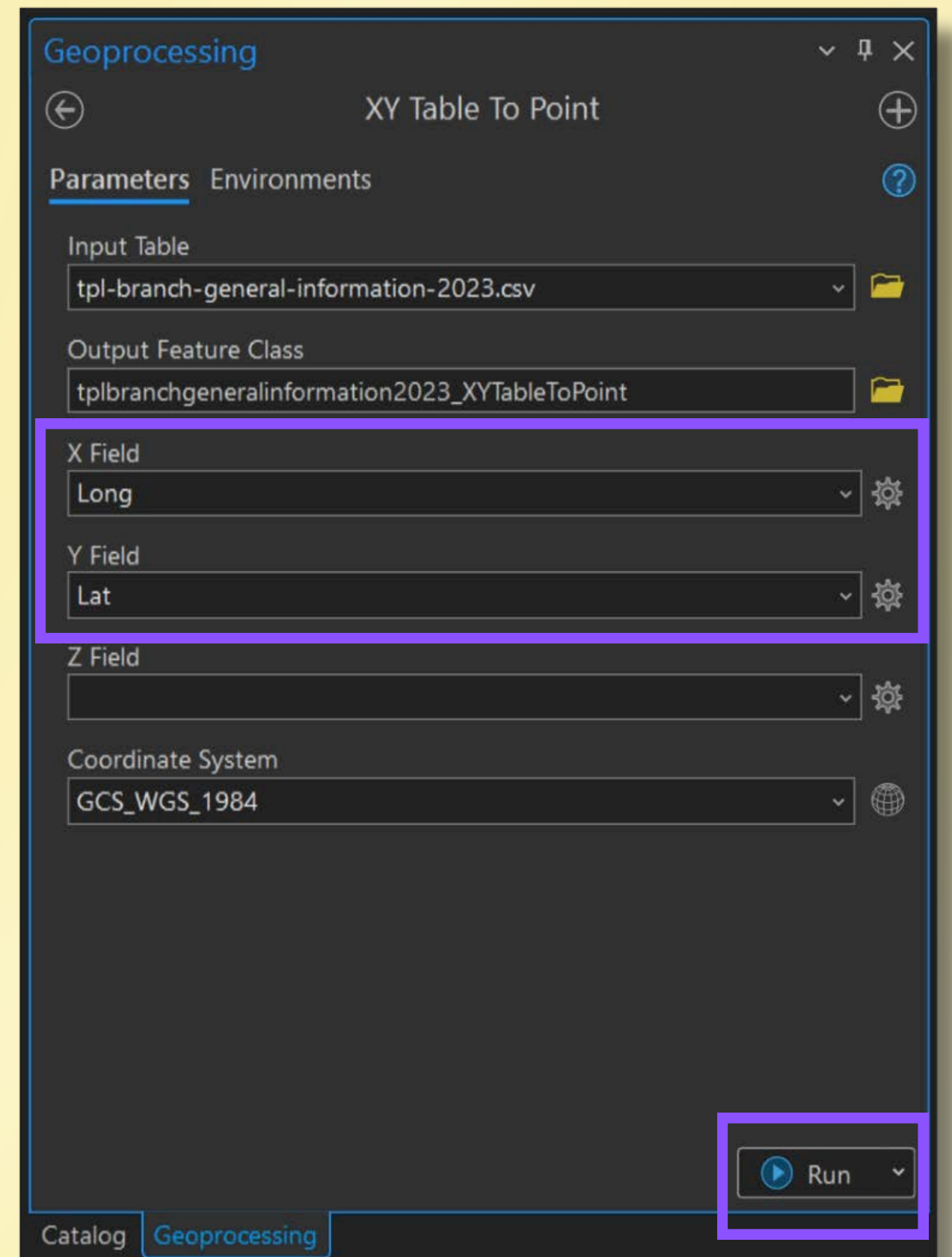


- Click the **folder icon** next to the **Input Table** input box.

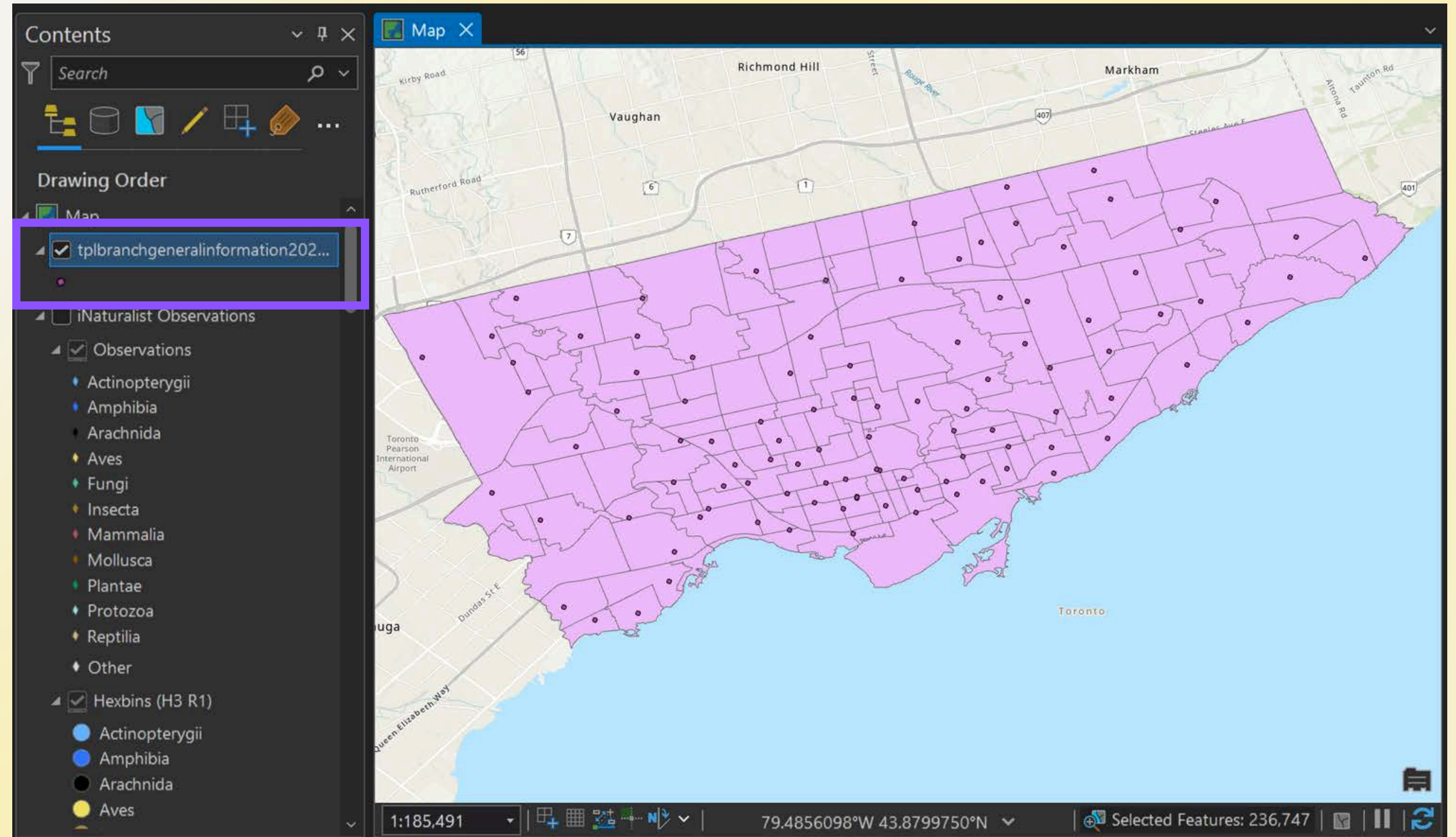
- Navigate to the CSV file. Select the file and click **OK**.



- Select **Long** from the **X Field** dropdown and **Lat** for the **Y Field** dropdown (if these don't automatically populate).
- Click **Run**.



- A new layer showing library locations has been added to the map.

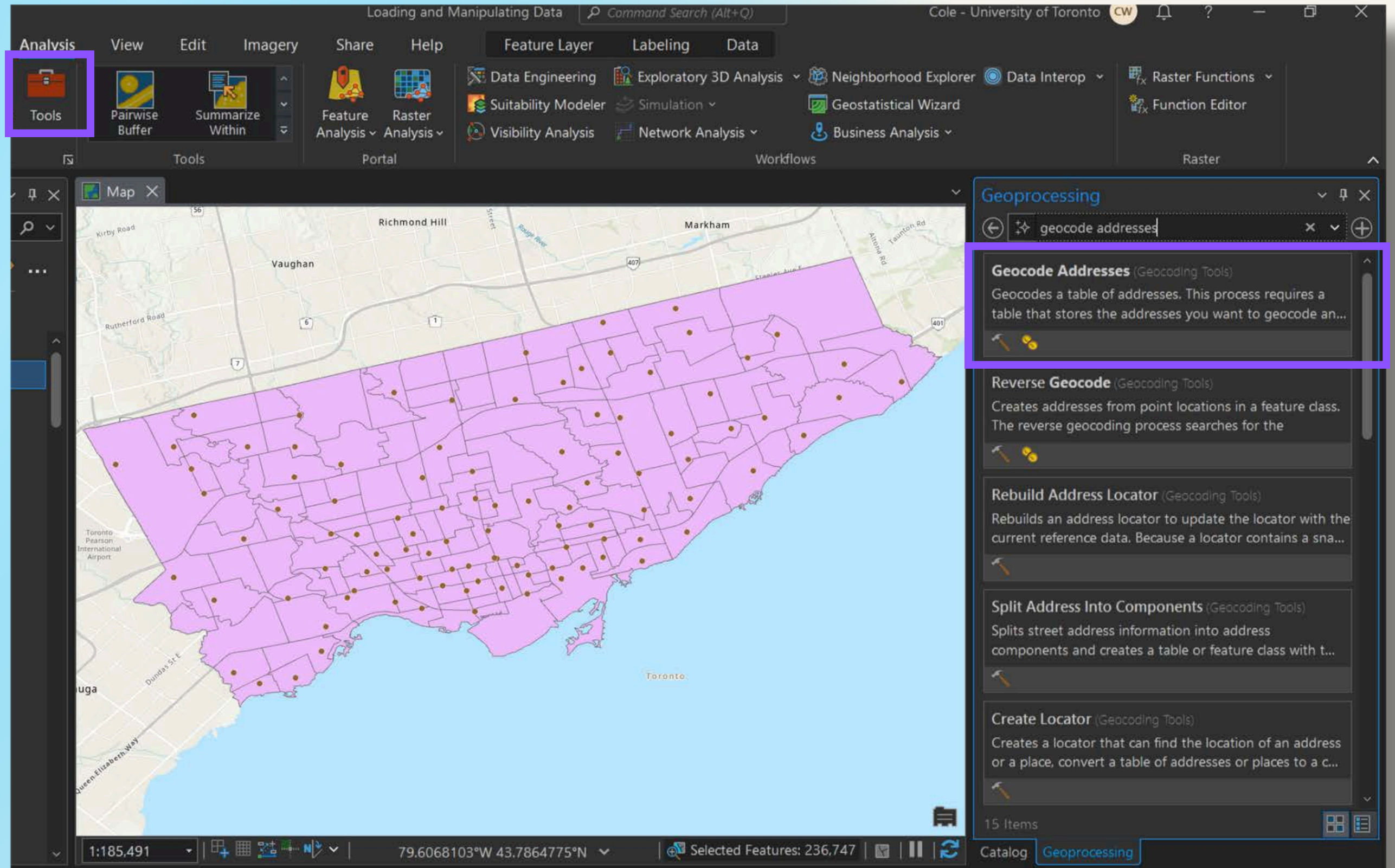


Add data from a spreadsheet: Geocoding

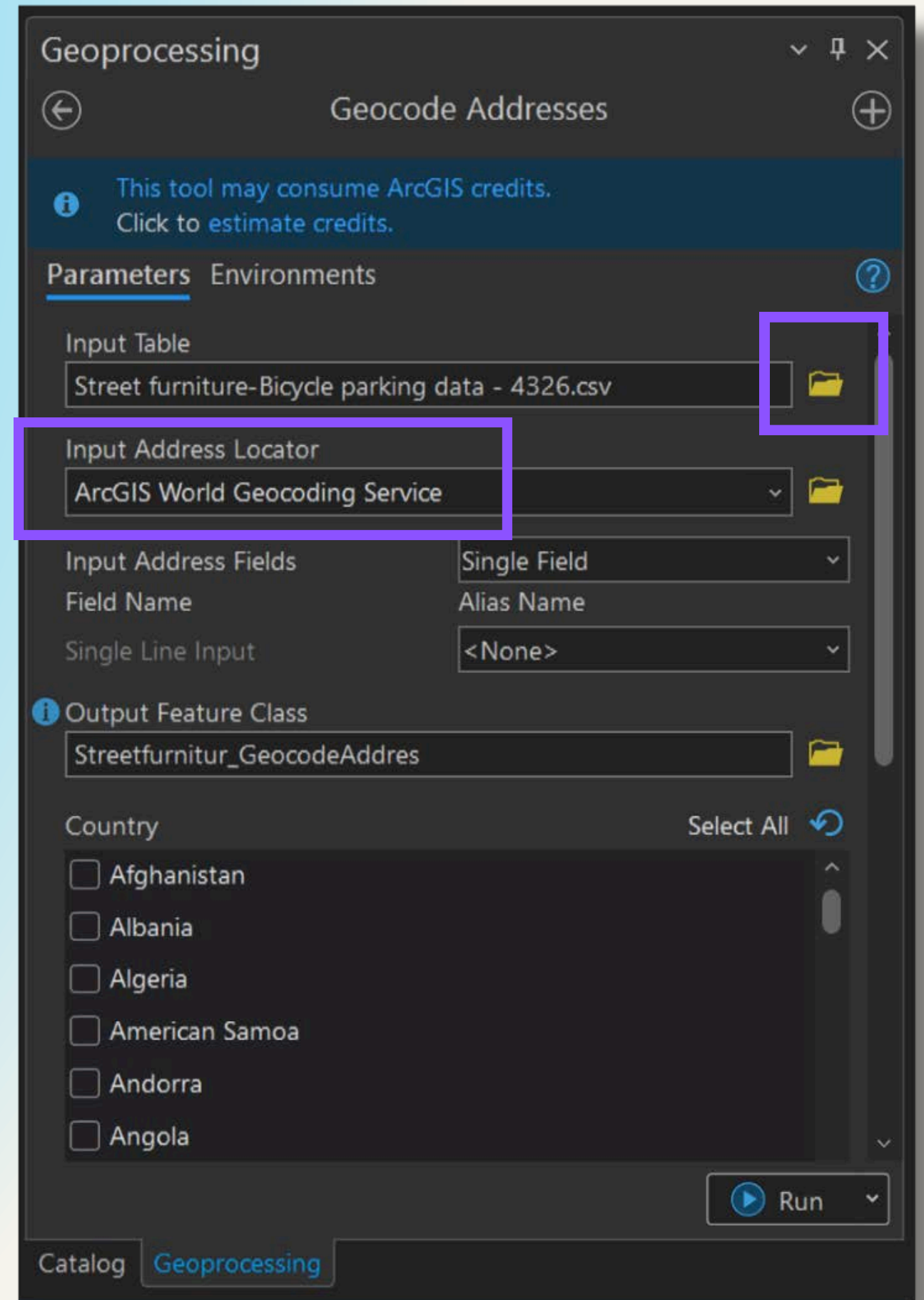
- Review the **Street furniture-Bicycle parking data - 4326.csv** file from the sample data in Excel.
- Note that this dataset contains no lat/long information; however, it **does** include **columns with street address** information.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	_id	OBJECTID	ID	ADDRESSN	ADDRESSST	FRONTING	SIDE	FROMSTRE	DIRECTION	SITEID	WARD	BIA	ASSETTYPE	STATUS	SDE_STATE_ID
2	1	5	BP-05830	4841-4881	Yonge St	None	None	Harlandale	None	None	18	Willowdale	Ring	Existing	
3	2	34	BP-03500	8	Kensington	None	None	Kensington	None	None	11	Kensington	Ring	Existing	
4	3	41	BP-11900	8	Assiniboine	None	None	Nelson Rd	None	None	7	None	Rack	Existing	
5	4	60	BP-15510	46	Wellesley S	None	None	Wellesley S	None	None	13	None	Ring	Temporarily Removed	
6	5	171	BP-15330	911	Davenport	None	None	Davenport	None	None	12	None	None	Existing	
7	6	175	BP-08910	20	Lombard S	None	None	Lombard S	None	None	13	Old Town T	None	Existing	
8	7	202	BP-14800	359	King St E	None	None	Derby St	None	None	13	Old Town T	Ring	Existing	
9	8	249	BP-13380	145	Queens Qu	None	None	York St	None	None	10	The Waterf	None	Existing	
10	9	251	BP-12070	1960	Queen St E	None	None	Kenilworth	None	None	19	The Beach	Ring	Existing	
11	10	276	BP-15960	87	Avenue Rd	Avenue Rd	East	Elgin Ave	North	None	11	None	Ring	Existing	
12	11	299	BP-05200	522	University	None	None	Elm St	None	None	11	None	Ring	Existing	
13	12	341	BP-03930	50	Blue Jays W	None	None	Mercer St	None	None	10	Toronto Dc	Ring	Temporarily Removed	
14	13	356	BP-05920	1313	Bloor St W	None	None	St Helens A	None	None	9	Bloordale V	Ring	Temporarily Removed	
15	14	417	BP-08040	145	Queens Qu	None	None	York St	None	None	10	The Waterf	None	Existing	
16	15	418	BP-07760	162	Mc Caul St	None	None	Mc Caul St	None	None	11	None	Ring	Existing	

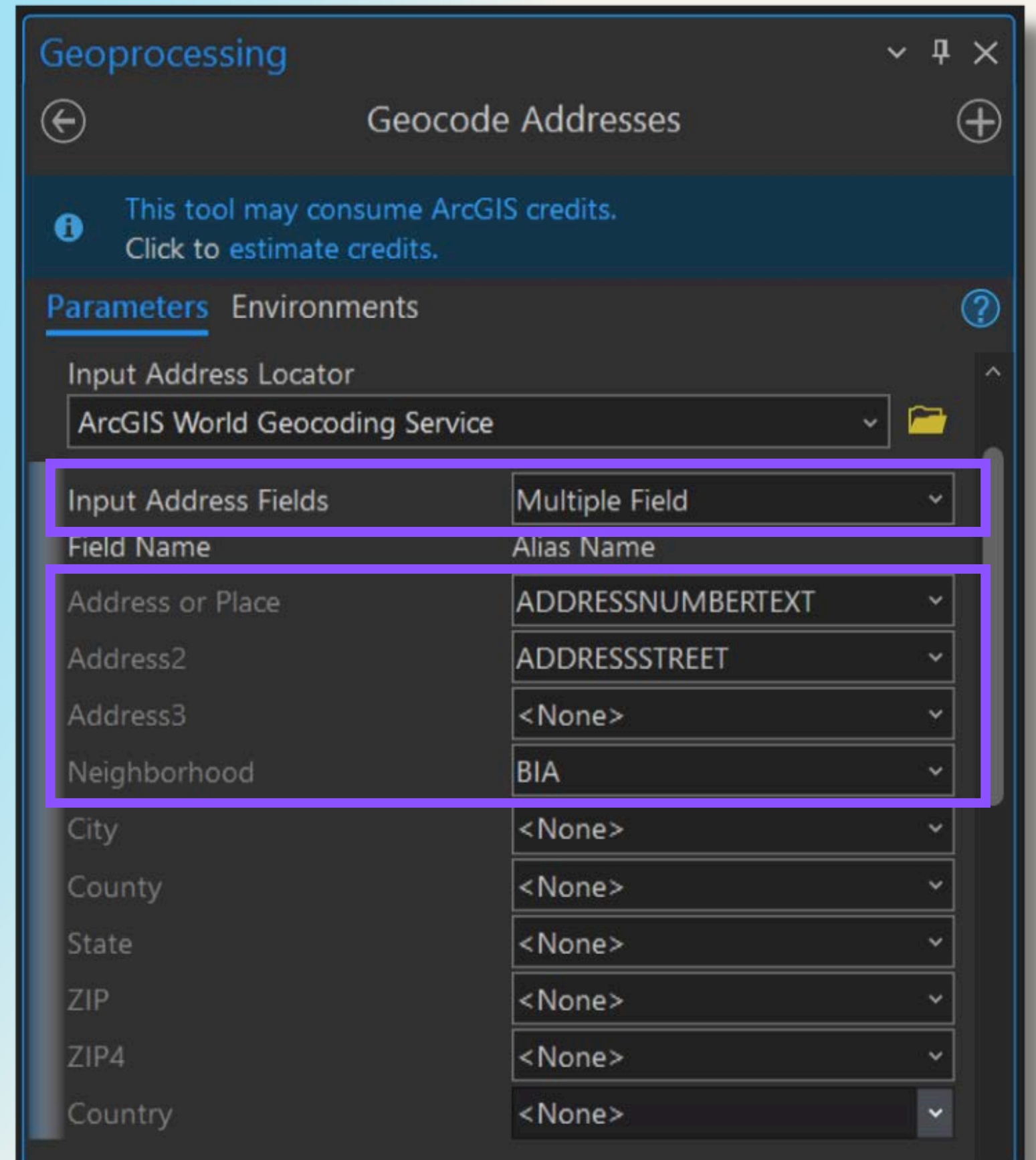
- Open the **Geoprocessing** pane by clicking the **Tools** button (**Analysis** tab)
- Search for and open the **Geocode Addresses** tool



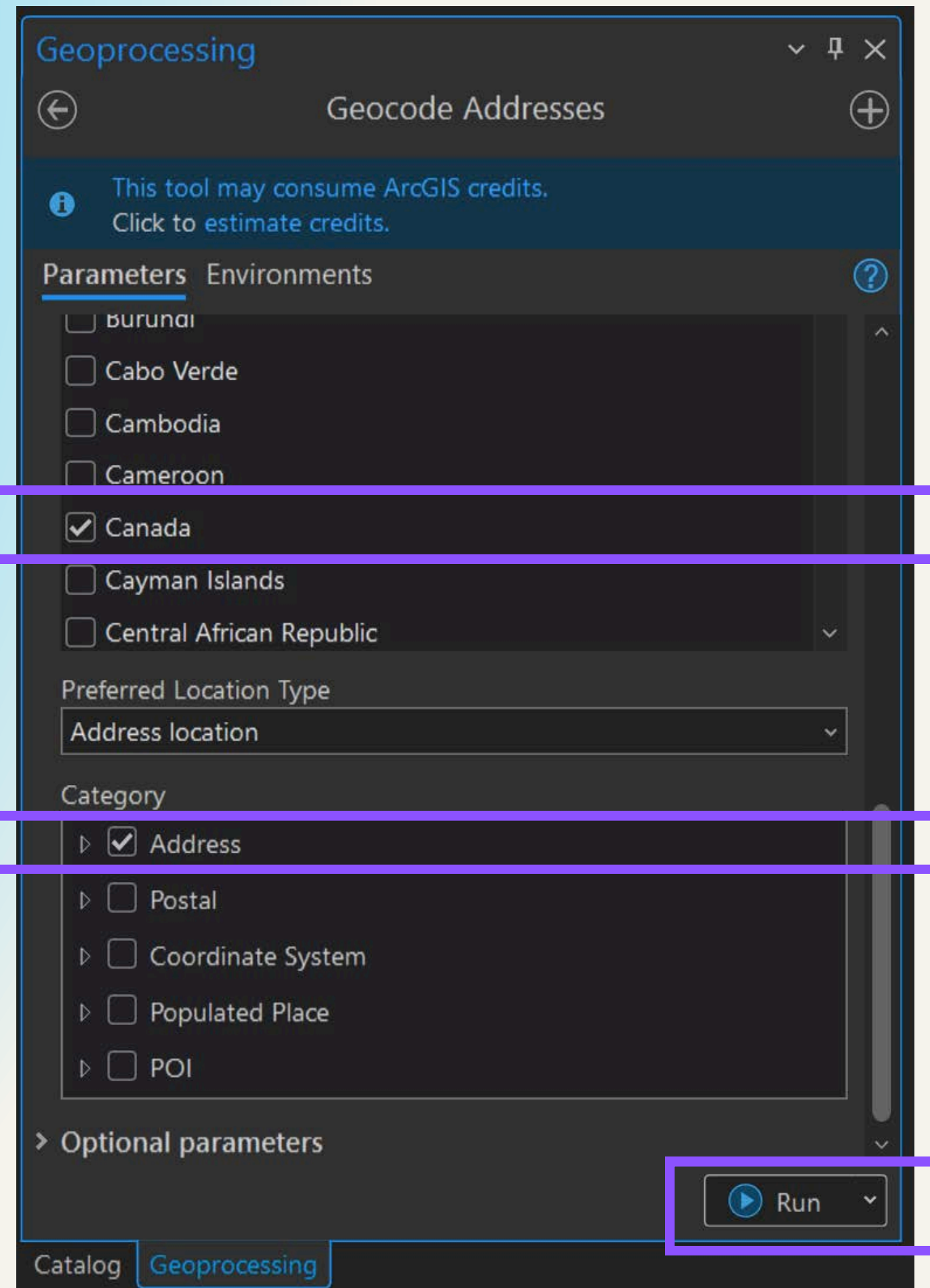
- Provide the **Input Table** parameter by clicking the **folder icon** and navigating to the bicycle parking csv file.
- For the **Input Address Locator** parameter, select **ArcGIS World Geocoding Service** from the dropdown.



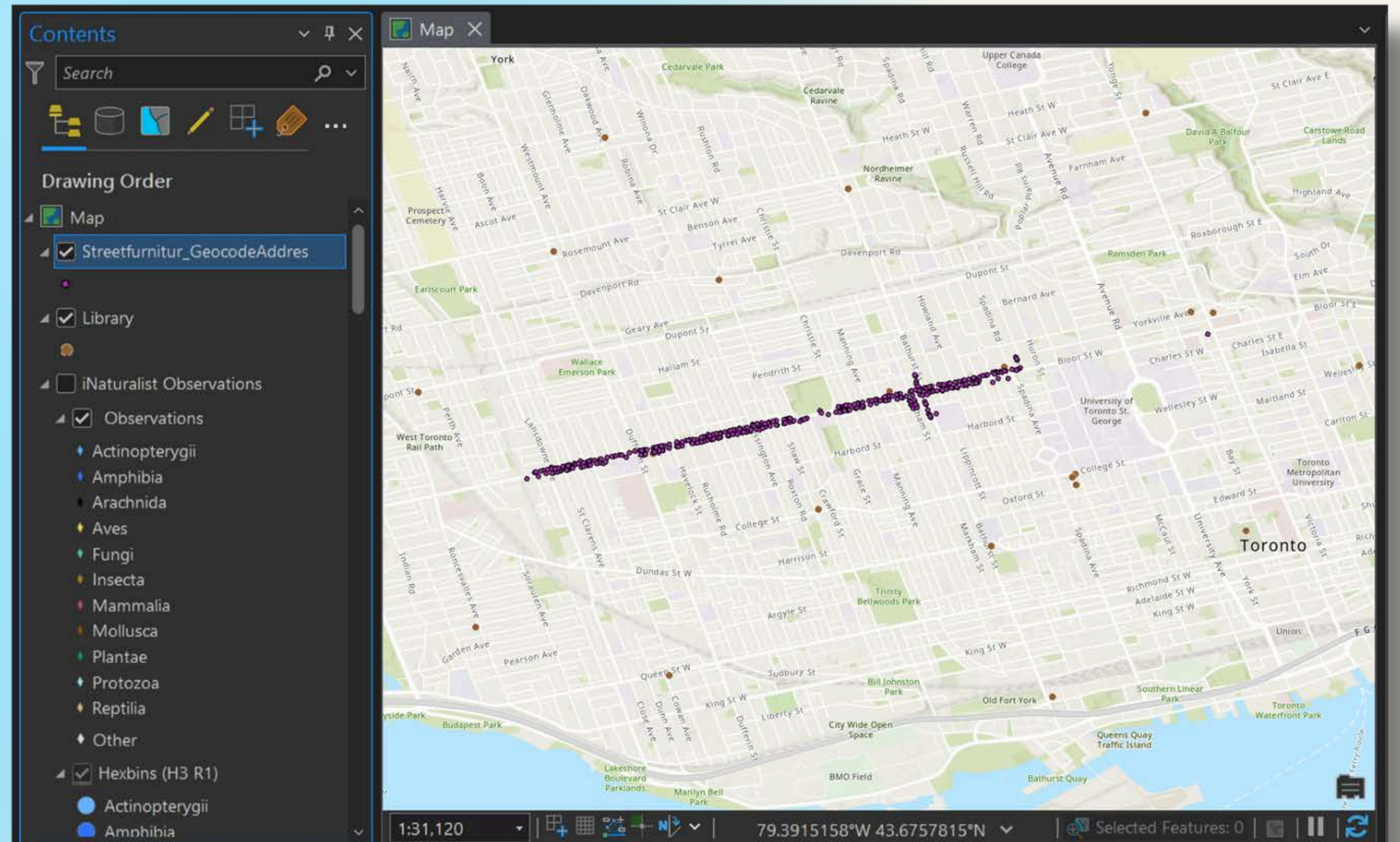
- Select **Multiple Field** for the **Input Address Fields** parameter.
- Referring to the names of the spreadsheet columns, provide values for the **Address or Place**, **Address2**, and **Neighborhood** parameters.



- Check **Canada** for the **Country**.
- Leave the **Preferred Location Type** as **Address location**.
- Select **Address** for the **Category**.
- Click **Run**.

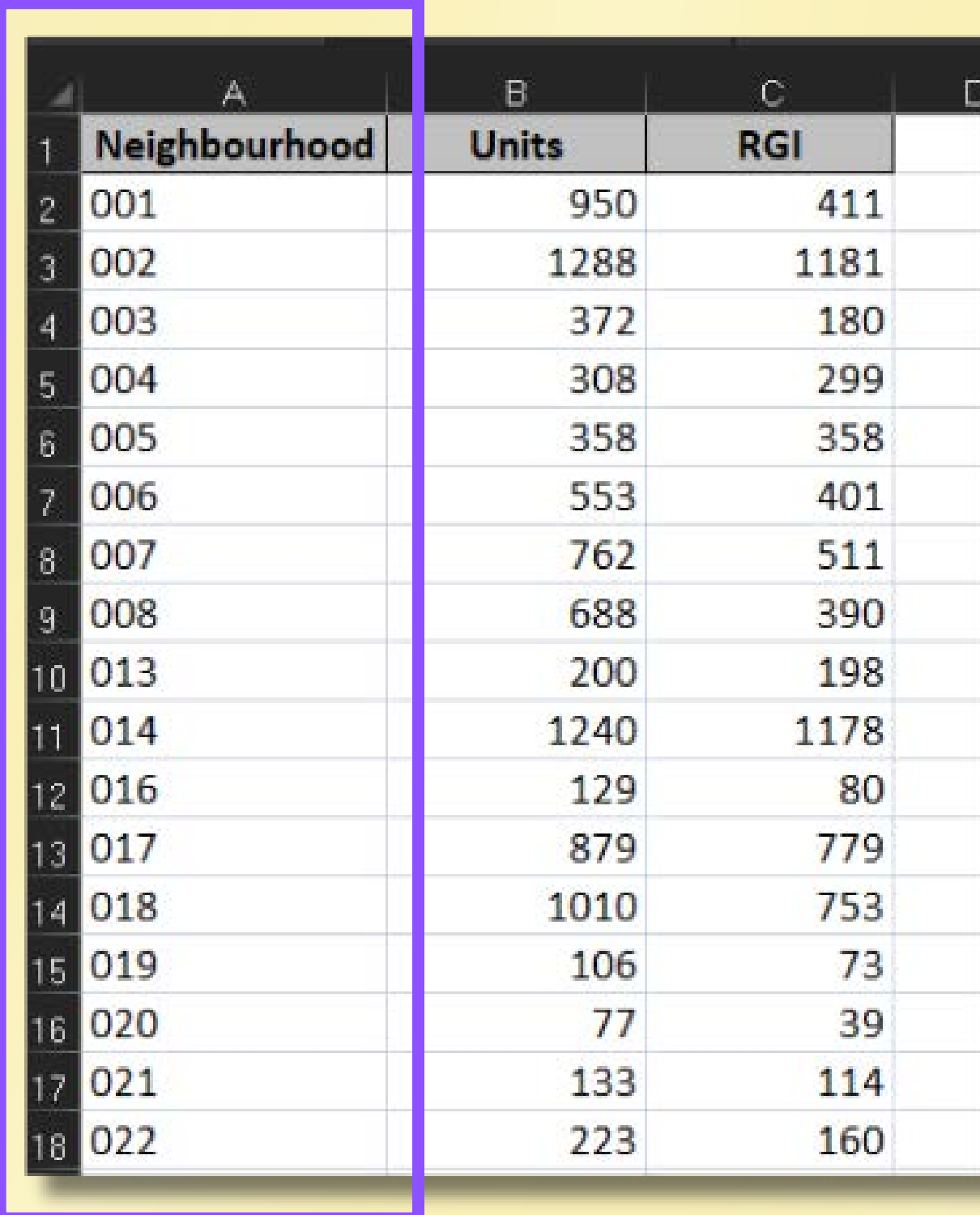


- Result: the software will attempt to look up locations for each address provided.



Add data from a spreadsheet: Attribute Join

- Review the **socialhousing.csv** file in the sample data folder.
- This dataset details social housing unit density exist **per Toronto neighbourhood**. Neighbourhoods are identified by a **unique ID number**.
- It also lists how many of these units are geared-to-income (RGI).

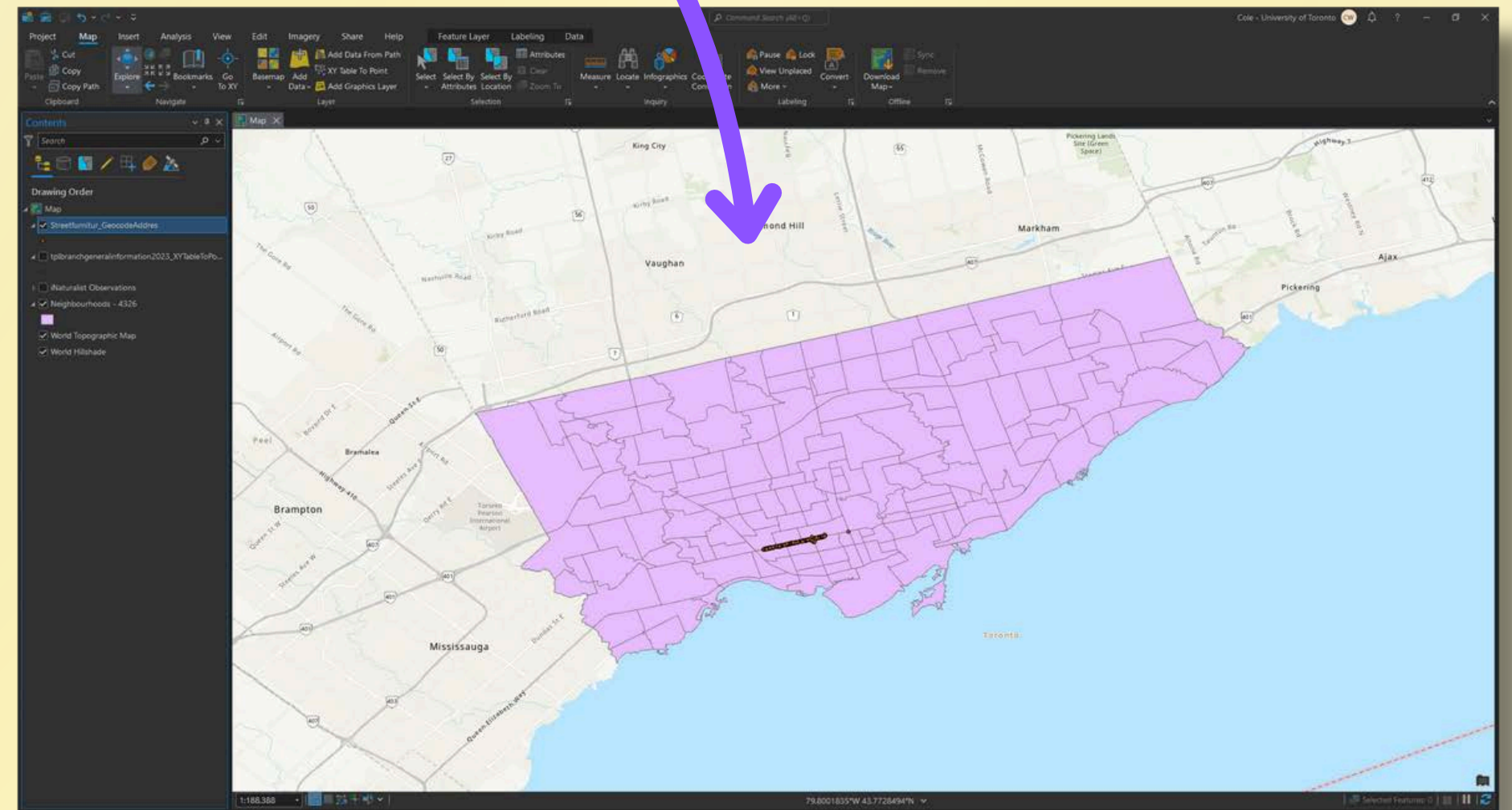
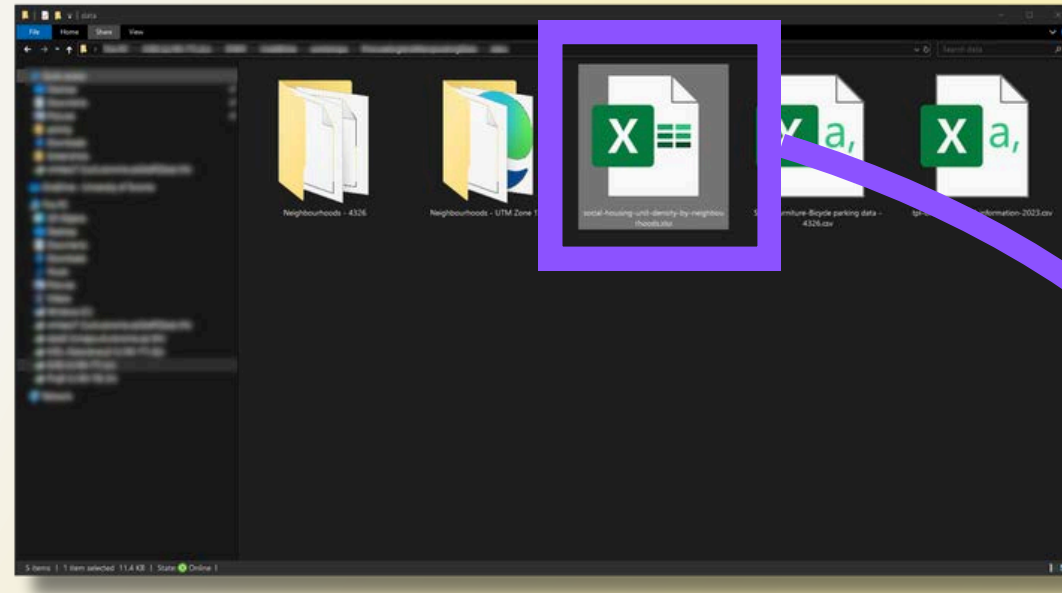


A screenshot of a spreadsheet with four columns: A (Neighbourhood), B (Units), C (RGI), and D (empty). The rows are numbered 1 to 18. A blue border highlights the first 18 rows of the spreadsheet.

	A	B	C	D
1	Neighbourhood	Units	RGI	
2	001	950	411	
3	002	1288	1181	
4	003	372	180	
5	004	308	299	
6	005	358	358	
7	006	553	401	
8	007	762	511	
9	008	688	390	
10	013	200	198	
11	014	1240	1178	
12	016	129	80	
13	017	879	779	
14	018	1010	753	
15	019	106	73	
16	020	77	39	
17	021	133	114	
18	022	223	160	

Add data from a spreadsheet: Attribute Join

- Add the **socialhousing.csv** file to the map.
- Use the **Add Data** button, or simply **drag and drop** the file from Windows Explorer into the map view.



Add data from a spreadsheet: Attribute Join

- Recall that the Neighbourhoods layer also contains an ID for each neighbourhood in its attribute table.
- We can **join** the housing data to the neighbourhood polygons by matching these IDs.

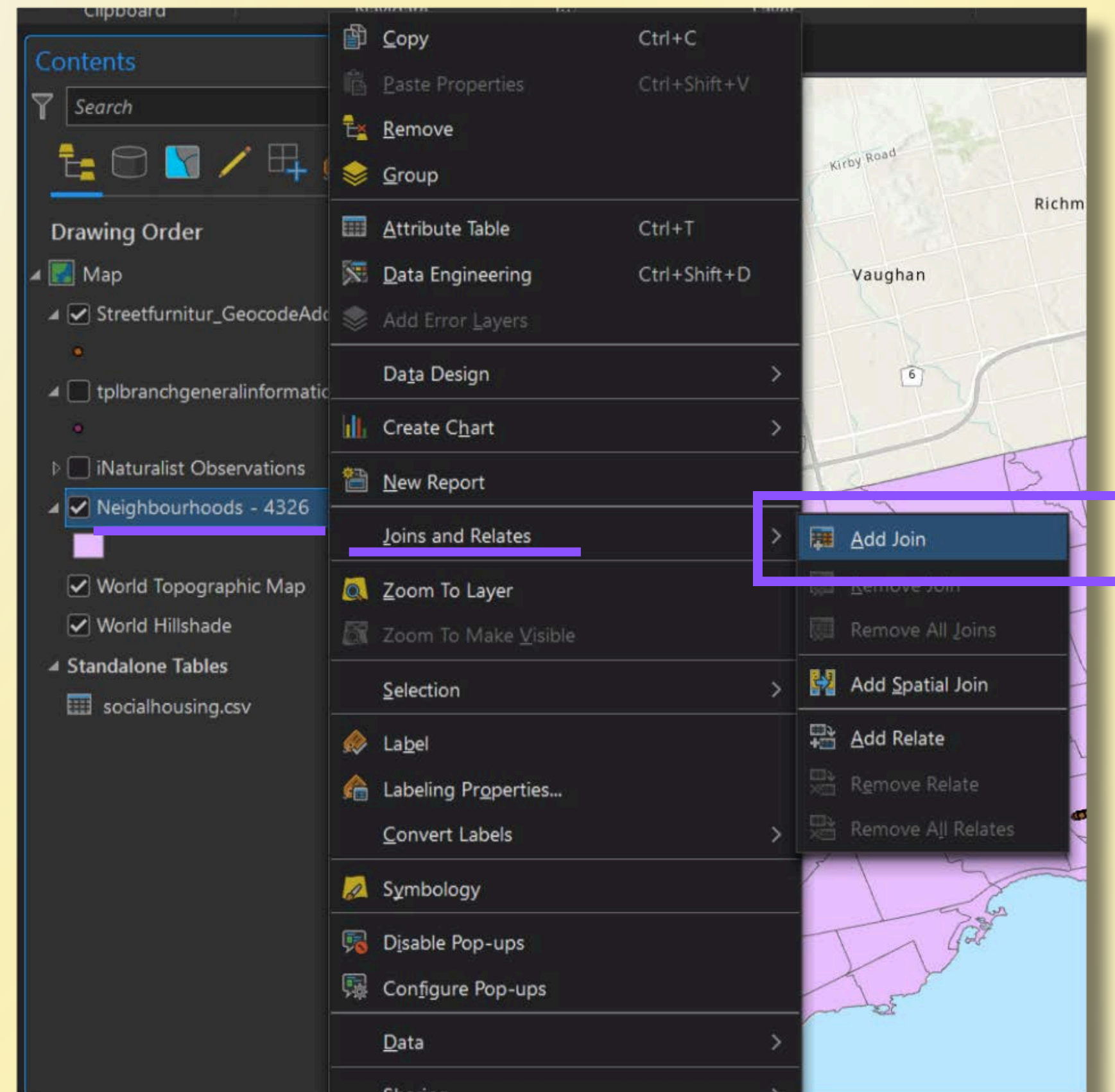
The image shows two attribute tables in QGIS. The left table, 'socialhousing.csv', has columns: Neighbourhood, Units, and RGI. The right table, 'Neighbourhoods - 4326', has columns: FID, Shape, _id1, AREA_ID2, AREA_AT3, PARENT_4, AREA_SH5, AREA_LO6, and AREA_NA7. Purple boxes highlight the 'Neighbourhood' column in the first table and the '_id1' column in the second table, indicating they are the fields used for the attribute join.

Neighbourhood	Units	RGI
1	950	411
2	1288	1181
3	372	180
4	308	299
5	358	358
6	553	401
7	762	511
8	688	390
9	200	198
10	1240	1178
11	129	80

FID	Shape	_id1	AREA_ID2	AREA_AT3	PARENT_4	AREA_SH5	AREA_LO6	AREA_NA7
1	Polygon	1	2502366	26022881	0	174	174	South Eglinton-Davisville
2	Polygon	2	2502365	26022880	0	173	173	North Toronto
3	Polygon	3	2502364	26022879	0	172	172	Dovercourt Village
4	Polygon	4	2502363	26022878	0	171	171	Junction-Wallace Emer...
5	Polygon	5	2502362	26022877	0	170	170	Yonge-Bay Corridor
6	Polygon	6	2502361	26022876	0	169	169	Bay-Cloverhill
7	Polygon	7	2502360	26022875	0	156	156	Bendale-Glen Andrew
8	Polygon	8	2502359	26022874	0	155	155	Downsview
9	Polygon	9	2502358	26022873	0	154	154	Oakdale-Beverley Heig...
10	Polygon	10	2502357	26022872	0	153	153	Avondale
11	Polygon	11	2502356	26022871	0	152	152	East Willowdale

Add data from a spreadsheet: Attribute Join

- Right-click the **Neighbourhoods** layer in the Contents pane.
- Choose **Joins and Relates -> Add Join**



Add data from a spreadsheet: Attribute Join

Specify the following:

- Input Table: **Neighbourhoods - 4326**
- Input Field: **_id1**
- Join Table: **socialhousing.csv**
- Join Field: **Neighbourhood**

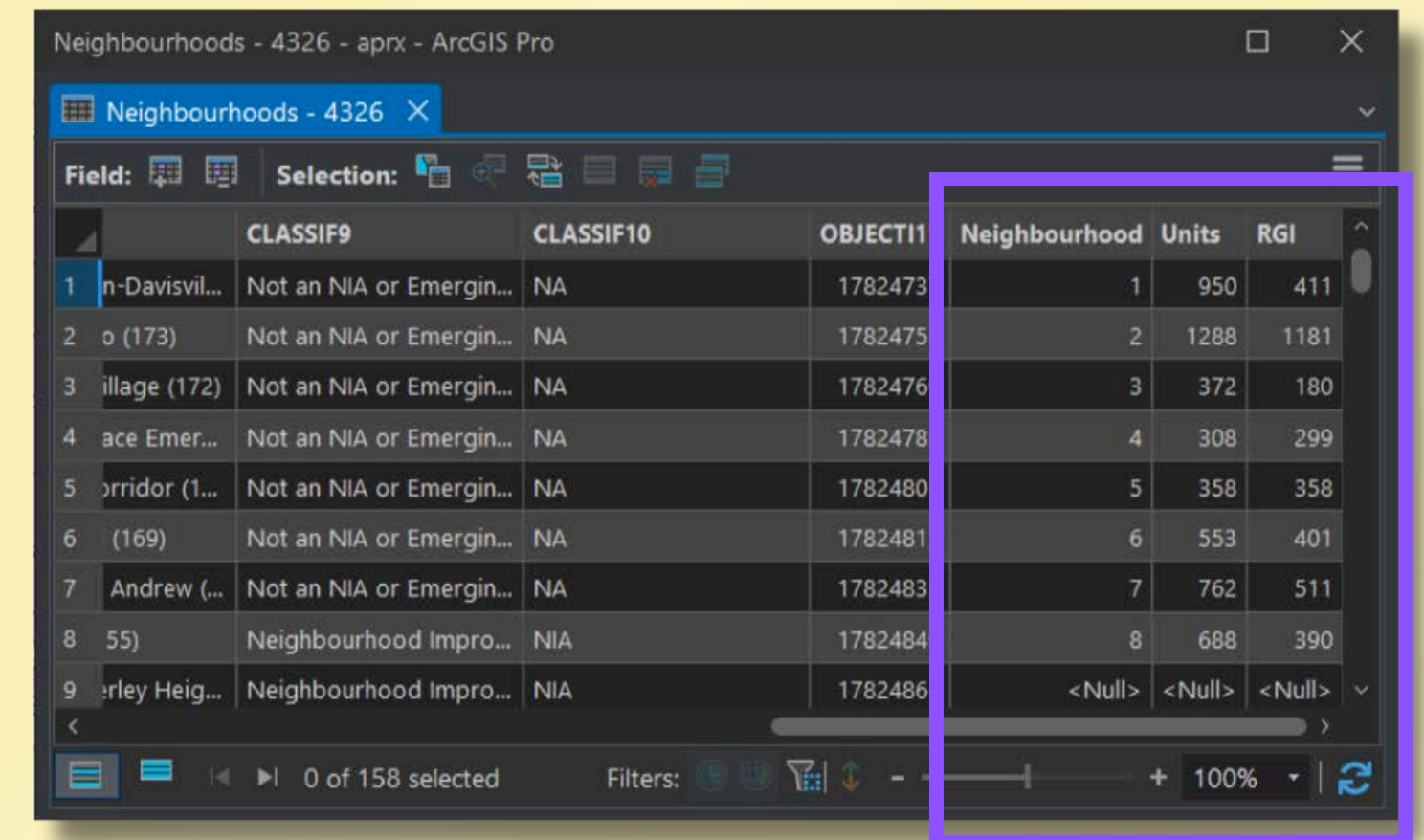
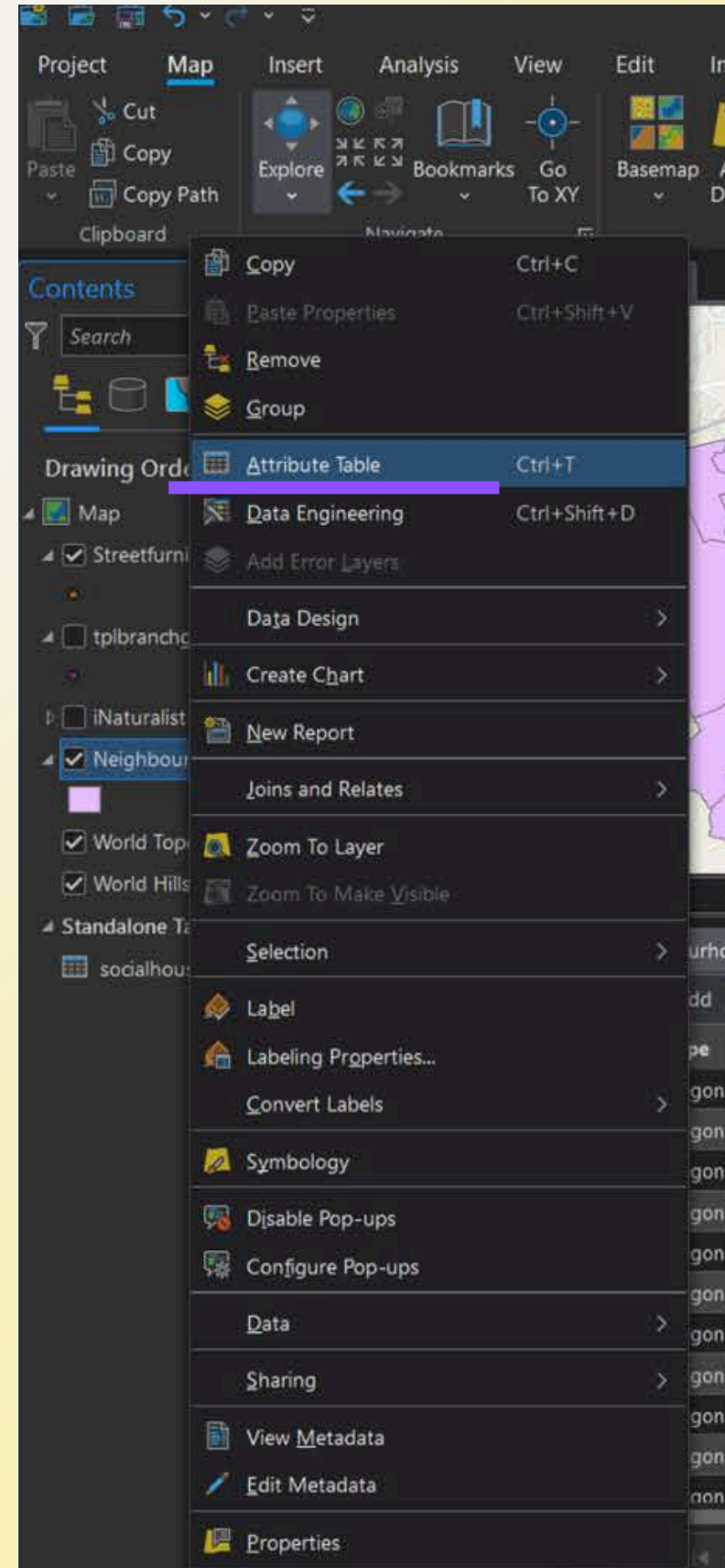
Click **OK**.

The screenshot shows the 'Add Join' dialog box with the following configuration:

- Input Table:** Neighbourhoods - 4326
- Input Field:** _id1
- Join Table:** socialhousing.csv
- Join Field:** Neighbourhood
- Keep all input records
- Index join fields
- Join Operation:** (empty dropdown)
- Buttons:** Validate Join, OK

Add data from a spreadsheet: Attribute Join

- Open the Neighbourhoods layer's attribute table.
- Scroll to the far right.
- **Data from the csv has successfully been joined to the polygon layer.**



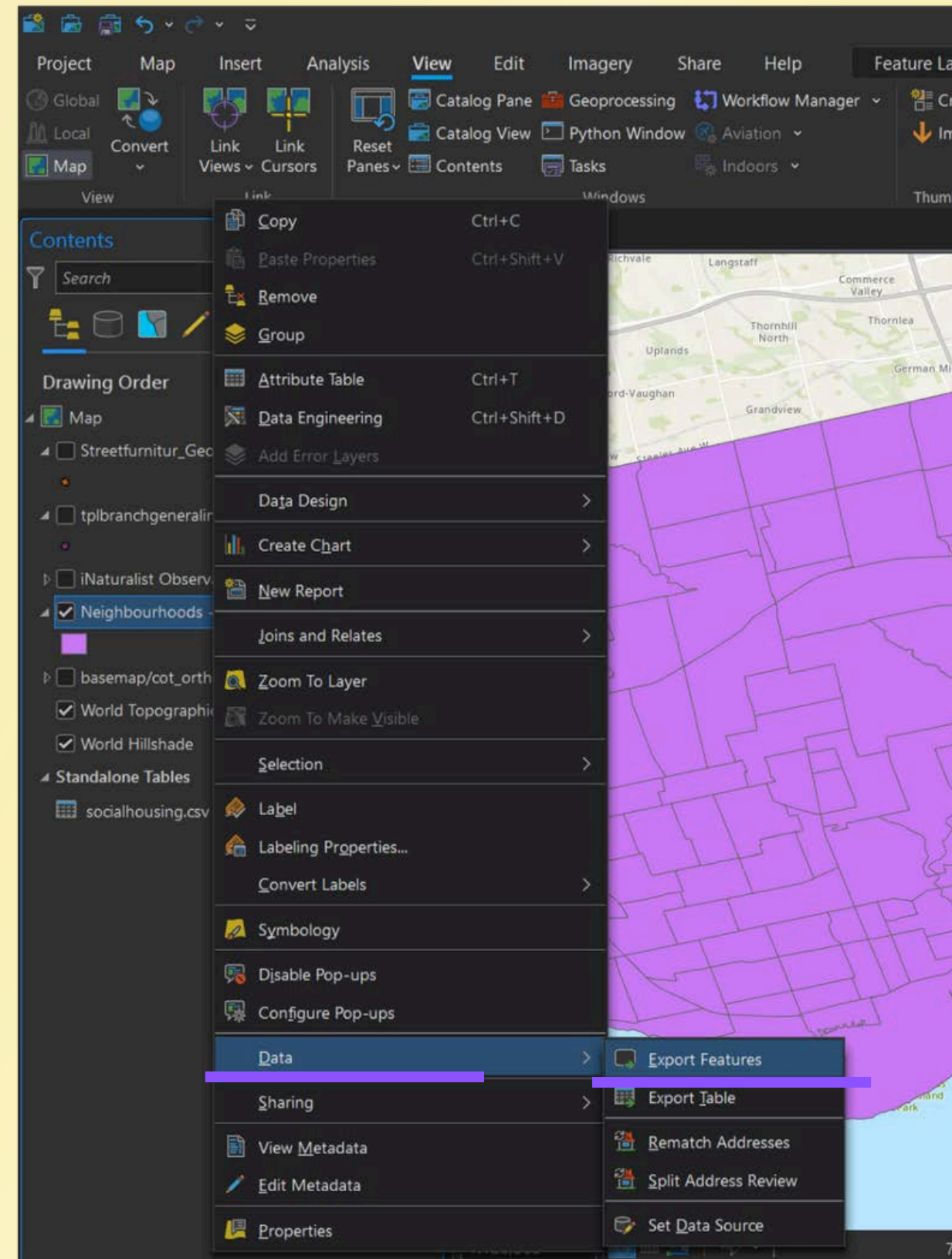
	CLASSIF9	CLASSIF10	OBJECTID	Neighbourhood	Units	RGI	
1	n-Davisvil...	Not an NIA or Emergen...	NA	1782473	1	950	411
2	o (173)	Not an NIA or Emergen...	NA	1782475	2	1288	1181
3	illage (172)	Not an NIA or Emergen...	NA	1782476	3	372	180
4	ace Emer...	Not an NIA or Emergen...	NA	1782478	4	308	299
5	orridor (1...	Not an NIA or Emergen...	NA	1782480	5	358	358
6	(169)	Not an NIA or Emergen...	NA	1782481	6	553	401
7	Andrew (...)	Not an NIA or Emergen...	NA	1782483	7	762	511
8	55)	Neighbourhood Impro...	NIA	1782484	8	688	390
9	rley Heig...	Neighbourhood Impro...	NIA	1782486	<Null>	<Null>	<Null>

Joined data!

Add data from a spreadsheet: Attribute Join

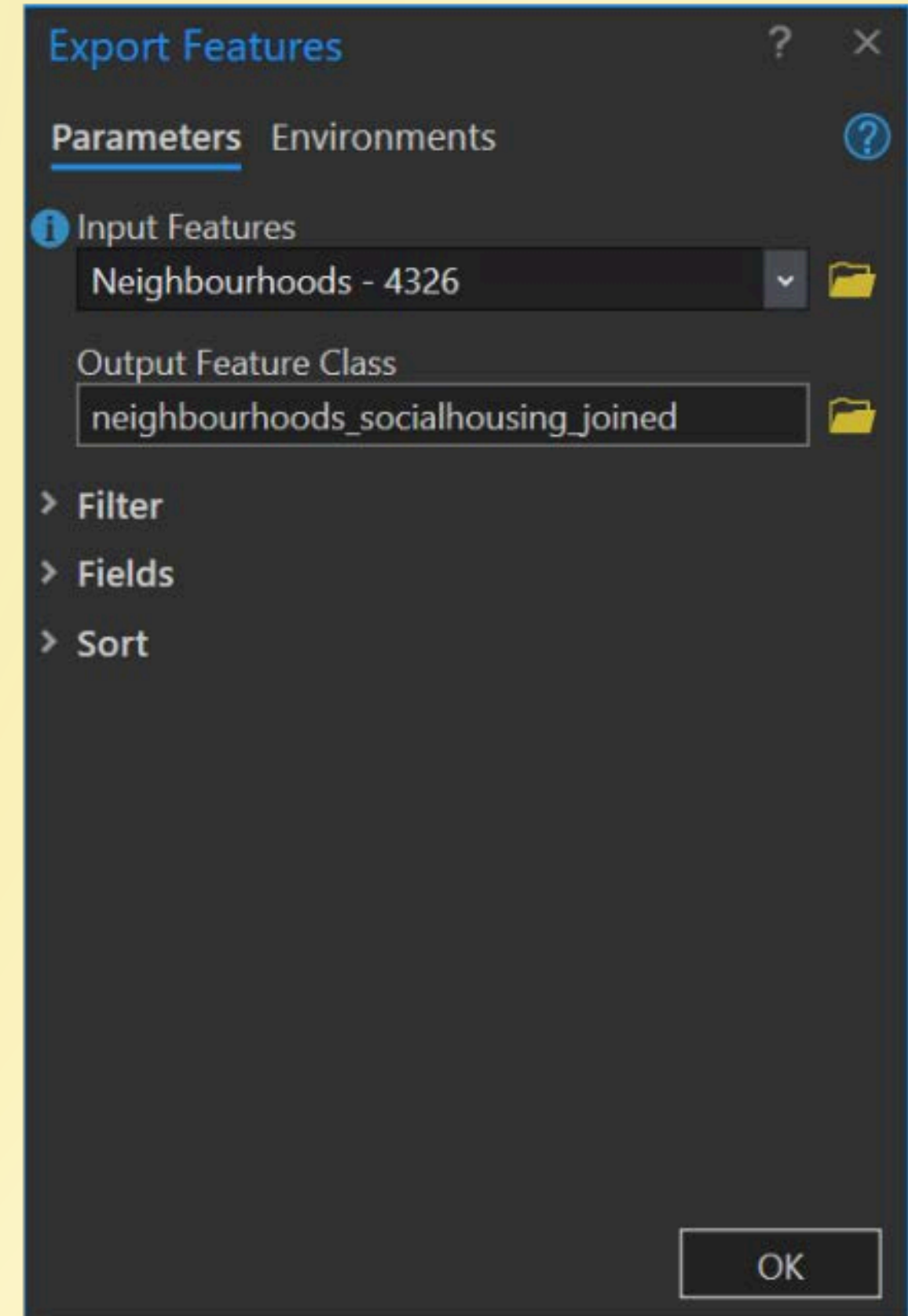
Export the layer to save a permanently-joined version of the data

- Right-click the layer name in the Contents pane
- From the menu, choose **Data -> Export Features**



Add data from a spreadsheet: Attribute Join

- The output layer will be saved in the project geodatabase by default.



Add data from a Web Service

Web services allow data to be shared from the internet.

To add a web service layer to Pro:

- Visit <https://open.toronto.ca/dataset/web-map-services/>
- Expand the **Download Data** section
- Click the **Visit Page** button next to the **Orthorectified Aerial Imagery - Most current year** item

The screenshot shows a web browser window displaying the 'Aerial LiDAR - Hillshade' dataset page. The page title is 'Aerial LiDAR - Hillshade'. Below the title is a descriptive paragraph: 'A hillshade is a hypothetical illumination of a surface by determining illumination values for each cell in a raster. It is calculated by setting a position for a hypothetical light source and calculating the illumination values of each cell in relation to neighboring cells. It can be used to greatly enhance the visualization of a surface for analysis or graphical display, especially when using transparency. The City of Toronto publishes hillshades in both bare earth (no above-ground features included), and full-feature. Bare Earth Full Feature'. Below the description are four expandable sections: 'DATA PREVIEW', 'DATA FEATURES', 'DATA QUALITY', and 'DOWNLOAD DATA'. The 'DOWNLOAD DATA' section is expanded and highlighted with a purple box. Below this section is a table with three columns: 'File', 'Format', and 'Data'. The table lists five items, all with 'web' format. The first item, 'Orthorectified Aerial Imagery - Most current year', has a 'VISIT PAGE' button next to it, which is also highlighted with a purple box. The other items are 'Orthorectified Aerial Imagery - 2022', 'Orthorectified Aerial Imagery - 2021', 'Orthorectified Aerial Imagery - 2020', and 'Orthorectified Aerial Imagery - 2018', each with a 'VISIT PAGE' button.

Aerial LiDAR - Hillshade

A hillshade is a hypothetical illumination of a surface by determining illumination values for each cell in a raster. It is calculated by setting a position for a hypothetical light source and calculating the illumination values of each cell in relation to neighboring cells. It can be used to greatly enhance the visualization of a surface for analysis or graphical display, especially when using transparency. The City of Toronto publishes hillshades in both bare earth (no above-ground features included), and full-feature. Bare Earth Full Feature

DATA PREVIEW

Not available for this dataset

DATA FEATURES

DATA QUALITY

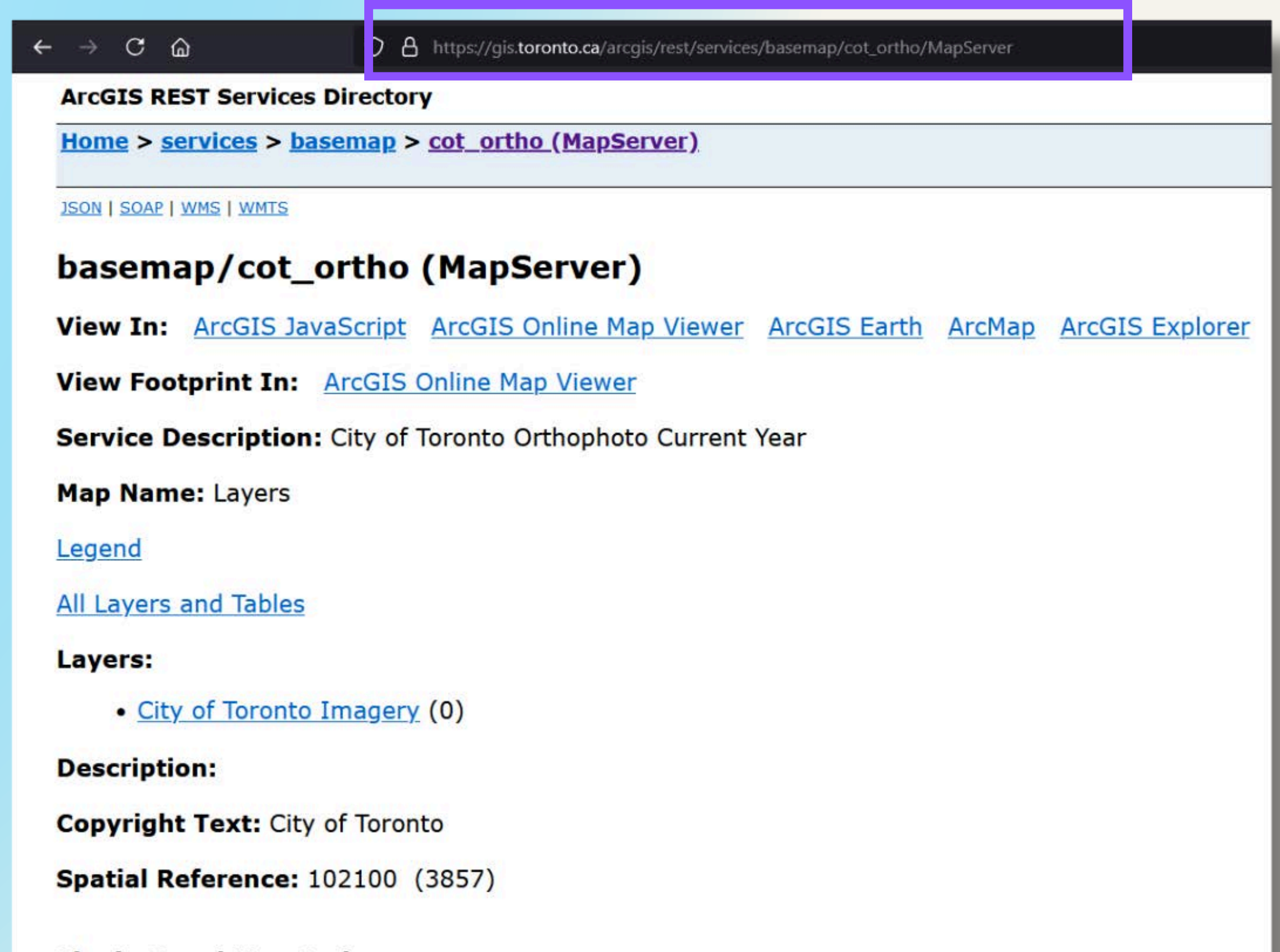
DOWNLOAD DATA

File	Format	Data
Orthorectified Aerial Imagery - Most current year	web	VISIT PAGE
Orthorectified Aerial Imagery - 2022	web	VISIT PAGE
Orthorectified Aerial Imagery - 2021	web	VISIT PAGE
Orthorectified Aerial Imagery - 2020	web	VISIT PAGE
Orthorectified Aerial Imagery - 2018	web	VISIT PAGE

Add data from a Web Service

- Copy the URL (Ctrl + C)

https://gis.toronto.ca/arcgis/rest/services/basemap/cot_ortho/MapServer

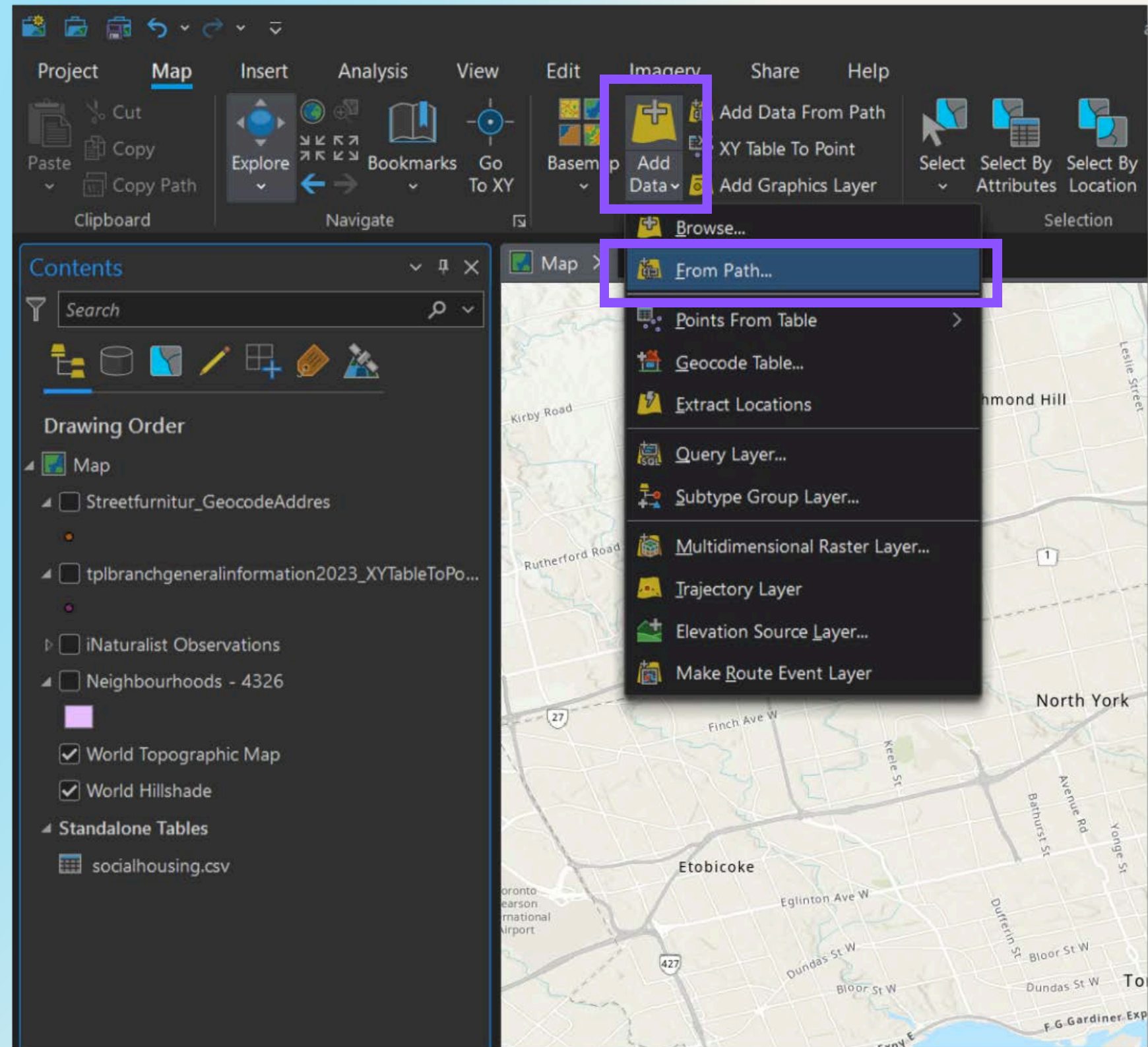


The screenshot shows a web browser window displaying the ArcGIS REST Services Directory. The address bar shows the URL https://gis.toronto.ca/arcgis/rest/services/basemap/cot_ortho/MapServer, which is highlighted with a purple box. The page content includes the following information:

- ArcGIS REST Services Directory**
- Home > [services](#) > [basemap](#) > [cot_ortho \(MapServer\)](#)
- [JSON](#) | [SOAP](#) | [WMS](#) | [WMTS](#)
- basemap/cot_ortho (MapServer)**
- View In:** [ArcGIS JavaScript](#) [ArcGIS Online Map Viewer](#) [ArcGIS Earth](#) [ArcMap](#) [ArcGIS Explorer](#)
- View Footprint In:** [ArcGIS Online Map Viewer](#)
- Service Description:** City of Toronto Orthophoto Current Year
- Map Name:** Layers
- [Legend](#)
- [All Layers and Tables](#)
- Layers:**
 - [City of Toronto Imagery](#) (0)
- Description:**
- Copyright Text:** City of Toronto
- Spatial Reference:** 102100 (3857)

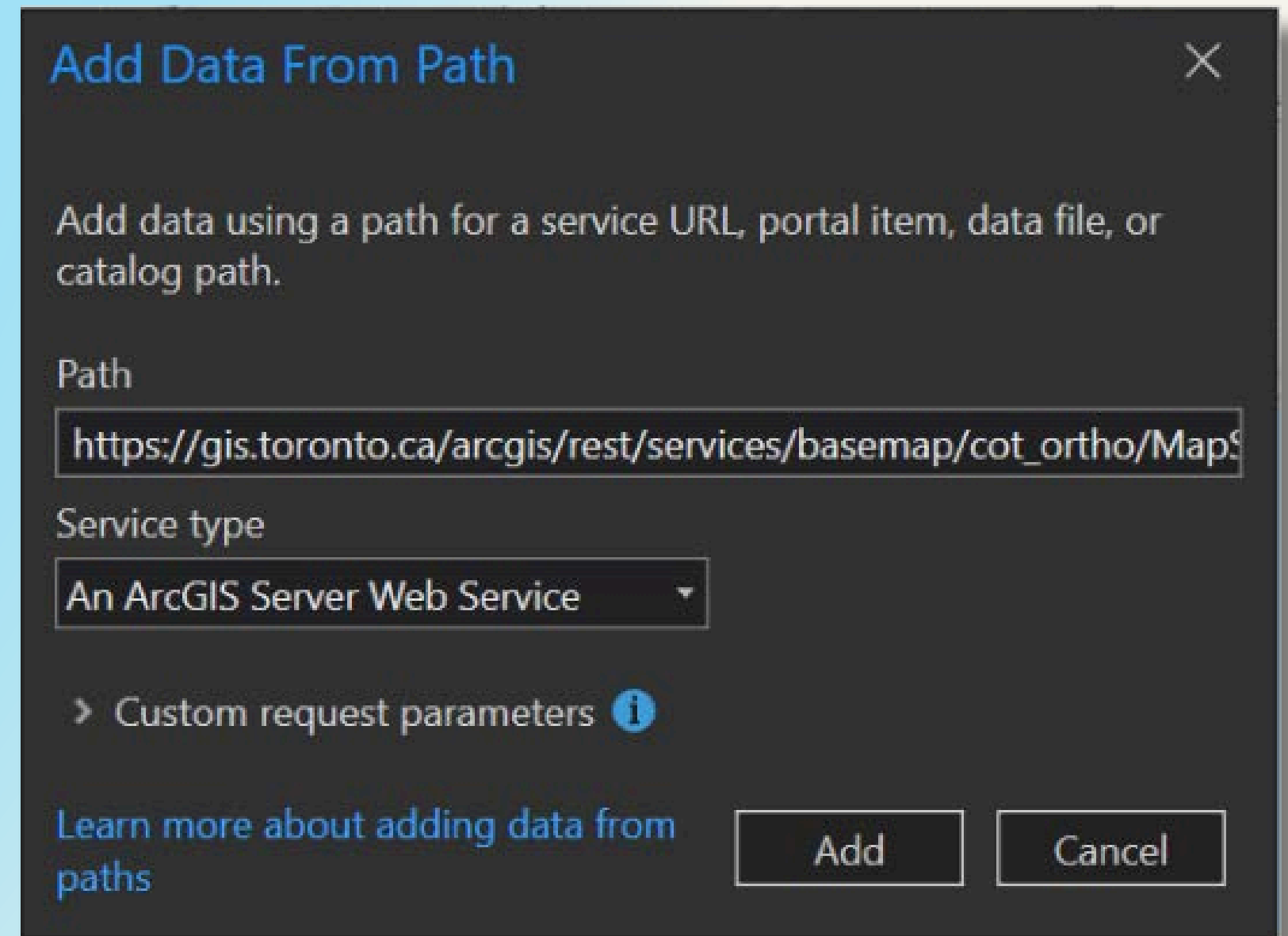
Add data from a Web Service

- In Pro, click the **Add Data** button (Map tab)
- Select **From Path...**



Add data from a Web Service

- Paste in the web service URL.
- Click Add.



Add Data From Path ✕

Add data using a path for a service URL, portal item, data file, or catalog path.

Path

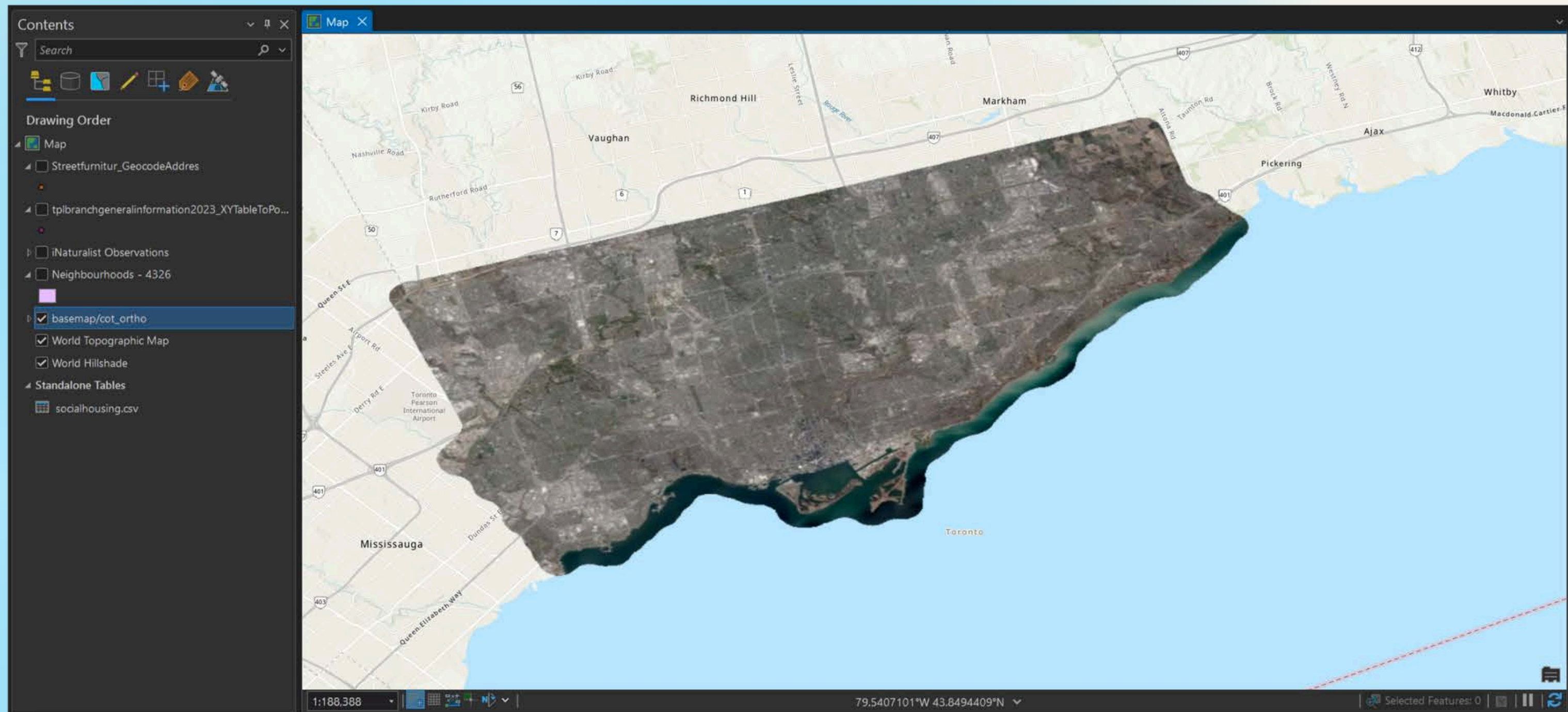
Service type

> Custom request parameters ⓘ

[Learn more about adding data from paths](#)

Add data from a Web Service

- Result:



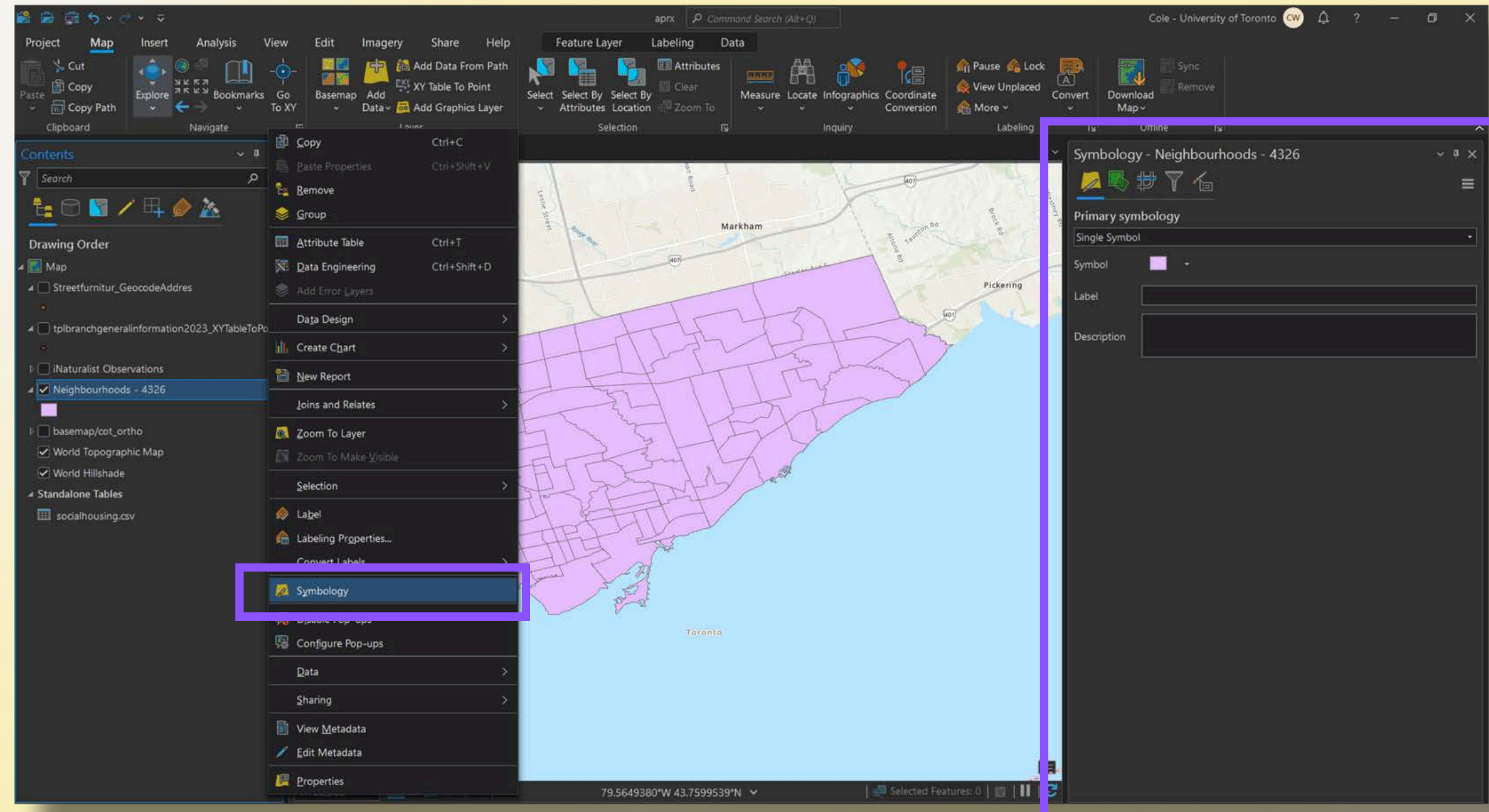
Symbology in ArcGIS Pro

- Symbology involves the use of symbols to represent geographic features (and their attributes) on the map
- Effective symbology makes it easier for viewers to understand complex information.

Symbology in ArcGIS Pro

Access Pro's symbology options:

- Right-click on the **neighbourhoods_social_housing_joined** layer in the Contents Pane
- Select **Symbology** from the pop-up menu
- The **Symbology Pane** will appear.

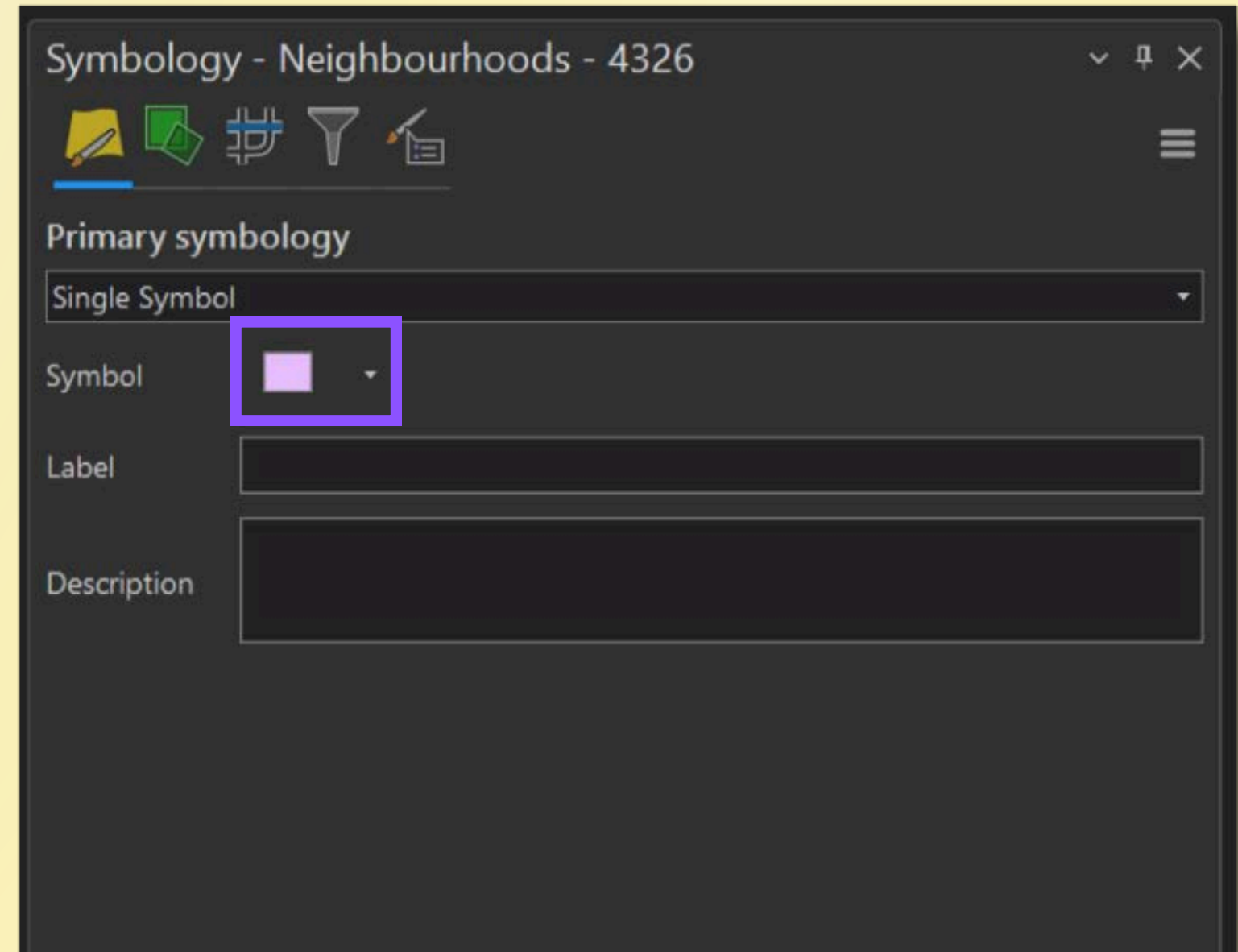


Symbology in ArcGIS Pro

Types of Symbology: Single Symbol

Single Symbol: All features in a layer are represented with the same symbol. Ideal for displaying features of the same type.

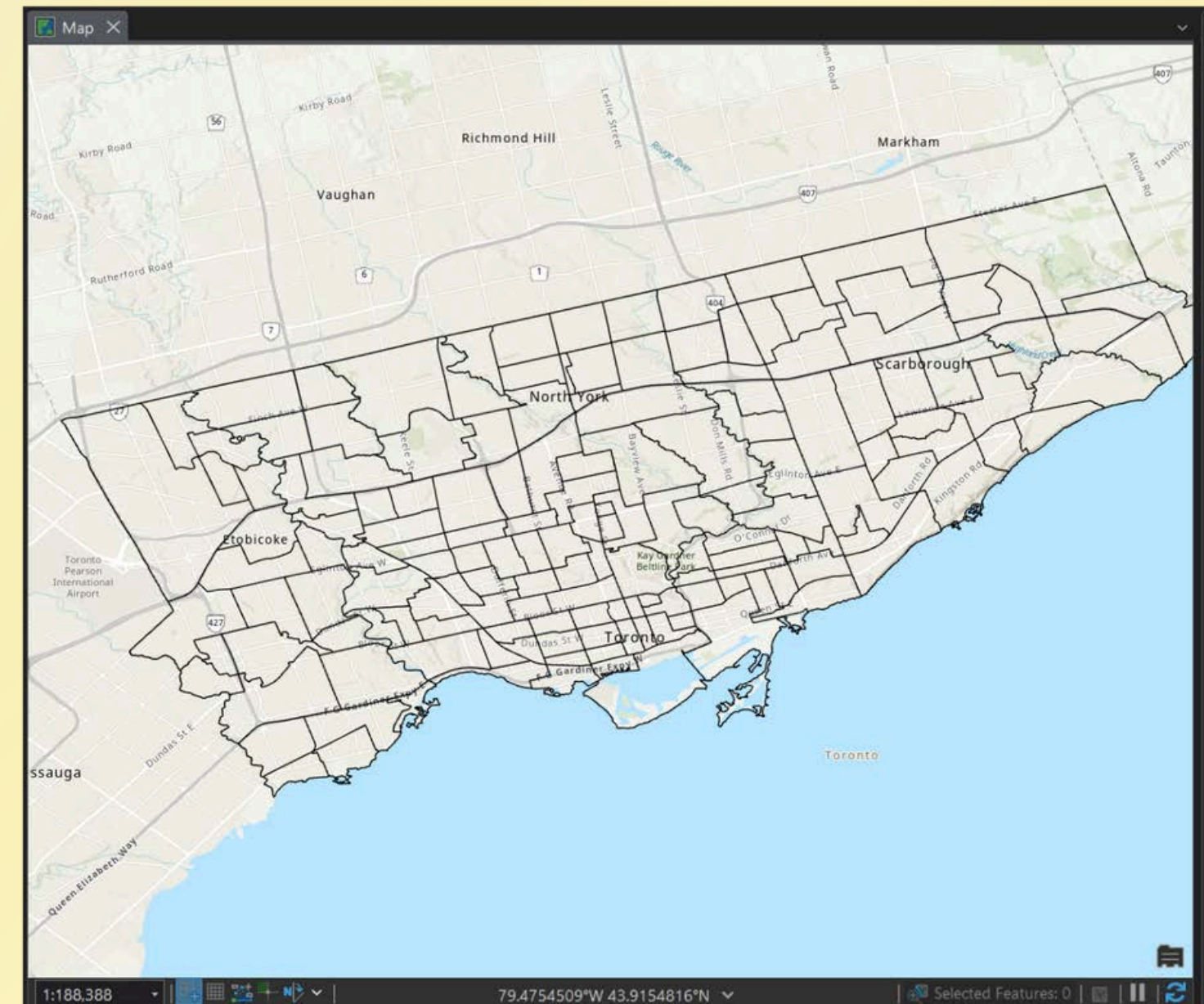
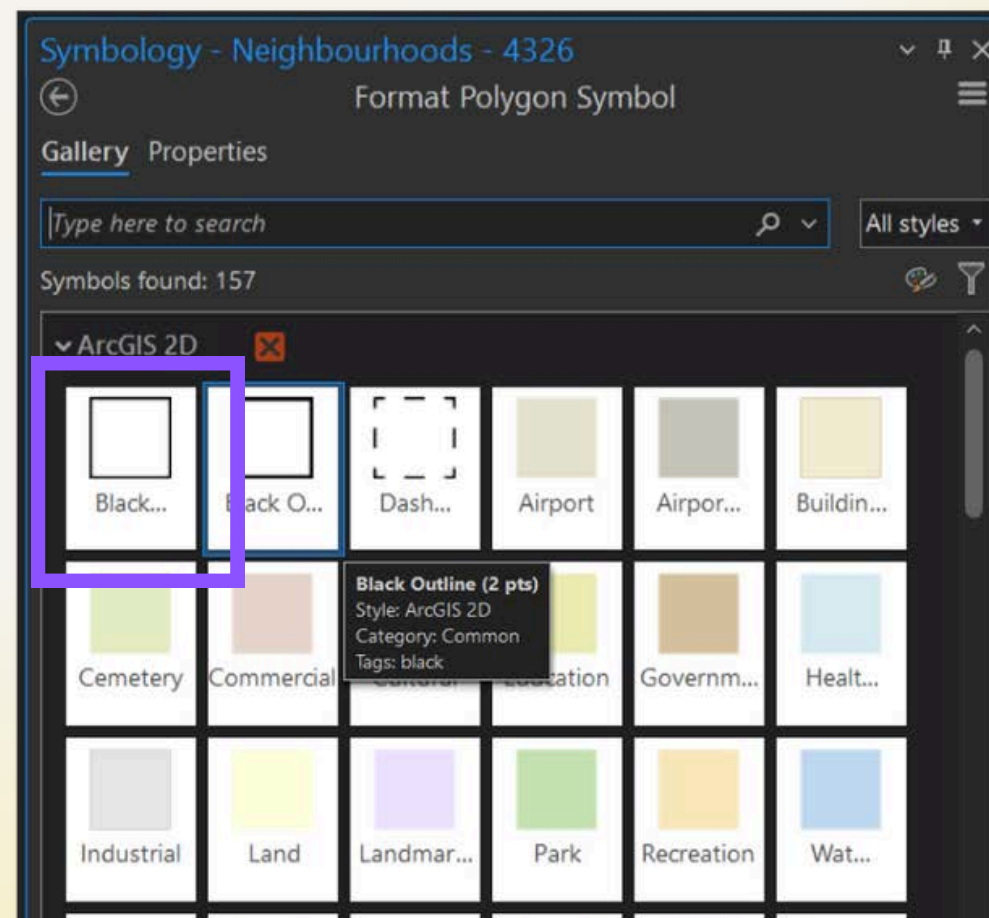
- The Neighbourhoods layer has this symbology style by default.
- To customize the symbology, click the symbol swatch on the Symbology pane.



Symbology in ArcGIS Pro

Types of Symbology: Single Symbol

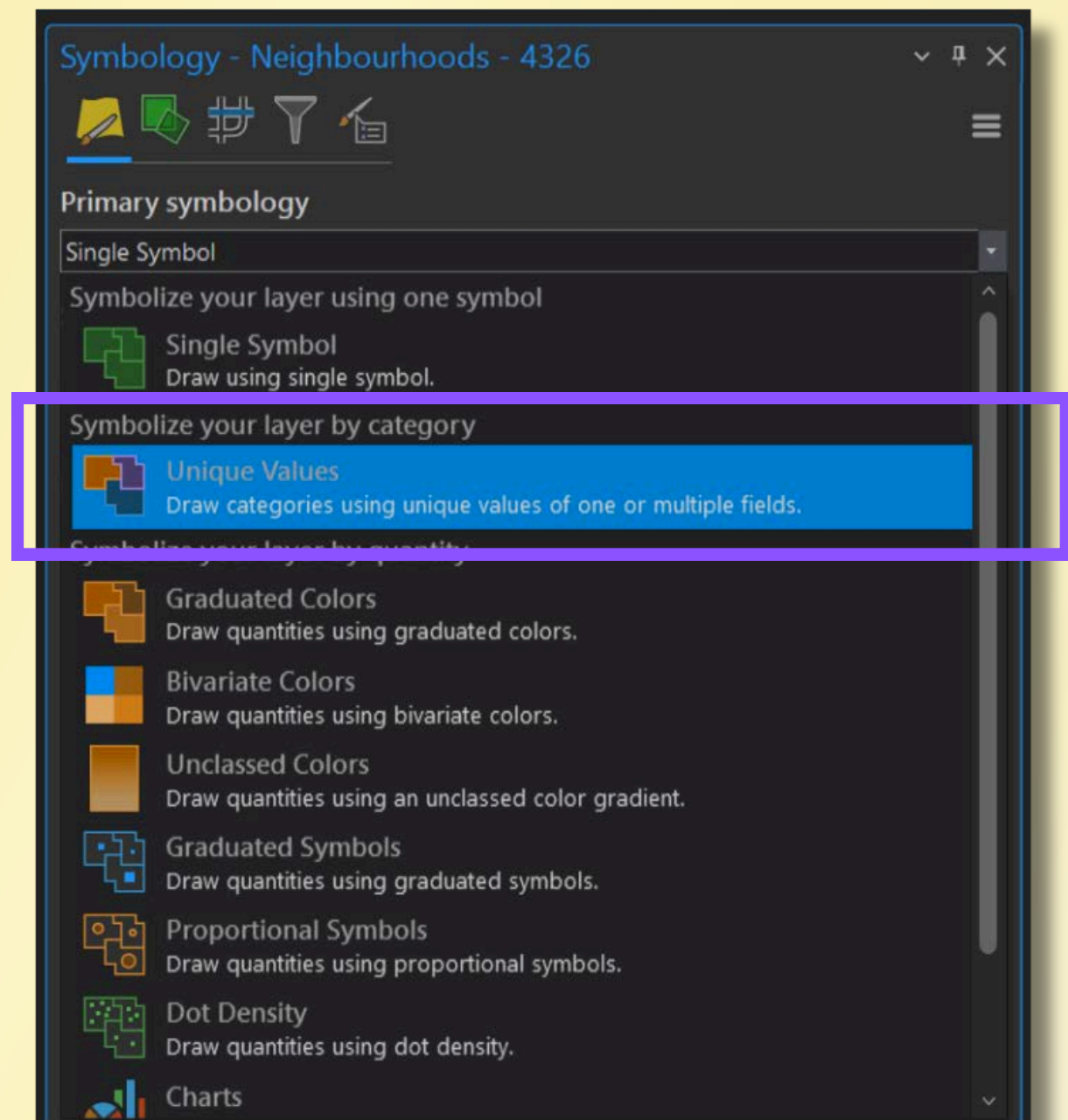
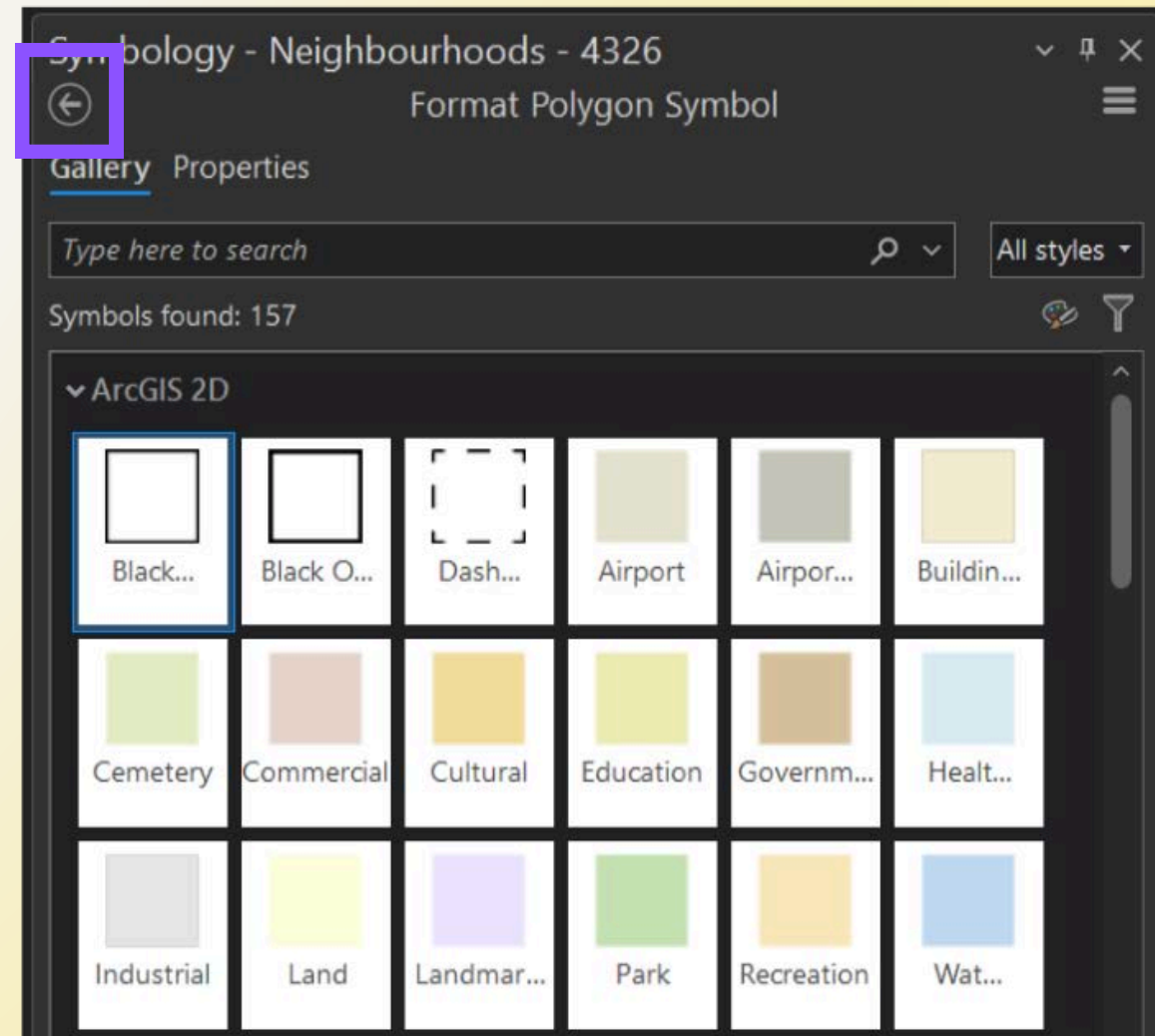
- Choose **Black Outline** from the Gallery.



Symbology in ArcGIS Pro

Types of Symbology: Unique Values

- Click the Back button to return to the main symbology options for the Neighbourhoods layer
- Choose **Unique Values** from the Primary symbology dropdown

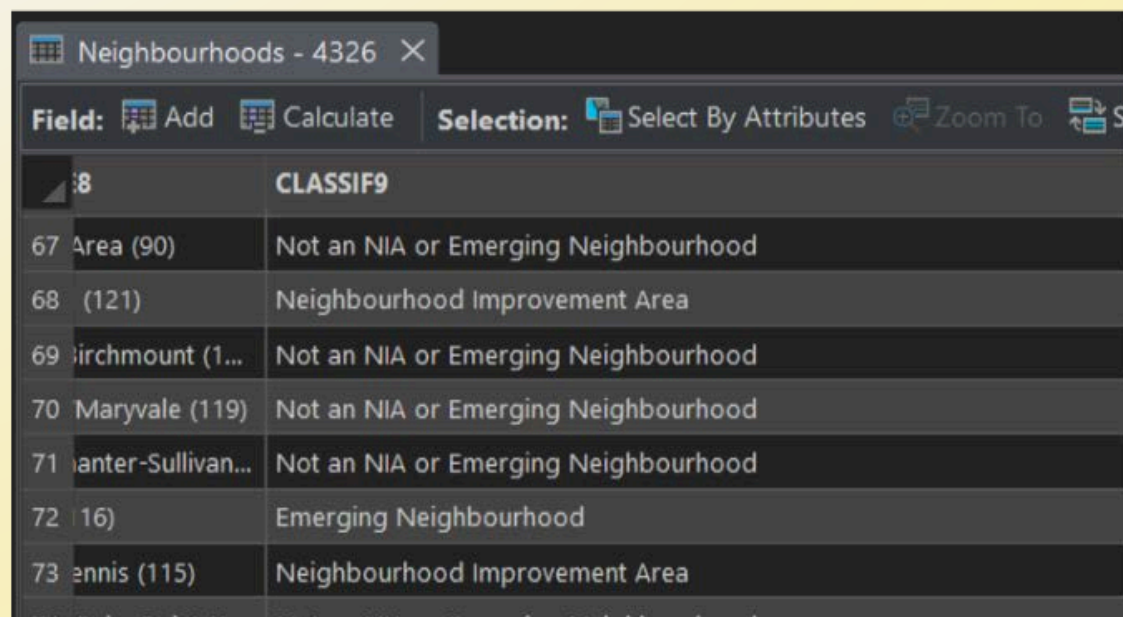


Symbology in ArcGIS Pro

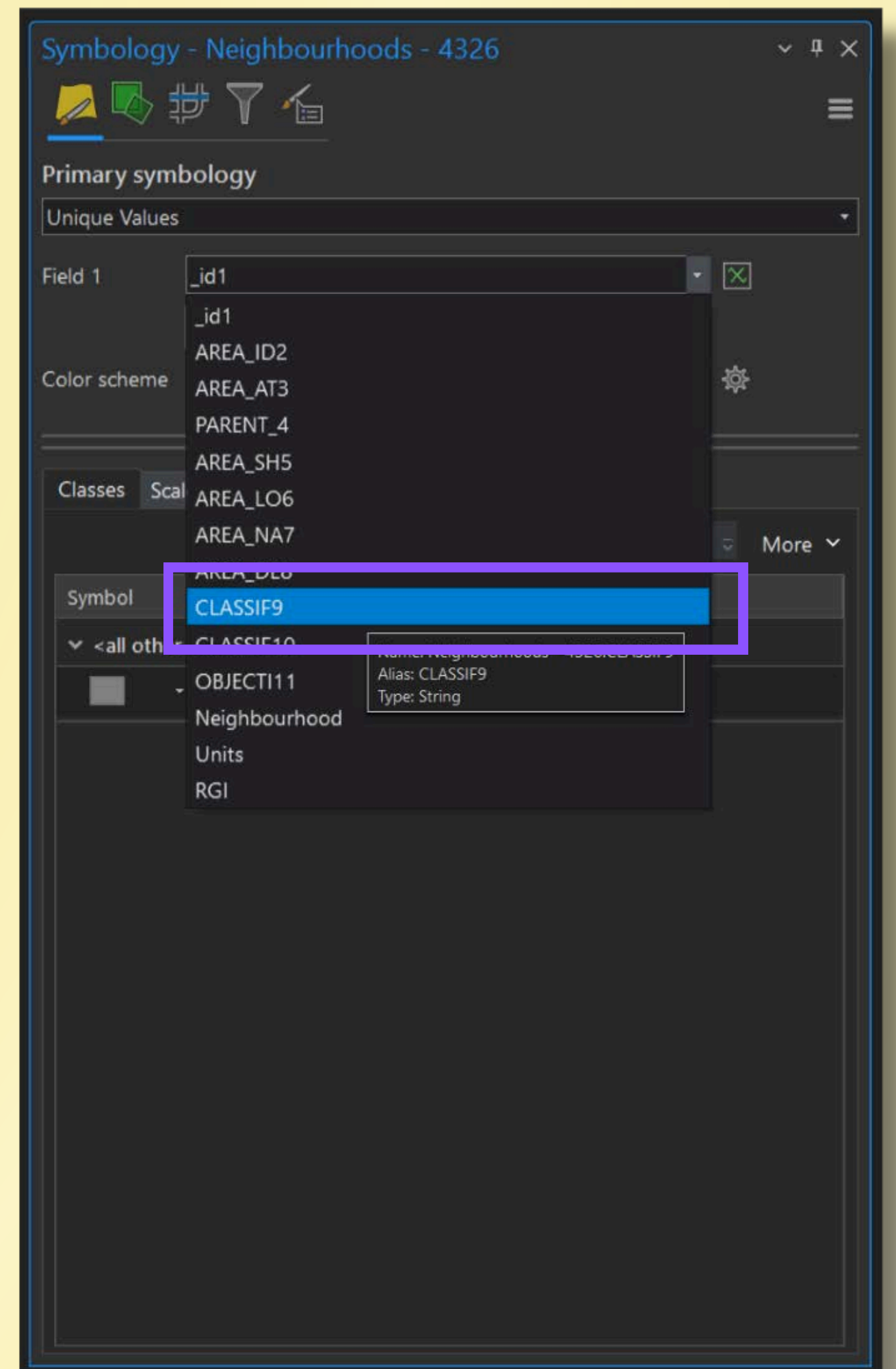
Types of Symbology: Unique Values

- Choose **CLASSIF9** from the **Field 1** dropdown menu.

Note: This field is not very well-named, but a review of the attribute table shows that it specifies each neighbourhood's Emerging Area or NIA status.



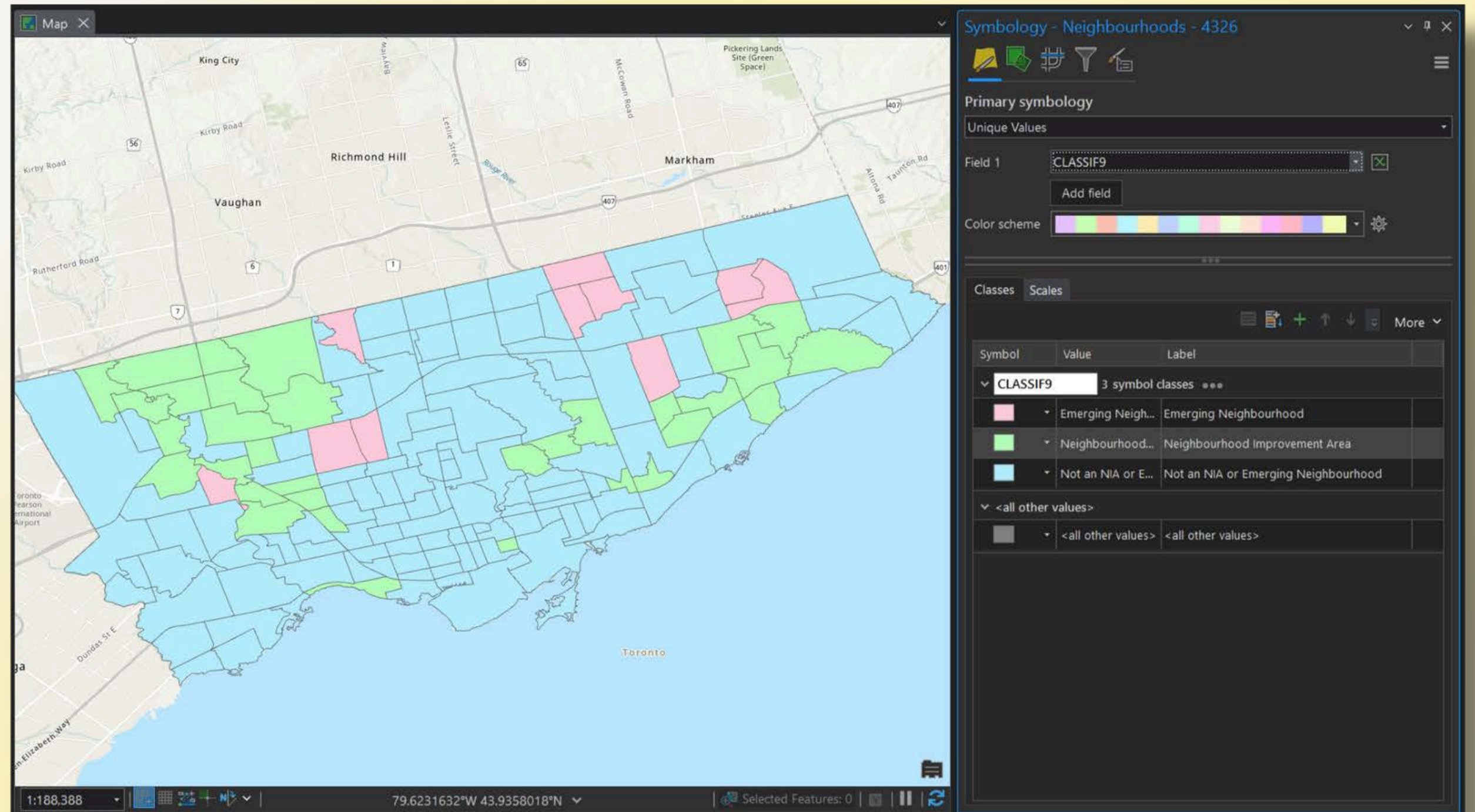
OBJECTID	CLASSIF9
67	Area (90)
68	(121)
69	birchmount (1...
70	Maryvale (119)
71	anter-Sullivan...
72	(16)
73	ennis (115)
74	aby Point (1...



Symbology in ArcGIS Pro

Types of Symbology: Unique Values

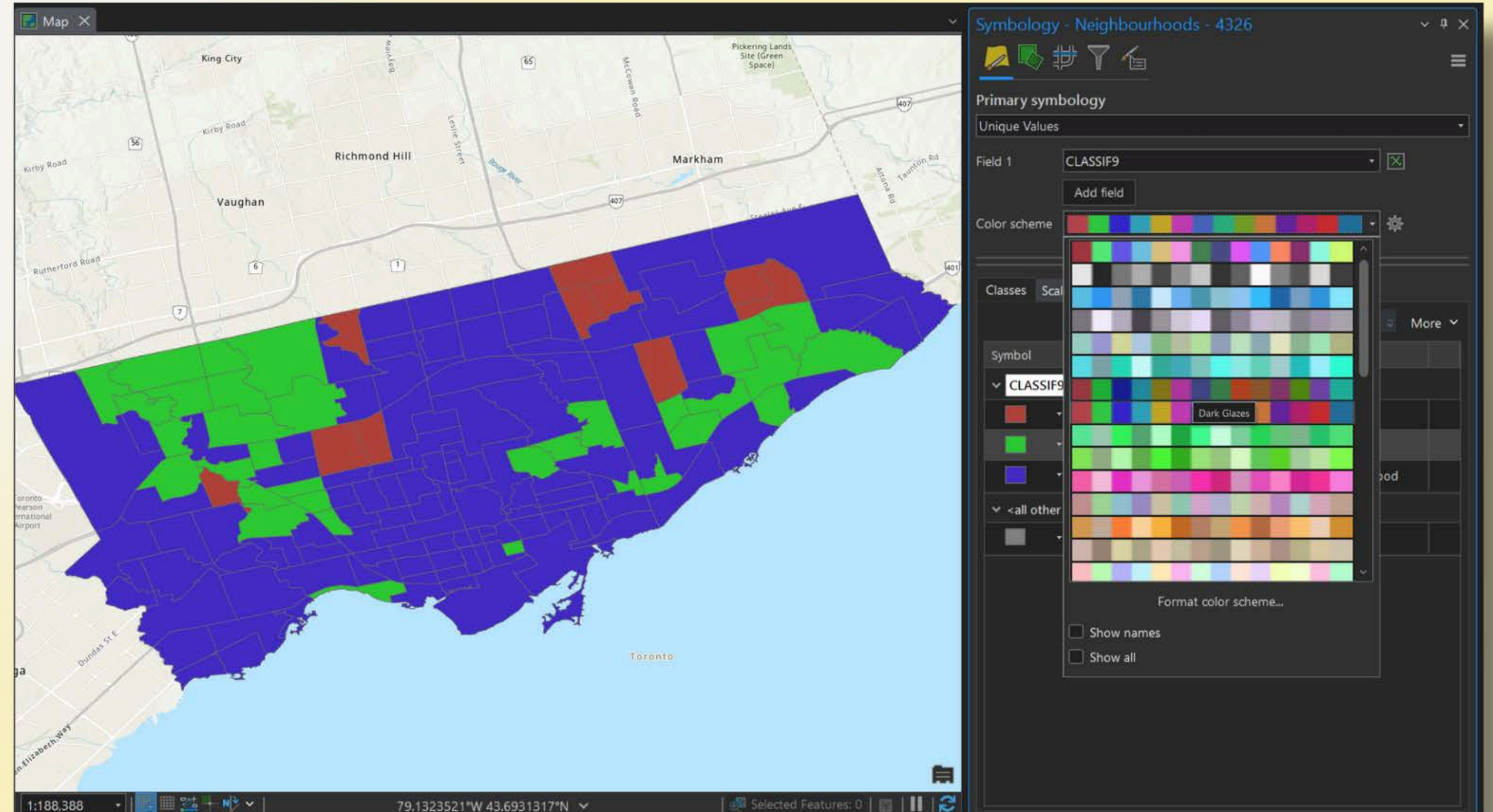
- Each polygon is now styled to reflect the attribute value in the CLASSIF9 field.



Symbology in ArcGIS Pro

Types of Symbology: Unique Values

- Various colour schemes can be selected from the **Color scheme** dropdown.

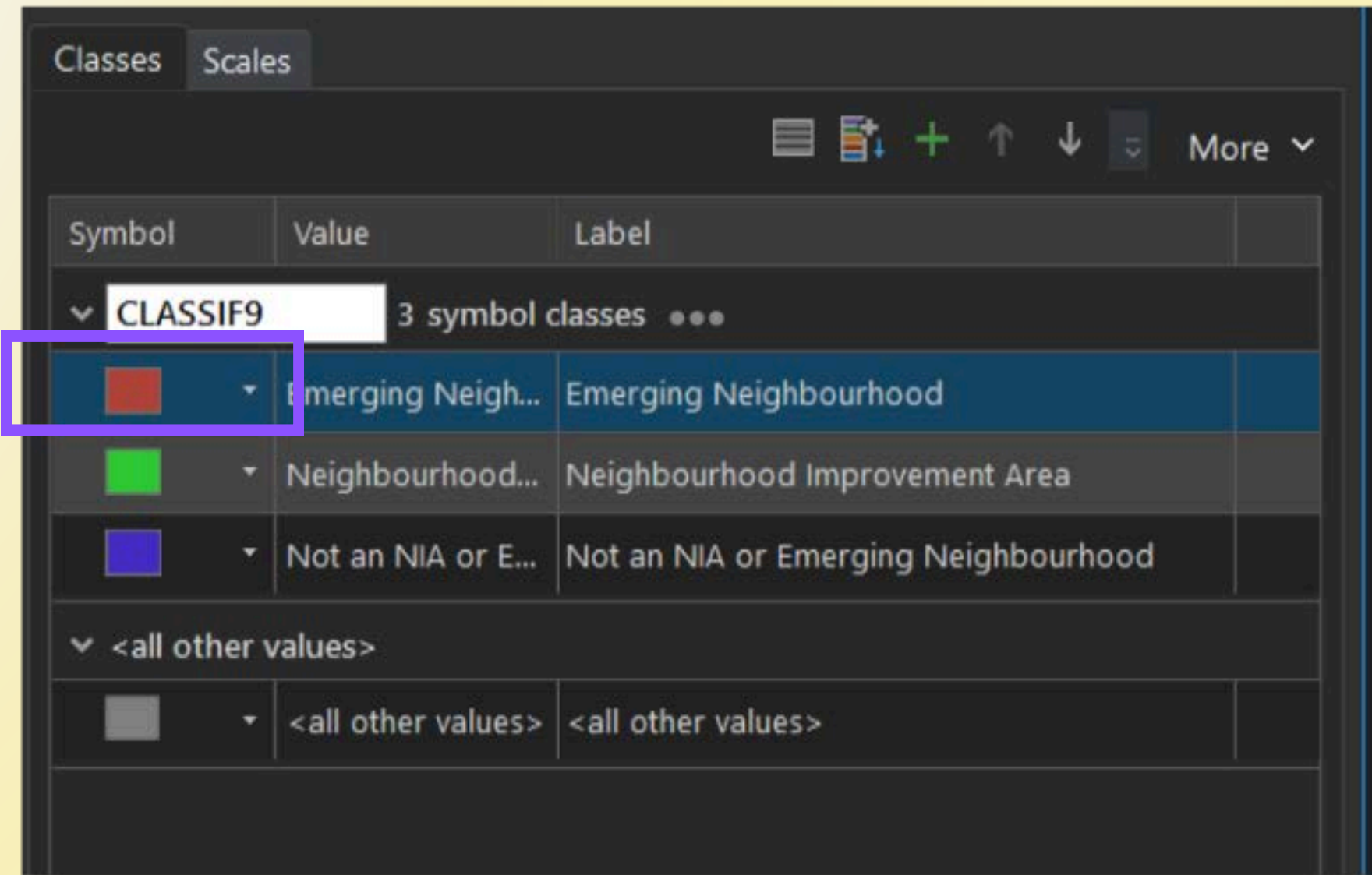


Symbology in ArcGIS Pro

Types of Symbology: Unique Values

Customize individual symbols:

- Click the swatch next to the Emerging Neighbourhood category.

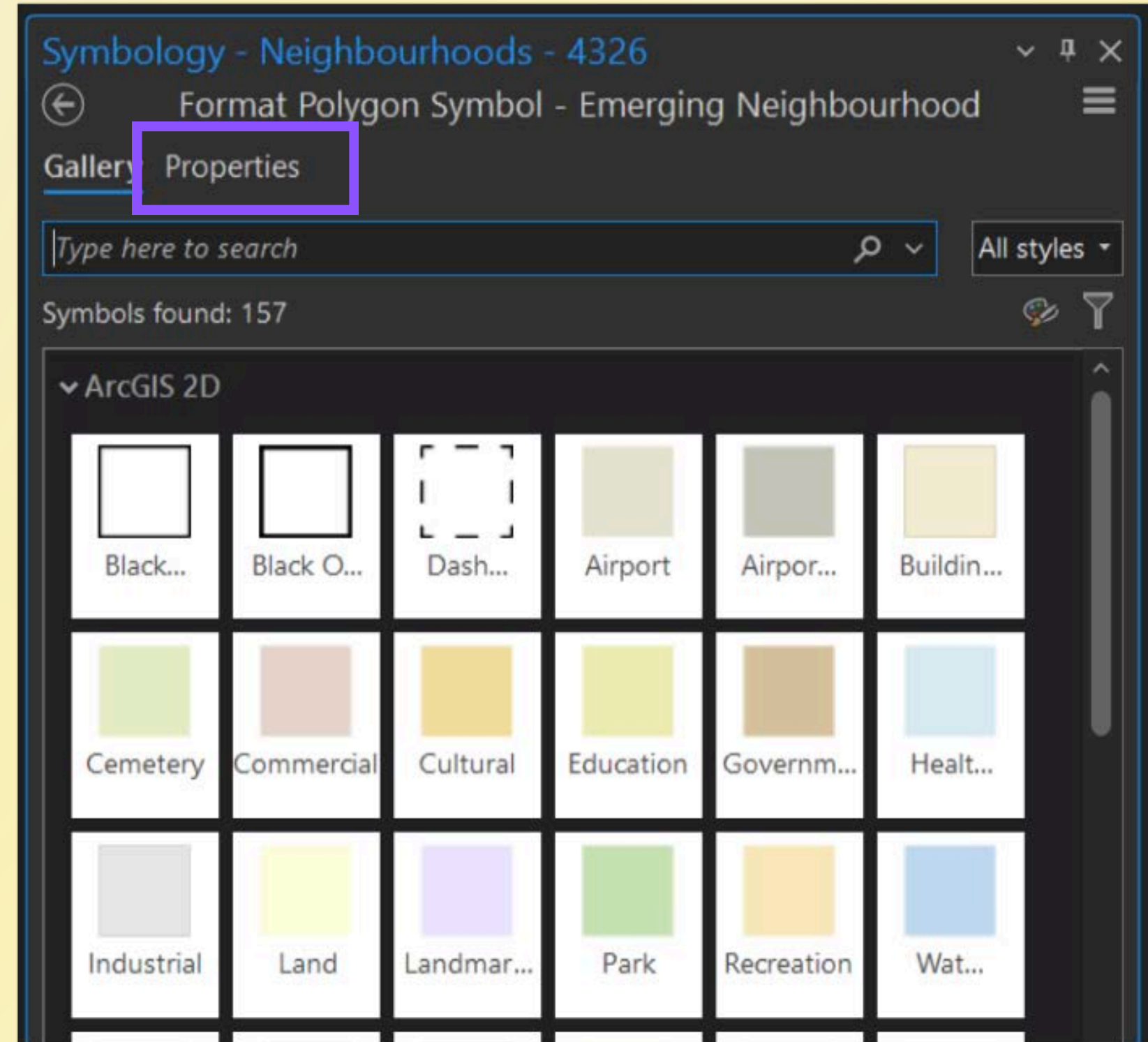


Symbology in ArcGIS Pro

Types of Symbology: Unique Values

Customize individual symbols:

- Click **Properties**.

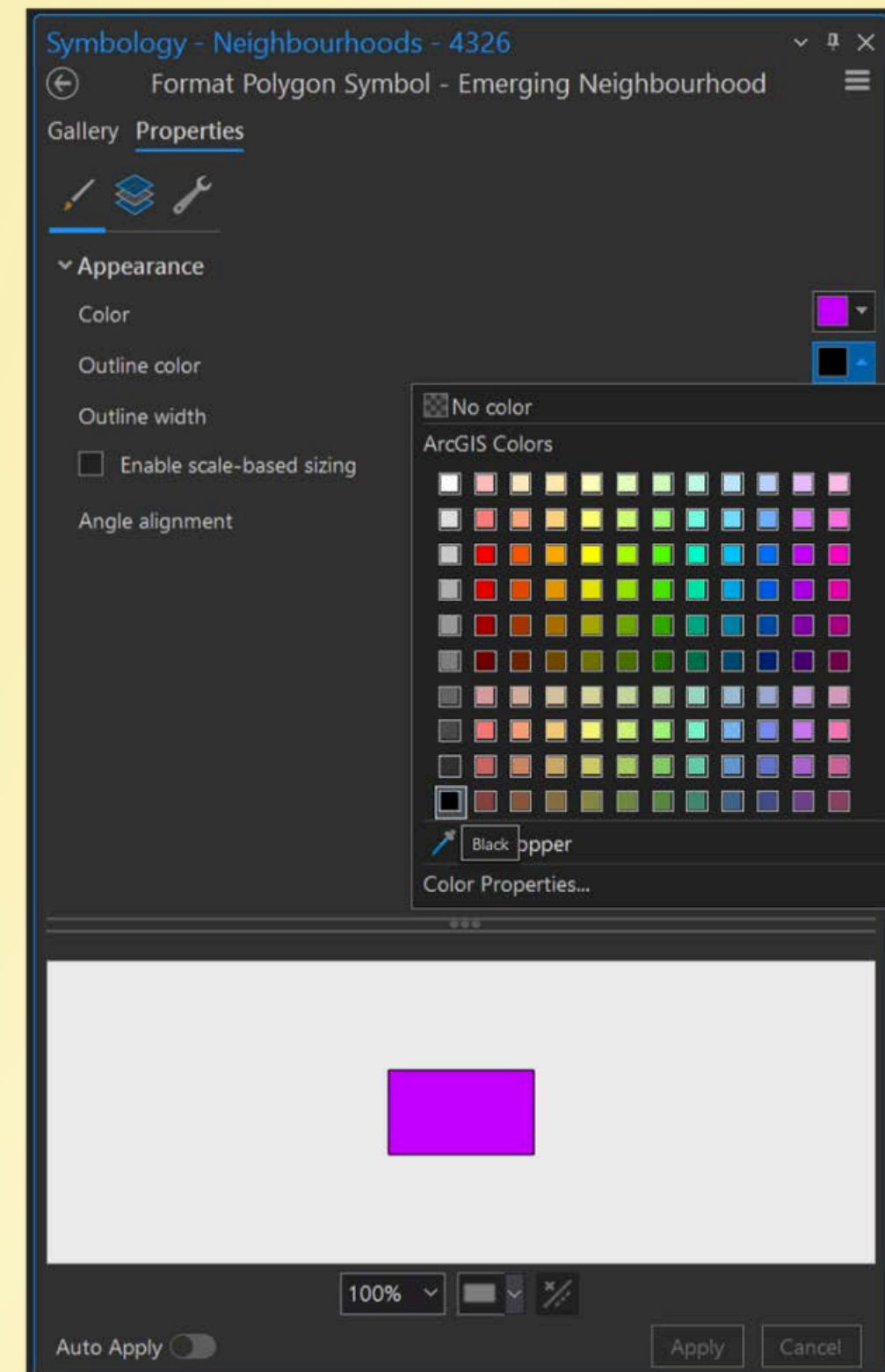


Symbology in ArcGIS Pro

Types of Symbology: Unique Values

Customize individual symbols:

- Adjust the **Fill Color**, **Outline Color**, and **Outline Width** settings.



Symbology in ArcGIS Pro

Types of Symbology: Graduated Symbols

- Return to the primary symbology view and select **Graduated Symbols**.
- Choose **RGI** for the field.

The screenshot shows the Symbology pane in ArcGIS Pro for a layer named 'neighbourhoods_socialhousing_joined'. The 'Primary symbology' is set to 'Graduated Symbols'. The 'Field' is 'RGI', 'Normalization' is '<None>', 'Method' is 'Natural Breaks (Jenks)', and 'Classes' is '5'. The 'Minimum size' is '4 pt' and the 'Maximum size' is '18 pt'. The 'Template' is set to 'Background'. The checkbox 'Draw graduated symbols above all layers' is checked. Below the configuration, the 'Classes' tab is active, showing a histogram with five classes. The histogram table is as follows:

Symbol	Upper value	Label
•	≤ 247	0 - 247
•	≤ 611	248 - 611
•	≤ 1145	612 - 1145
•	≤ 1926	1146 - 1926
•	≤ 2926	1927 - 2926

Symbology in ArcGIS Pro

Types of Symbology: Graduated Symbols

- Click the symbol to change the template

Symbology - neighbourhoods_socialhousing_joined

Primary symbology

Graduated Symbols


Field: RGI

Normalization: <None>

Method: Natural Breaks (Jenks)

Classes: 5

Minimum size: 4 pt, Maximum size: 18 pt

Template:  Background

Draw graduated symbols above all layers

Classes Histogram

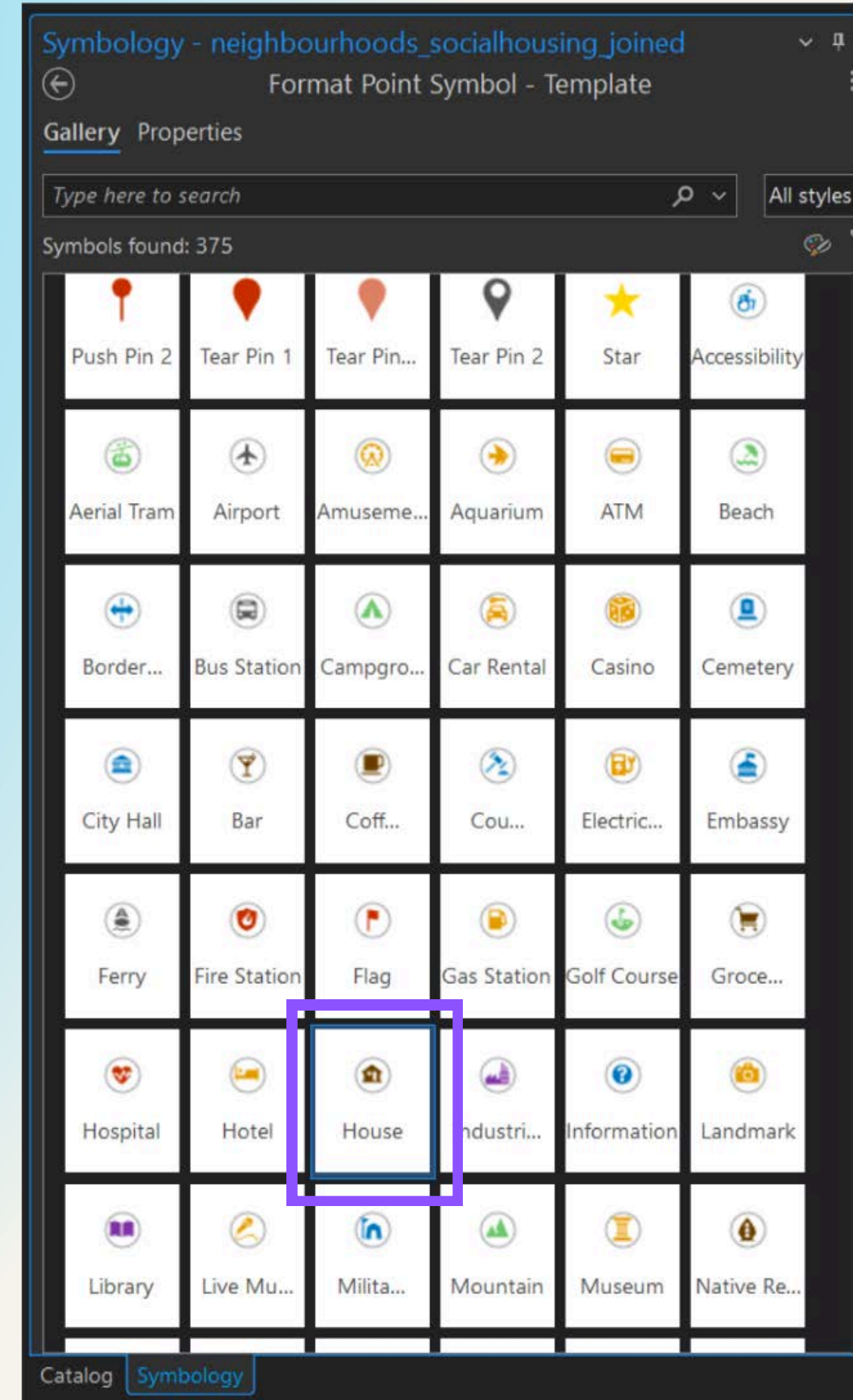
Symbol	Upper value	Label
•	≤ 247	0 - 247
•	≤ 611	248 - 611
•	≤ 1145	612 - 1145
•	≤ 1926	1146 - 1926
•	≤ 2926	1927 - 2926

Catalog Symbology

Symbology in ArcGIS Pro

Types of Symbology: Graduated Symbols

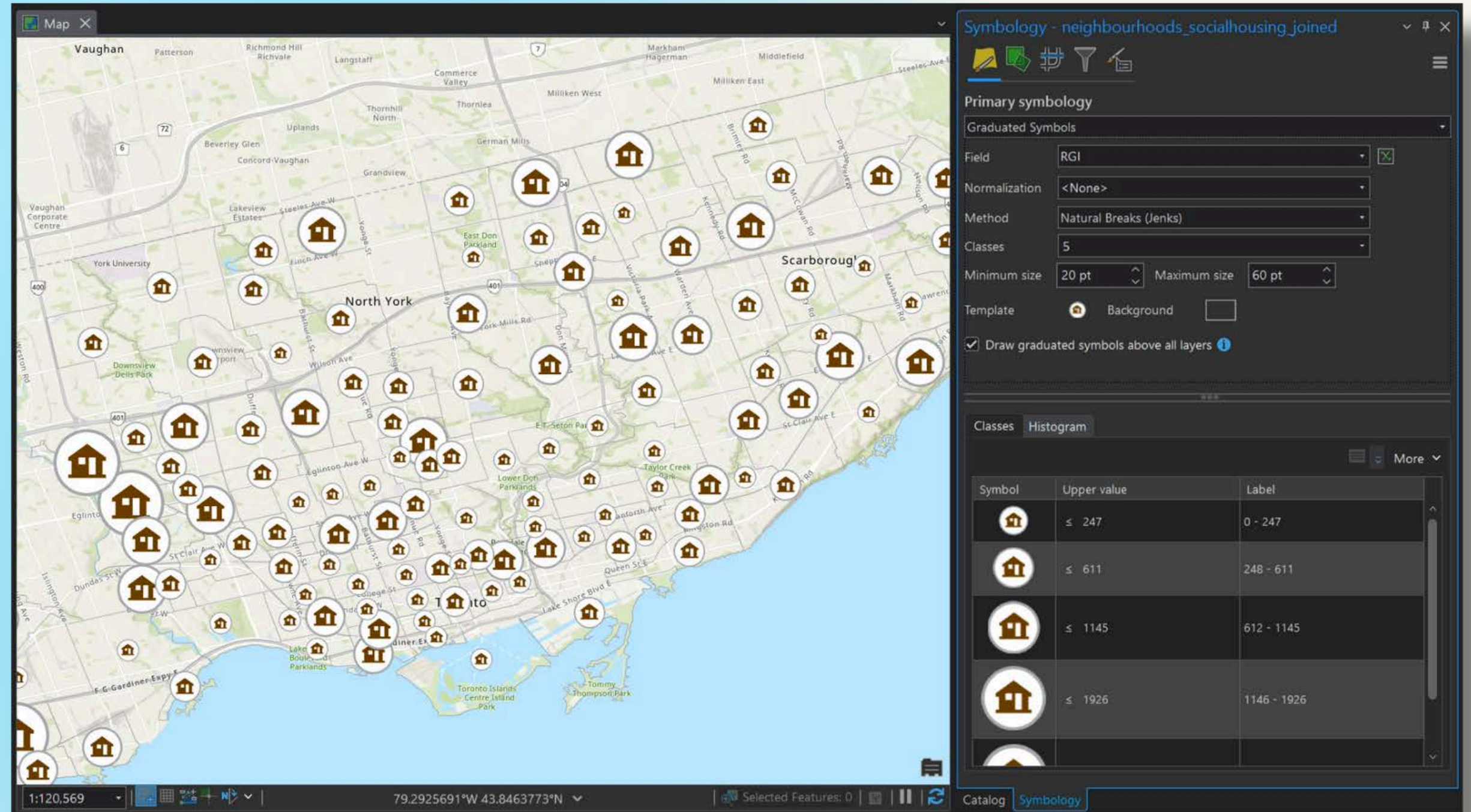
- Choose a symbol from the Gallery.



Symbology in ArcGIS Pro

Types of Symbology: Graduated Symbols






- Adjust Minimum and Maximum symbol sizes.
- Result: Attribute information is visualized by symbol size.



The screenshot displays the ArcGIS Pro interface. The main map window shows a map of Toronto with numerous house-shaped symbols of varying sizes. The Symbology pane on the right is open, showing the following settings:

- Primary symbology: Graduated Symbols
- Field: RGI
- Normalization: <None>
- Method: Natural Breaks (Jenks)
- Classes: 5
- Minimum size: 20 pt, Maximum size: 60 pt
- Template: Background
- Draw graduated symbols above all layers: checked

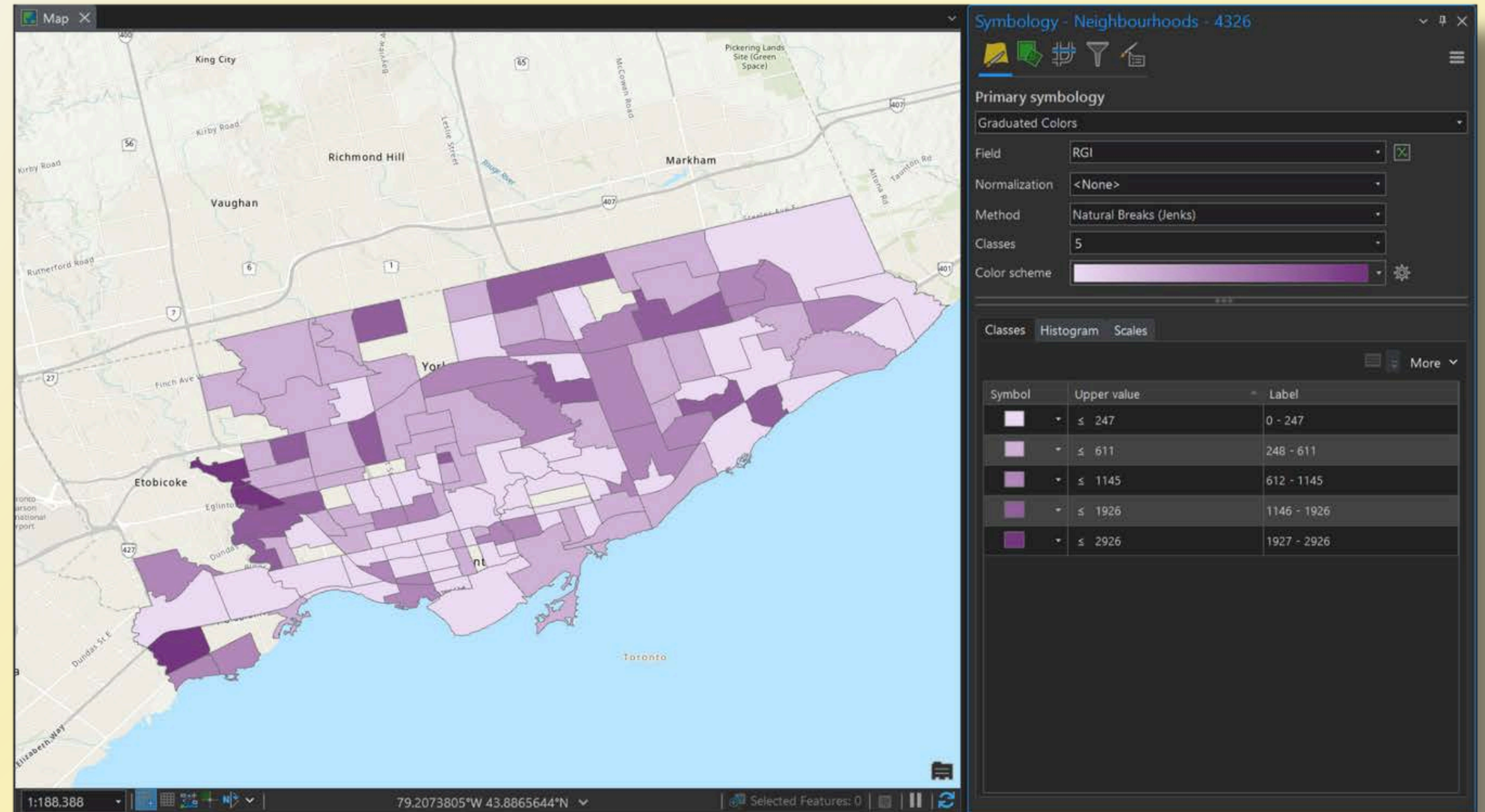
The Symbology pane also shows a histogram of the data distribution:

Symbol	Upper value	Label
	≤ 247	0 - 247
	≤ 611	248 - 611
	≤ 1145	612 - 1145
	≤ 1926	1146 - 1926
		

Symbology in ArcGIS Pro

Types of Symbology: Graduated Colours

- Return to the primary symbology view and select **Graduated Colors**.
- Choose **RGI** for the field.
- Choose a **colour ramp**.
- The map symbology now communicates information re: the quantity of rent geared to income housing per neighbourhood.



Filter Data using Definition Queries

- Open the **Attribute Table** of the libraries layer:
 - Right-click the layer name and select **Show Attribute Table**, or select the layer name and press **Ctrl + t**.
- Note that some records have **<Null>** for their address

OBJECTID *	Shape *	_id	BranchCode	PhysicalBranch	BranchName	Address	PostalCode	Website	Te
1	Point	1	AB	1	Albion	1515 Albion Road, Tor...	M9V 1B2	https://www.tpl.ca/albion	41
2	Point	2	ACD	1	Albert Campbell	496 Birchmount Road,...	M1K 1N8	https://www.tpl.ca/albert	41
3	Point	3	AD	1	Alderwood	2 Orianna Drive, Toron...	M8W 4Y1	https://www.tpl.ca/alderw	41
4	Point	4	AG	1	Agincourt	155 Bonis Avenue, Tor...	M1T 3W6	https://www.tpl.ca/agincc	41
5	Point	5	AH	1	Armour Heights	2140 Avenue Road, To...	M5M 4M7	https://www.tpl.ca/armou	41
6	Point	6	AL	0	Answerline	<Null>	<Null>	https://www.tpl.ca/contact	41
7	Point	7	AN	1	Annette Street	145 Annette Street, Tor...	M6P 1B2	https://www.tpl.ca/annett	41
8	Point	8	AP	1	Amesbury Park	1565 Lawrence Avenue...	M6L 1A8	https://www.tpl.ca/amest	41
9	Point	9	BB	1	Brookbanks	210 Brookbanks Drive,...	M3A 2T8	https://www.tpl.ca/brook	41
10	Point	10	BC	1	Black Creek	North York Sheridan M...	M3L 1B2	https://www.tpl.ca/blackc	41
11	Point	11	BD	1	Bendale	1515 Danforth Road, T...	M1J 1H5	https://www.tpl.ca/benda	41
12	Point	12	BE	1	Beaches	2161 Queen Street Eas...	M4L 1J1	https://www.tpl.ca/beach	41
13	Point	13	BF	1	Barbara Frum	20 Covington Road, To...	M6A 2C1	https://www.tpl.ca/barba	41
14	Point	14	BKONE	0	Bookmobile One	<Null>	<Null>	https://www.tpl.ca/bookn	<f
15	Point	15	BKTWO	0	Bookmobile Two	<Null>	<Null>	https://www.tpl.ca/bookn	<f
16	Point	16	BL	1	Bloor/Gladstone	1101 Bloor Street West...	M6H 1M7	https://www.tpl.ca/bloor	41
17	Point	17	BR	1	Brentwood	36 Brentwood Road N...	M8X 2B5	https://www.tpl.ca/brentv	41
18	Point	18	BRW	1	Bridlewood	Bridlewood Mall, 157A...	M1W 2S8	https://www.tpl.ca/bridle	41

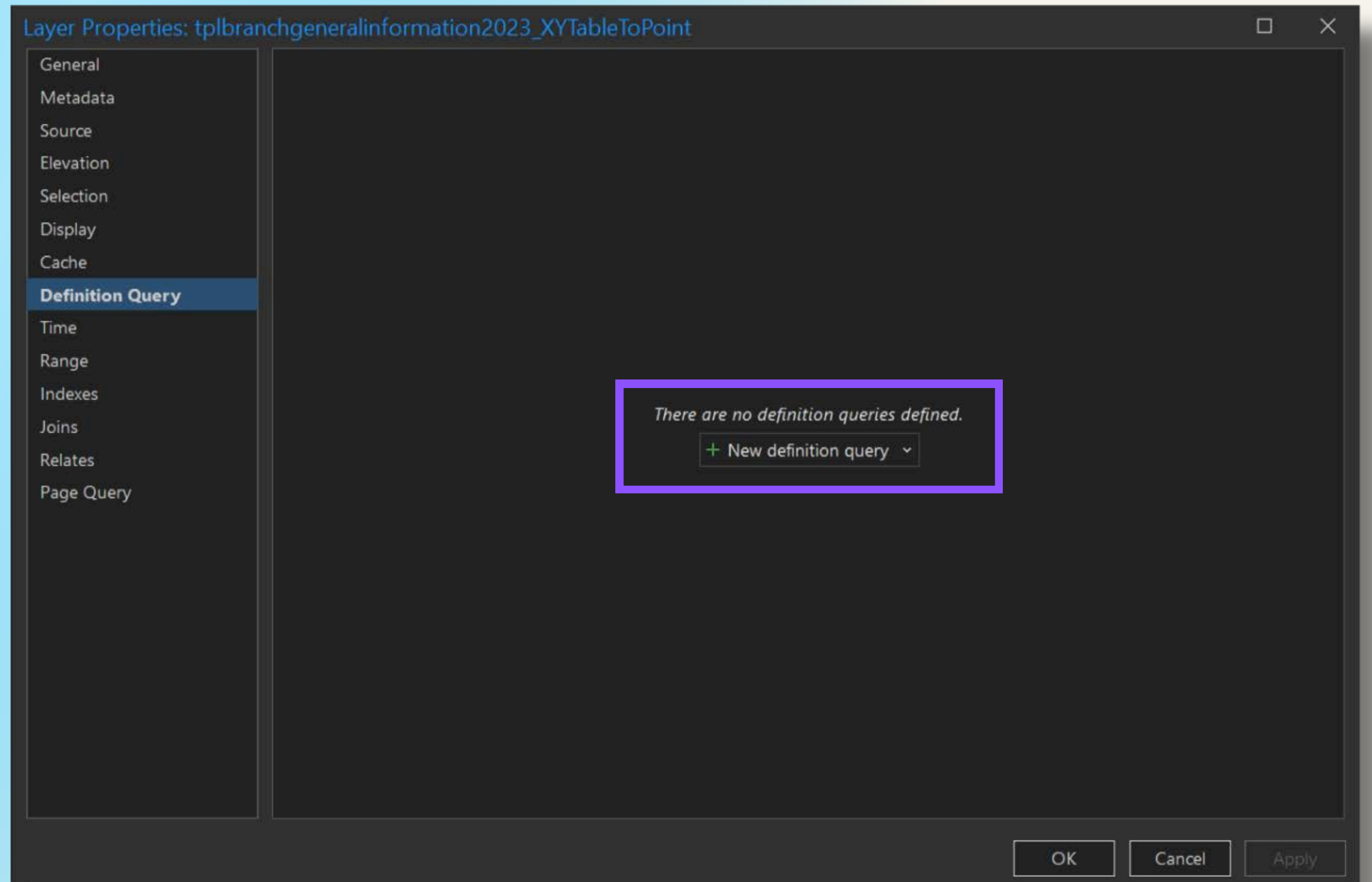
Filter Data using Definition Queries

- These records also lack latitude and longitude information, and are not displayed anywhere on the map
- Let's filter out these layers to exclude them from further analysis

	cyProgram	Workstations	ServiceTier	Lat	Long	NBHDNo	NBHDName	TPLNIA	WardNo	WardName	PresentSiteYear
1	1	38	DL	43.739826	-79.584096	2	Mount Olive-Silverston...	1	1	Etobicoke North	2017
2	0	36	DL	43.708019	-79.269252	120	Clairlea-Birchmount	1	20	Scarborough Southwest	1971
3	0	7	NL	43.601944	-79.547252	20	Alderwood	0	3	Etobicoke-Lakeshore	1999
4	0	42	DL	43.785167	-79.29343	118	Tam O'Shanter-Sullivan	0	22	Scarborough-Agincourt	1991
5	0	5	NL	43.739337	-79.421889	39	Bedford Park-Nortown	0	8	Eglinton-Lawrence	1982
6	<Null>	<Null>	RR	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
7	0	11	NL	43.663359	-79.466348	90	Junction Area	0	4	Parkdale-High Park	1908
8	0	6	NL	43.706456	-79.485726	30	Brookhaven-Amesbury	1	5	York South-Weston	1967
9	0	9	NL	43.759507	-79.325904	150	Fenside-Parkwoods	0	16	Don Valley East	1968
10	0	7	NL	43.721219	-79.510467	26	Downsview-Roding-CFB	1	7	Humber River-Black Cr...	2002
11	0	9	NL	43.751063	-79.244052	157	Bendale South	1	21	Scarborough Centre	1961
12	0	12	NL	43.67013	-79.298526	63	The Beaches	0	19	Beaches-East York	1914
13	1	30	DL	43.720752	-79.432215	32	Englemount-Lawrence	0	8	Eglinton-Lawrence	1992
14	<Null>	<Null>	NL	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
15	<Null>	<Null>	NL	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>	<Null>
16	0	36	DL	43.659878	-79.434022	83	Dufferin Grove	0	9	Davenport	1913
17	0	33	DL	43.647448	-79.514259	15	Kingsway South	0	3	Etobicoke-Lakeshore	1955
18	0	7	NL	43.797144	-79.31777	147	L'Amoreaux West	0	22	Scarborough-Agincourt	1992

Filter Data using Definition Queries

- Open the layer's Properties and select the **Definition Query** tab.
- Definition queries allow you to display only the subset of data that meets the conditions you set.
- Click **New Definition Query**.

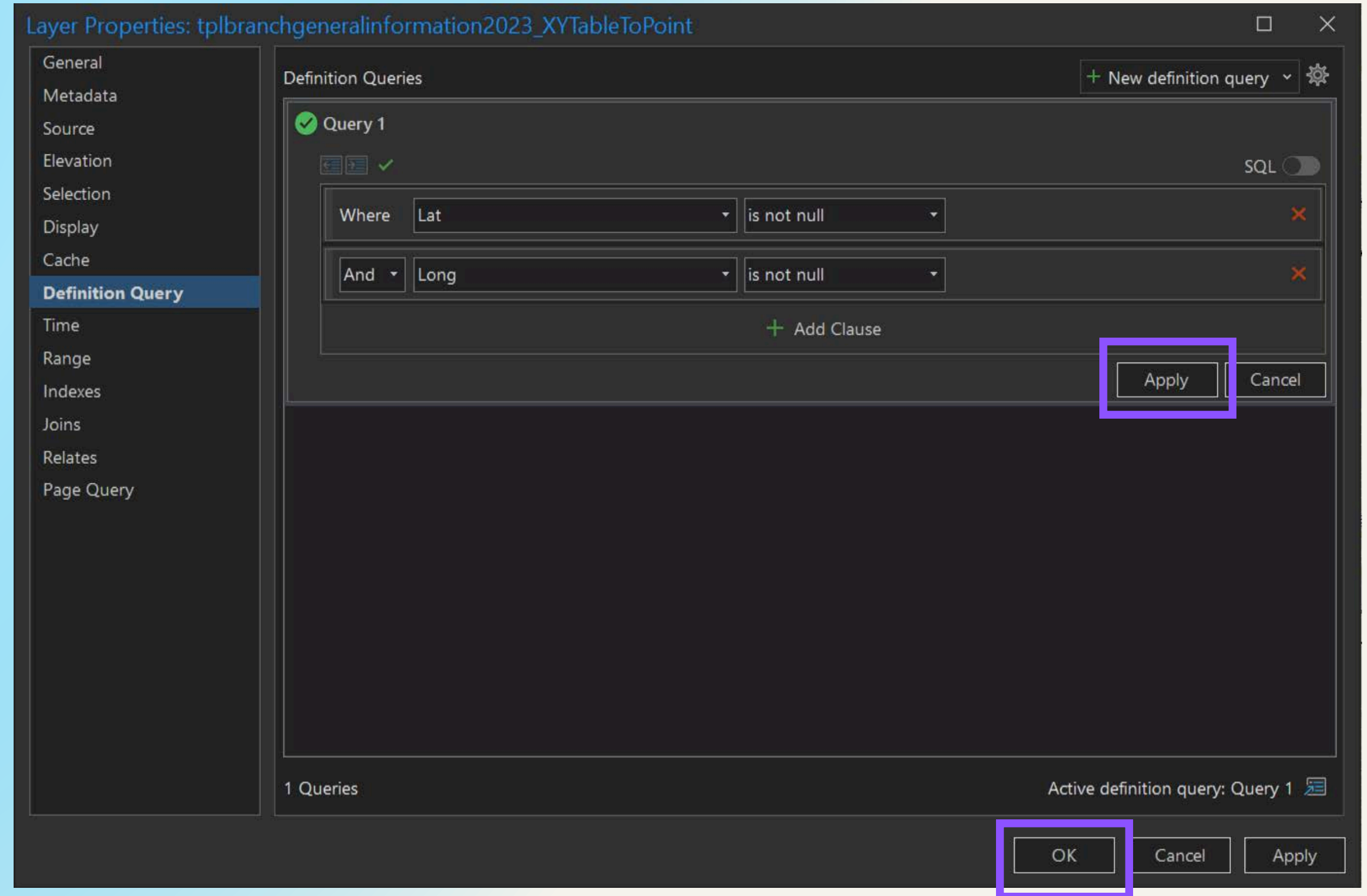


Filter Data using Definition Queries

- Create the query:
where Lat is not null And Long is not null

- Click **Apply**.

- Click **OK**.



Filter Data using Definition Queries

- Only the records that are associated with a physical location remain

tplbranchgeneralinfo..._XYTableToPoint

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy

	OBJECTID *	Shape *	_id	BranchCode	PhysicalBranch	BranchName	Address	PostalCode	Website	Te
1	1	Point	1	AB	1	Albion	1515 Albion Road, Tor...	M9V 1B2	https://www.tpl.ca/albion	41
2	2	Point	2	ACD	1	Albert Campbell	496 Birchmount Road,...	M1K 1N8	https://www.tpl.ca/albert	41
3	3	Point	3	AD	1	Alderwood	2 Orianna Drive, Toron...	M8W 4Y1	https://www.tpl.ca/alderw	41
4	4	Point	4	AG	1	Agincourt	155 Bonis Avenue, Tor...	M1T 3W6	https://www.tpl.ca/agincc	41
5	5	Point	5	AH	1	Armour Heights	2140 Avenue Road, To...	M5M 4M7	https://www.tpl.ca/armou	41
6	7	Point	7	AN	1	Annette Street	145 Annette Street, Tor...	M6P 1P3	https://www.tpl.ca/annett	41
7	8	Point	8	AP	1	Amesbury Park	1565 Lawrence Avenue...	M6L 1A8	https://www.tpl.ca/amesk	41
8	9	Point	9	BB	1	Brookbanks	210 Brookbanks Drive,...	M3A 2T8	https://www.tpl.ca/brook	41
9	10	Point	10	BC	1	Black Creek	North York Sheridan M...	M3L 1B2	https://www.tpl.ca/blackc	41
10	11	Point	11	BD	1	Bendale	1515 Danforth Road, T...	M1J 1H5	https://www.tpl.ca/benda	41
11	12	Point	12	BE	1	Beaches	2161 Queen Street Eas...	M4L 1J1	https://www.tpl.ca/beach	41
12	13	Point	13	BF	1	Barbara Frum	20 Covington Road, To...	M6A 3C1	https://www.tpl.ca/barba	41
13	16	Point	16	BL	1	Bloor/Gladstone	1101 Bloor Street West...	M6H 1M7	https://www.tpl.ca/bloorc	41
14	17	Point	17	BR	1	Brentwood	36 Brentwood Road N...	M8X 2B5	https://www.tpl.ca/brentv	41
15	18	Point	18	BRW	1	Bridlewood	Bridlewood Mall, 157A...	M1W 2S8	https://www.tpl.ca/bridle	41
16	19	Point	19	BUR	1	Burrows Hall	1081 Progress Avenue,...	M1B 5Z6	https://www.tpl.ca/burro	41
17	20	Point	20	CC	1	Cliffcrest	3017 Kingston Road, T...	M1M 1P1	https://www.tpl.ca/cliffcre	41
18	21	Point	21	CE	1	Centennial	578 Finch Avenue West...	M2R 1N7	https://www.tpl.ca/center	41
19	22	Point	22	CED	1	Cedarbrae	545 Markham Road, T...	M1H 2A1	https://www.tpl.ca/cedarl	41

0 of 102 selected

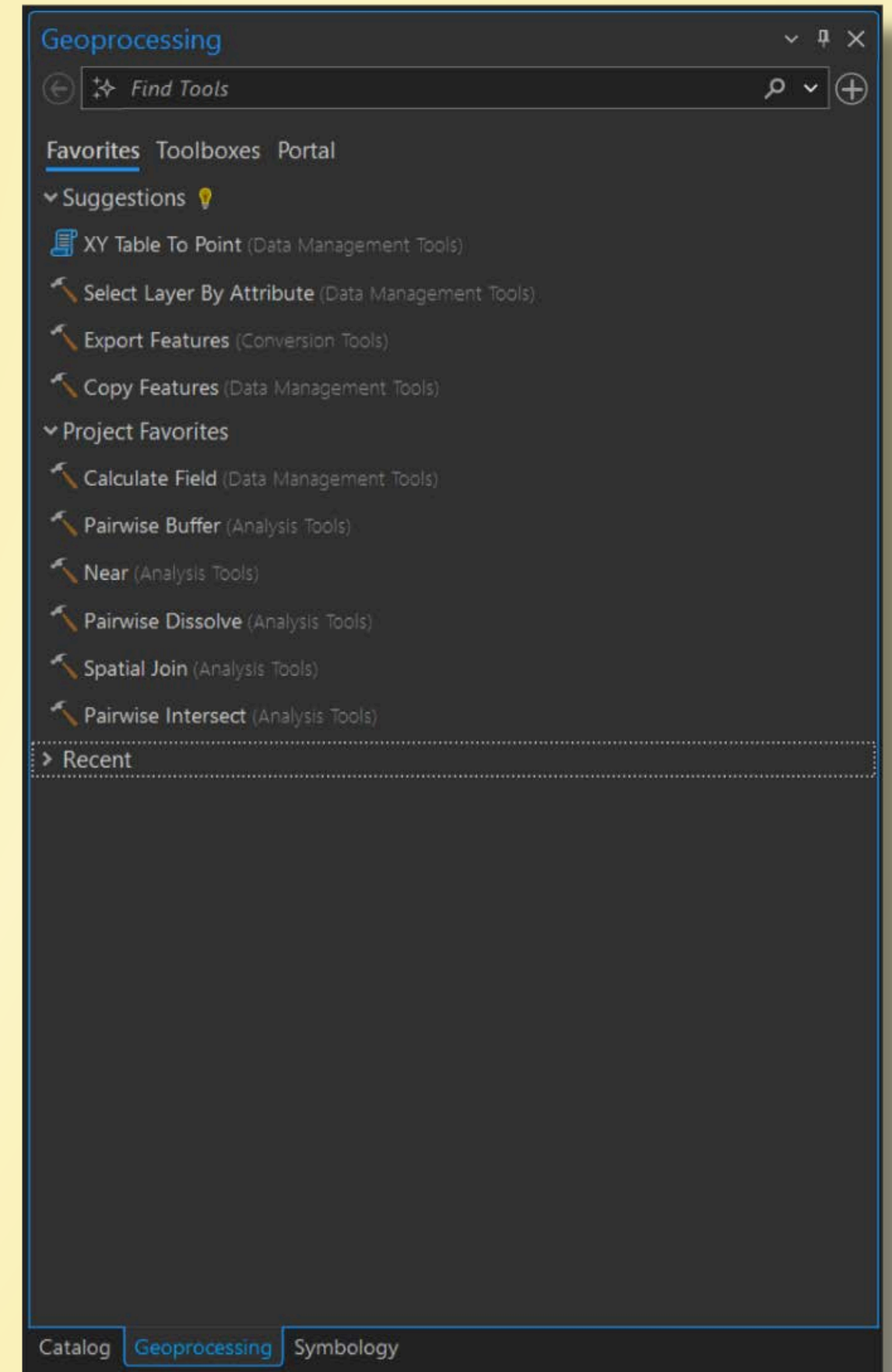
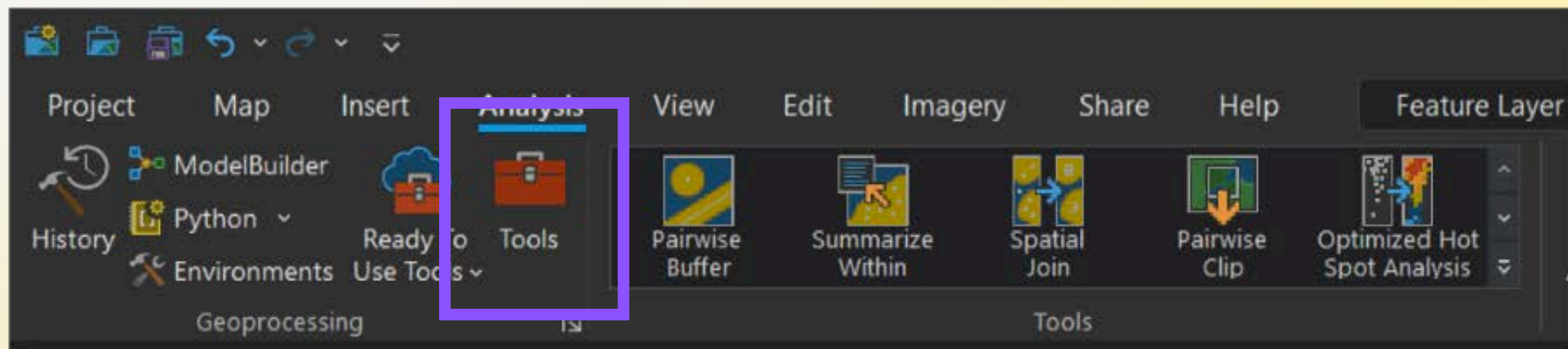
Filters: 100%

Geoprocessing

- **Geoprocessing tools** allow users to transform spatial layers and related data
- Typically accept input layer(s) along with other parameters, and output a new layer.
- ArcGIS Pro includes hundreds of geoprocessing tools

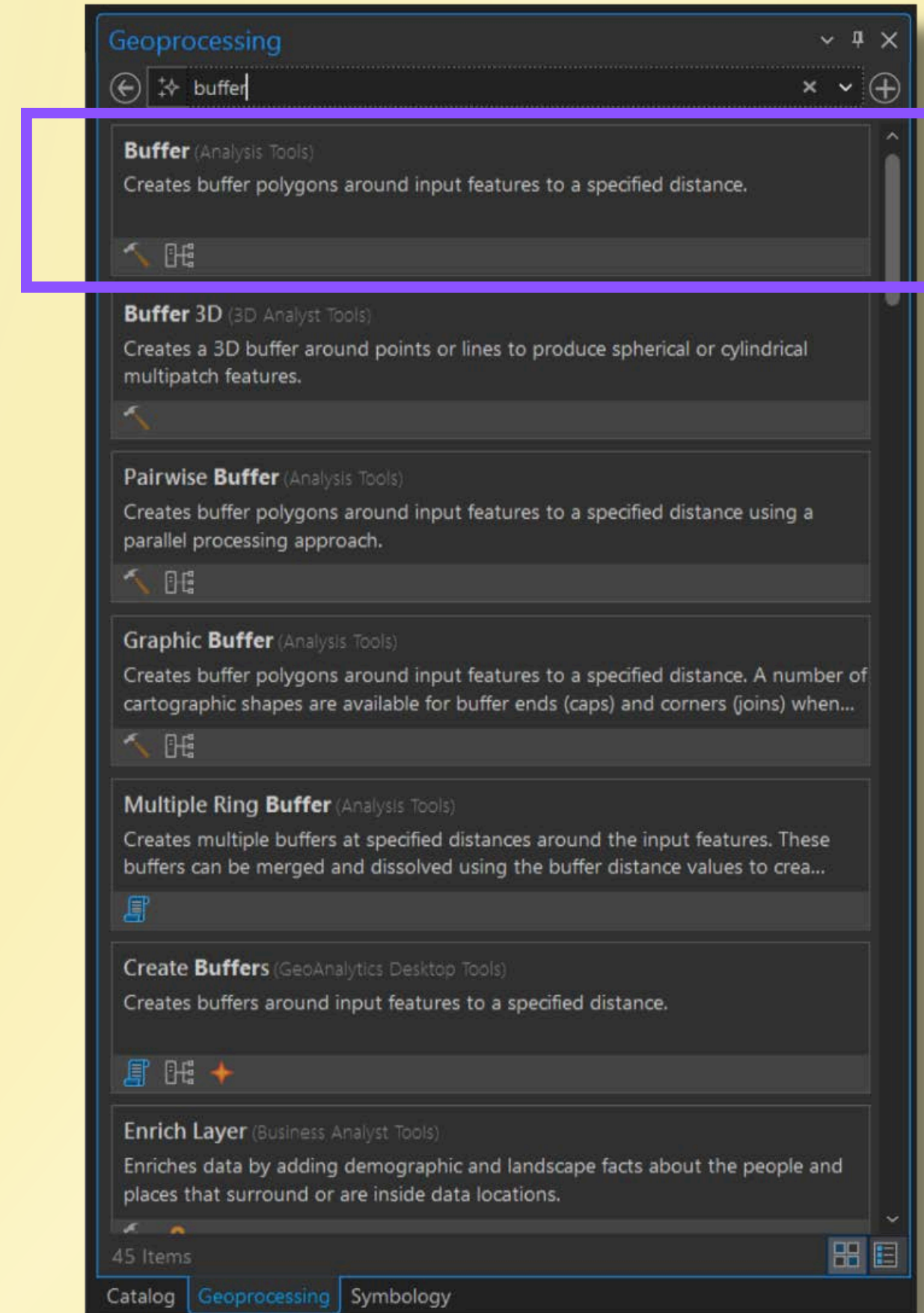
Geoprocessing Example: Buffer

- From the Analysis Tab/
Geoprocessing group, click
the **Tools** button.
- The Geoprocessing Pane will
appear.



Geoprocessing Example: Buffer

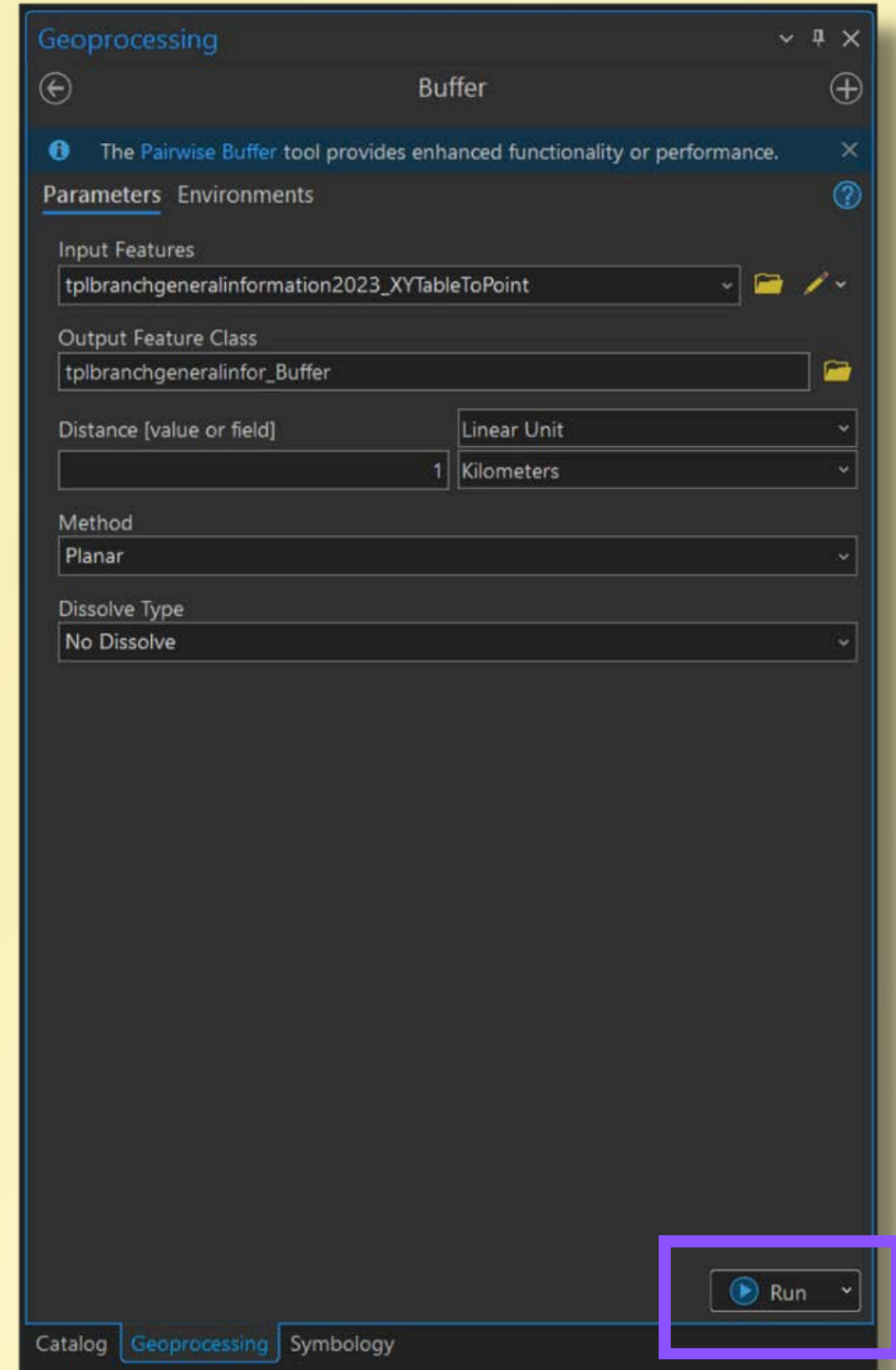
- Search for **Buffer** and click the first result.



Geoprocessing Example: Buffer

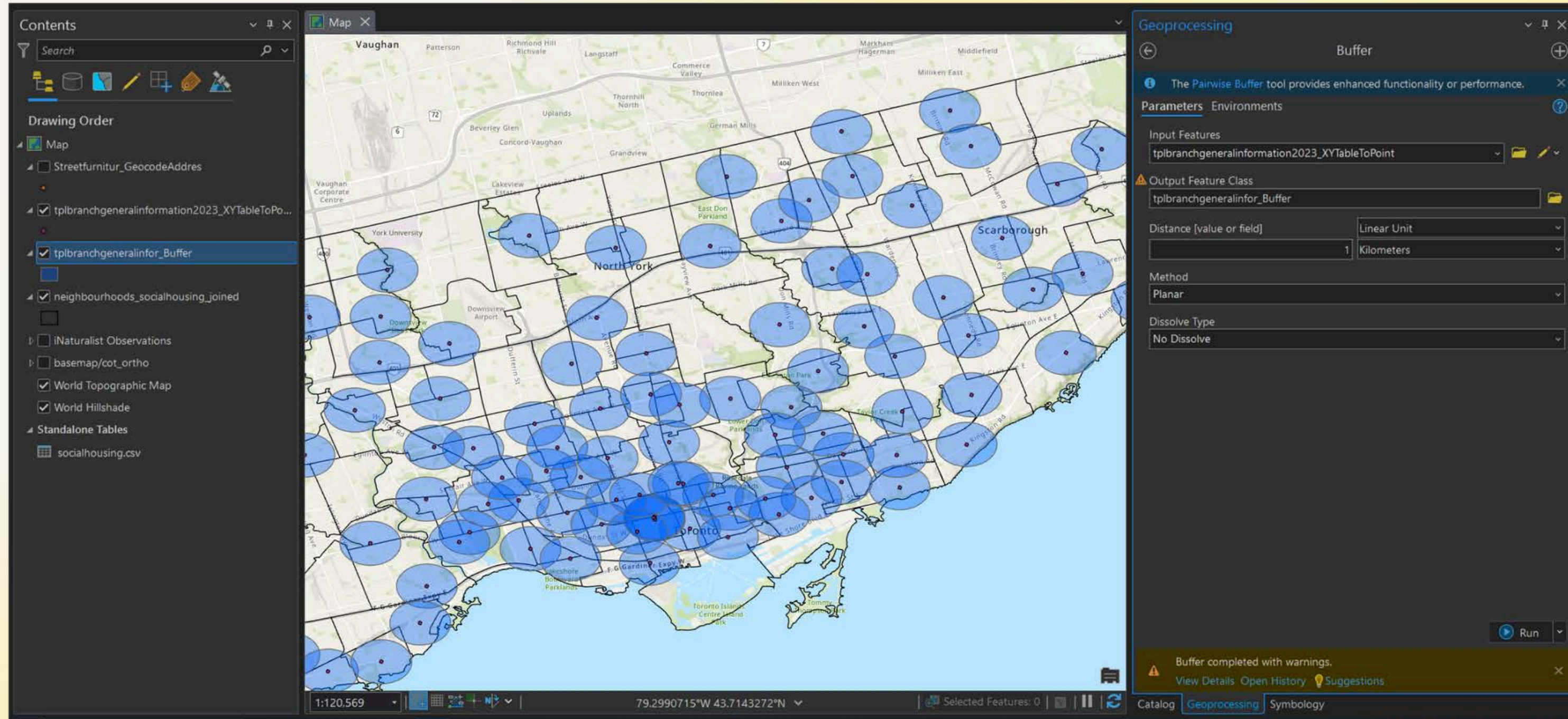
Parameters:

- Input Features: **Libraries**
- Distance: **1 kilometre**
- Click **Run**.



Geoprocessing Example: Buffer

Result:



The screenshot displays the ArcGIS Desktop interface during a Buffer tool execution. The central map shows a geographic area with a grid of blue circular buffers overlaid on it. The buffers are centered on points from the 'tpibranchgeneralinformation2023_XYTableToPoint' dataset. The Geoprocessing pane on the right shows the following parameters:

- Tool:** Buffer
- Input Features:** tpibranchgeneralinformation2023_XYTableToPoint
- Output Feature Class:** tpibranchgeneralinfor_Buffer
- Distance [value or field]:** 1
- Linear Unit:** Kilometers
- Method:** Planar
- Dissolve Type:** No Dissolve

A status bar at the bottom of the Geoprocessing pane indicates: "Buffer completed with warnings. View Details Open History Suggestions".

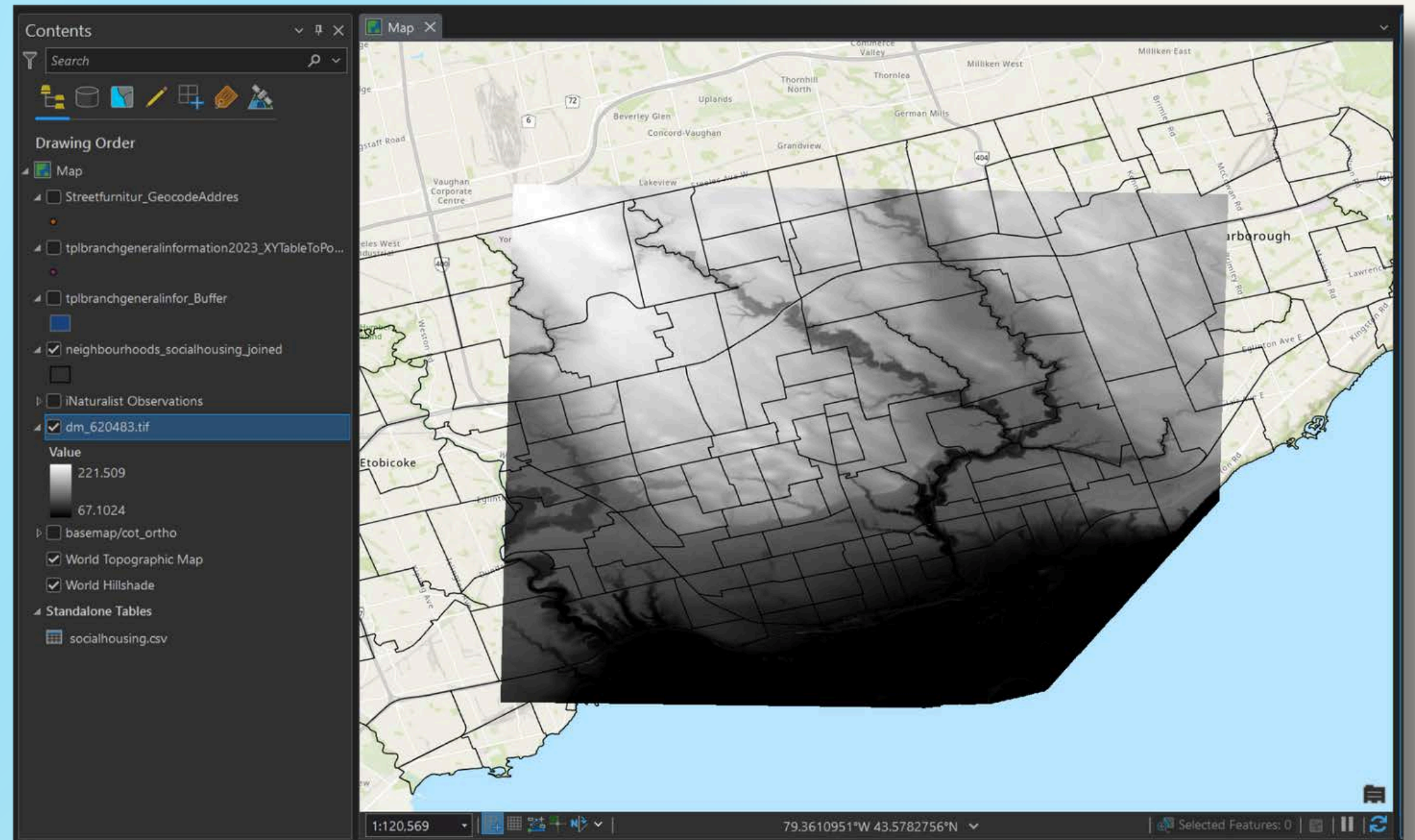
Working with Raster Data

Raster data

- Geographic information expressed as a grid of pixels (also called 'cells').
- Each pixel represents a specific value, such as elevation, temperature, or land cover class.
- Common file formats:
 - **TIFF/GeoTIFF** - Very common in desktop publishing and GIS
 - **Esri Grid** - Proprietary ArcGIS format
 - **NetCDF** - Multidimensional raster data

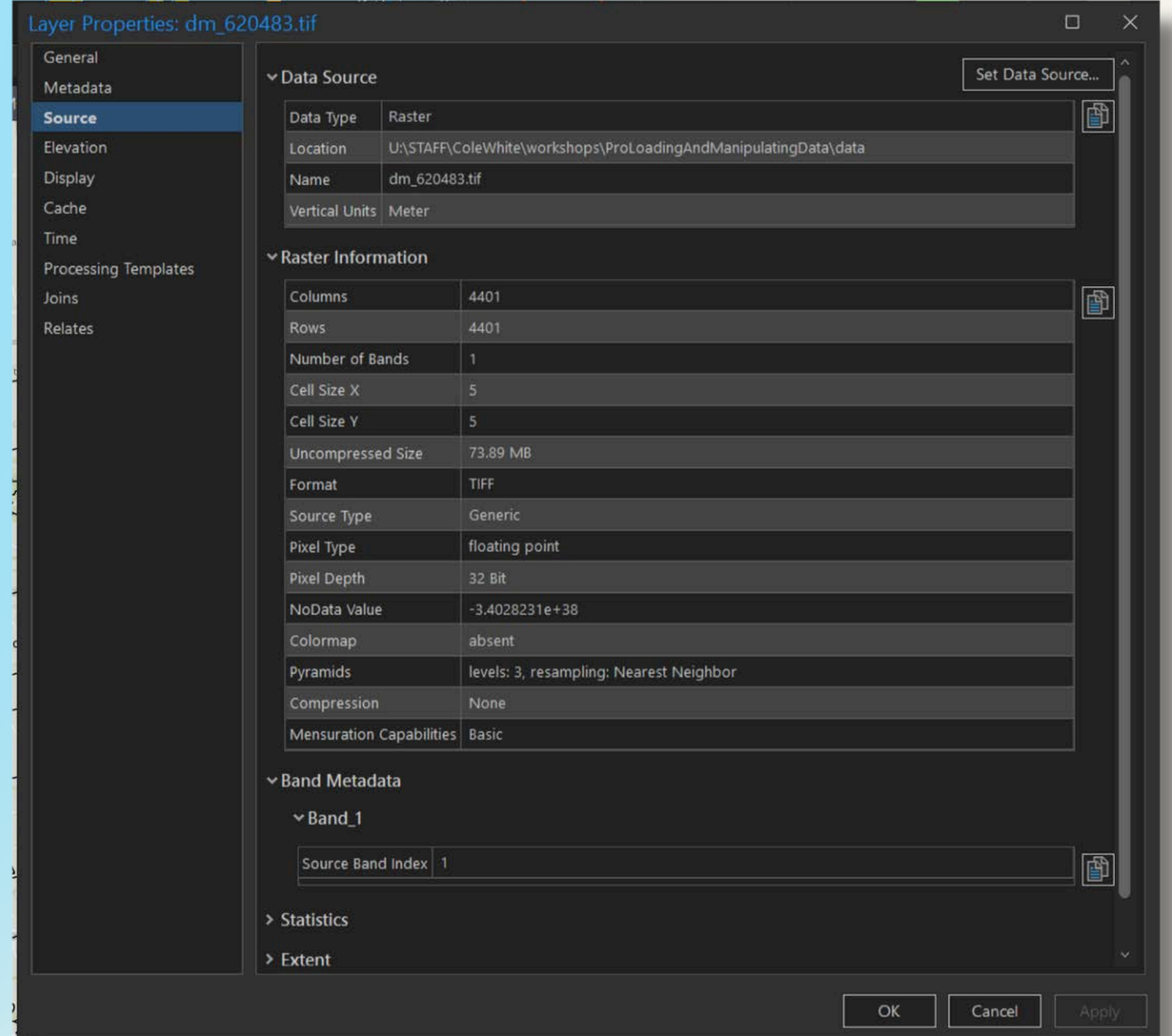
Working with Raster Data

- Add the **dm_620483.tif** file from the workshop data to the map
- Double click on the layer name in the Contents pane to view the layer's properties.



Working with Raster Data

- Note the number of **columns** and **rows**, number of **bands**, **cell size**, and **spatial reference**.



The screenshot shows the 'Layer Properties: dm_620483.tif' dialog box. The 'Source' tab is selected in the left-hand menu. The 'Data Source' section shows the following information:

Data Type	Raster
Location	U:\STAFF\ColeWhite\workshops\ProLoadingAndManipulatingData\data
Name	dm_620483.tif
Vertical Units	Meter

The 'Raster Information' section shows the following details:

Columns	4401
Rows	4401
Number of Bands	1
Cell Size X	5
Cell Size Y	5
Uncompressed Size	73.89 MB
Format	TIFF
Source Type	Generic
Pixel Type	floating point
Pixel Depth	32 Bit
NoData Value	-3.4028231e+38
Colormap	absent
Pyramids	levels: 3, resampling: Nearest Neighbor
Compression	None
Mensuration Capabilities	Basic

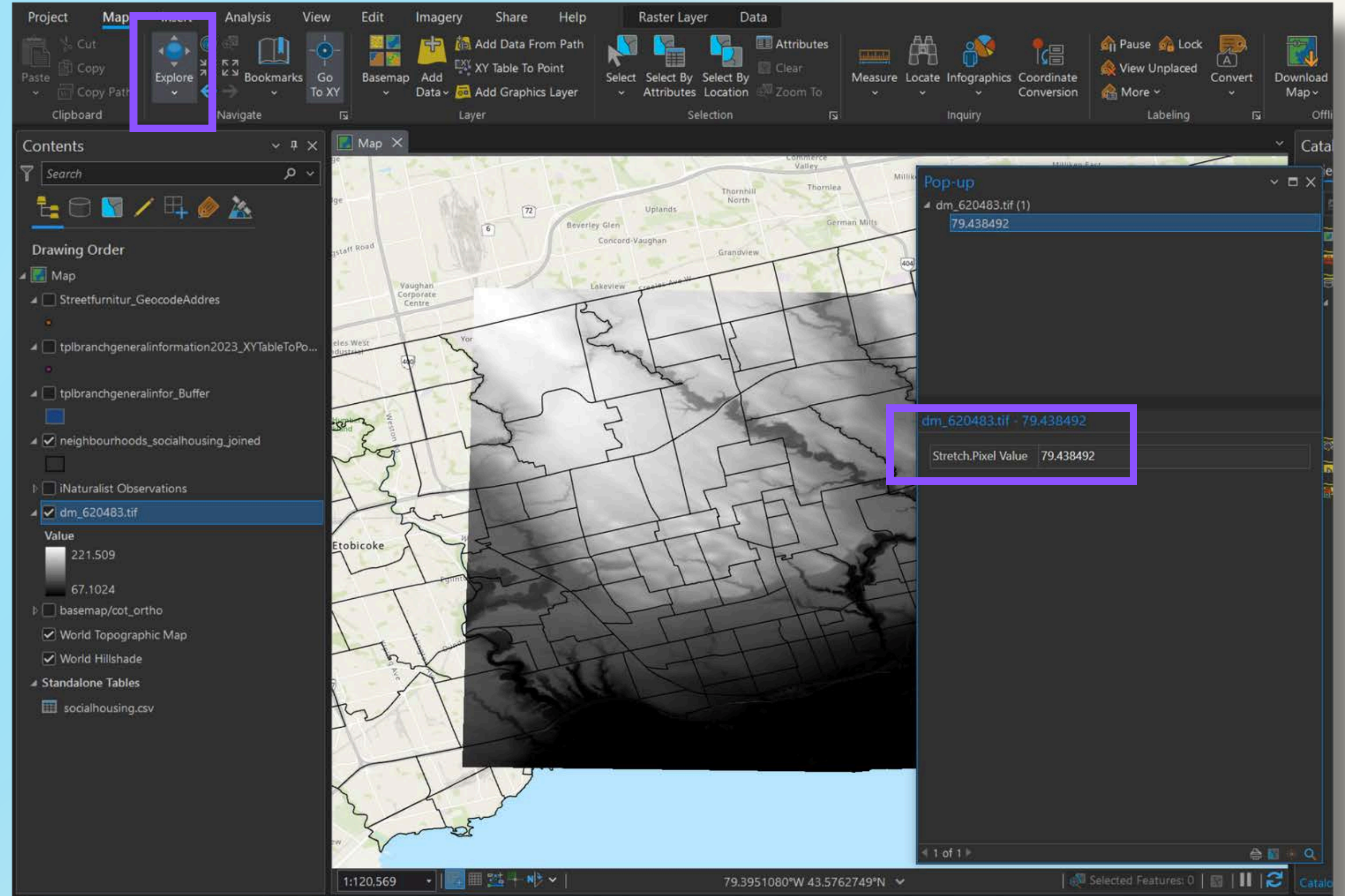
The 'Band Metadata' section shows the following information for 'Band_1':

Source Band Index	1
-------------------	---

At the bottom of the dialog, there are buttons for 'OK', 'Cancel', and 'Apply'.

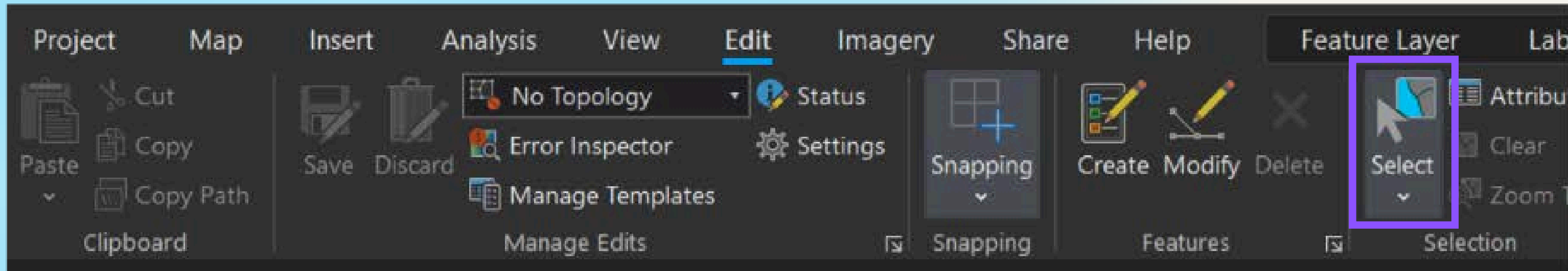
Working with Raster Data

- The **Explore** tool can be used to query pixel (elevation) values



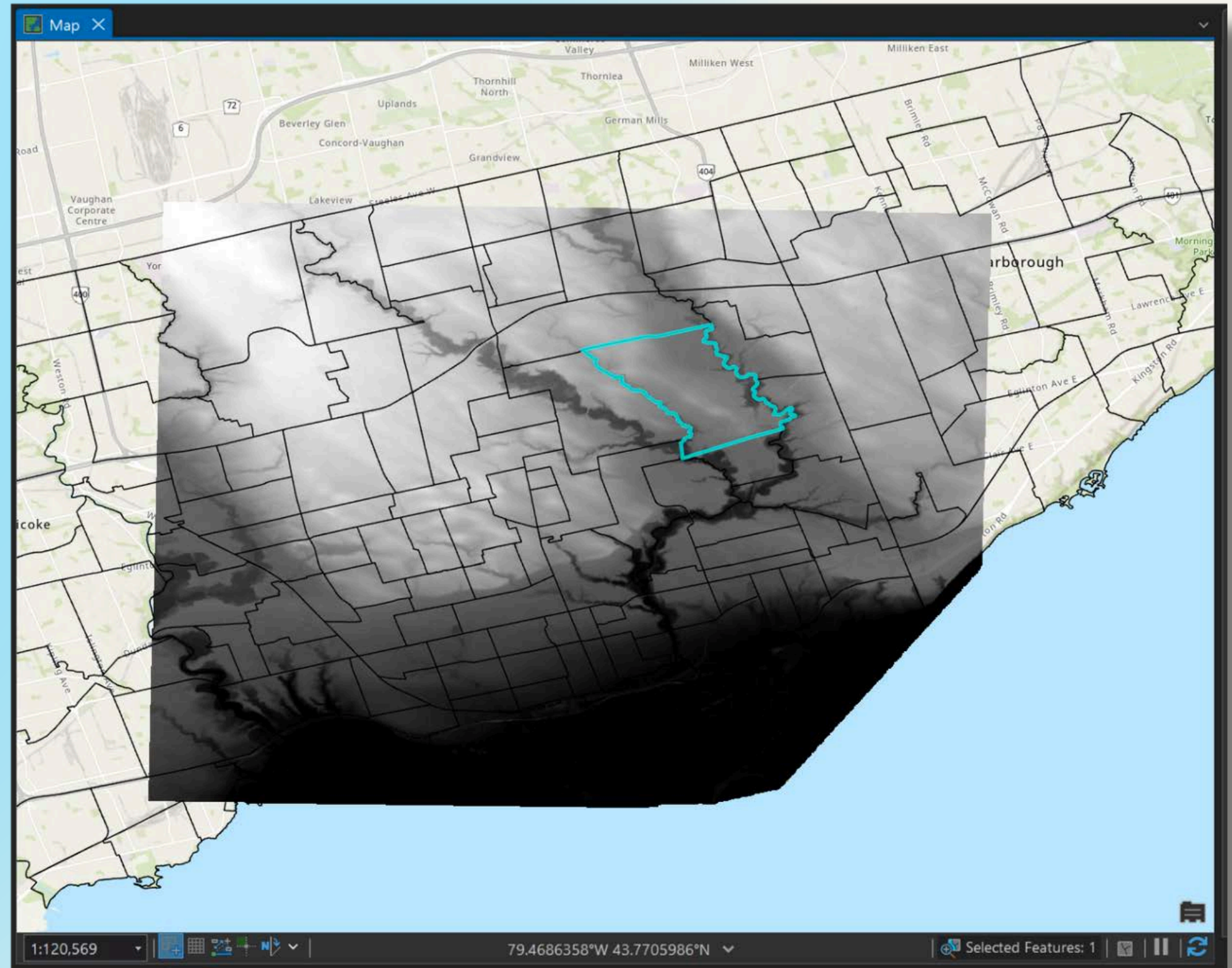
Working with Raster Data: Geoprocessing

- From the Edit tab/Selection group, choose the **Select** tool.



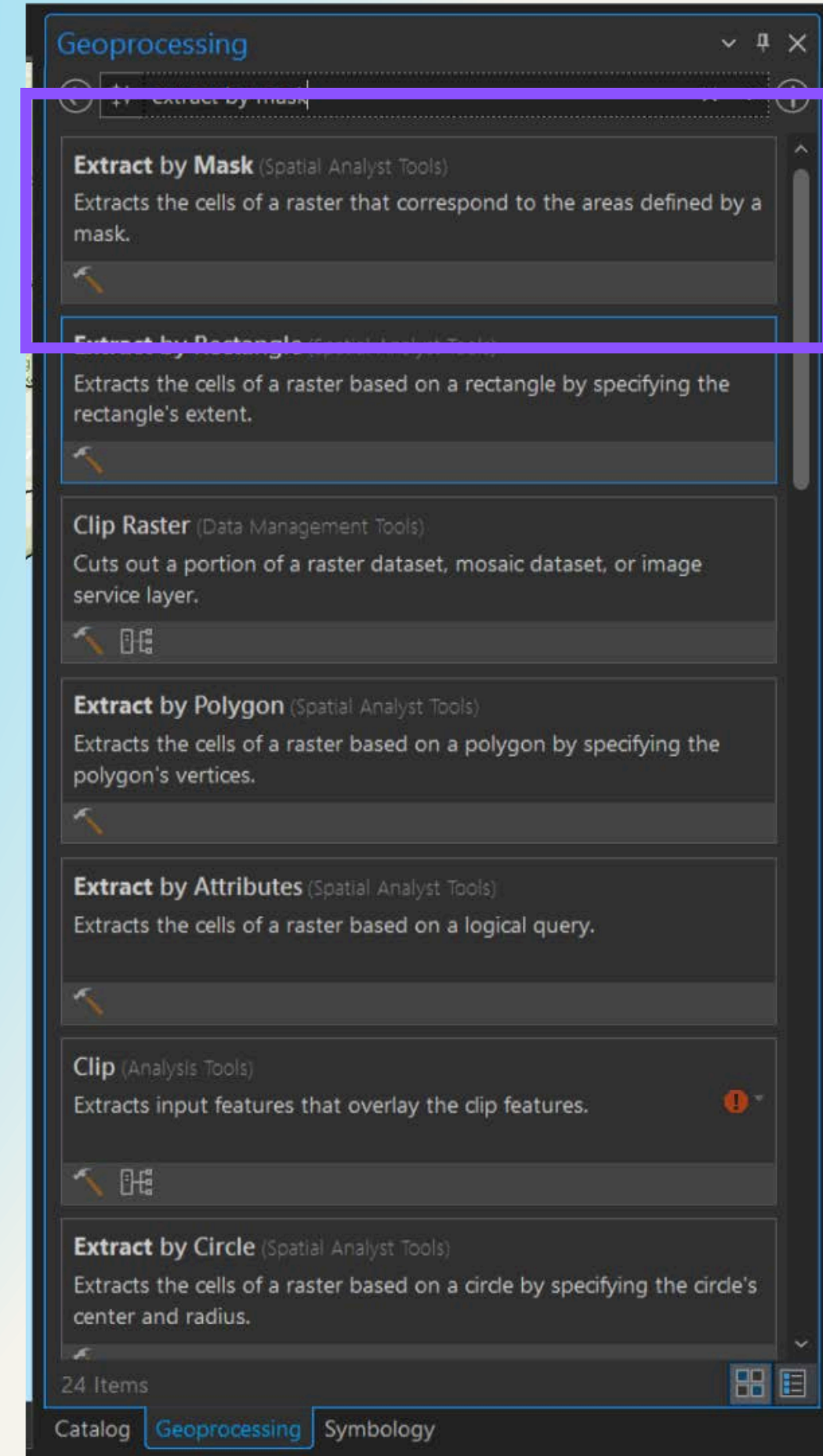
Working with Raster Data: Geoprocessing

- Click within the map view to select one of the neighbourhood polygons.



Working with Raster Data: Geoprocessing

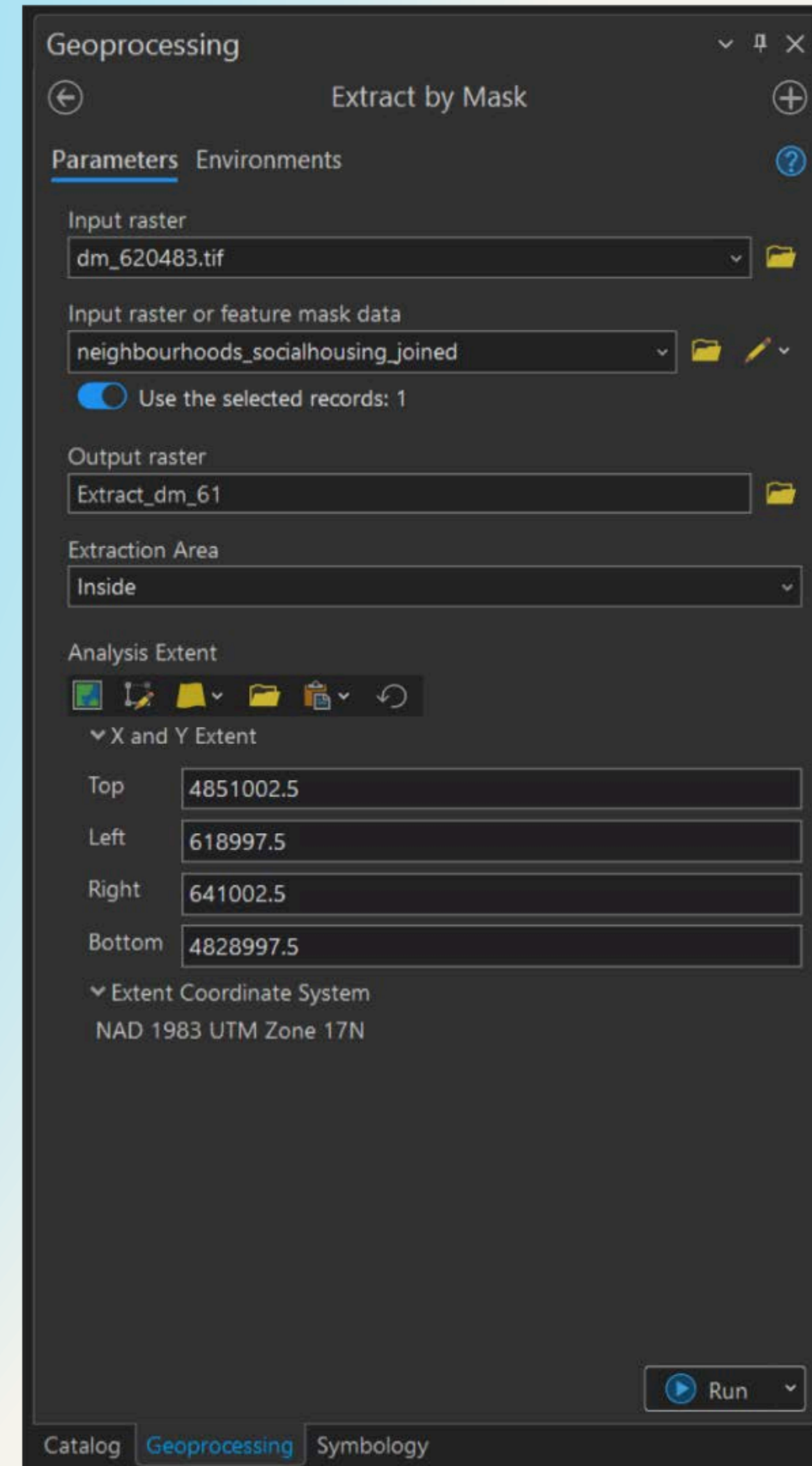
- From the **Geoprocessing** pane, open the **Extract by Mask** tool.



Working with Raster Data: Geoprocessing

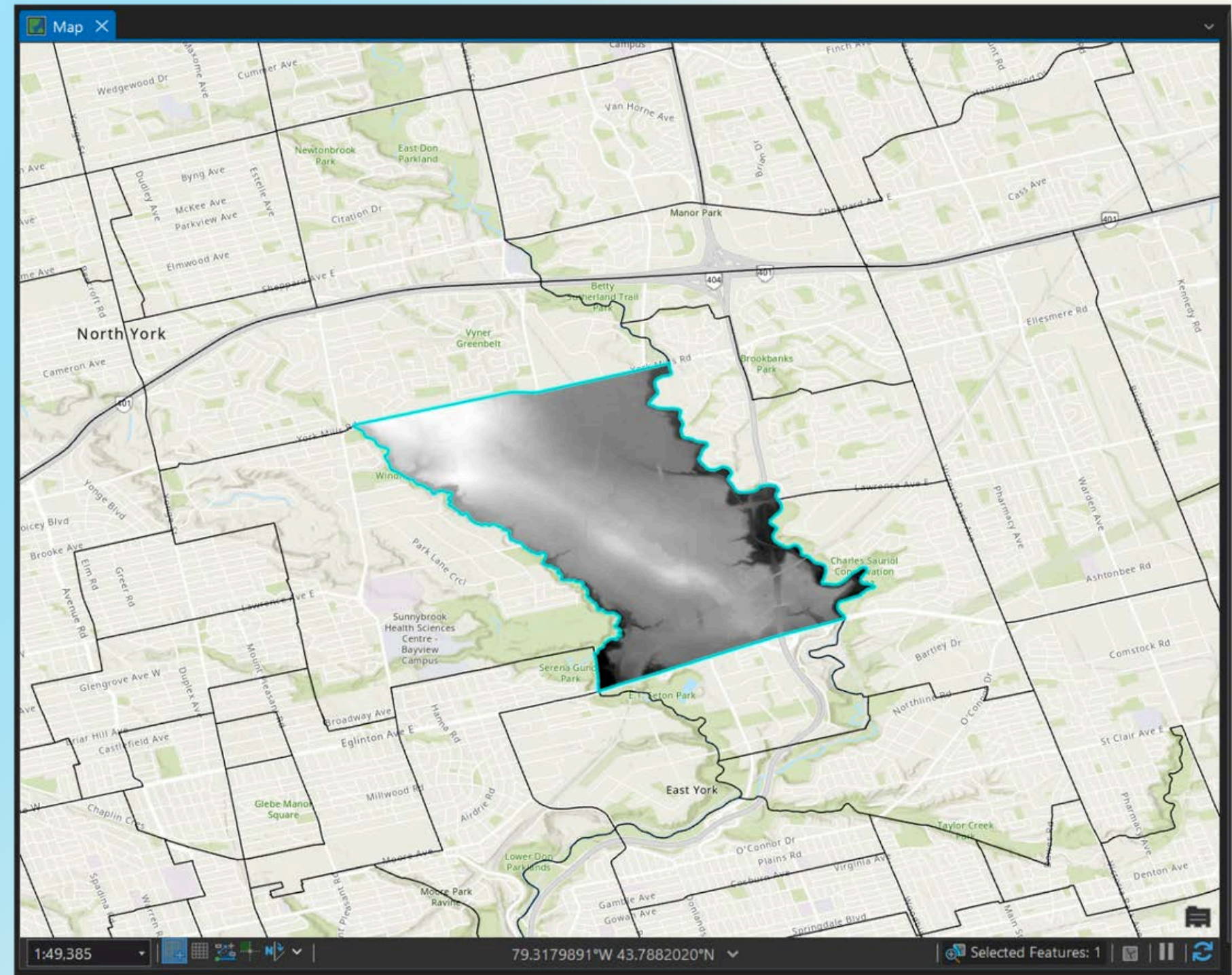
Input Parameters:

- Input raster: DEM
- Input raster or feature mask data: The neighbourhoods layer
- Note that the tool honours the layer selection
- Click Run.



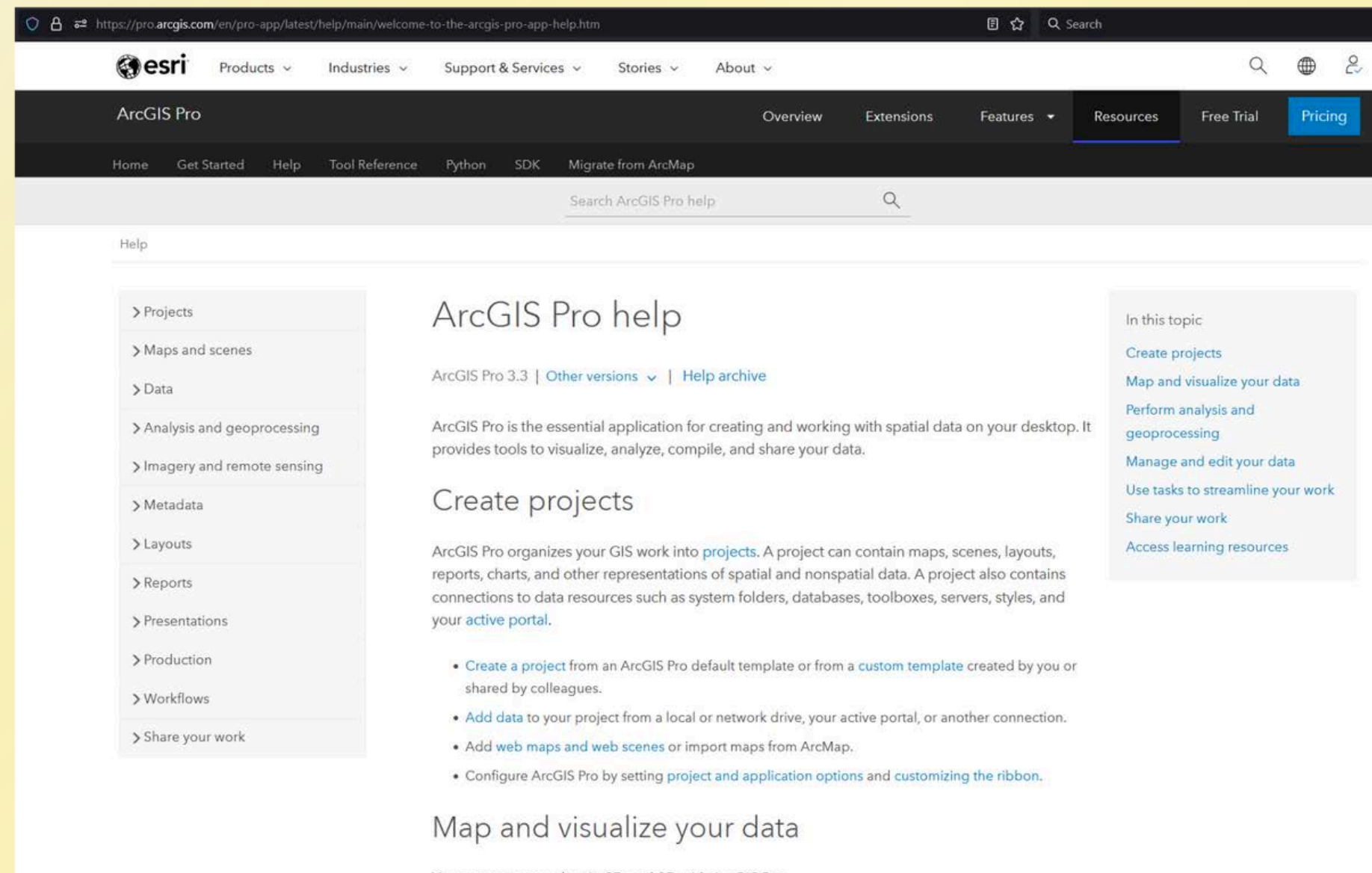
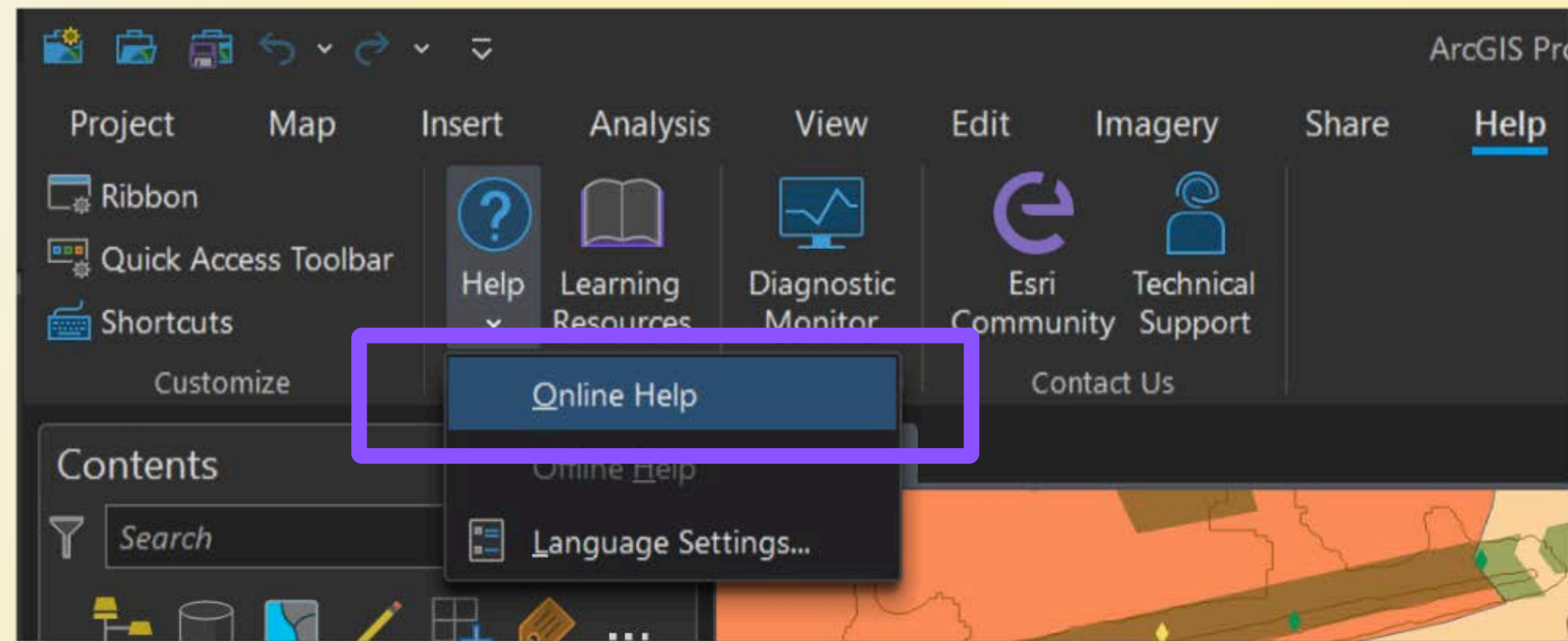
Working with Raster Data: Geoprocessing

Result:



Getting Help

- From the **Help** tab in Pro, choose **Help** -> **Online Help**
- A website will be launched where you can access detailed documentation for the latest version of Pro.



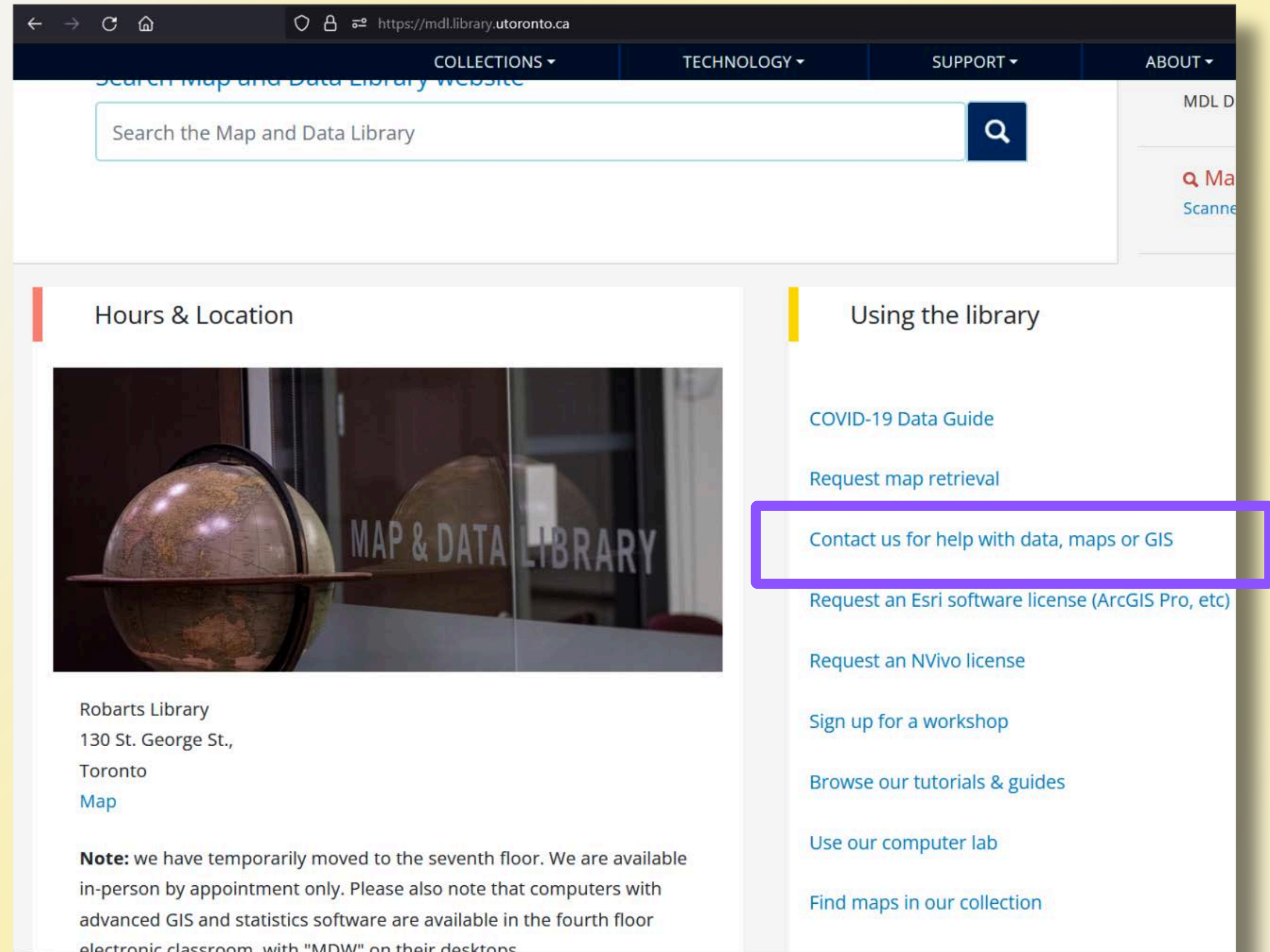
Getting Help

- Visit <https://www.esri.com/training/> and log in with your UTORid.
- The **Course Catalog** contains many helpful, beginner-friendly tutorials.

The screenshot shows the Esri Academy Course Catalog page. At the top, there is a navigation bar with the Esri logo and links for Products, Industries, Support & Services, Stories, and About. Below this is a secondary navigation bar with links for Esri Academy, About, Catalog (which is highlighted), Certification, My Academy, and Help. Underneath, there are more specific links for Course Catalog, Courses by Schedule, Courses by Location, New and Retired Training, and Learning Plans. The main heading is "Explore Our Courses". A search bar labeled "Search Courses" is present, along with a "Search Tips" link. Below the search bar is a "Browse by Topic" section with nine icons representing different course categories: Getting Started, ArcGIS Products, Data Management, Mapping, Spatial Analysis & Data Science, Field Operations, Scripting & Development, Imagery & Remote Sensing, and 3D Visualization & Analytics. At the bottom, there are filters for FORMATS (Viewing All), PRODUCTS (Viewing All), Maintenance Subscription, and Free. The SORT dropdown is set to "Recently Added". The page shows "Viewing Results: 500". Three course cards are visible, each with a "NEW" badge: "Using ArcGIS AllSource for Geospatial Intelligence Analysis" (2 Days (16 Hours)), "Esri ArcGIS Pro Foundation Certification 2025" (Added by Esri Technical Certification on August 13, 2024), and "Esri ArcGIS Pro Associate Certification 2025" (Added by Esri Technical Certification on August 13, 2024).

Getting Help

- Contact the Map and Data Library



The screenshot shows the website for the Map and Data Library at the University of Toronto. The browser address bar displays <https://mdl.library.utoronto.ca>. The navigation menu includes [COLLECTIONS](#), [TECHNOLOGY](#), [SUPPORT](#), and [ABOUT](#). A search bar is located below the navigation menu with the placeholder text "Search the Map and Data Library".

The main content area is divided into two columns. The left column is titled "Hours & Location" and features a photograph of a globe in a library setting with the text "MAP & DATA LIBRARY" overlaid. Below the image, the address is listed: "Robarts Library, 130 St. George St., Toronto". A link for "Map" is provided. A note states: "Note: we have temporarily moved to the seventh floor. We are available in-person by appointment only. Please also note that computers with advanced GIS and statistics software are available in the fourth floor electronic classroom, with 'MDW' on their desktops."

The right column is titled "Using the library" and contains a list of services, each with a corresponding link: "COVID-19 Data Guide", "Request map retrieval", "Contact us for help with data, maps or GIS" (highlighted with a purple box), "Request an Esri software license (ArcGIS Pro, etc)", "Request an NVivo license", "Sign up for a workshop", "Browse our tutorials & guides", "Use our computer lab", and "Find maps in our collection".

Next Steps

- Layout creation
- Analysis
- Working with raster data
- Automation
- Artificial Intelligence/Machine Learning



Resources: Finding Spatial Data

MDL Geospatial Data Collection

<https://mdl.library.utoronto.ca/collections/geospatial-data>

Scholars GeoPortal

<https://geo.scholarsportal.info>

Natural Earth Data

<https://www.naturalearthdata.com/>

Open Street Map

<https://www.openstreetmap.org>

City of Toronto Open Data

<https://open.toronto.ca/>

Ontario GeoHub

<https://geohub.lio.gov.on.ca/>

Toronto and Region Conservation Authority

Open Data

<https://data.trca.ca/>

GIS at NASA

<https://www.earthdata.nasa.gov/learn/gis>

ArcGIS Hub

<https://hub.arcgis.com/search>

Living Atlas

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

USGS EarthExplorer

<https://earthexplorer.usgs.gov/>

Thank you!