

Spatial Analysis with ArcGIS Pro

Welcome! The workshop will start shortly.

Download the data here:

<https://uoft.me/ProAnalysis>



Please mute your mic and turn off your video



Use the chat to ask questions



Slides will be shared

Spatial Analysis with ArcGIS Pro

Location intelligence for real-world
problems

<https://uoft.me/ProAnalysis>

How to use modern GIS to visualize, analyze, and communicate spatial solutions

What We'll Cover

01

Introduction

02

The ArcGIS Pro
Application

03

Map Creation &
Analysis

04

Sharing &
Collaboration

05

Resources

The Map and Data Library

- Data collections
- Workshops and training
- In-person and virtual support

Robarts Library

7th Floor

Open 11am - 5pm weekdays by
appointment

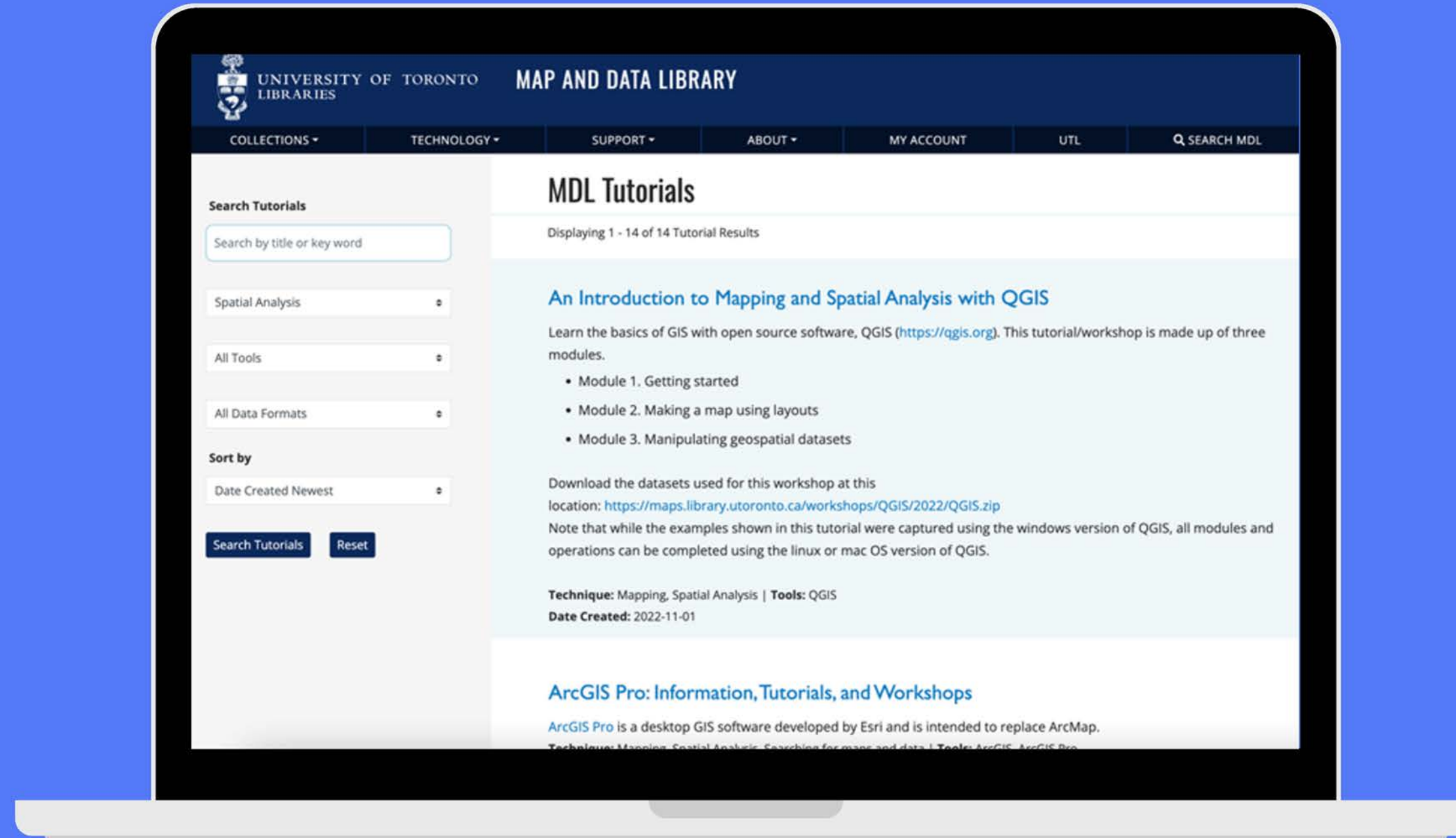
<https://mdl.library.utoronto.ca/>



1. Introduction

MDL: Tutorials and Workshops

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



1. Introduction

Map and Data Library: Getting Help

Virtual support:

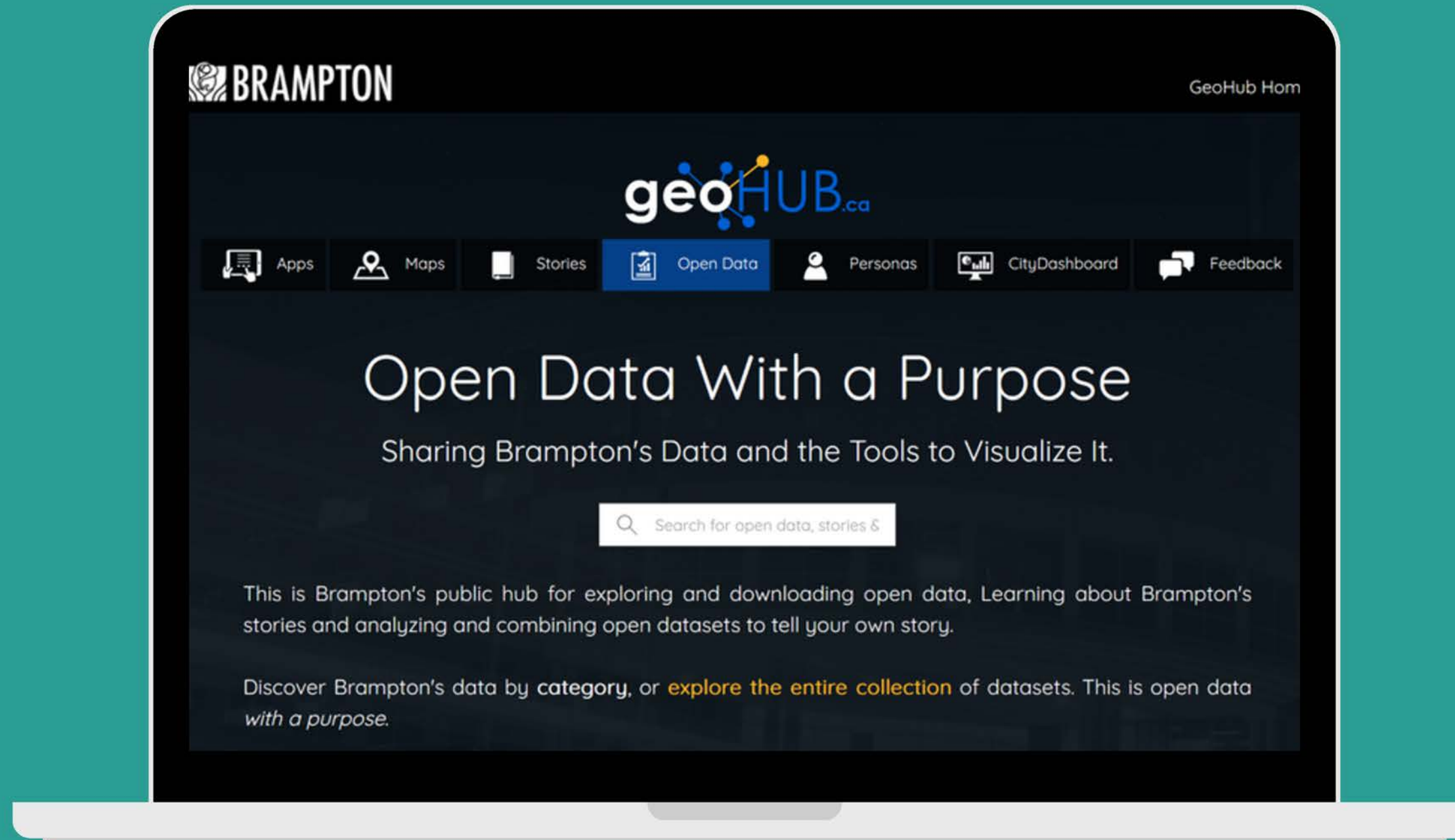
- Email us to get started
mdl@library.utoronto.ca

In-person support:

- Reference Area:
Robarts, 7th Floor
Monday-Friday, 11am-5pm



1. Introduction Open Data





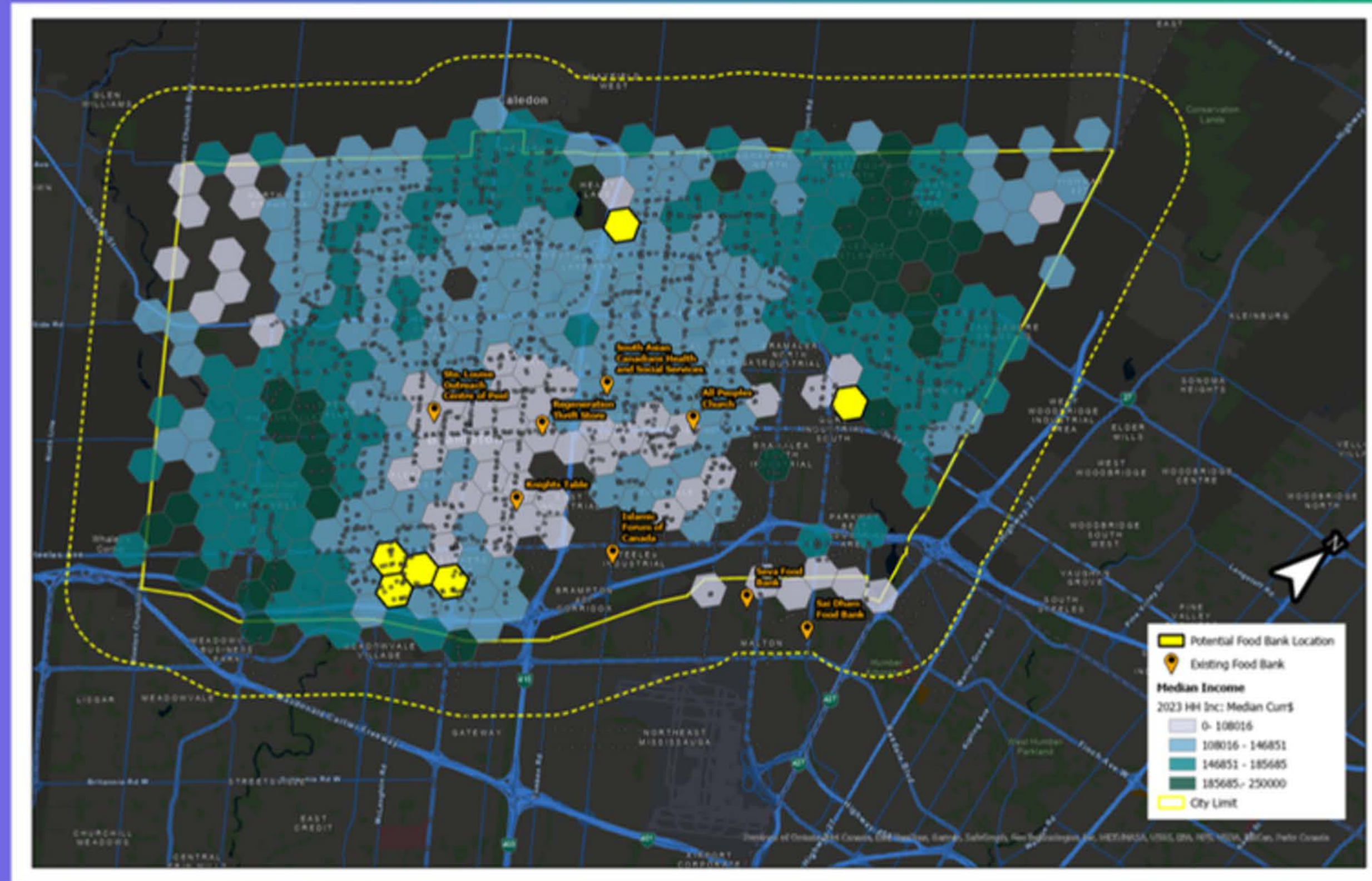
1. Introduction

Spatial Problem Solving Example: Public Health

- Identify health trends by location
- Find locations to implement new services for those at risk
- Track infectious diseases
- Study how demographic factors affect the health of communities
- Report on cases of a virus

1. Introduction

- This is the map we'll create.





1. Introduction

Case Study: Where to establish new food banks in Brampton

- What are the criteria to determine the best locations?
 - Income level?
 - Population density?
 - Existing resources?
 - Transportation network?
 - Land use?
 - Community needs?



1. Introduction

Case Study: Where to establish new food banks in Brampton

- What **spatial** and/or **statistical data** will we need to locate or create?
 - Road network?
 - Demographic data from the Canadian Census?
 - Existing services?
 - Health statistics?



1. Introduction

Case Study: Where to establish new food banks in Brampton

- What tools/software will be used?
 - ArcGIS Online?
 - ArcGIS Pro?
 - QGIS?



1. Introduction

Case Study: Where to establish new food banks in Brampton

- How will the results be shared?
 - Reports?
 - Interactive web maps?
 - Dashboards?
 - Presentations?
 - Posters?

1. Introduction

Designing a GIS project

Find and assess spatial data

- MDL Website, Open Data, ArcGIS Online/Living Atlas, etc.
- Create your own data if needed.
- Assess data quality, software compatibility, completeness, licensing.

Symbolization & analysis

- Style, Labels, Filters, etc.
- Use analysis tools to gain insights.

Sharing & collaboration

- Results can be shared as digital data, printed as map layouts, or uploaded to ArcGIS Online and shared as interactive web maps.

2. ArcGIS Pro



ArcGIS[®] Pro

2. ArcGIS Pro Logging In

The image shows a dark-themed dialog box titled "ArcGIS Sign In" with a close button (X) in the top right corner. The dialog is divided into sections. The first section is "ArcGIS login" with a dropdown arrow. The second section is "Your ArcGIS organization's URL" with an expand/collapse arrow. Below this, there is a text input field containing "utoronto" and a domain dropdown menu showing ".maps.arcgis.com". A checkbox labeled "Remember this URL" is checked. A blue "Continue" button is located at the bottom right of the main content area. At the bottom of the dialog, there is a checkbox for "Sign in automatically" which is checked, and a link "Configure Licensing Sign In Using Browser" in blue text.

ArcGIS Sign In

ArcGIS login

Your ArcGIS organization's URL

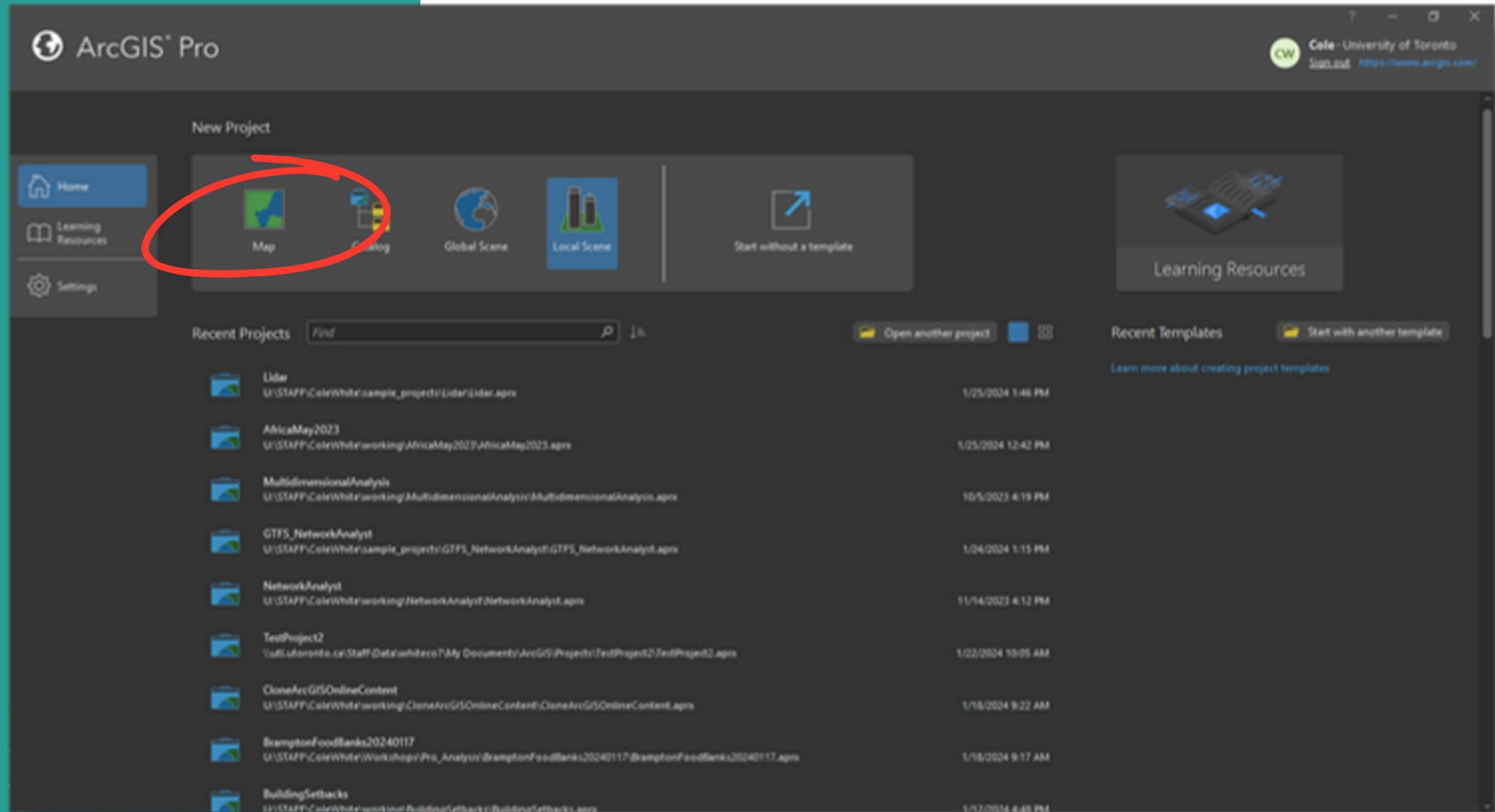
utoronto .maps.arcgis.com

Remember this URL

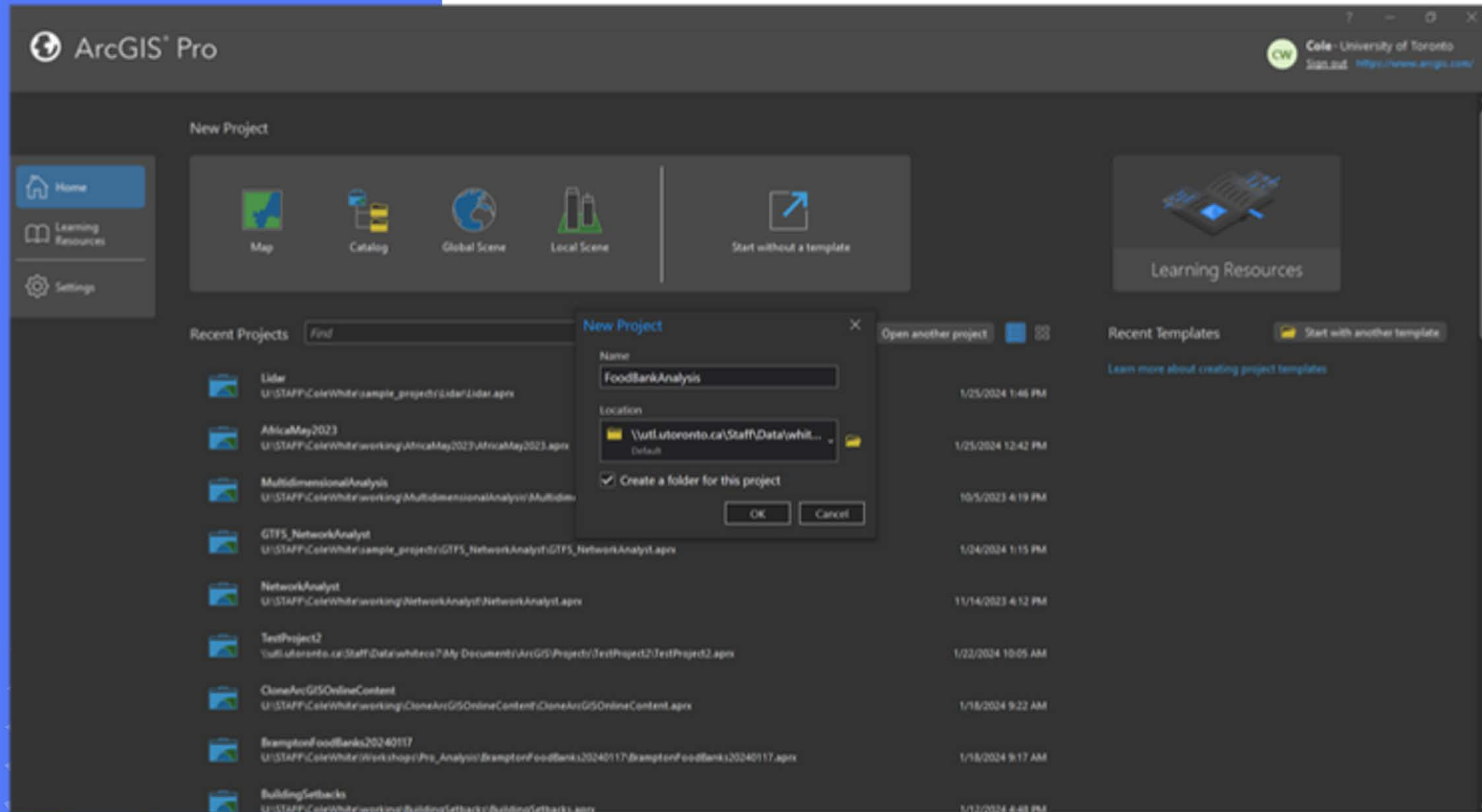
Continue

Sign in automatically [Configure Licensing Sign In Using Browser](#)

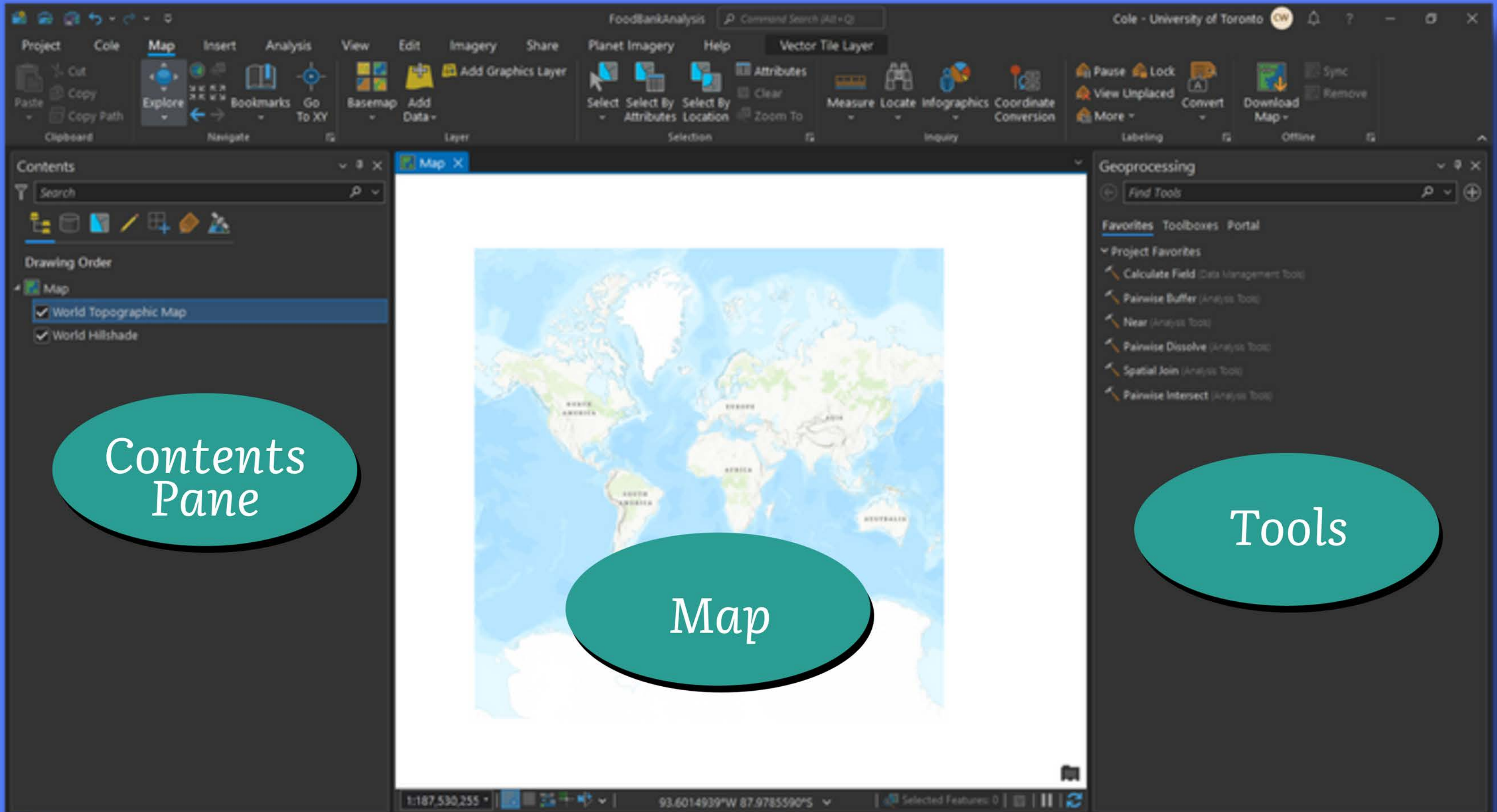
2. ArcGIS Pro Creating a new Project



2. ArcGIS Pro Creating a new Project



2. ArcGIS Pro



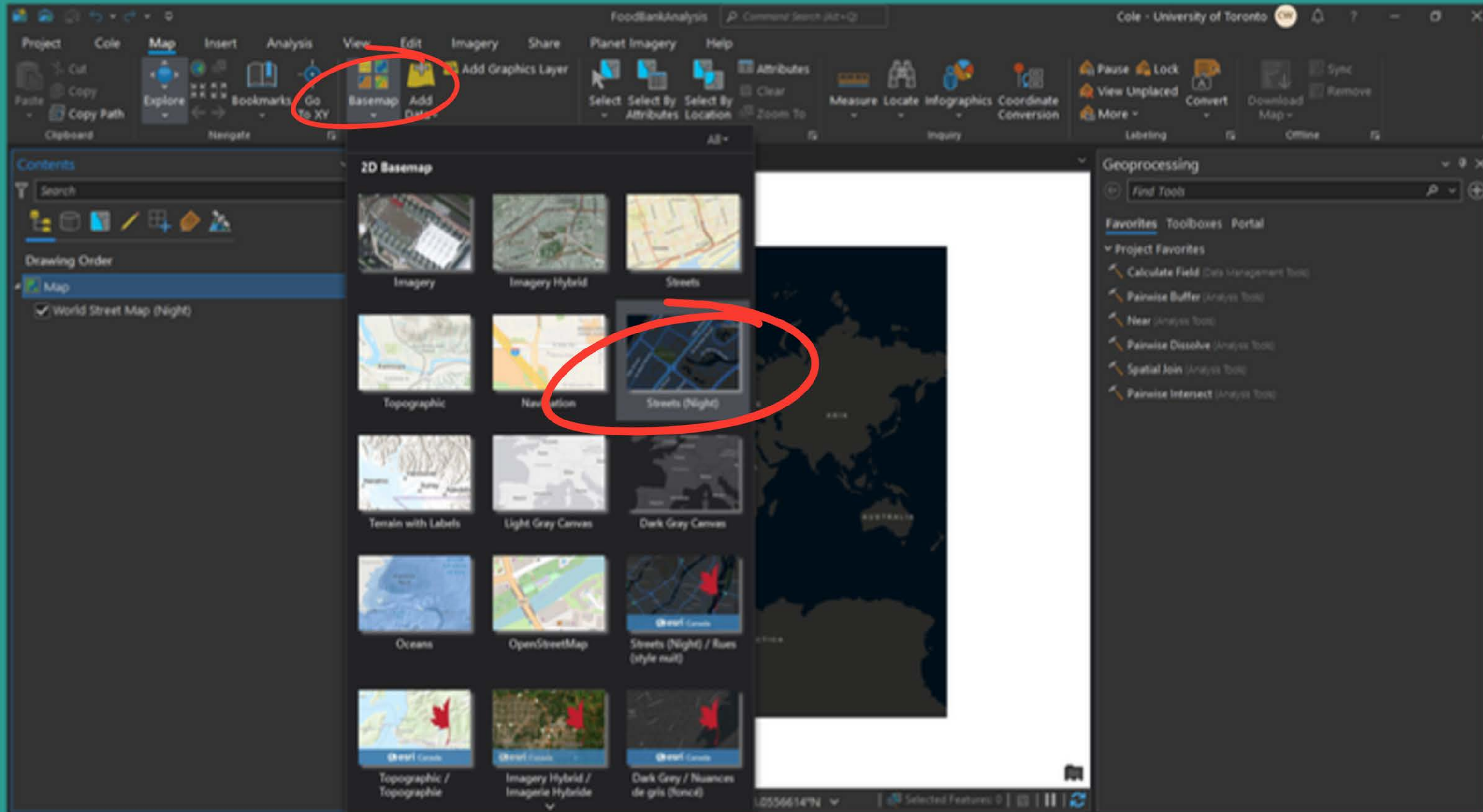
Contents
Pane

Map

Tools

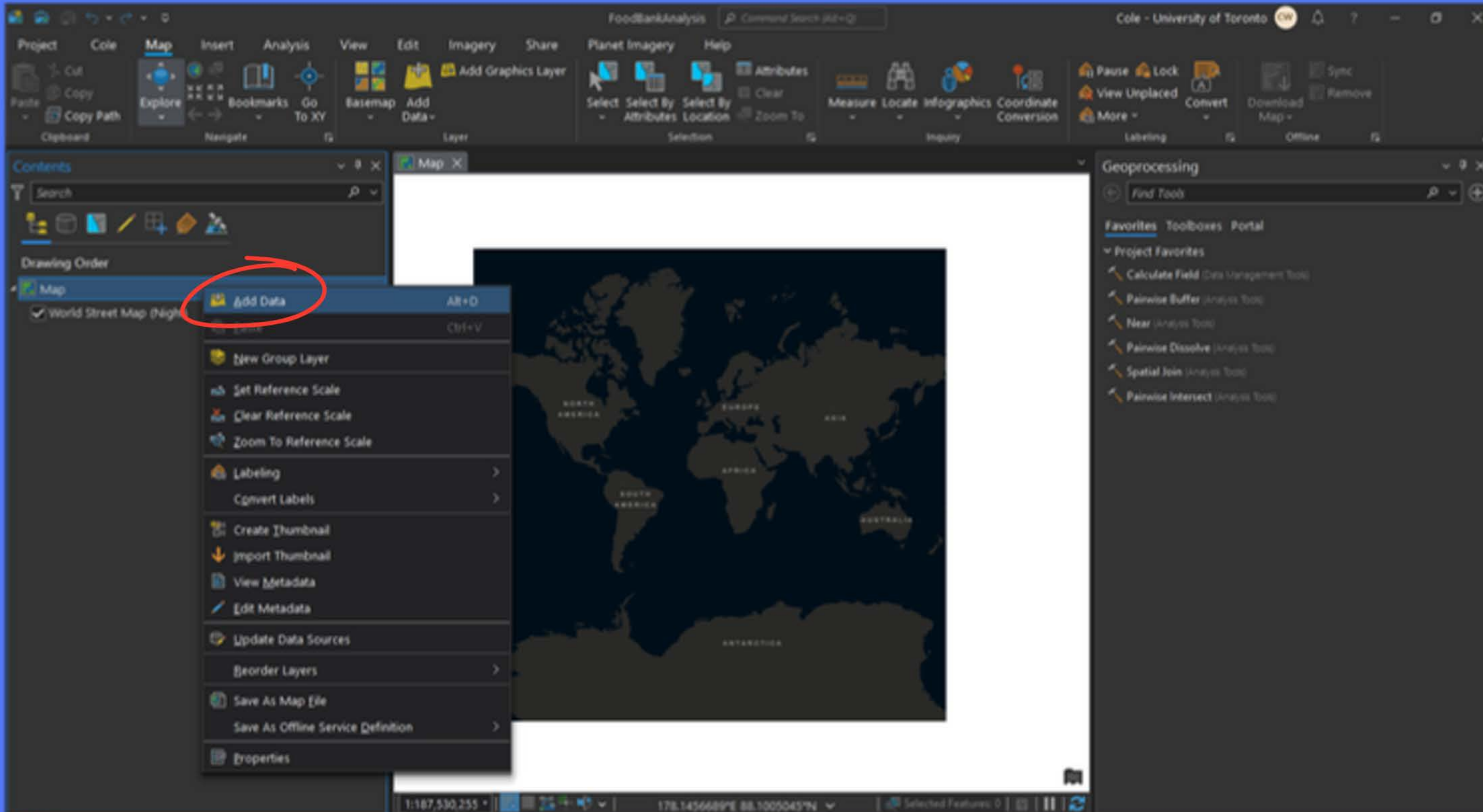
2. ArcGIS Pro

- Change the **Basemap**.



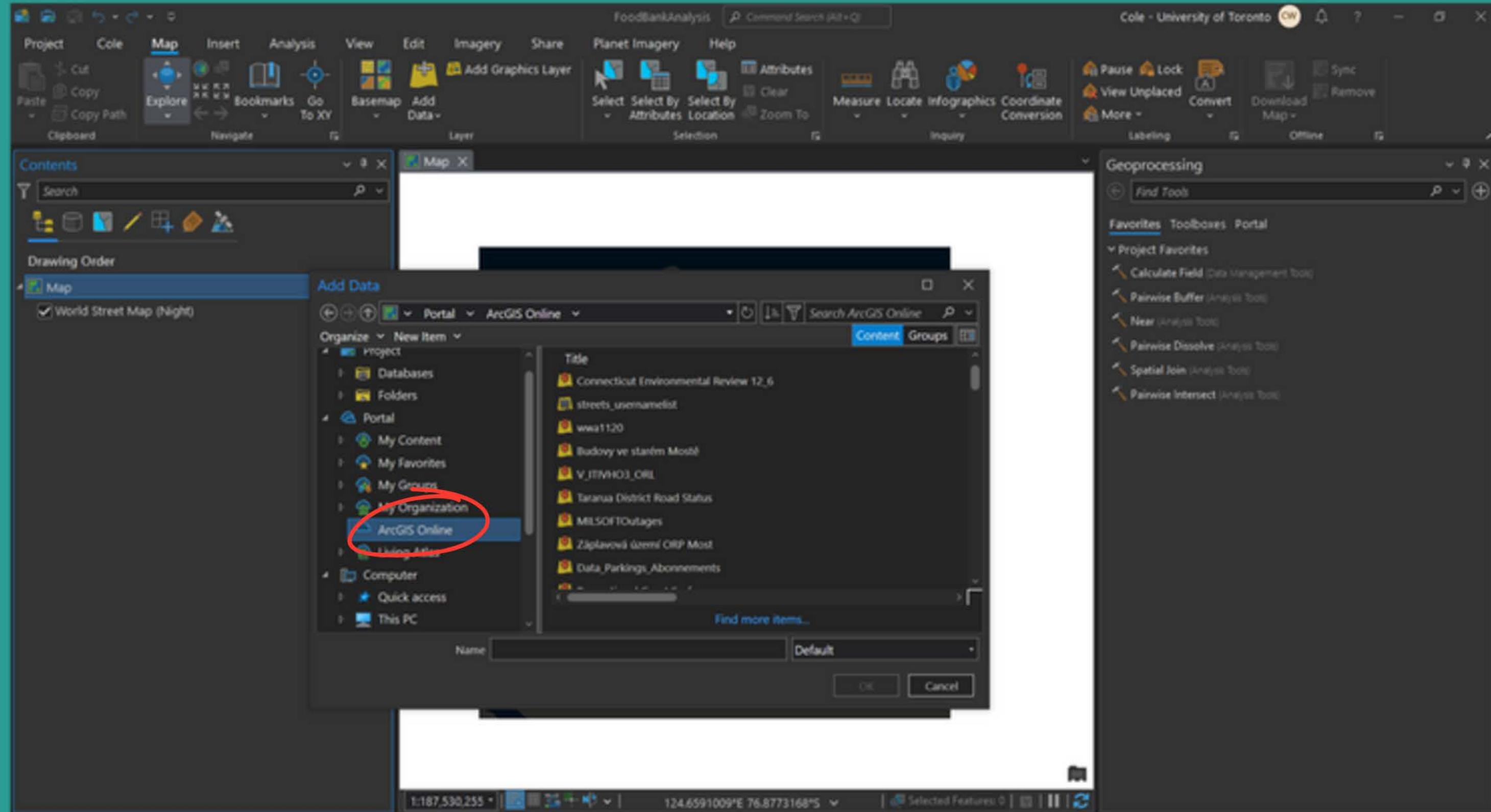
2. ArcGIS Pro

- Add Data.



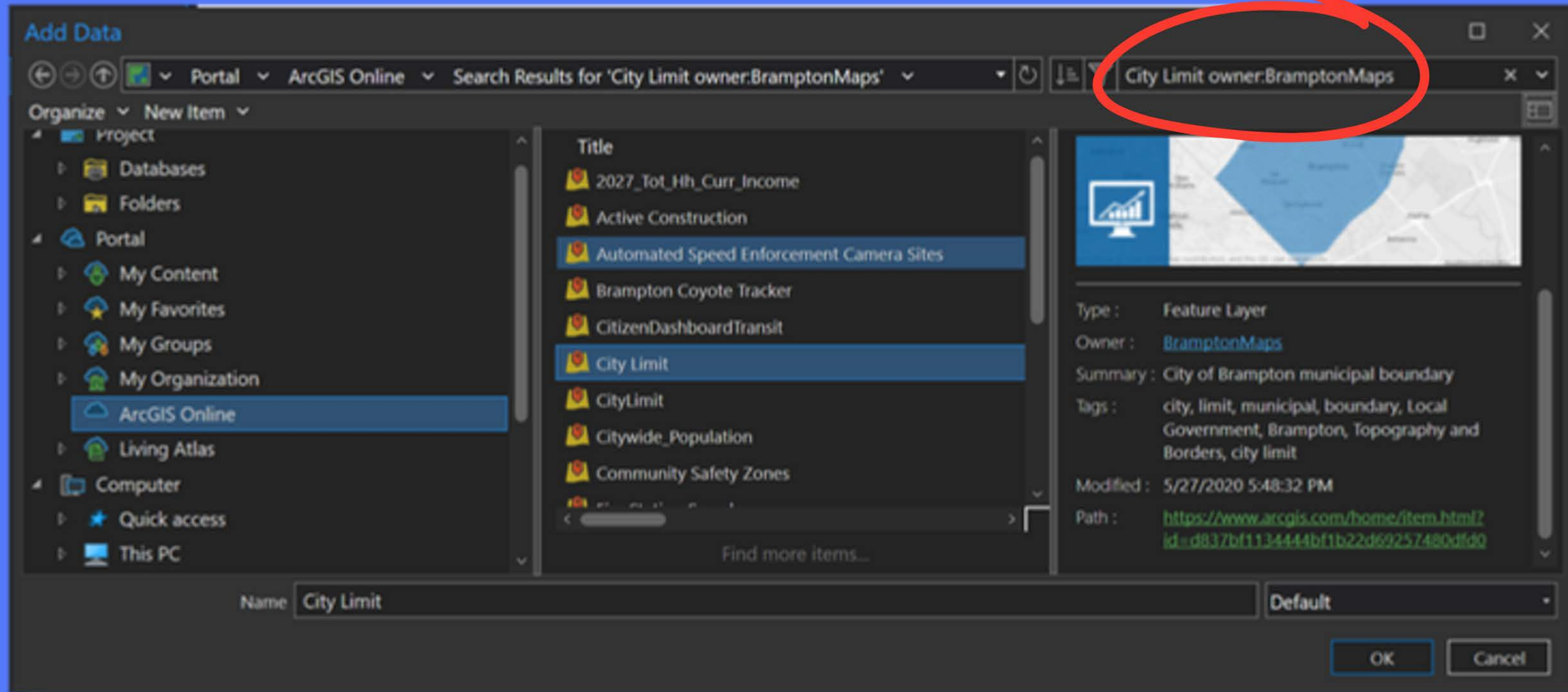
2. ArcGIS Pro

- Choose ArcGIS Online.



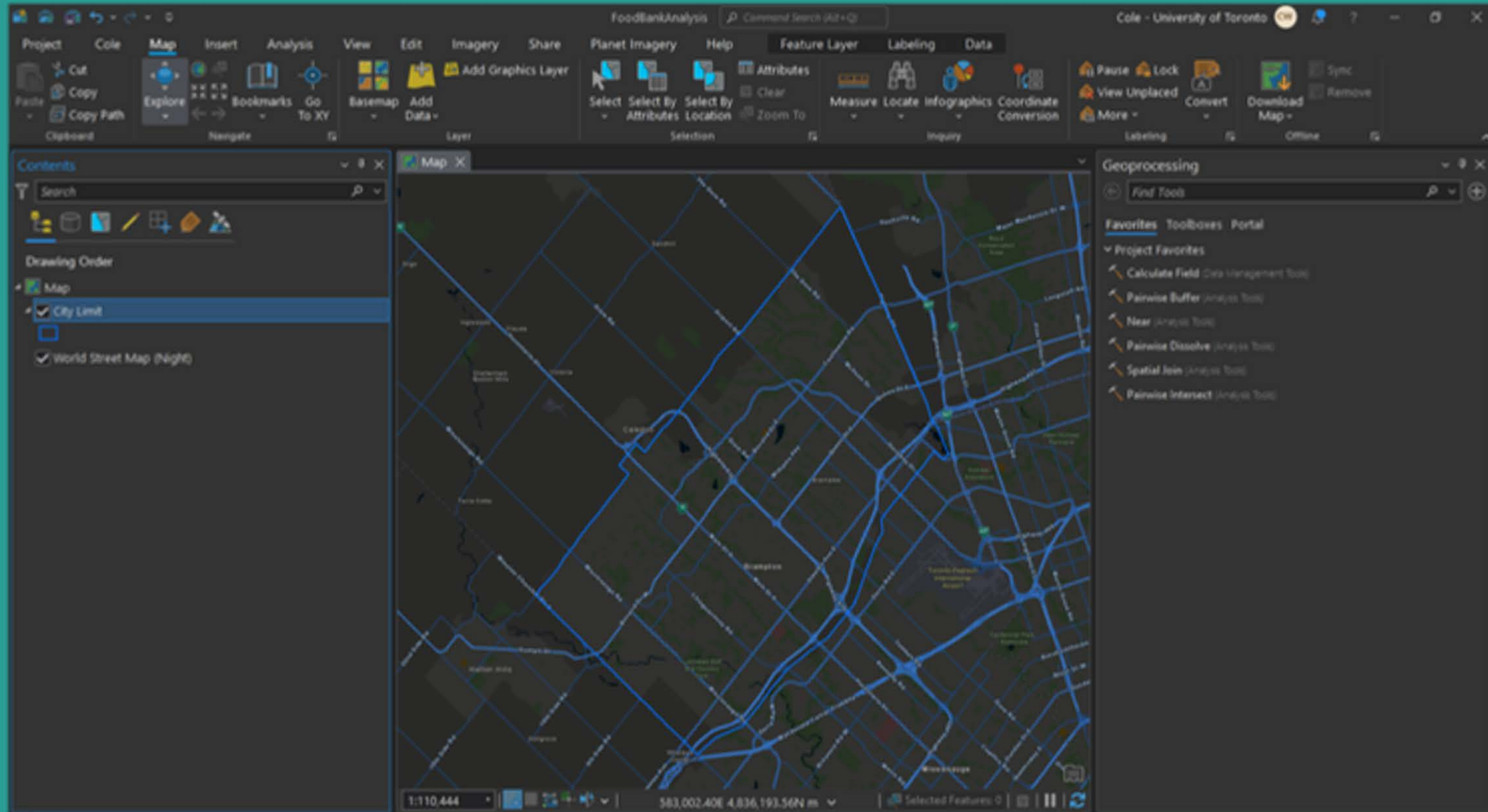
2. ArcGIS Pro

- Search for:
City Limit owner: BramptonMaps



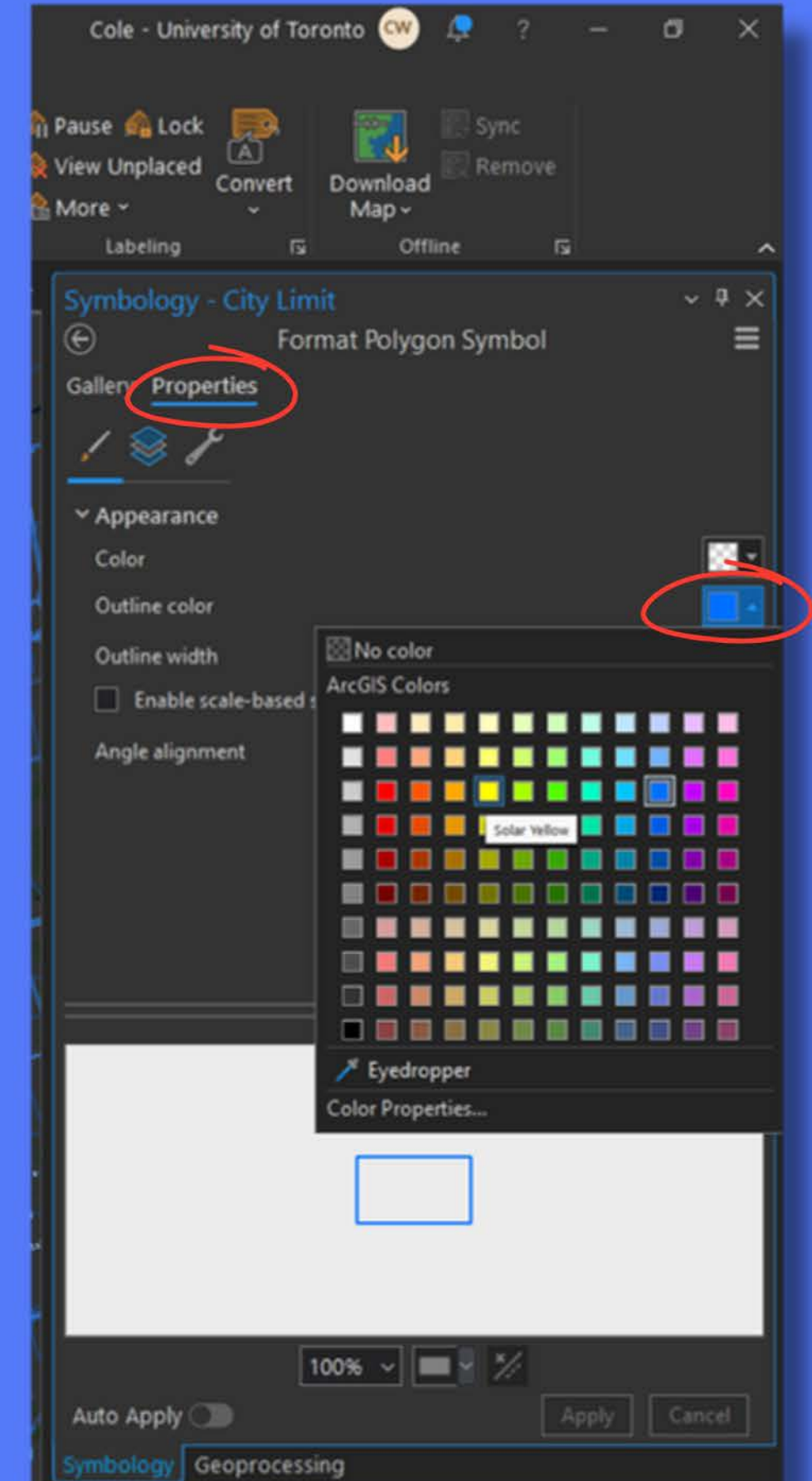
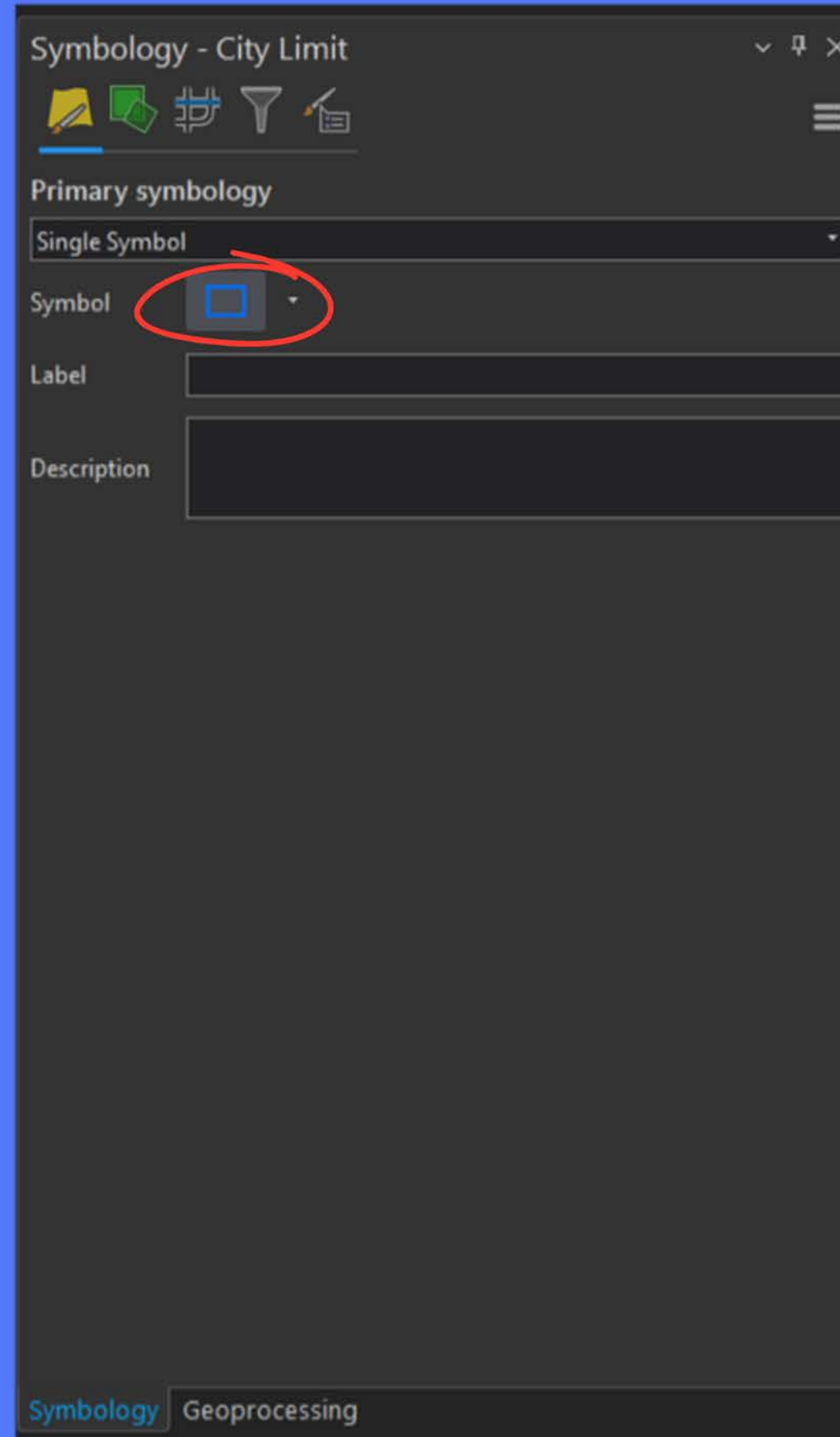
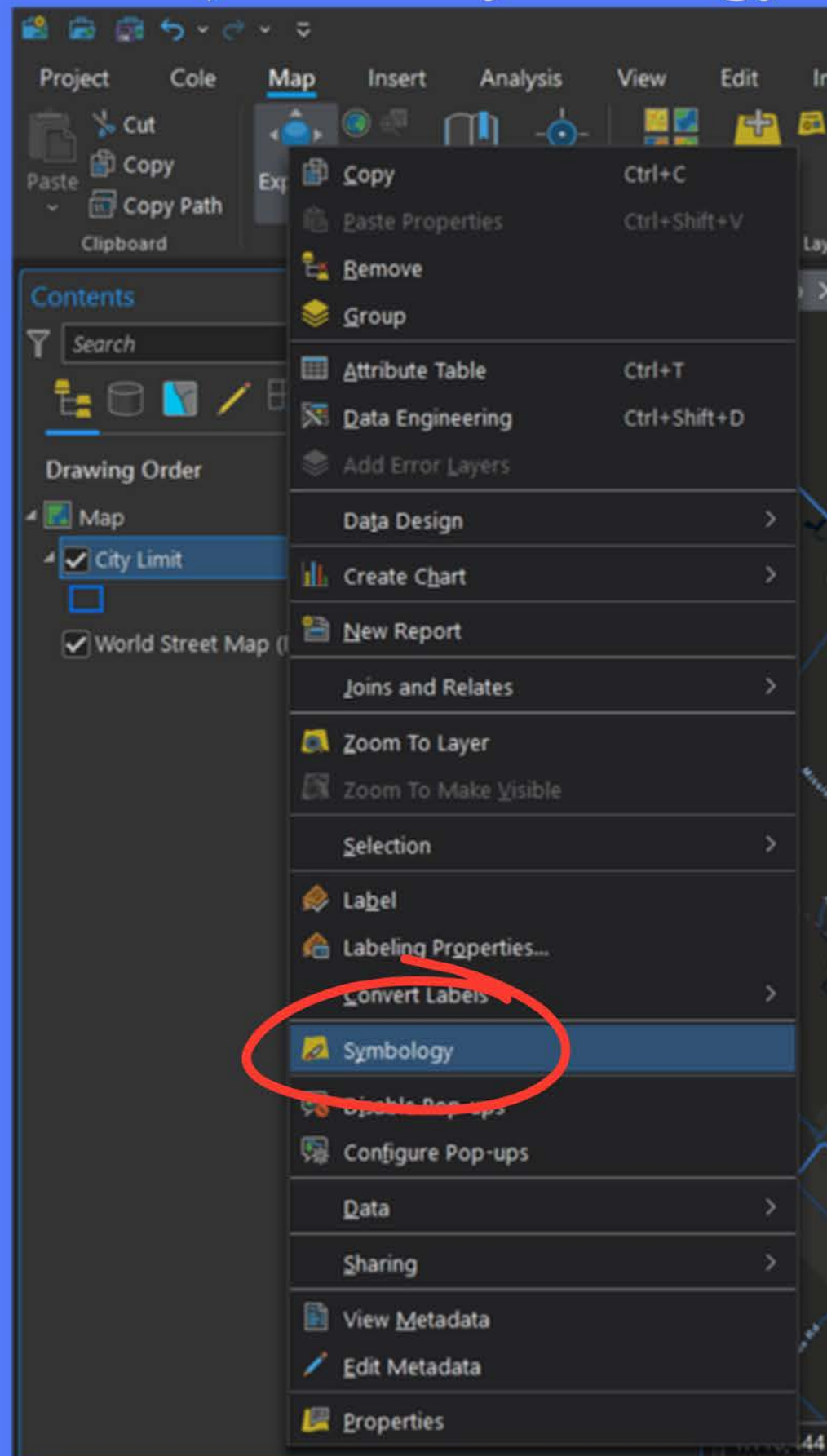
2. ArcGIS Pro

- Click **OK**. The layer is added to the map.



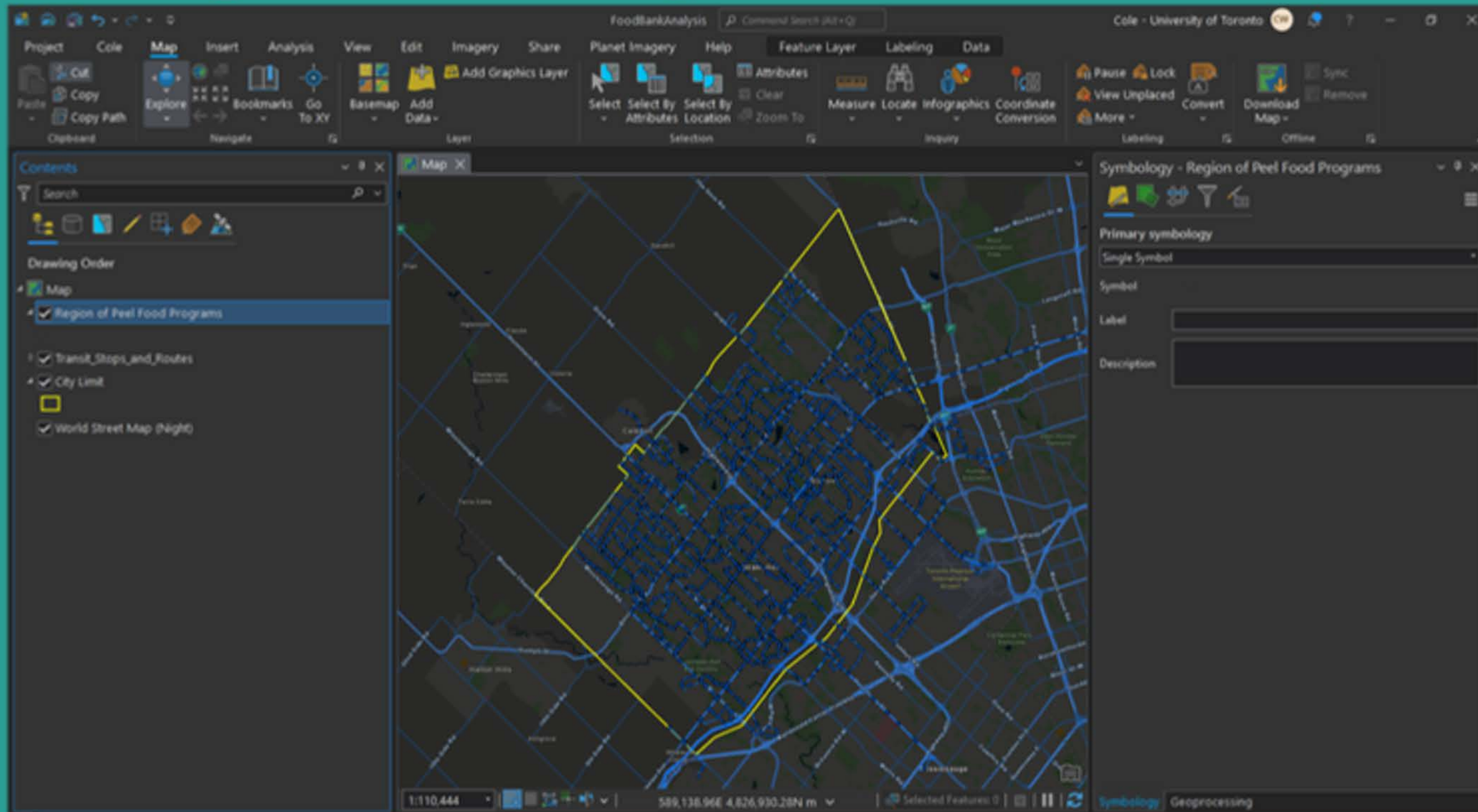
2. ArcGIS Pro

- Adjust the symbology.



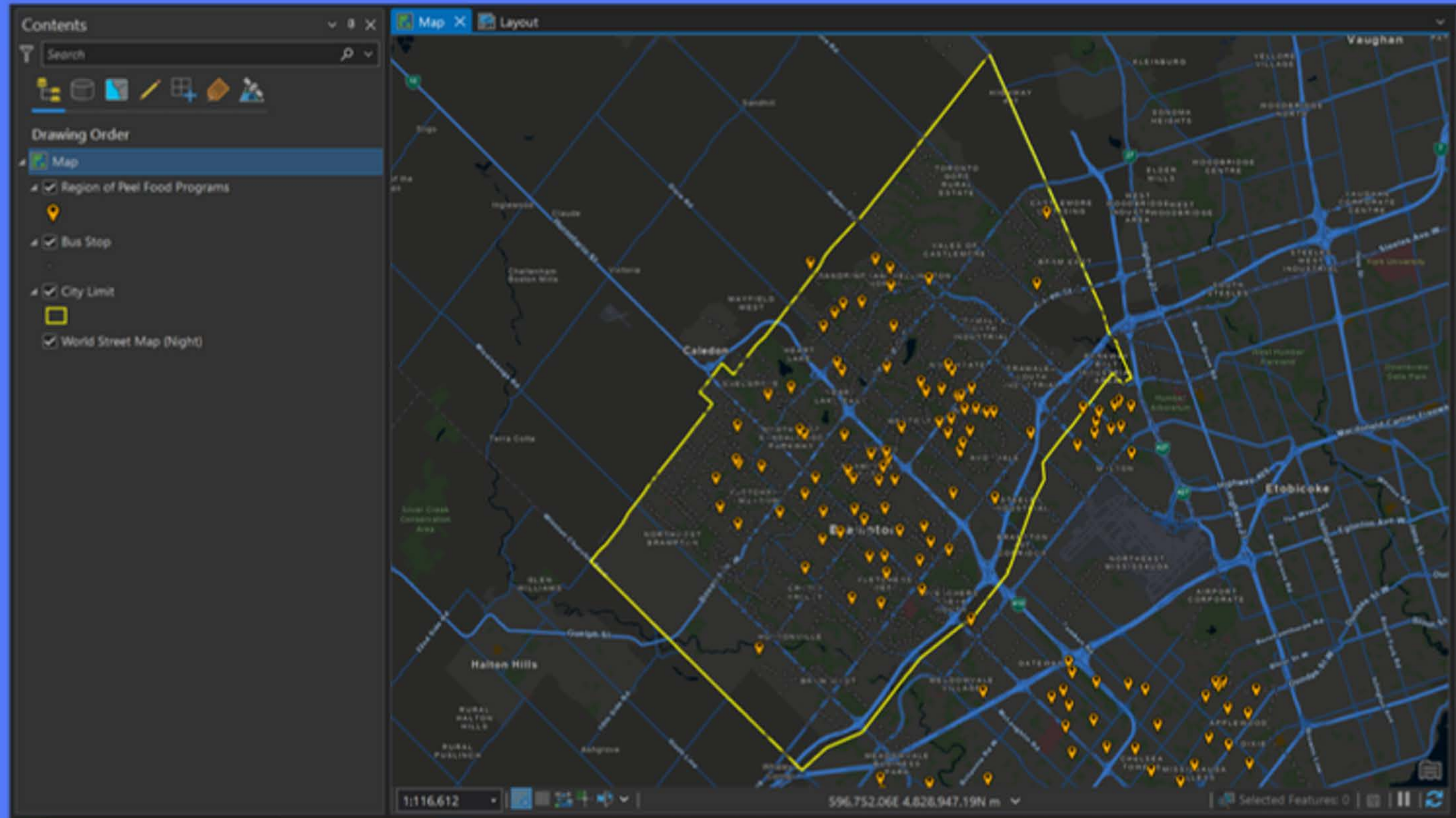
2. ArcGIS Pro

- Add the following layers (also by searching and using the owner: BramptonMaps flag):
 - **Transit_Stops_and_Routes**
 - **Region of Peel Food Programs**



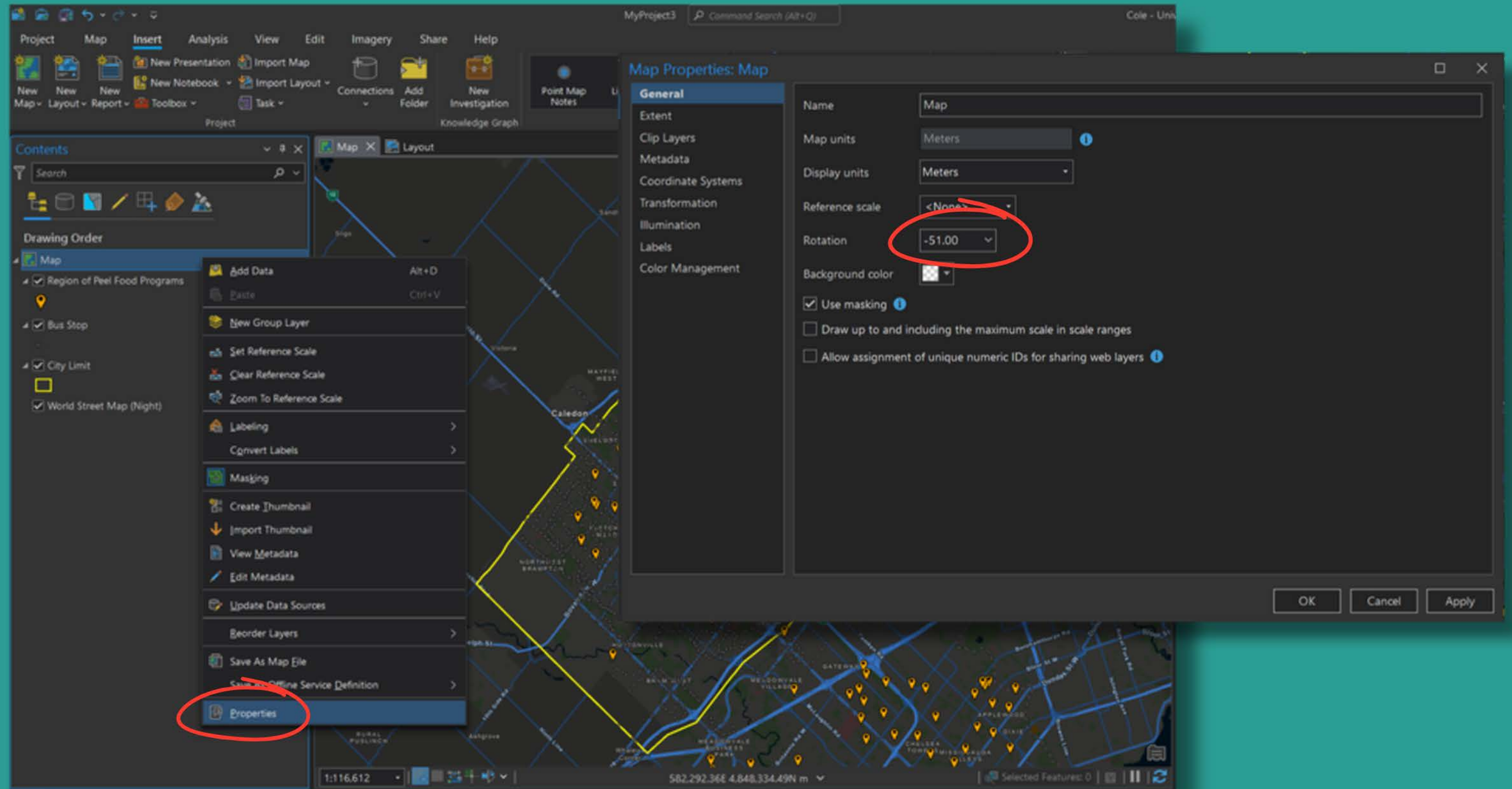
2. ArcGIS Pro

- Customize the **symbology** for each layer.



2. ArcGIS Pro

- Open the **Map Properties**
- Set the map rotation to **-51**



2. ArcGIS Pro

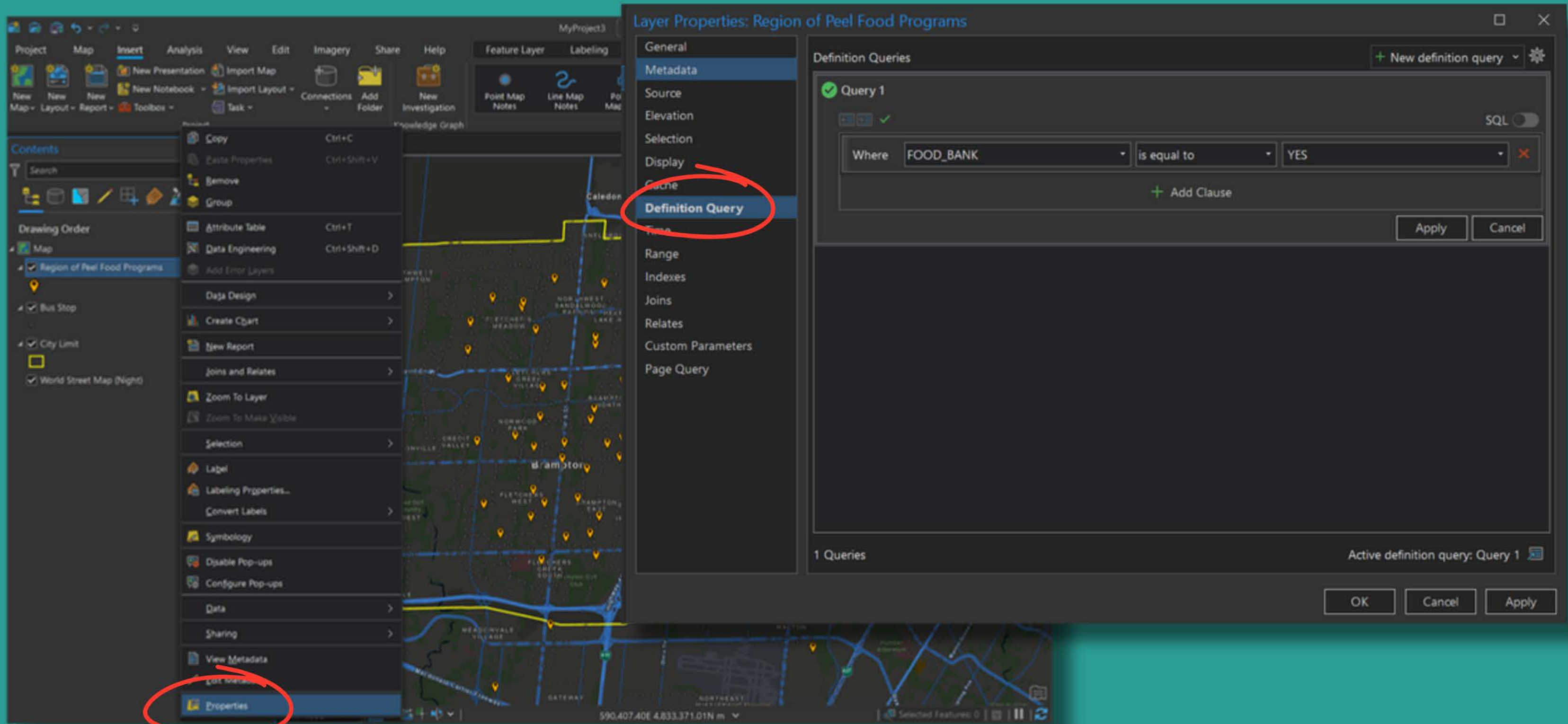
- Review the **Attribute Table** of the Region of Peel Food Programs layer.

The screenshot shows the ArcGIS Pro interface with the Attribute Table for the 'Region of Peel Food Programs' layer open. The table contains 11 rows of data. The 'Attribute Table' option in the Contents pane is highlighted with a red circle.

	MUN	PHONE	WEBSITE	FOOD_BANK	Sch_FD_PRO	LEGEND *	BREAKFAST
1	Mississauga	905-566-2359	https://acorn2oak.ca/	NO	NO	Food Pantry	NO
2	Caledon	647-981-6281	https://www.albionhillsco	N/A	N/A	Community Garden	N/A
3	Brampton	437-317-9517	https://allpeopleschurch	YES	N/A	Food Bank	N/A
4	Caledon	905-857-9144	https://schools.peelschoi	N/A	YES	School Food Programs	N/A
5	Caledon	519-941-3729	https://schools.peelschoi	N/A	YES	School Food Programs	N/A
6	Mississauga	905-412-1000	https://www.dpcdsb.org/	N/A	YES	School Food Programs	N/A
7	Brampton	905-456-3159	https://schools.peelschoi	N/A	YES	School Food Programs	N/A
8	Mississauga	905-676-1287	https://www.dpcdsb.org/	N/A	YES	School Food Programs	N/A
9	Brampton	905-793-6070	https://schools.peelschoi	N/A	YES	School Food Programs	N/A
10	Brampton	905-457-6107	https://schools.peelschoi	N/A	YES	School Food Programs	N/A
11	Brampton	905-794-0852	https://schools.peelschoi	N/A	YES	School Food Programs	N/A

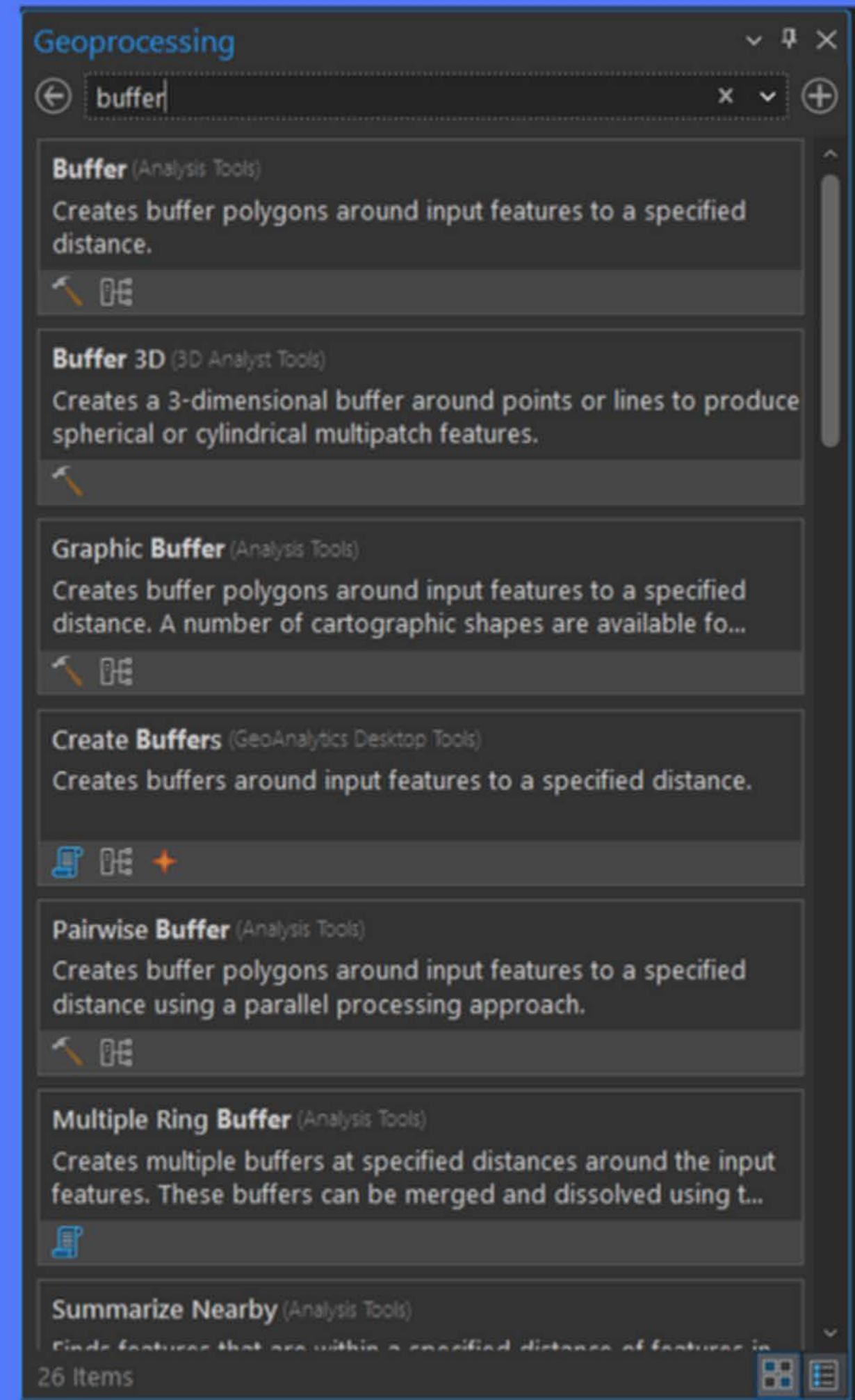
2. ArcGIS Pro

- **Filter** the Food Programs layer using a Definition Query.
- Build the expression: **FOOD_BANK is equal to YES**.



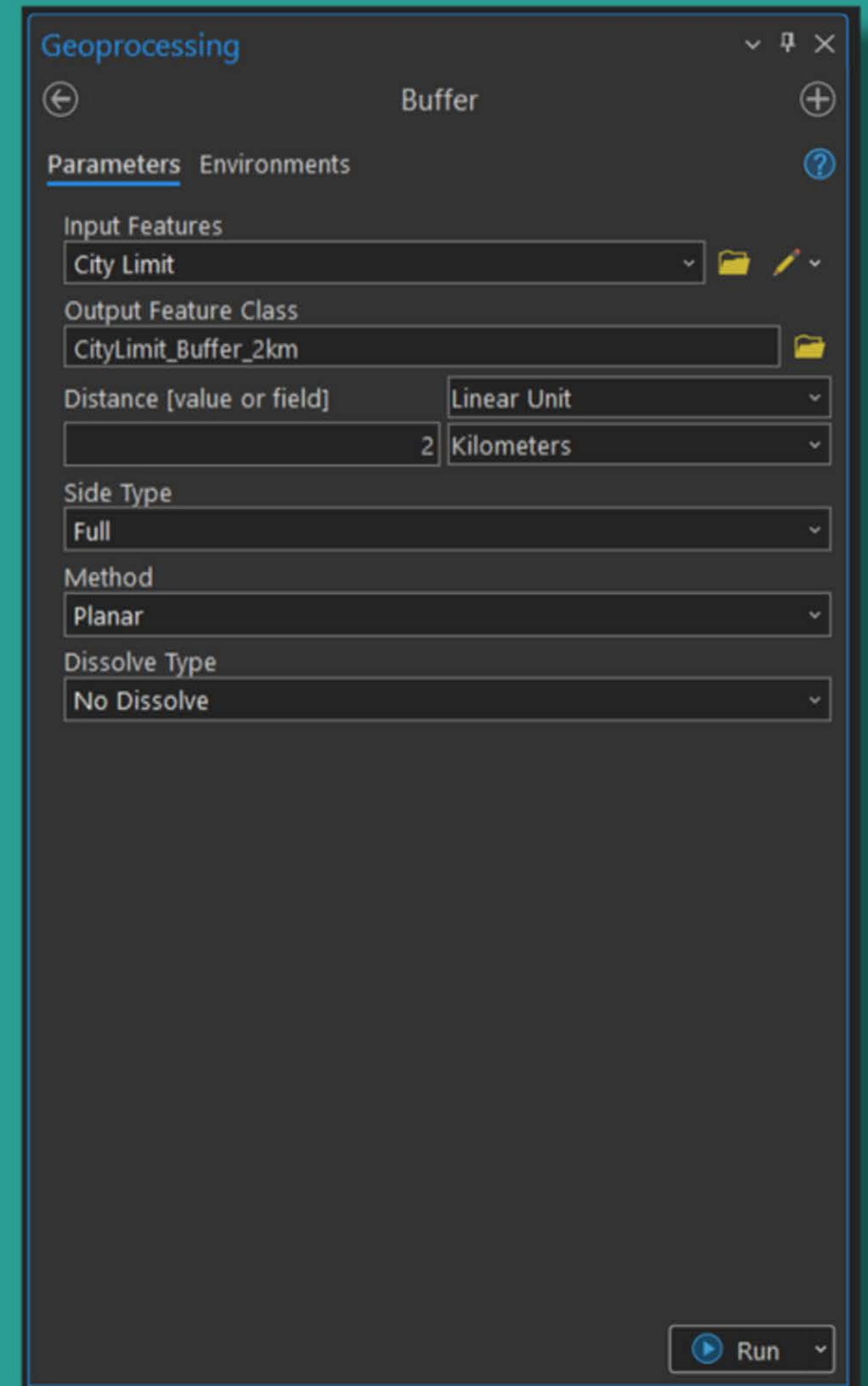
2. ArcGIS Pro

- Create a 2km buffer around the City Limit (this will be our study area).
- From the **Geoprocessing** pane, search for and open the **Buffer** tool.



2. ArcGIS Pro

- Select the **City Limit** layer for the **Input Features** parameter.
- Give the output feature class a descriptive name.
- Specify **2** for the **Distance** value and **Kilometers** for the **Unit**.
- The other parameters can be left at the default values.
- Click **Run**.



2. ArcGIS Pro

- Adjust the symbology of the new buffered layer.

The screenshot displays the ArcGIS Pro interface with the Symbology pane open for the 'CityLimit_Buffer_2km' layer. The map shows a city grid with a yellow dashed buffer around a central area. The Symbology pane is set to 'Format Polygon Symbol' and shows the following settings:

- Solid stroke
- Solid fill
- Appearance: Color (Yellow), Width (2 pt)
- Offset effect: Off
- Dash effect: Dash type (5 3), Dash template (5 3), At line ends (No constraint)

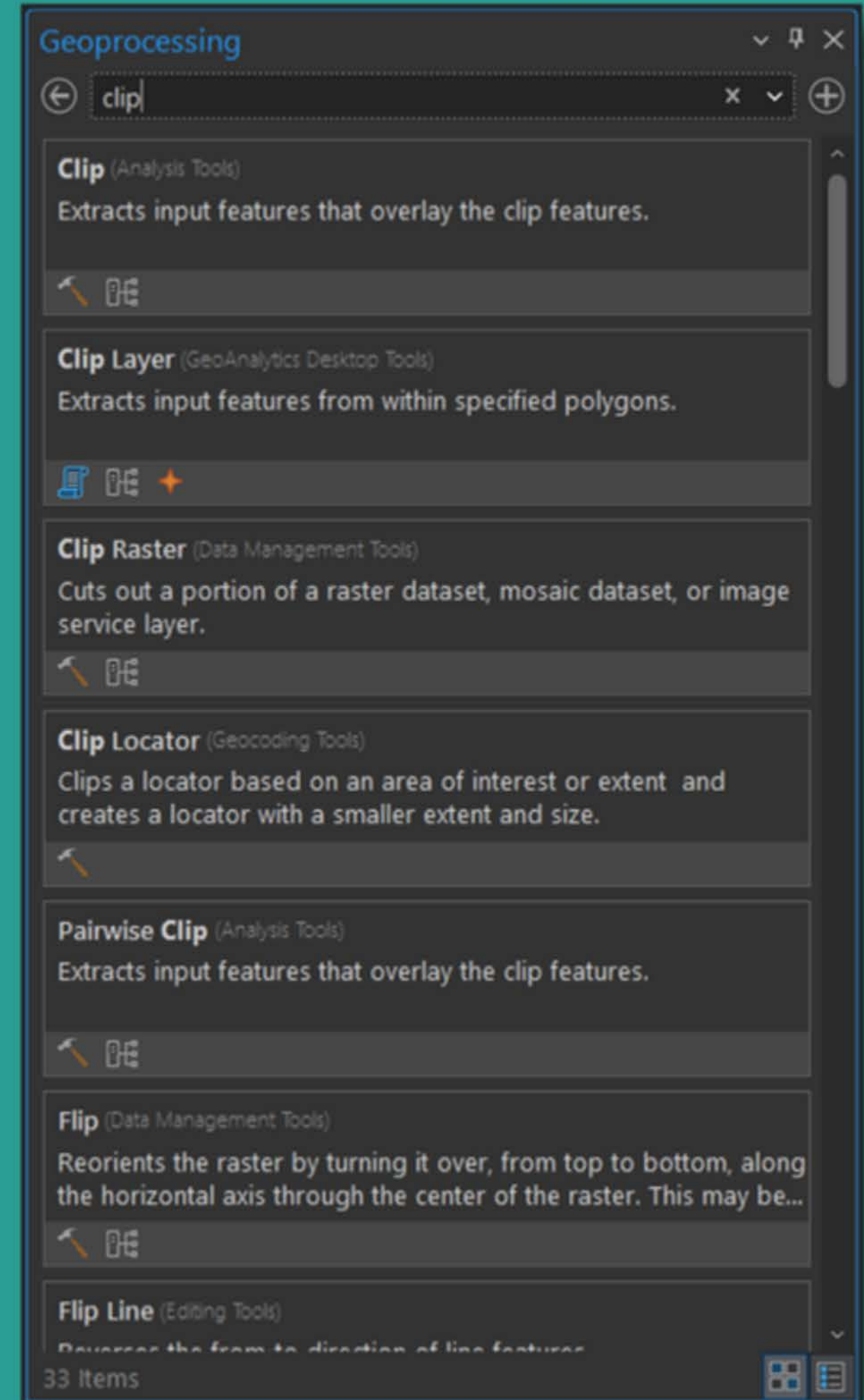
The Contents pane on the left shows the following layers:

- Map
- Region of Peel Food Programs
- Transit_Stops_and_Routes
- Bus Stops
- Bus Routes
- CityLimit_Buffer_2km** (highlighted with a red circle)
- City Limit
- World Street Map (Night)

The Symbology pane title bar also shows 'CityLimit_Buffer_2km' and 'Format Polygon Symbol'. The map view shows a city grid with a yellow dashed buffer around a central area. The Symbology pane is open, showing the 'Format Polygon Symbol' settings. The 'Solid stroke' option is checked, and the 'Dash effect' is also checked, with a dash type of '5 3' and a dash template of '5 3'. The 'At line ends' setting is 'No constraint'. The 'Appearance' section shows a yellow color and a width of 2 pt. The 'Offset effect' is turned off. The 'Auto Apply' checkbox is checked. The 'Apply' and 'Cancel' buttons are visible at the bottom of the pane.

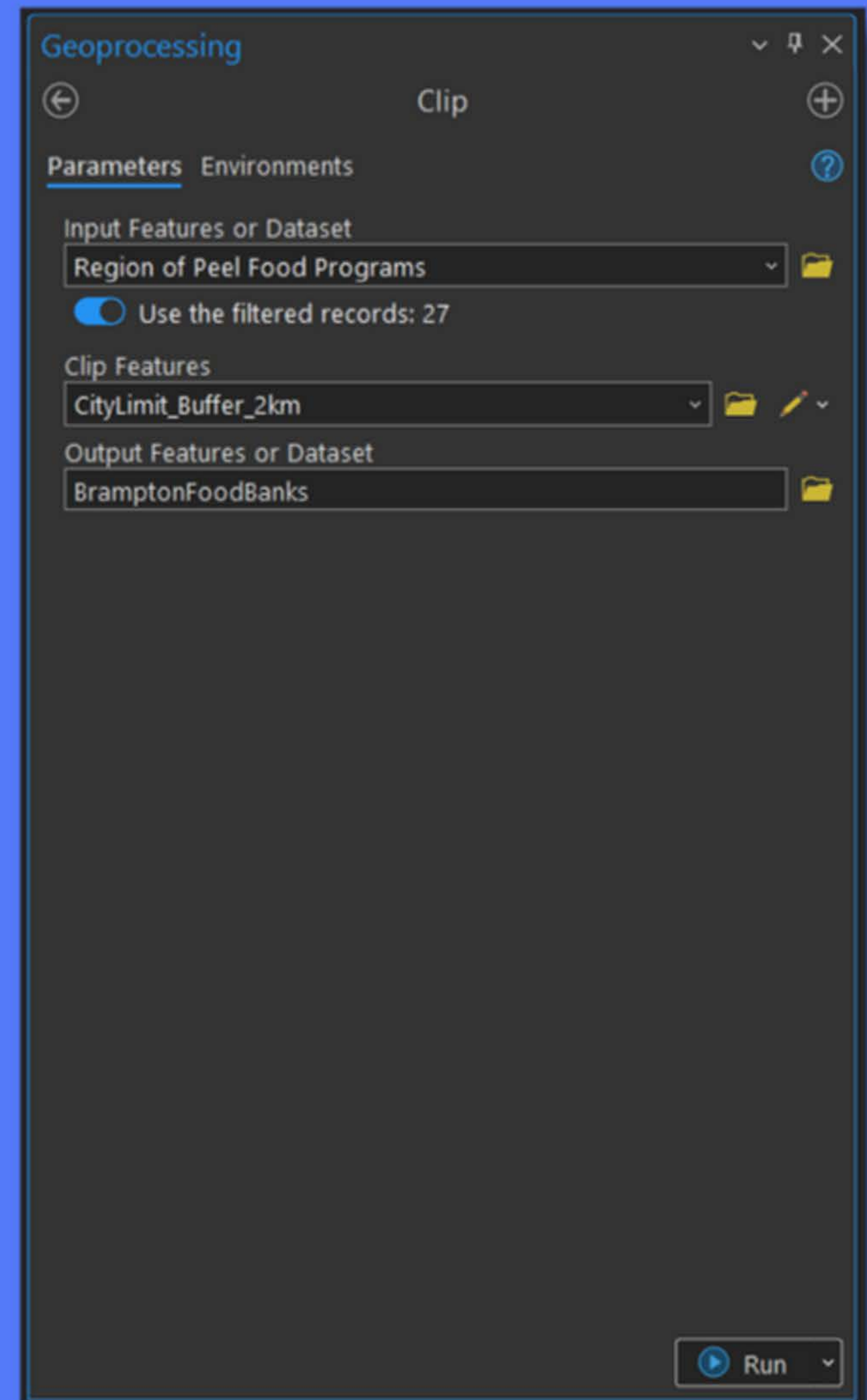
2. ArcGIS Pro

- Create a layer containing only food banks within the study area.
- In the **Geoprocessing** pane, search for and open the **Clip** tool.



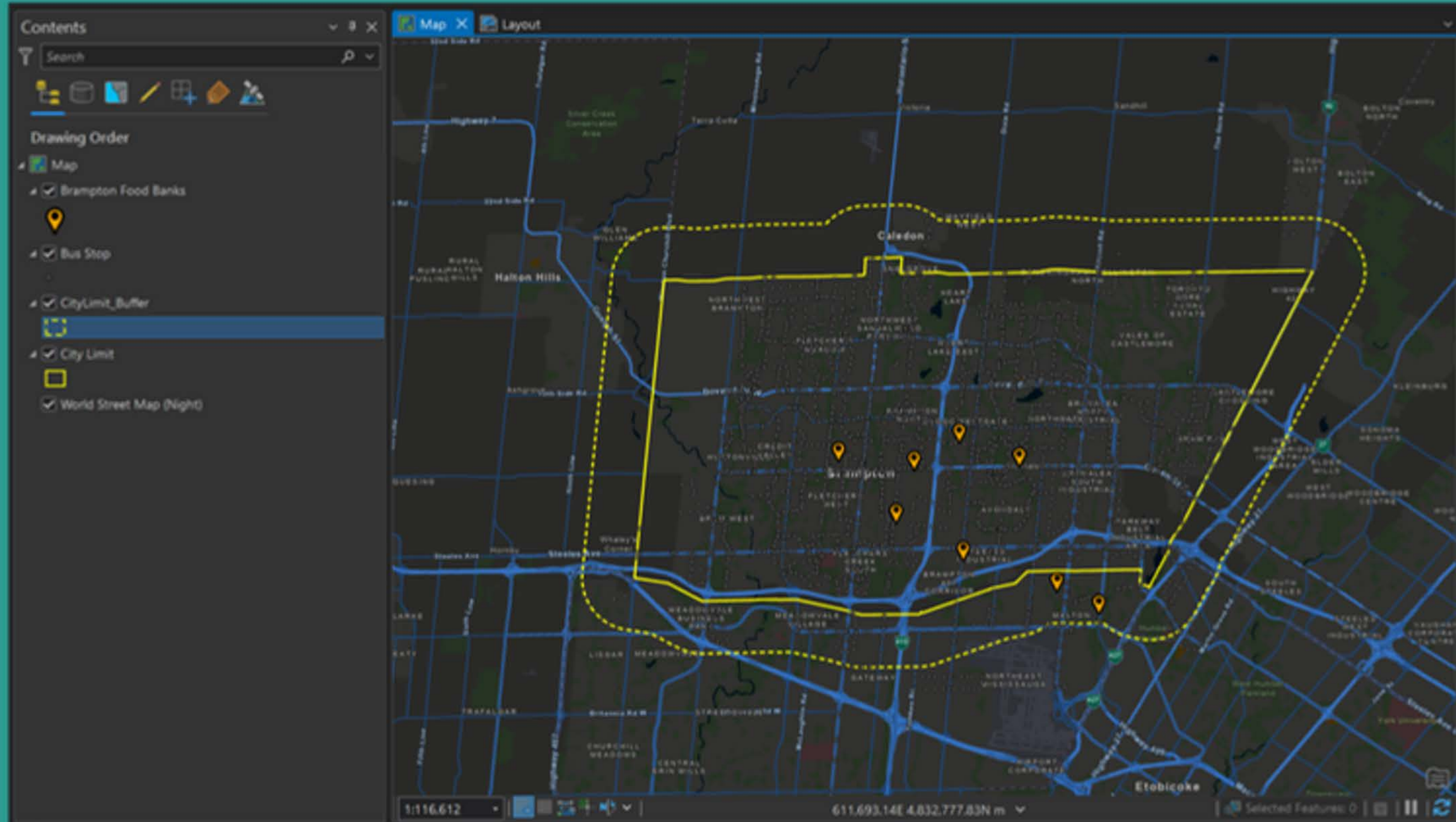
2. ArcGIS Pro

- Specify the **Region of Peel Food Programs** as the **Input Features or Dataset**.
- Leave 'Use the filtered records' toggled **on**.
- Select the buffer layer as the **Clip Features**.
- Give the output a descriptive name.
- Click Run.



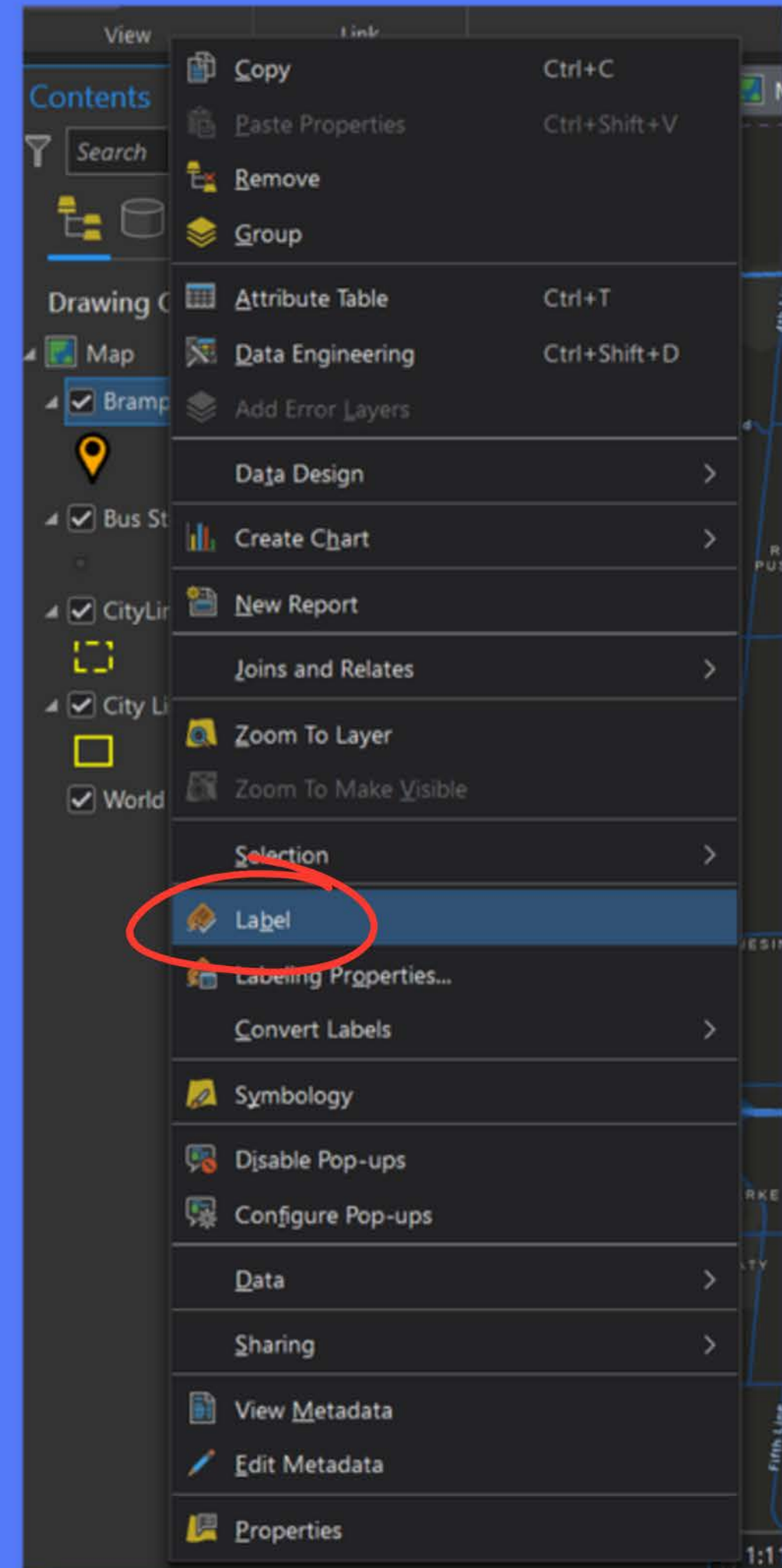
2. ArcGIS Pro

- Remove the original Region of Peel Food Programs layer.



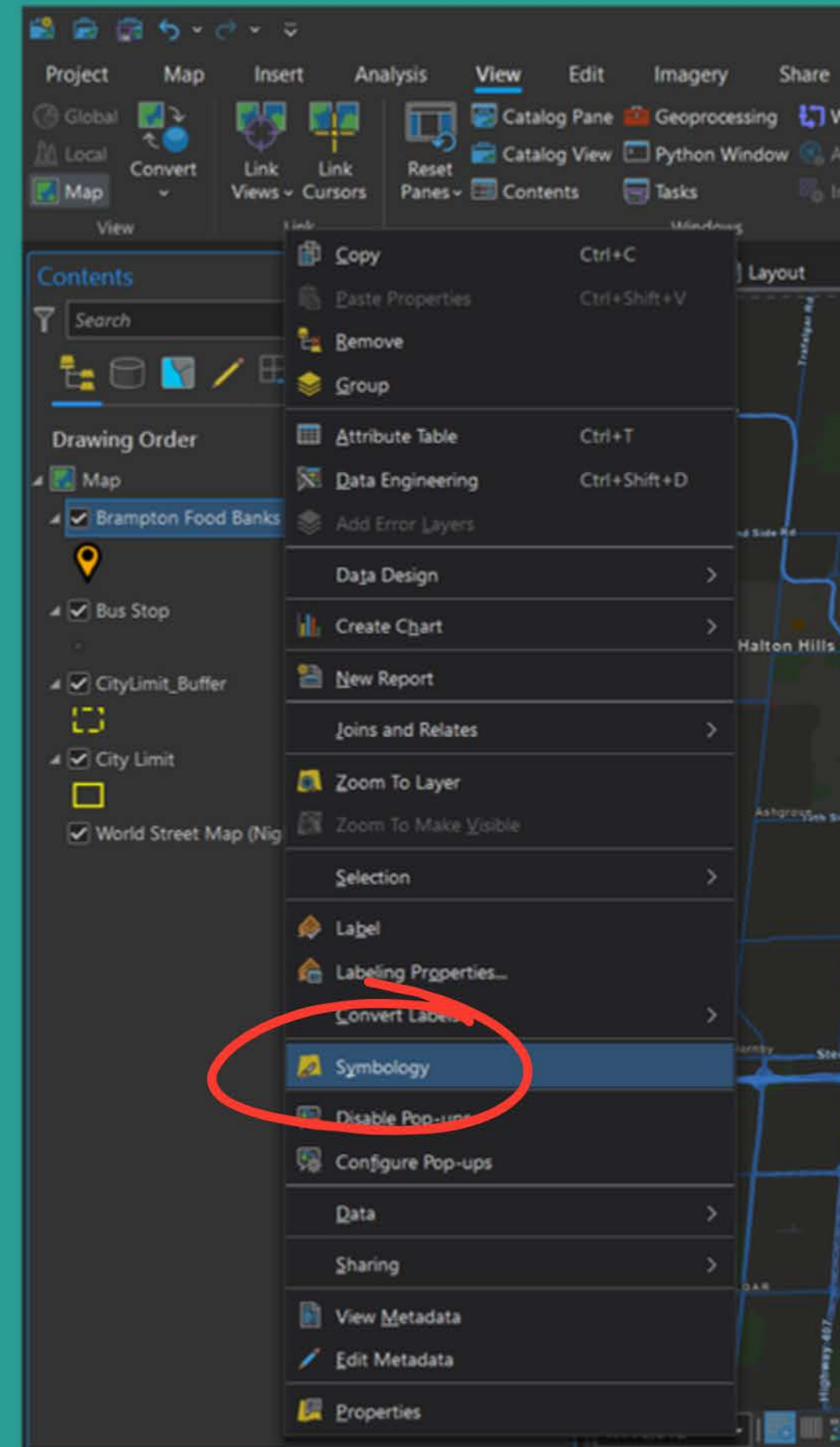
2. ArcGIS Pro

- Create labels for the existing food bank locations
- Right-click the BramptonFoodBanks layer and click the **Label** menu item to enable labels.



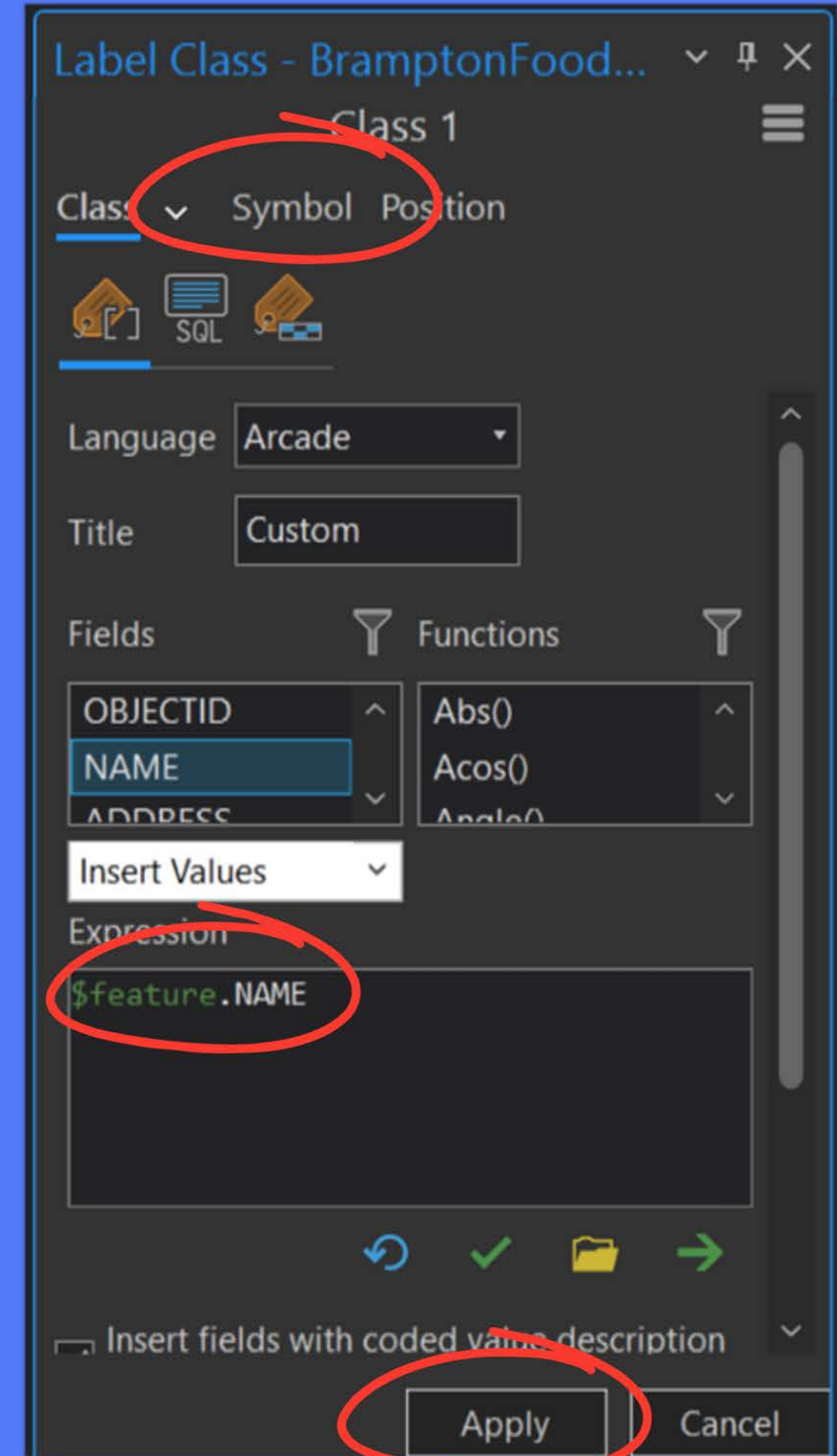
2. ArcGIS Pro

- Right-click the BramptonFoodBanks layer again.
- Click the **Labeling Properties** item in the contextual menu.



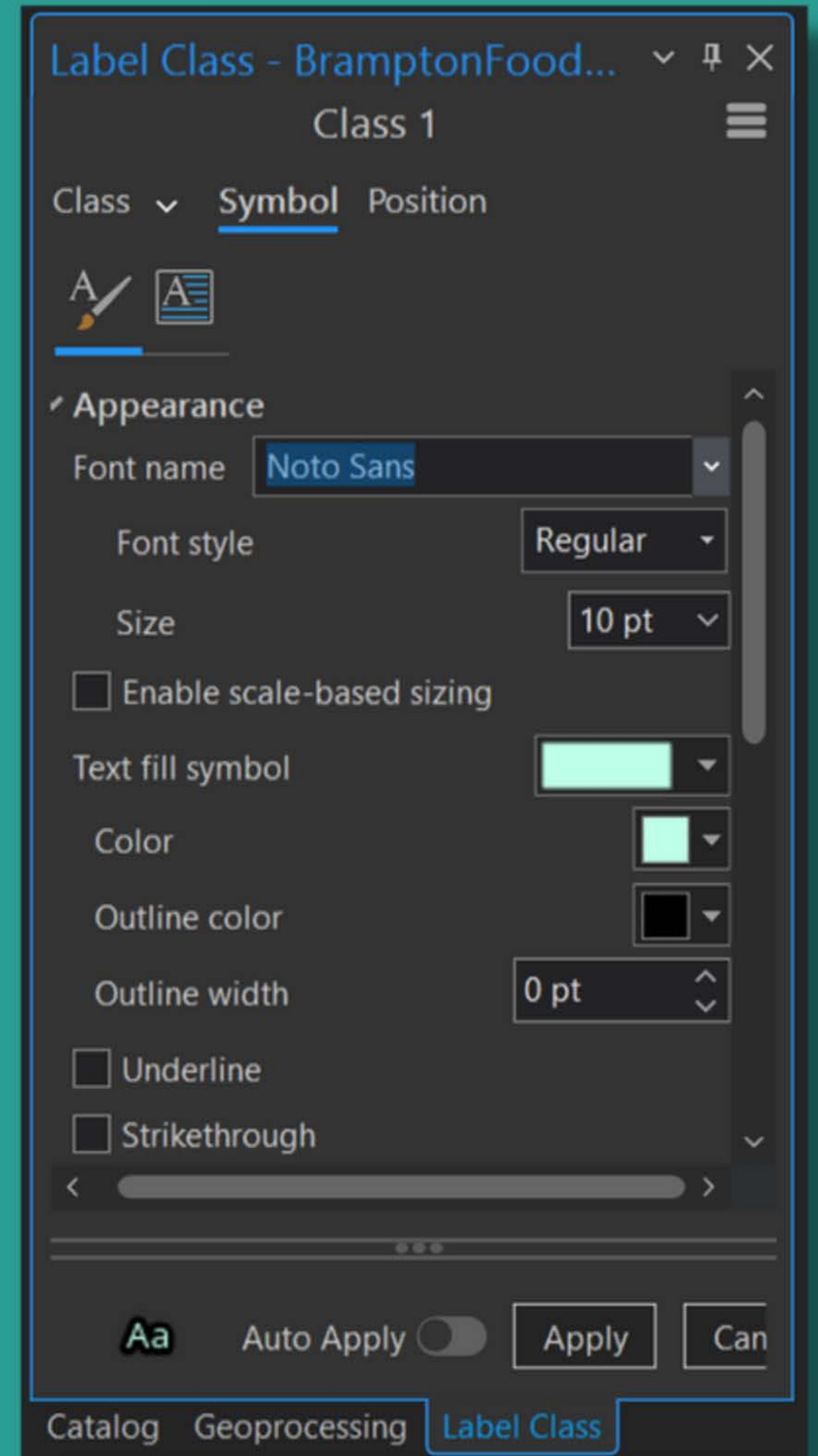
2. ArcGIS Pro

- Select **NAME** as the label field if it isn't already
- The Expression box should contain text reading **\$feature.NAME**
- Click **Apply**.
- Next, click the **Symbol** tab to customize the label's appearance.



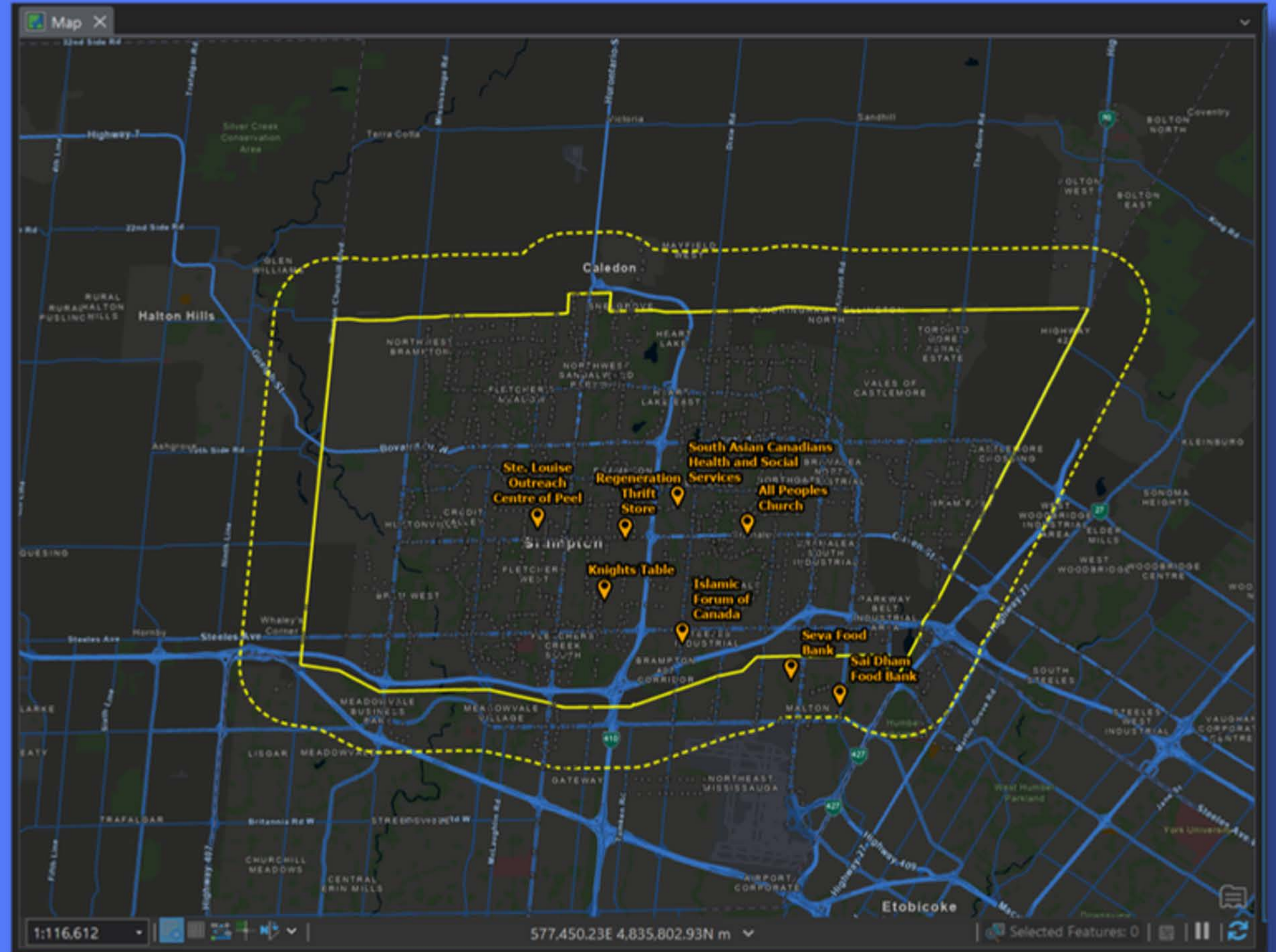
2. ArcGIS Pro

- Adjust the label font, size, and colour.
- Click Apply.



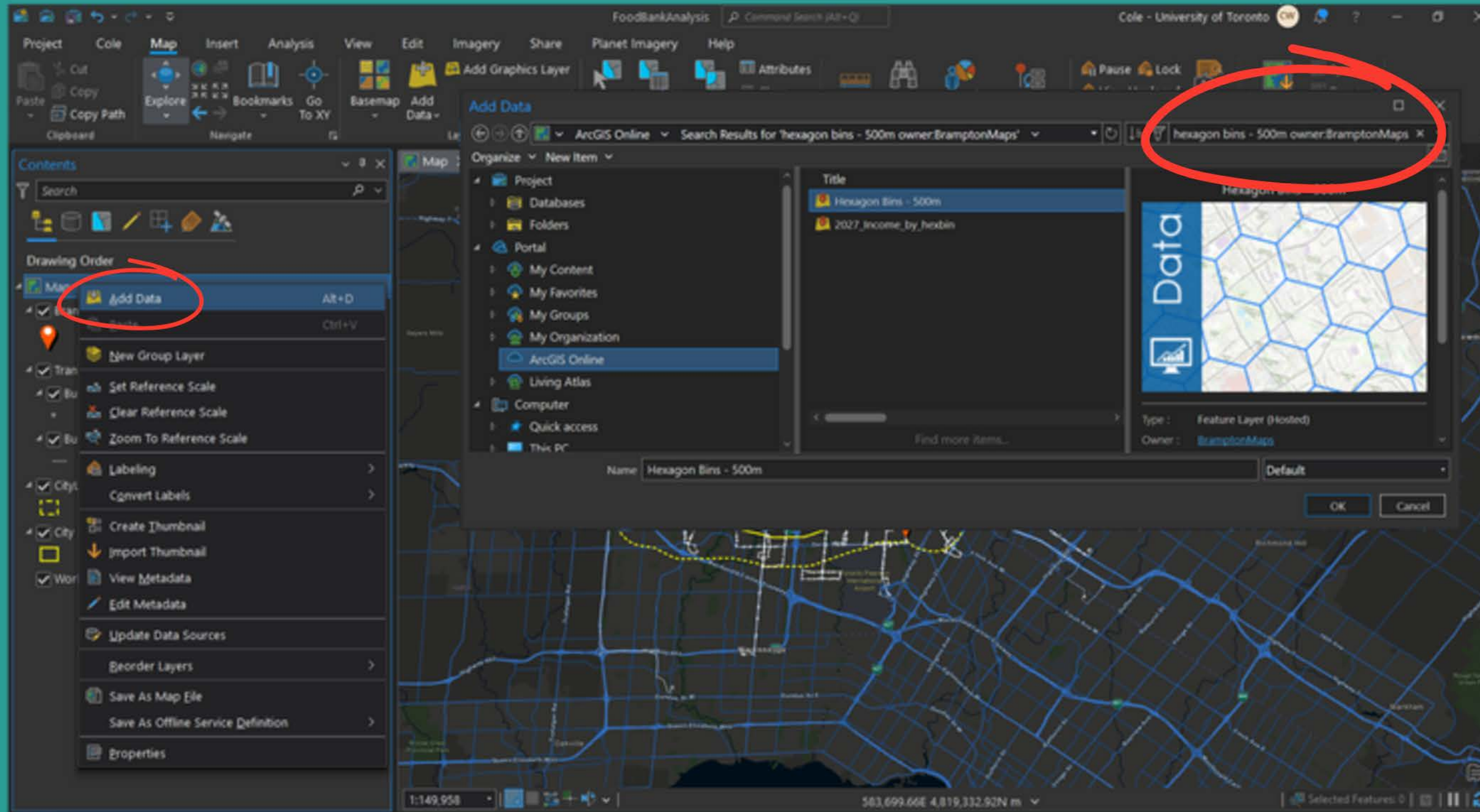
2. ArcGIS Pro

- Labels will now appear for each point.



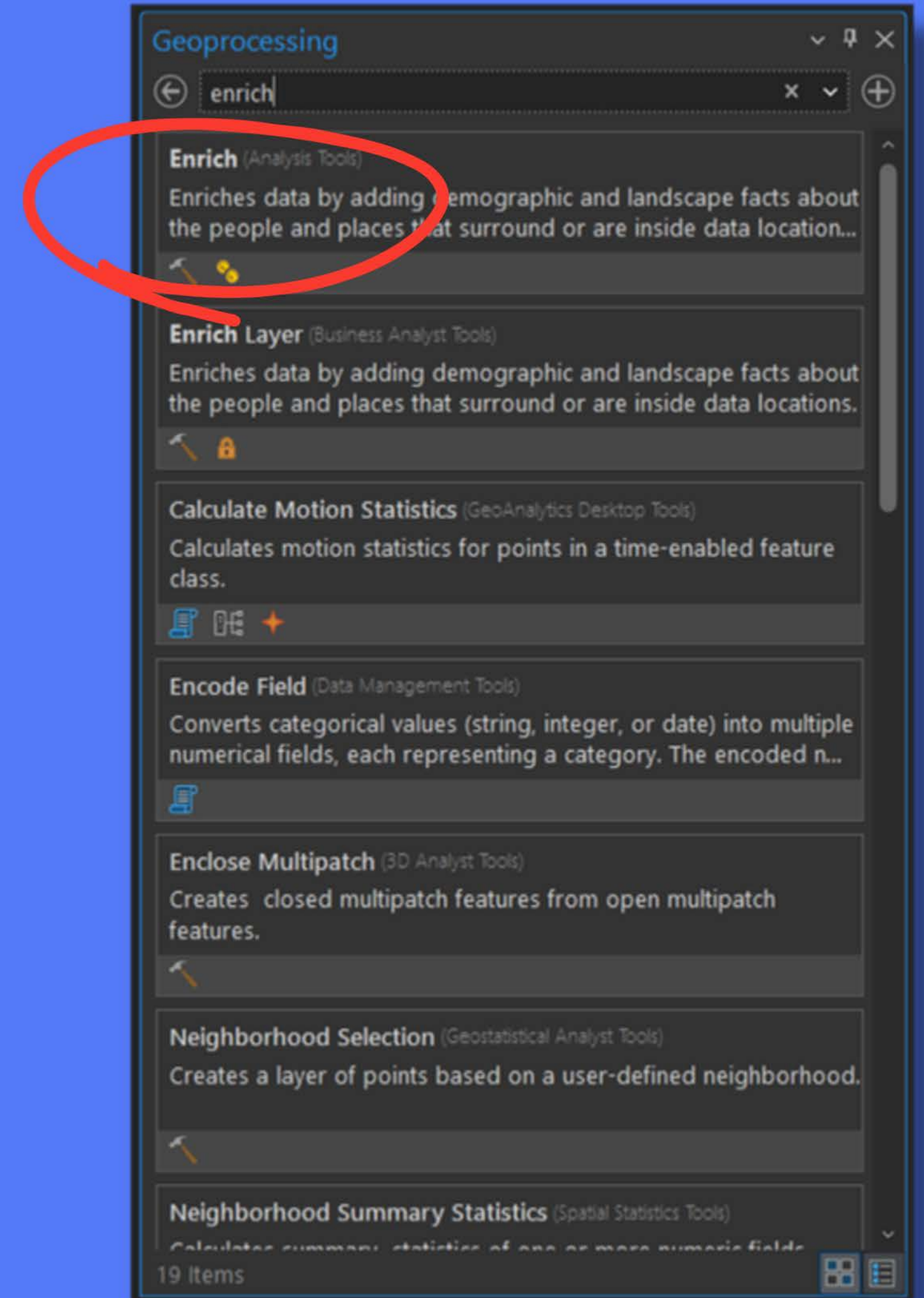
2. ArcGIS Online

- Analyze income within the study area.
- Add Data
- Search for and select **Hexagon Bins - 500m owner:BramptonMaps** within ArcGIS Online. Click OK.



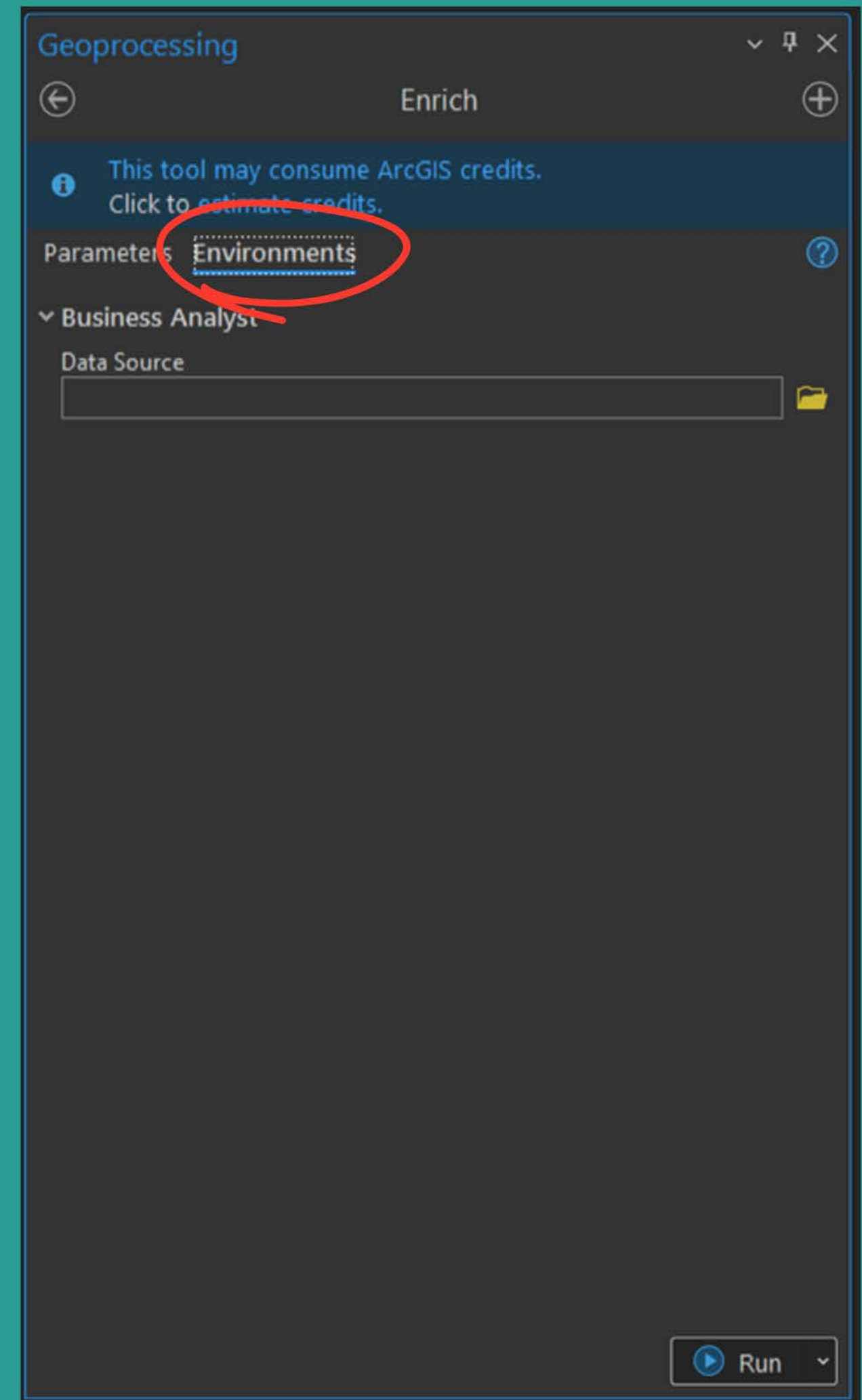
2. ArcGIS Pro

- In the **Geoprocessing** pane, search for and open the **Enrich** tool.



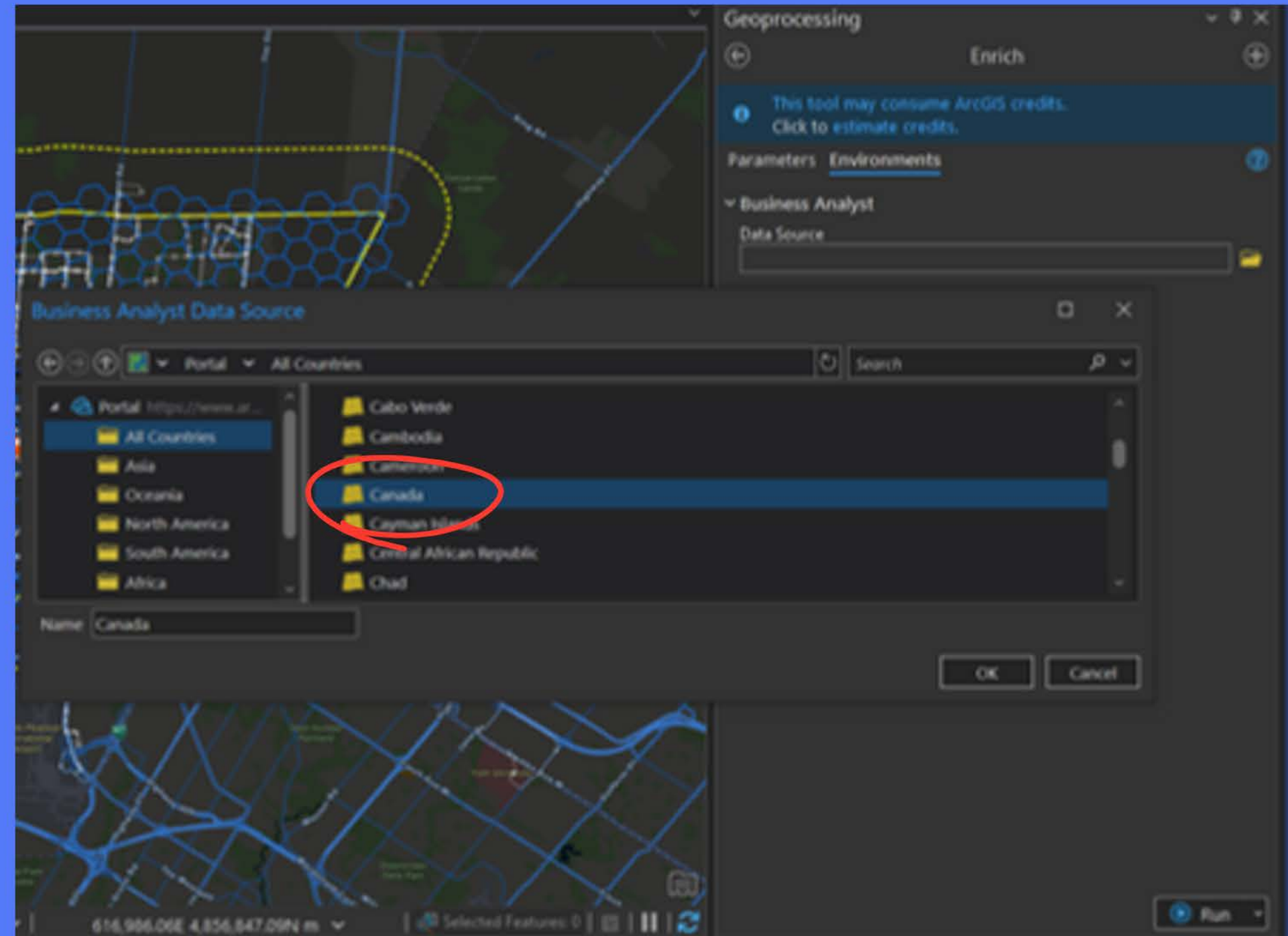
2. ArcGIS Pro

- The Enrich tool defaults to United States locations. Change this by clicking on the **Environments** tab.
- Click the **folder icon** to the left of the Data Source box.



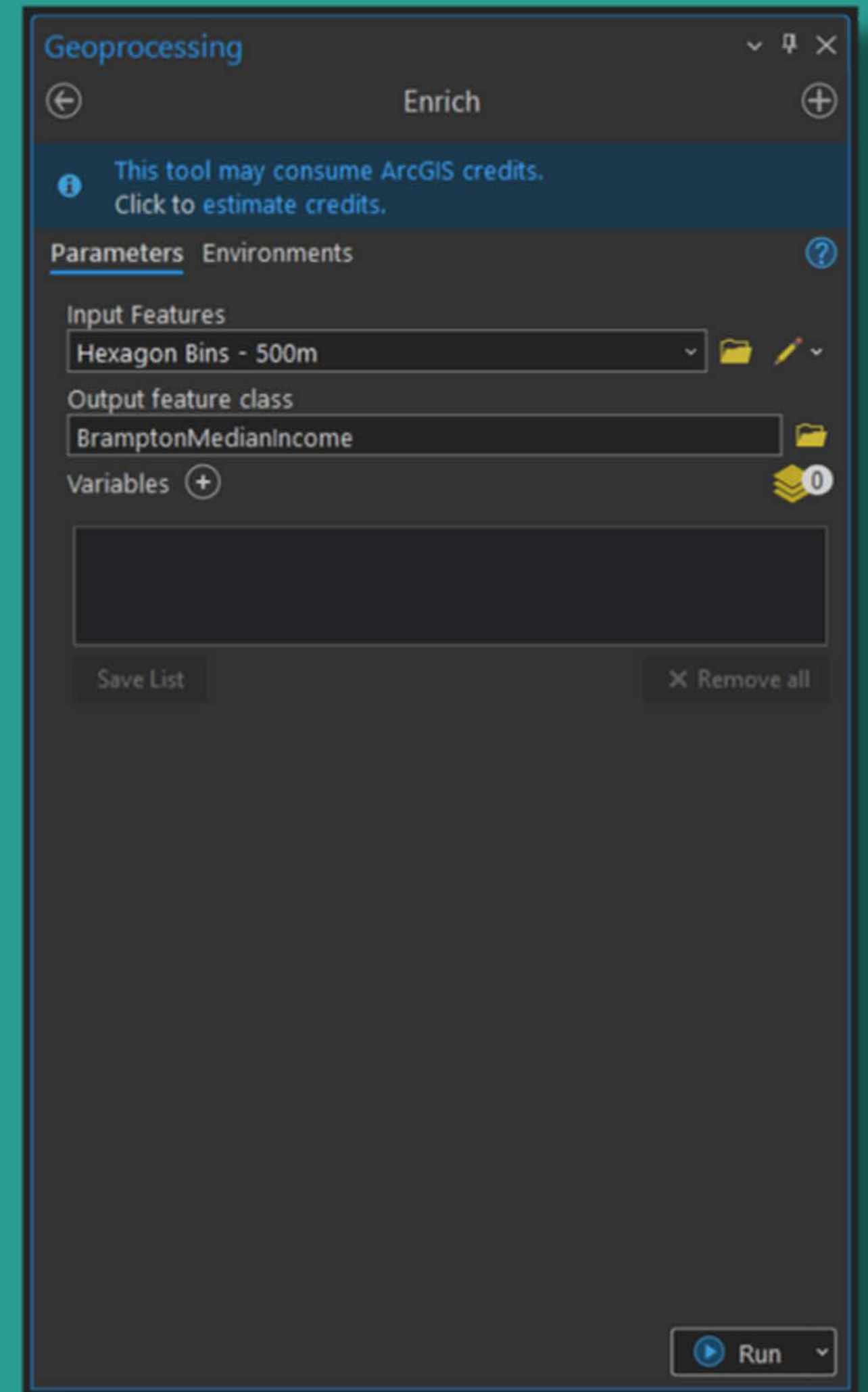
2. ArcGIS Pro

- Find and select Canada. Click OK.



2. ArcGIS Pro

- In the **Parameters** tab of the **Enrich** tool, specify the following:
- **Input Features:** Select the **Hexagon Bins - 500m** layer
- **Output feature class:** Enter **BramptonMedianIncome** or another descriptive name.

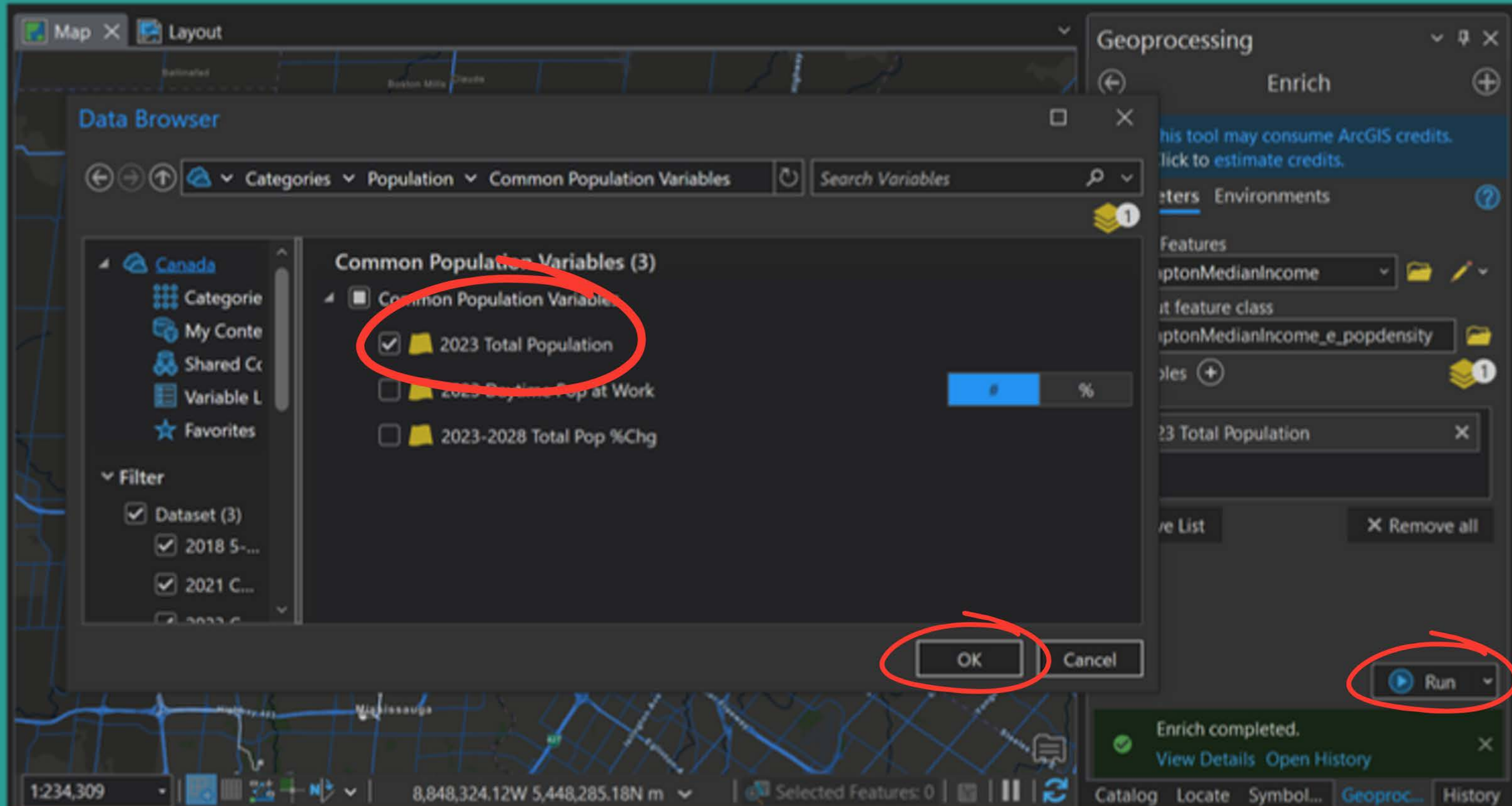


2. ArcGIS Pro

- Click the + button next to the word Variables.
- Navigate to Income > **Common Income Variables**.
- Check the box next to **2023 HH Inc. Median Curr\$**.

2. ArcGIS Pro

- Navigate to **Population > Common Population Variables**.
- Check the box next to **2023 Total Population**.
- Click **OK**. Click **Run**.



2. ArcGIS Pro

- Review the **Attribute Table** of the new layer created by the **Enrich** tool.
- The layer now includes median household income values and population counts for each feature.

The screenshot displays the ArcGIS Pro interface with the **Enrich** tool results. The **Contents** pane on the left shows the **BramptonMedianIncome** layer selected. The **Map** pane shows a street map with orange location pins. The **Geoprocessing** pane on the right shows the **Enrich** tool parameters, including the input **Hexagon Bins - 500m** and the output **BramptonMedianIncome**. The **Variables** section shows the variable **2023 HH Inc: Median Curr\$** with an **Index** button. A **Run** button is visible at the bottom right of the Geoprocessing pane.

The **Attribute Table** for the **BramptonMedianIncome** layer is shown below, displaying the following data:

ID	ANAL_OID	sourceCountry	apportionmentConfidence	populationToPolygonSizeRating	2023 HH Inc: Median Curr\$	Shape
1	1	CA	-1	-1	115762.63	299
2	2	CA	-1	-1	200000	299
3	3	CA	-1	-1	0	299
4	4	CA	-1	-1	146153.85	299
5	5	CA	-1	-1	135044.64	299
6	6	CA	-1	-1	144411.76	299
7	7	CA	-1	-1	115328.05	299
8	8	CA	-1	-1	110204.06	299
9	9	CA	-1	-1	81183.43	299

2. ArcGIS Pro

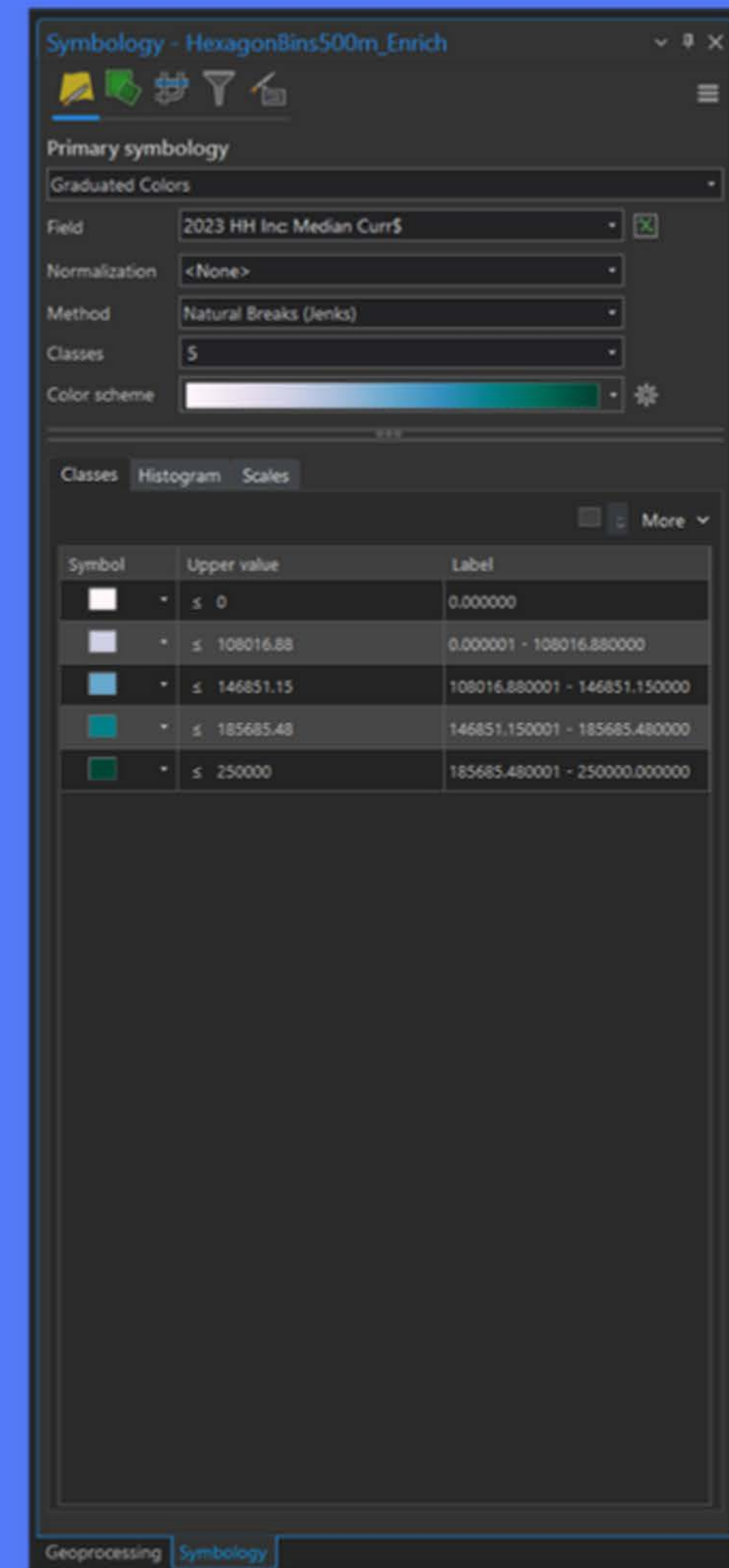
- Open the **Symbology** pane for the BramptonMedianIncome layer
- From the Primary Symbology dropdown, choose **Graduated Colors**.

The screenshot displays the ArcGIS Pro interface with the Symbology pane open for the 'BramptonMedianIncome' layer. The 'Primary symbology' dropdown is set to 'Graduated Colors'. The map view shows a street map with a data table overlaid at the bottom. The data table has the following columns and values:

apportionmentConfidence	populationToPolygonSizeRating	2023 HH Inc: Median Curr\$	Shape
-1	-1	115782.83	299
-1	-1	200000	299
-1	-1	0	299
-1	-1	146153.85	299
-1	-1	135044.64	299
-1	-1	144411.76	299
-1	-1	115328.05	299
-1	-1	110204.08	299
-1	-1	81183.43	299

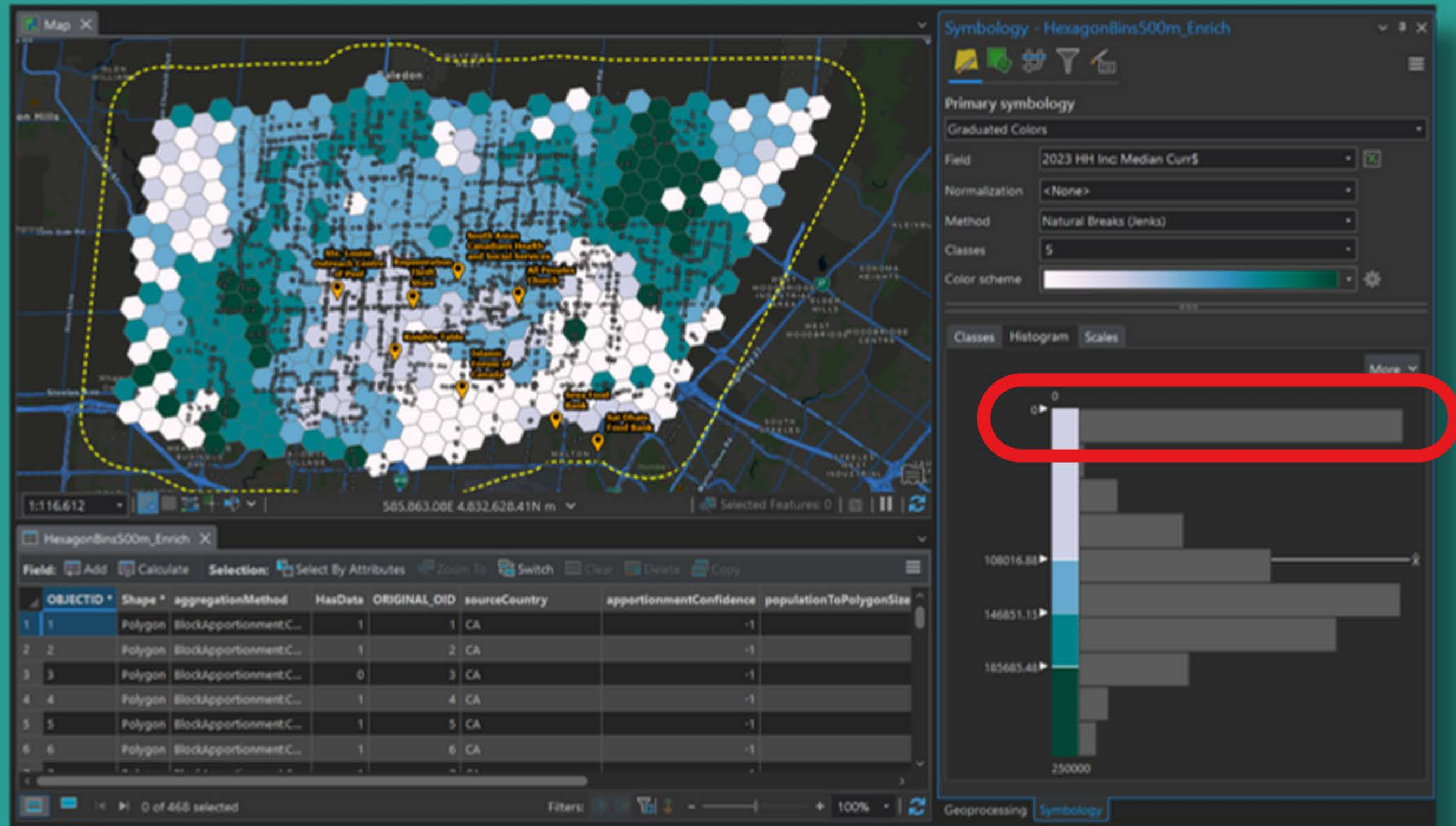
2. ArcGIS Pro

- Select **2023 HH Inc: Median Curr\$** for the Field
- Input 5 for the number of classes
- Choose a colour ramp
- Note: you may wish to experiment with the classification method, number of classes, and color scheme to see how the same data may be visualized in different ways.



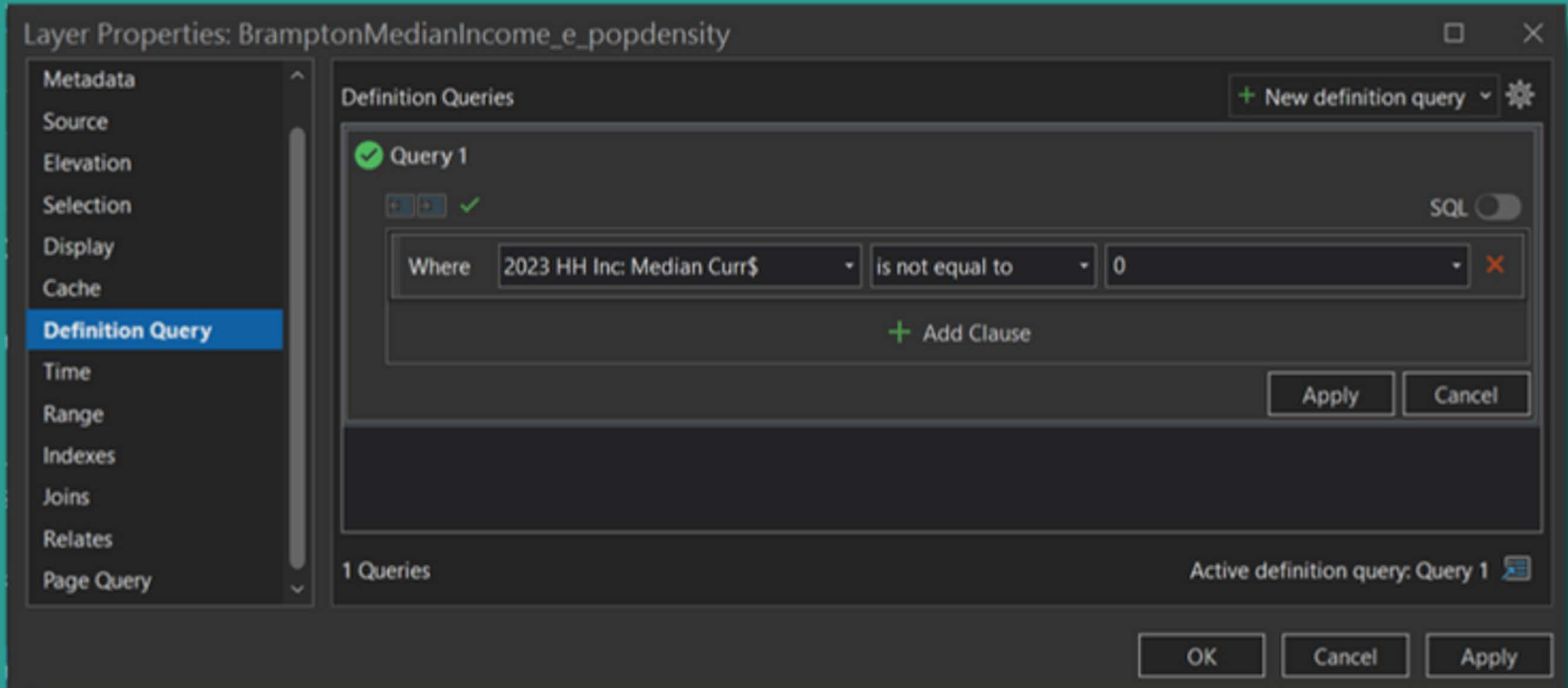
2. ArcGIS Pro

- Click on the **Histogram** tab of the Symbology pane.
- Note the high number of zeros for the Median Income field.
- This is because some features had no data returned by the Enrich Layer function.



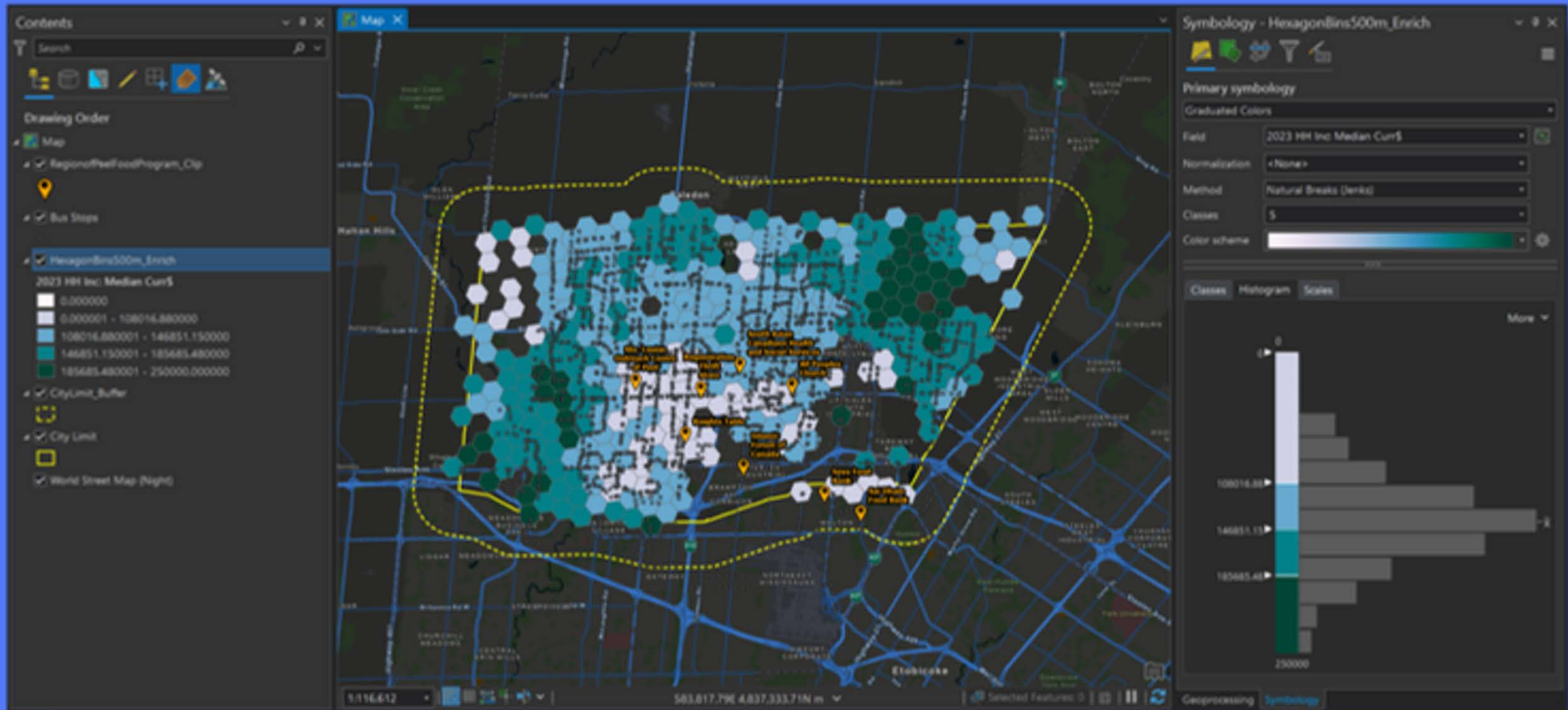
2. ArcGIS Pro

- Add a **Definition Query** to the Median Income layer to filter out the zeros.
- Build the expression: **2023 HH Inc: Median Curr\$ is not equal to 0**
- Click **Apply**. Click **OK**.



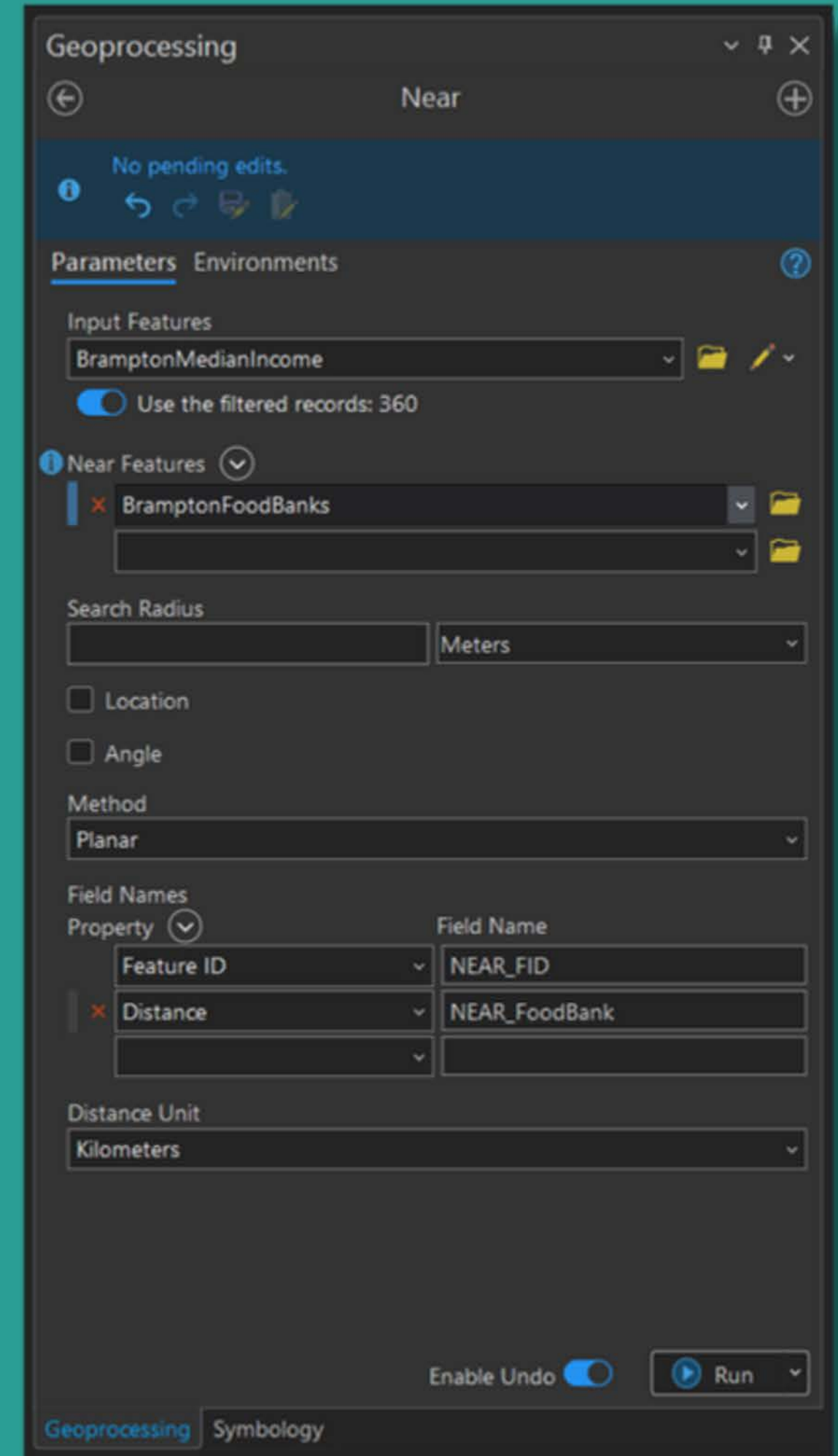
2. ArcGIS Pro

- Remove the original Hexagon grid layer. The map should look something like this.



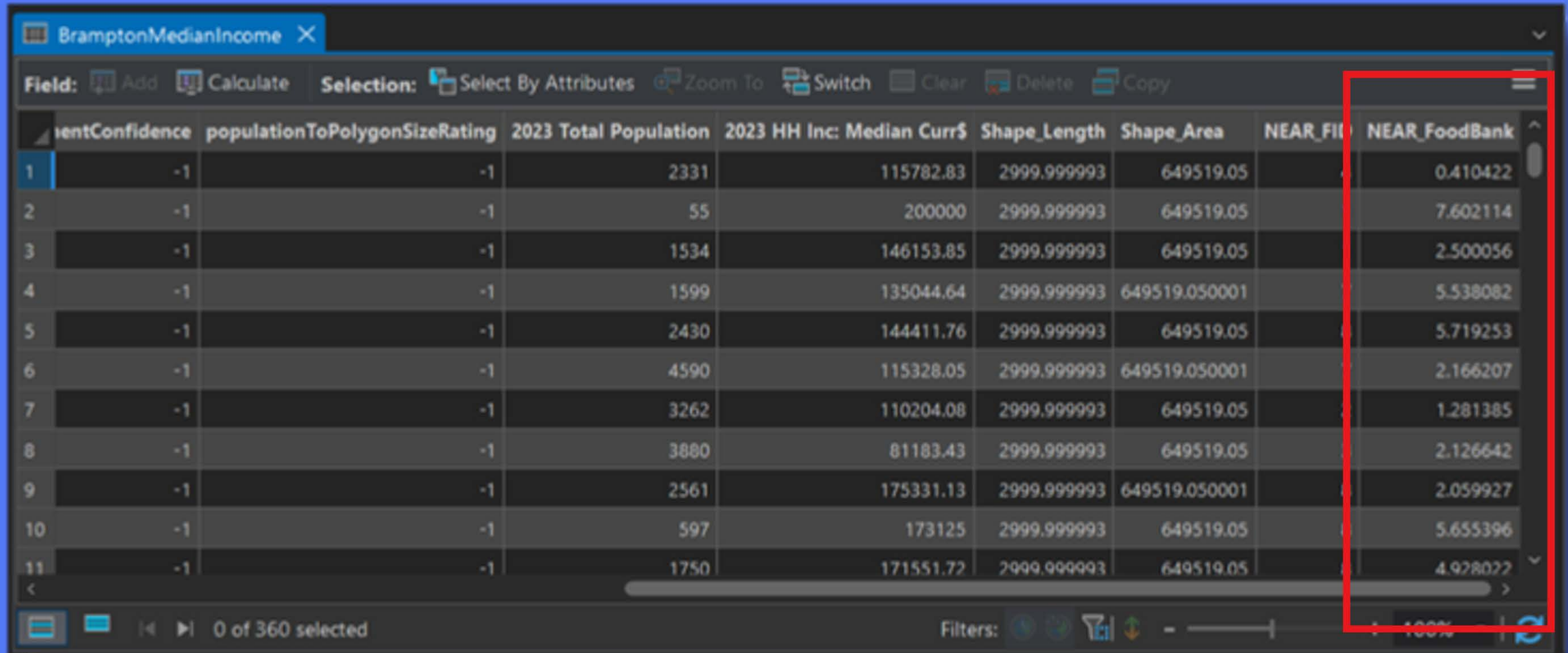
2. ArcGIS Pro

- How far is each area from a food bank?
- Open the **Near** geoprocessing tool.
- Specify the geoenriched layer as the **Input Features**.
- Input the Food Banks layer for the **Near Features**.
- Distance Unit = **Kilometres**.
- Distance Field Name = **NEAR_FoodBank**
- Click **Run**.



2. ArcGIS Pro

- The layer's Attribute Table now contains a field called **NEAR_FoodBank**.
- The attribute values in the NEAR_FoodBank field represent how far each area is from a food bank, in kilometres.

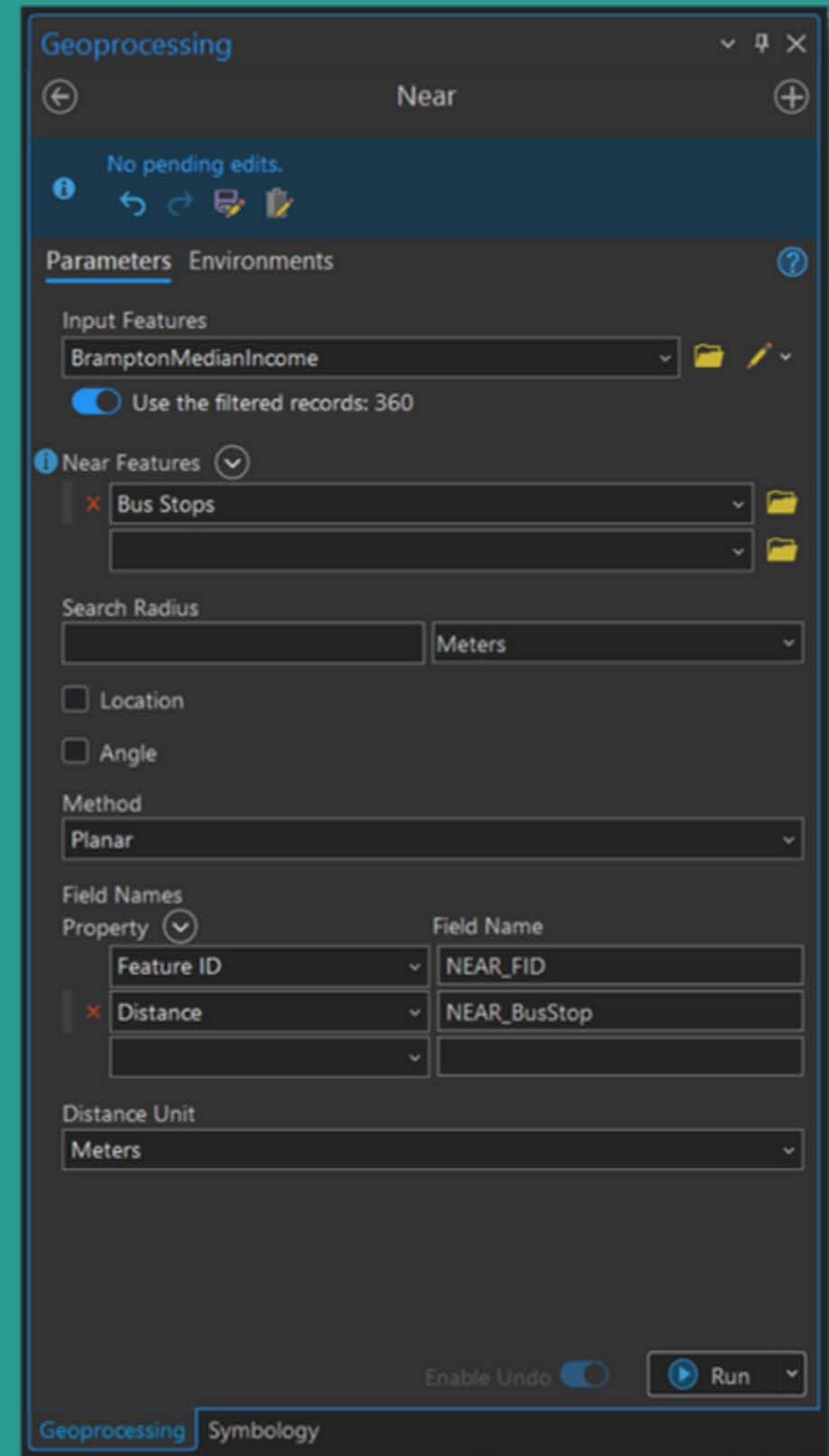


The screenshot displays the Attribute Table for the 'BramptonMedianIncome' layer. The table includes the following columns: ObjectID, PercentConfidence, populationToPolygonSizeRating, 2023 Total Population, 2023 HH Inc: Median Curr\$, Shape_Length, Shape_Area, NEAR_FoodBank, and NEAR_FoodBank. The NEAR_FoodBank column is highlighted with a red box, indicating its importance in the context of the slide. The values in this column represent the distance from each area to the nearest food bank in kilometers.

ObjectID	PercentConfidence	populationToPolygonSizeRating	2023 Total Population	2023 HH Inc: Median Curr\$	Shape_Length	Shape_Area	NEAR_FoodBank	NEAR_FoodBank
1	-1	-1	2331	115782.83	2999.999993	649519.05	0.410422	0.410422
2	-1	-1	55	200000	2999.999993	649519.05	7.602114	7.602114
3	-1	-1	1534	146153.85	2999.999993	649519.05	2.500056	2.500056
4	-1	-1	1599	135044.64	2999.999993	649519.050001	5.538082	5.538082
5	-1	-1	2430	144411.76	2999.999993	649519.05	5.719253	5.719253
6	-1	-1	4590	115328.05	2999.999993	649519.050001	2.166207	2.166207
7	-1	-1	3262	110204.08	2999.999993	649519.05	1.281385	1.281385
8	-1	-1	3880	81183.43	2999.999993	649519.05	2.126642	2.126642
9	-1	-1	2561	175331.13	2999.999993	649519.050001	2.059927	2.059927
10	-1	-1	597	173125	2999.999993	649519.05	5.655396	5.655396
11	-1	-1	1750	171551.72	2999.999993	649519.05	4.928022	4.928022

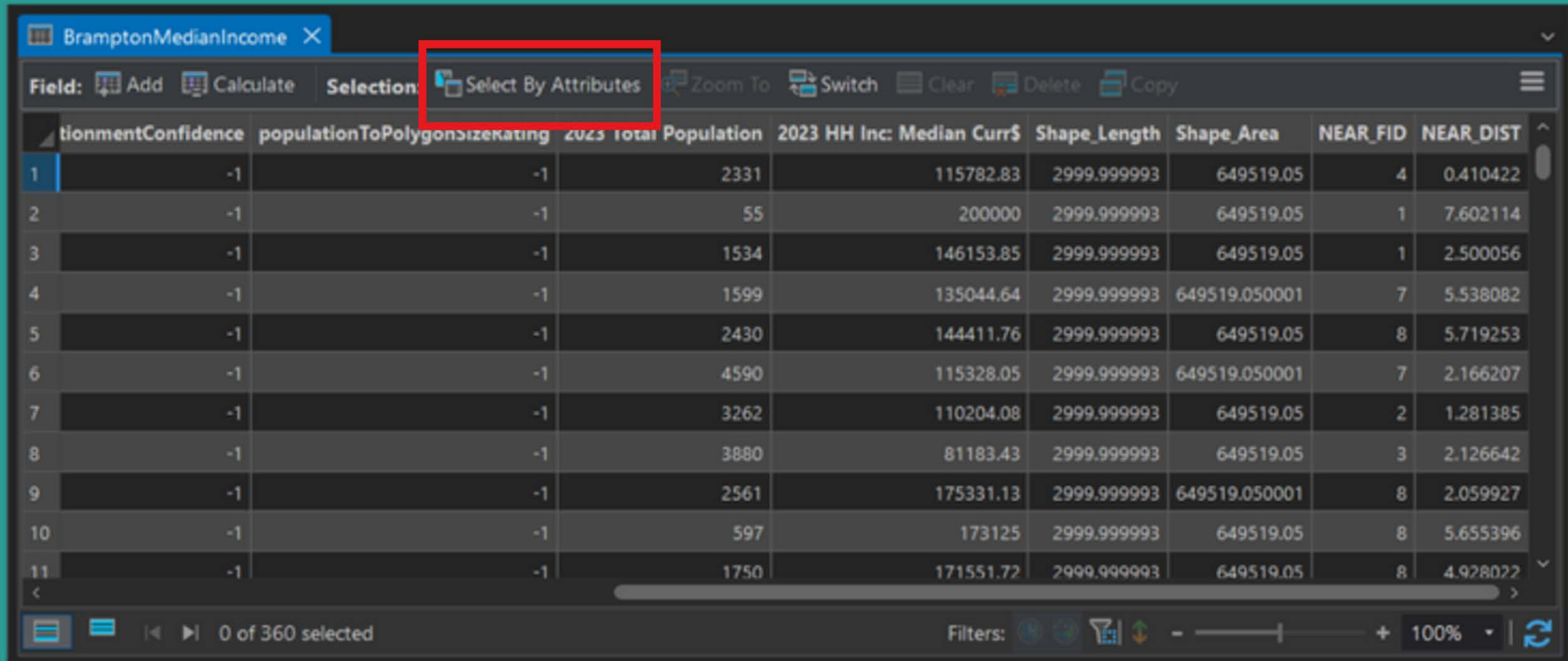
2. ArcGIS Pro

- How far is each area from a bus stop?
- Open the **Near** geoprocessing tool.
- Specify the geoenriched layer as the **Input Features**.
- Input the Bus Stops layer for the **Near Features**.
- Distance Unit = **Metres**.
- Distance Field Name = **NEAR_BusStop**
- Click **Run**.



2. ArcGIS Pro

- Use the information in the attribute table to select some potential locations.
- Click the **Select by Attributes** button.

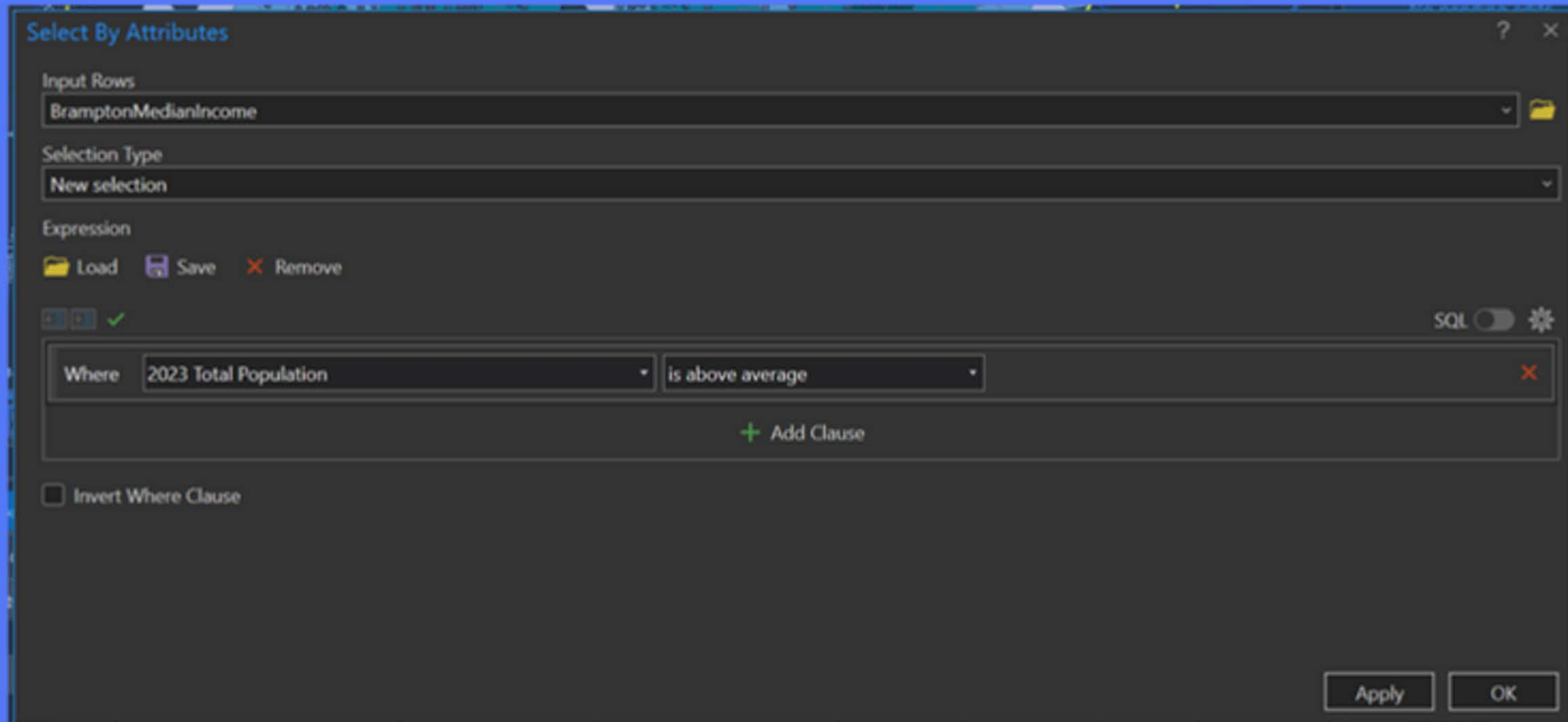


The screenshot shows the attribute table for a layer named 'BramptonMedianIncome'. The 'Select By Attributes' button in the top toolbar is highlighted with a red box. The table contains 11 rows of data with the following columns: Row ID, LocationConfidence, populationToPolygonSizeRating, 2023 total Population, 2023 HH Inc: Median Curr\$, Shape_Length, Shape_Area, NEAR_FID, and NEAR_DIST.

Row ID	LocationConfidence	populationToPolygonSizeRating	2023 total Population	2023 HH Inc: Median Curr\$	Shape_Length	Shape_Area	NEAR_FID	NEAR_DIST
1	-1	-1	2331	115782.83	2999.999993	649519.05	4	0.410422
2	-1	-1	55	200000	2999.999993	649519.05	1	7.602114
3	-1	-1	1534	146153.85	2999.999993	649519.05	1	2.500056
4	-1	-1	1599	135044.64	2999.999993	649519.050001	7	5.538082
5	-1	-1	2430	144411.76	2999.999993	649519.05	8	5.719253
6	-1	-1	4590	115328.05	2999.999993	649519.050001	7	2.166207
7	-1	-1	3262	110204.08	2999.999993	649519.05	2	1.281385
8	-1	-1	3880	81183.43	2999.999993	649519.05	3	2.126642
9	-1	-1	2561	175331.13	2999.999993	649519.050001	8	2.059927
10	-1	-1	597	173125	2999.999993	649519.05	8	5.655396
11	-1	-1	1750	171551.72	2999.999993	649519.05	8	4.928022

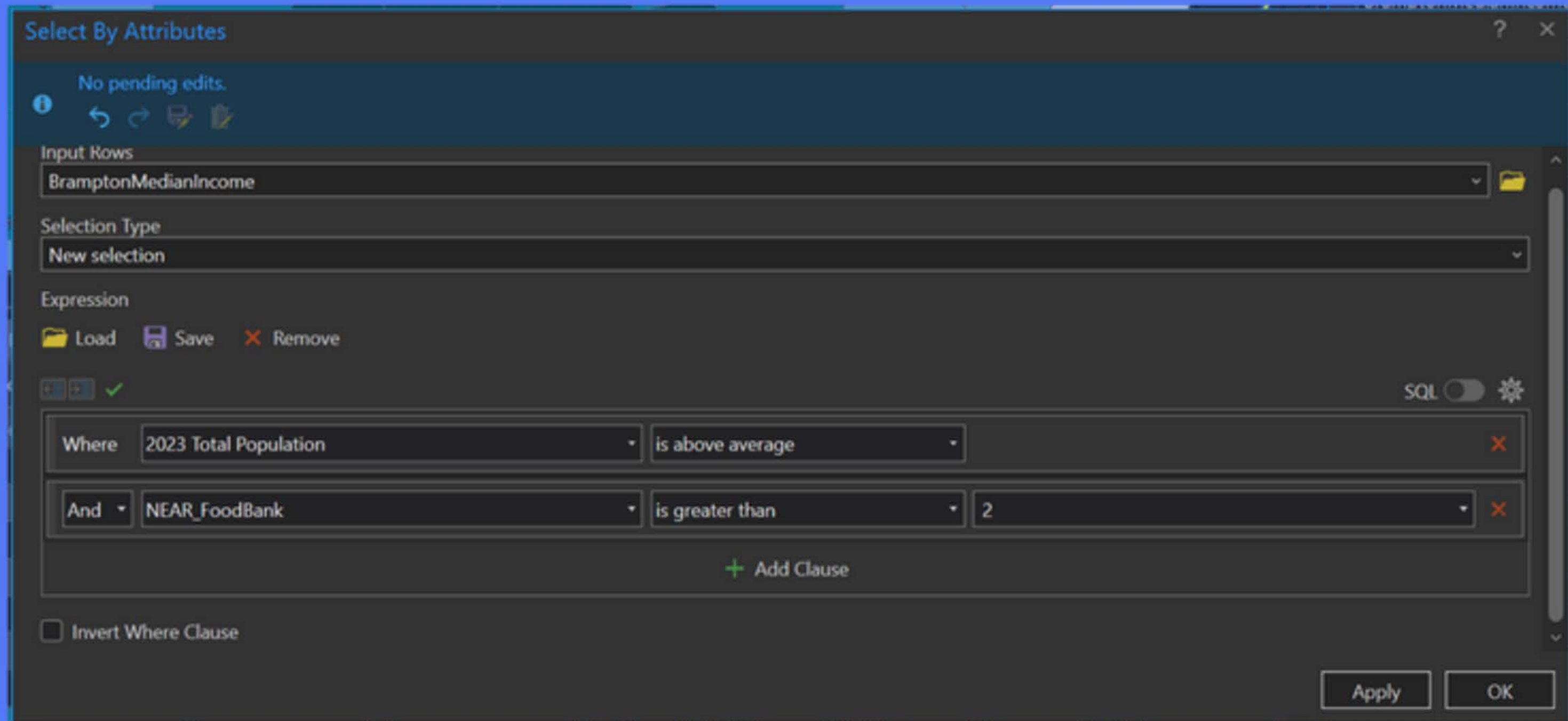
2. ArcGIS Pro

- We will build an expression to find areas that are:
 - **Densely populated**



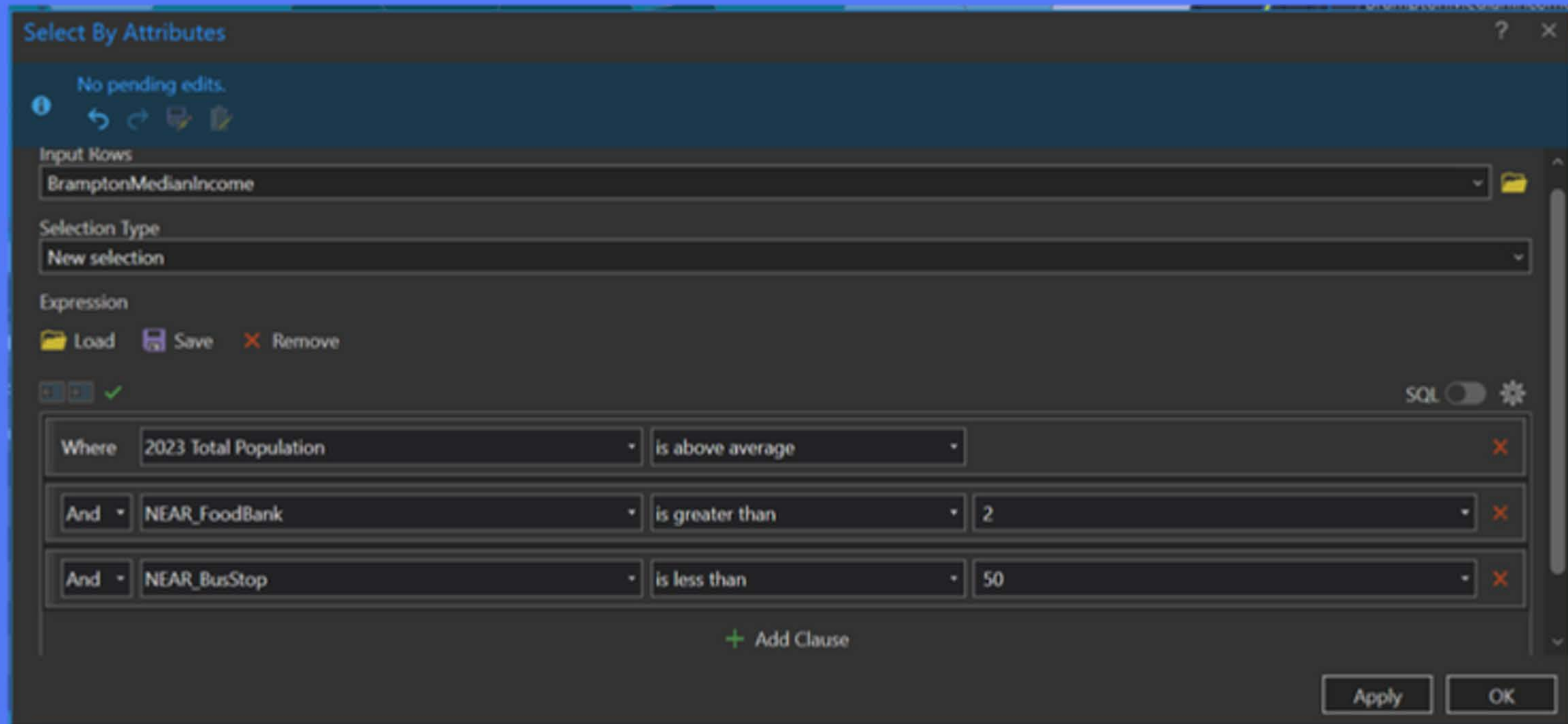
2. ArcGIS Pro

- We will build an expression to find areas that are:
 - Densely populated
 - **More than 2km from an existing food bank**



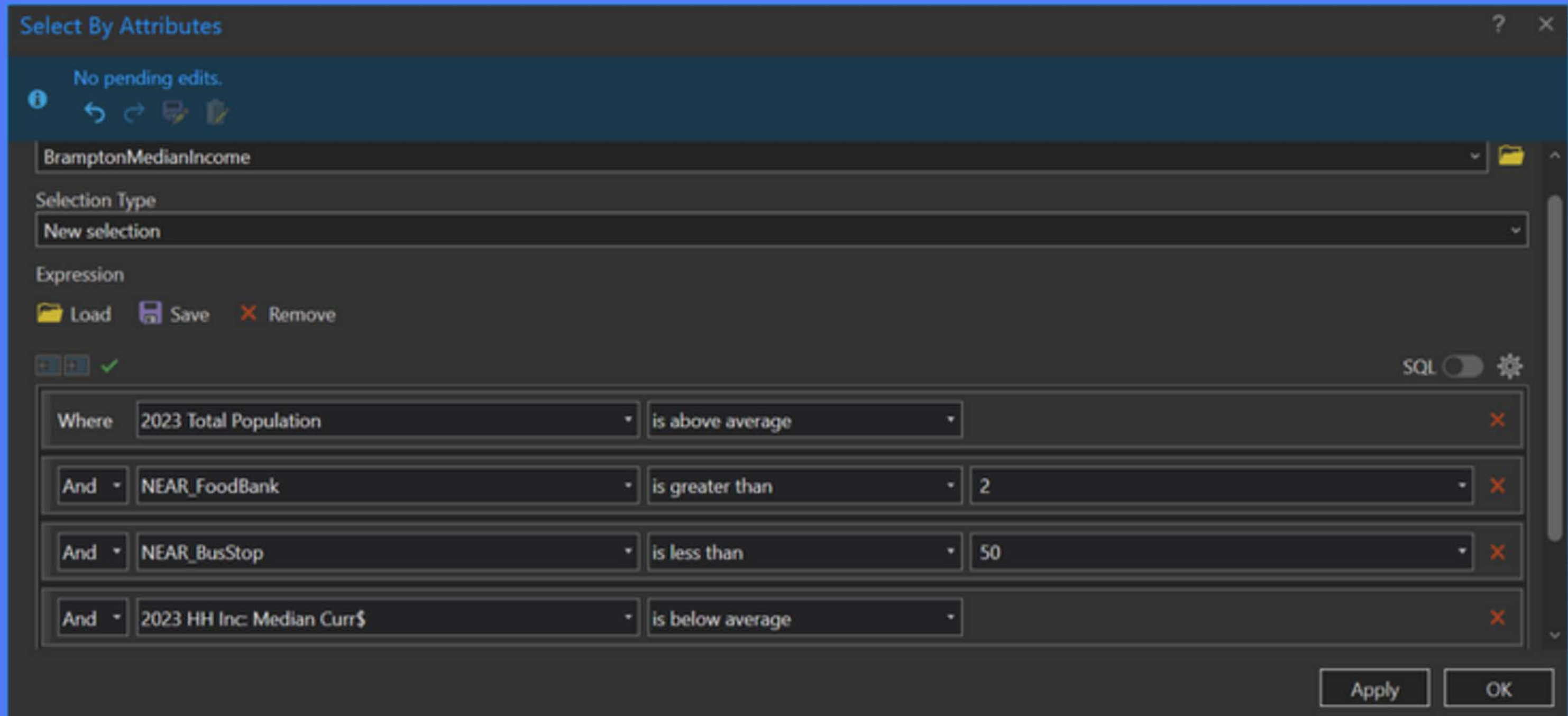
2. ArcGIS Pro

- We will build an expression to find areas that are:
 - Densely populated
 - More than 3km from an existing food bank
 - **Within 50 metres of a bus stop**



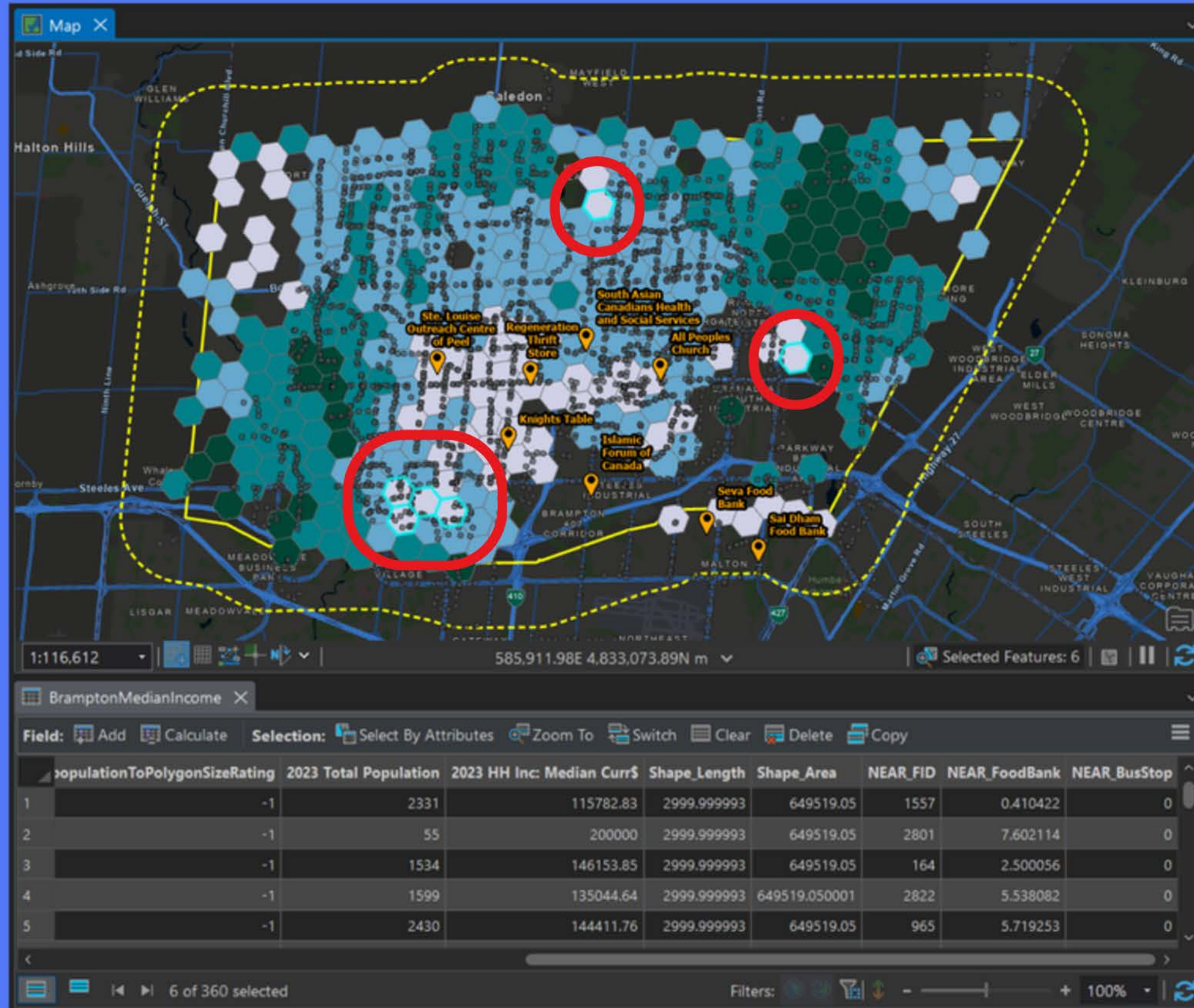
2. ArcGIS Pro

- We will build an expression to find areas that are:
 - Densely populated
 - More than 3km from an existing food bank
 - Within 50 metres of a bus stop
 - **Relatively low-income**

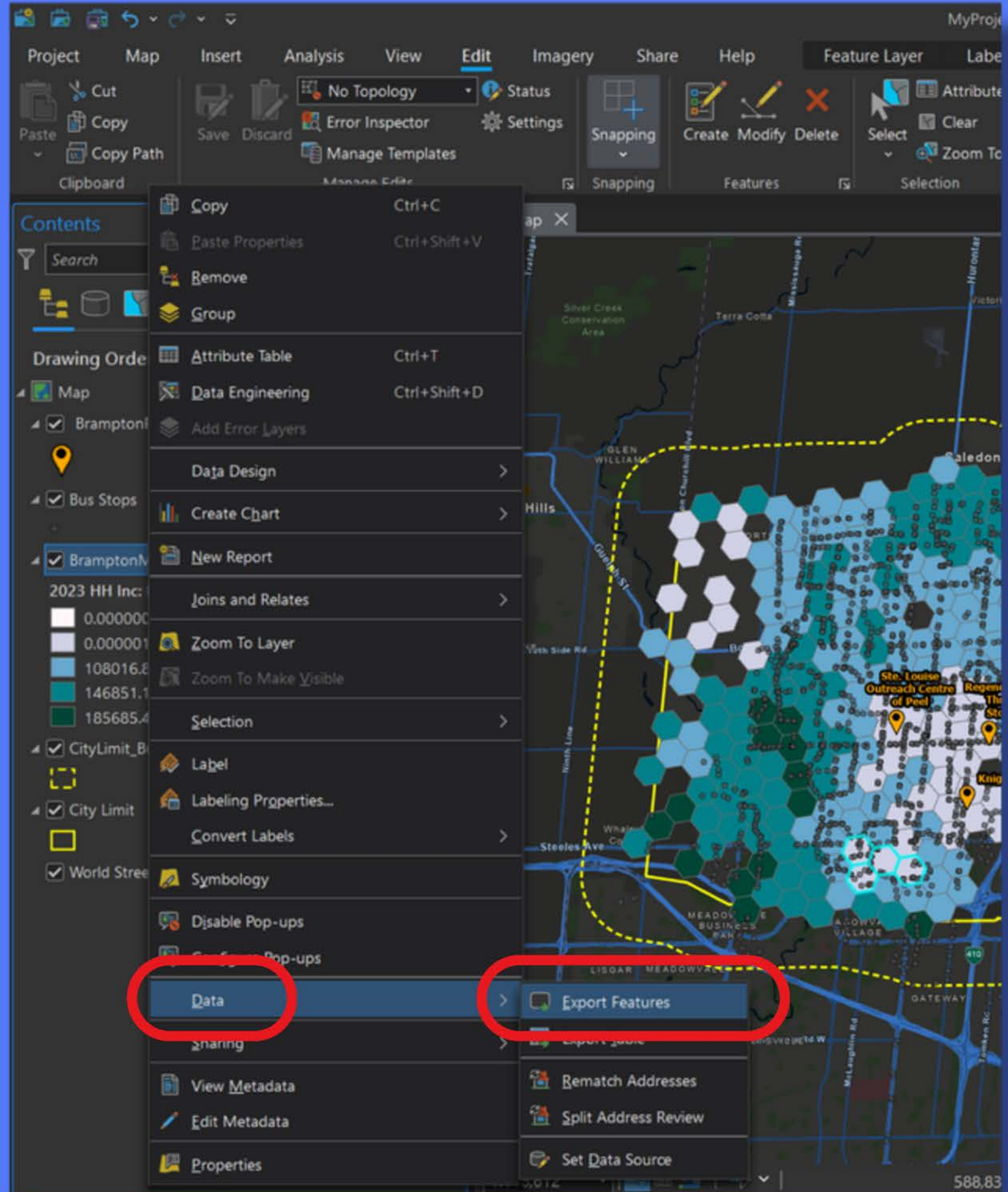


2. ArcGIS Pro

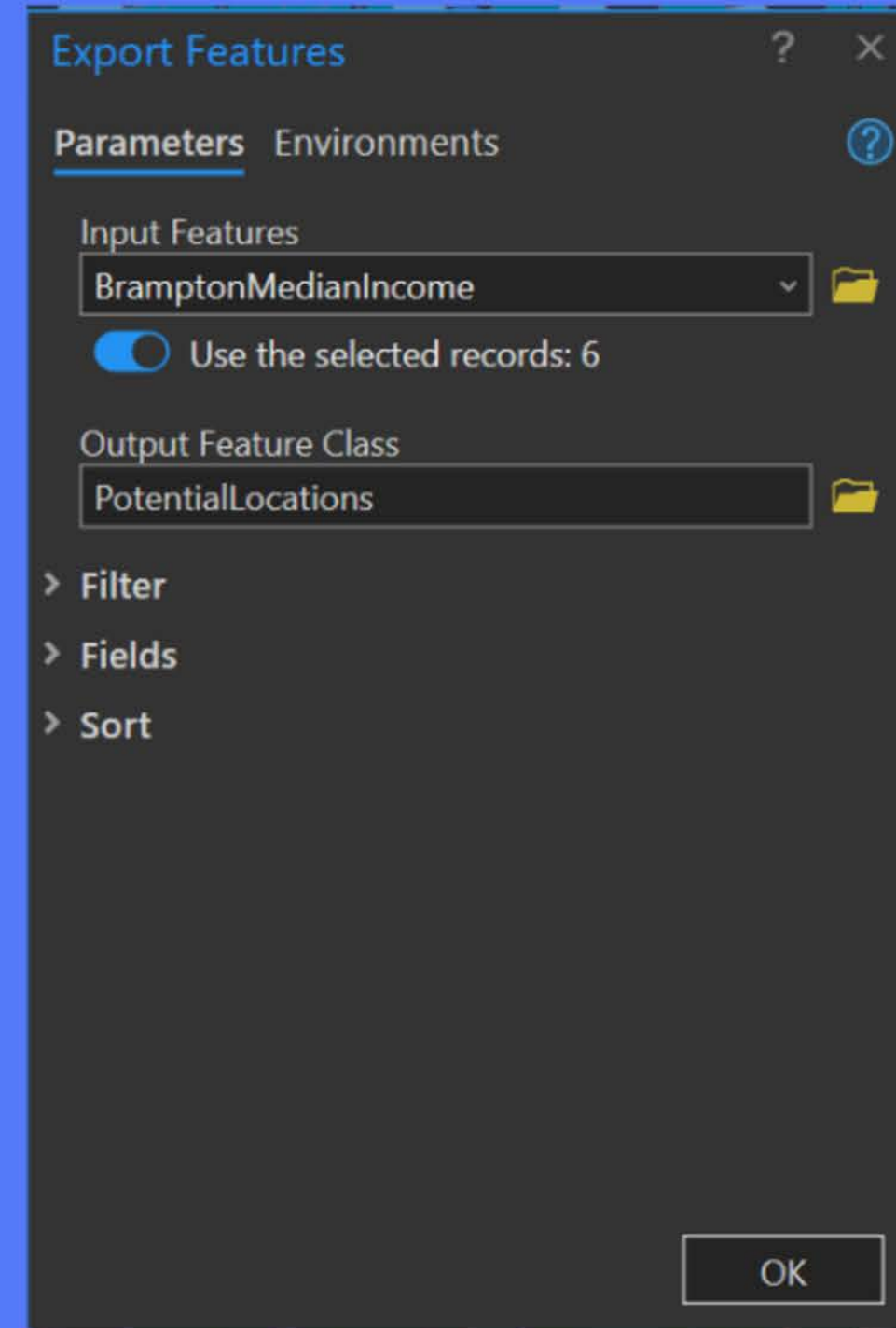
- Click OK.
- Results will be something like this:



2. ArcGIS Pro

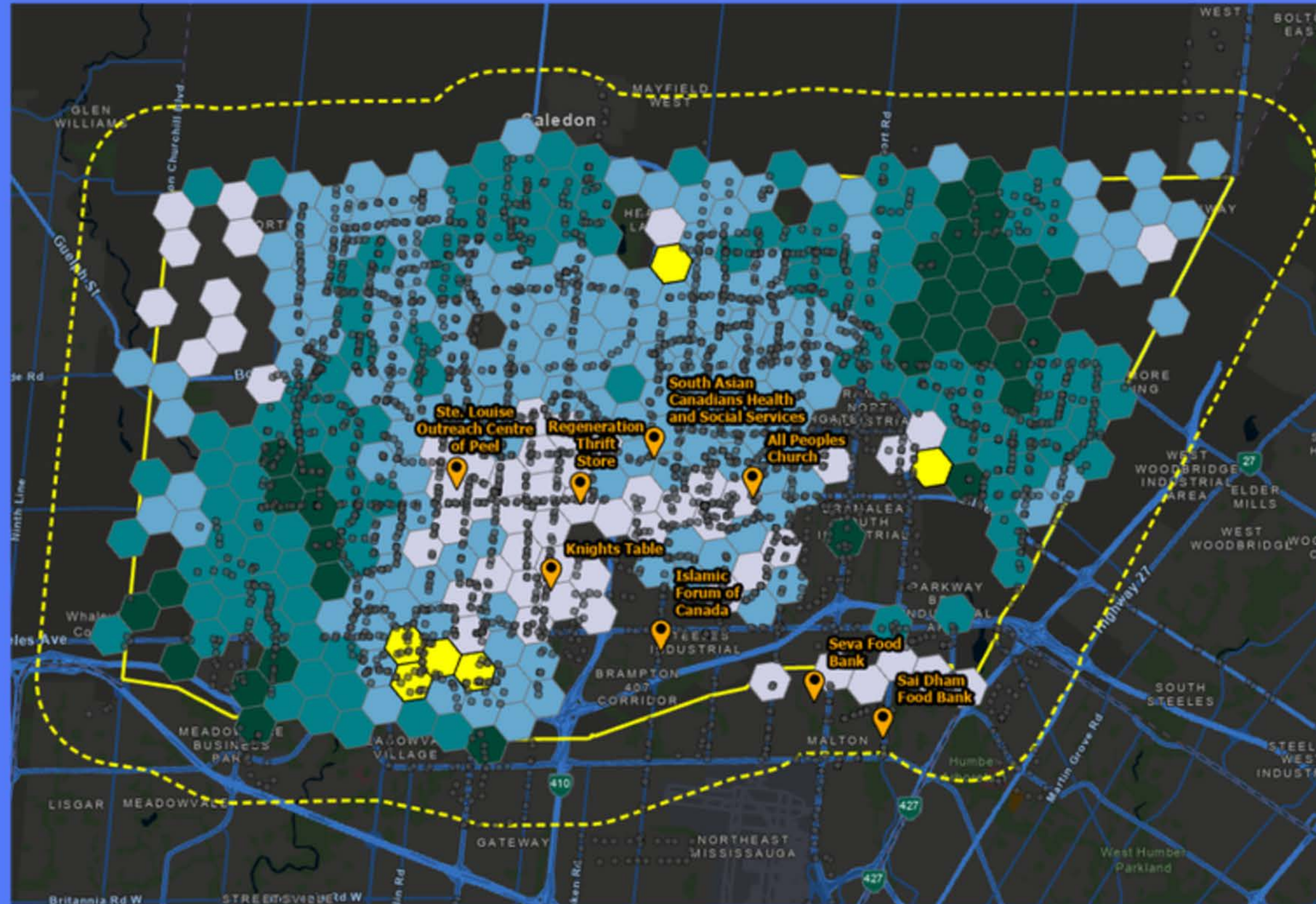


- Export the selection to create a new layer.



2. ArcGIS Pro

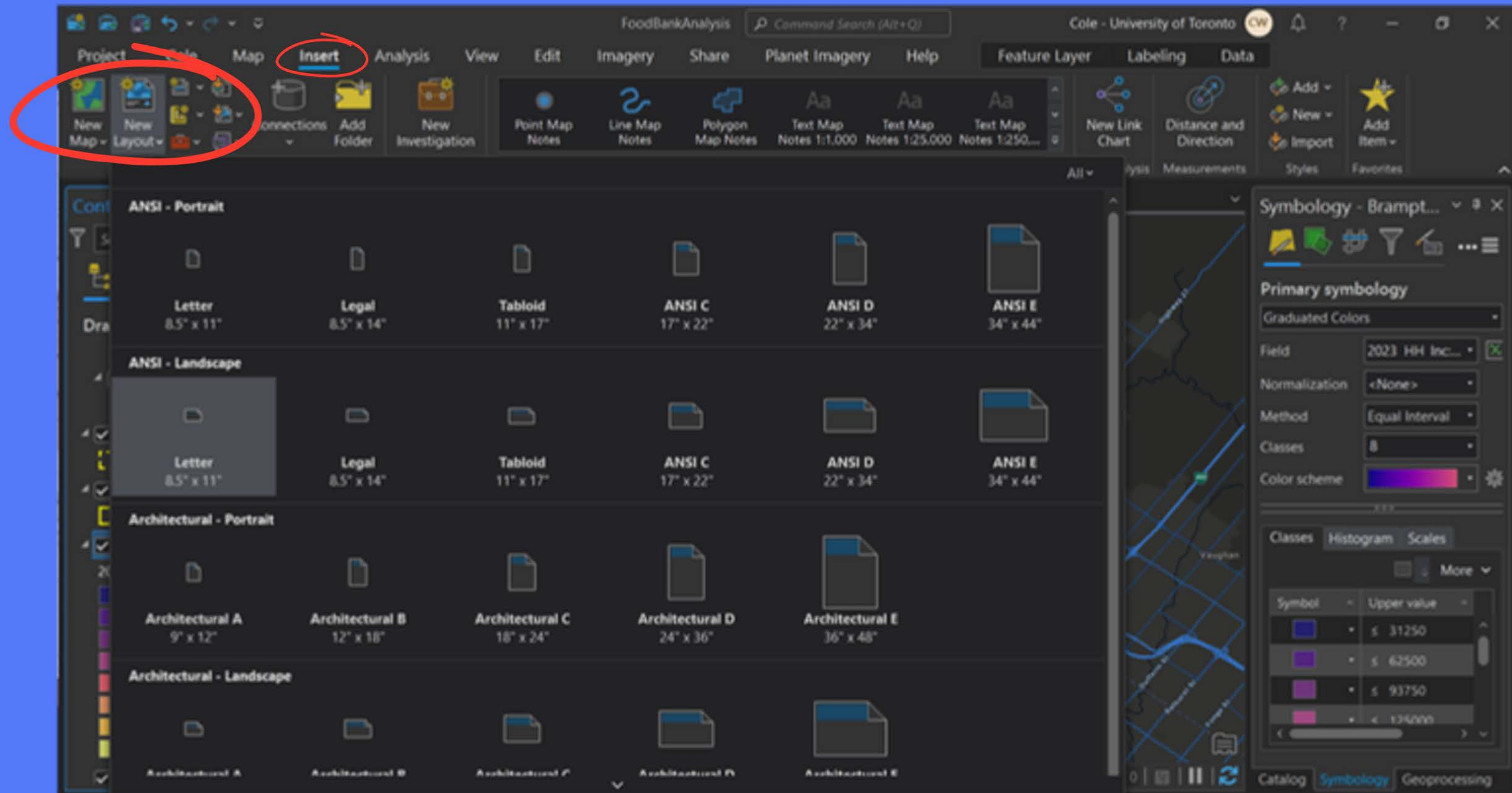
- Result:



- Based on the result, where would the best locations be to establish new food banks in Brampton, Ontario?
- What could be done to make this analysis better?

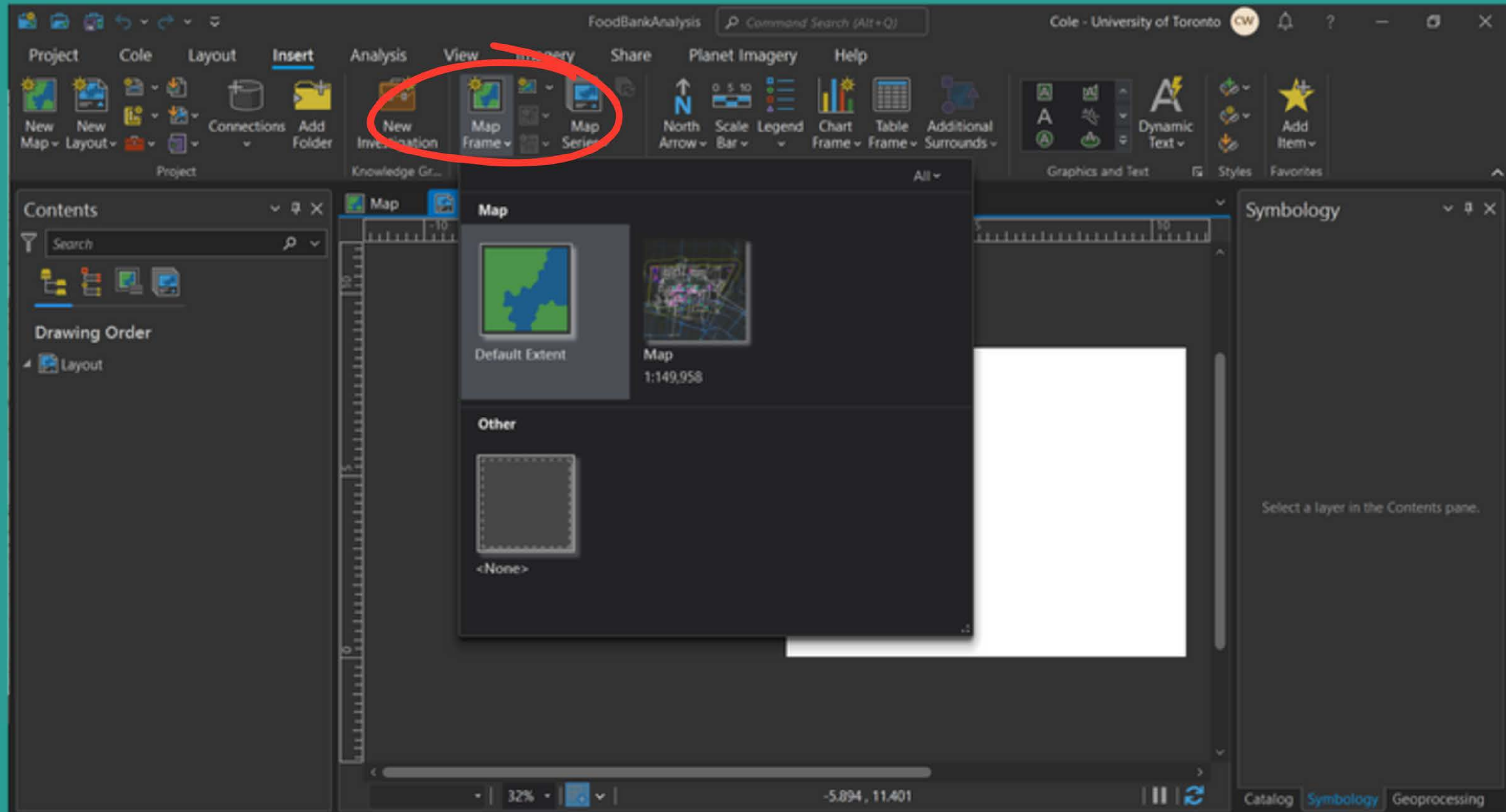
2. ArcGIS Pro - Next Steps - Layouts

- Next steps: Create a map **Layout** by choosing New Layout from the Insert tab



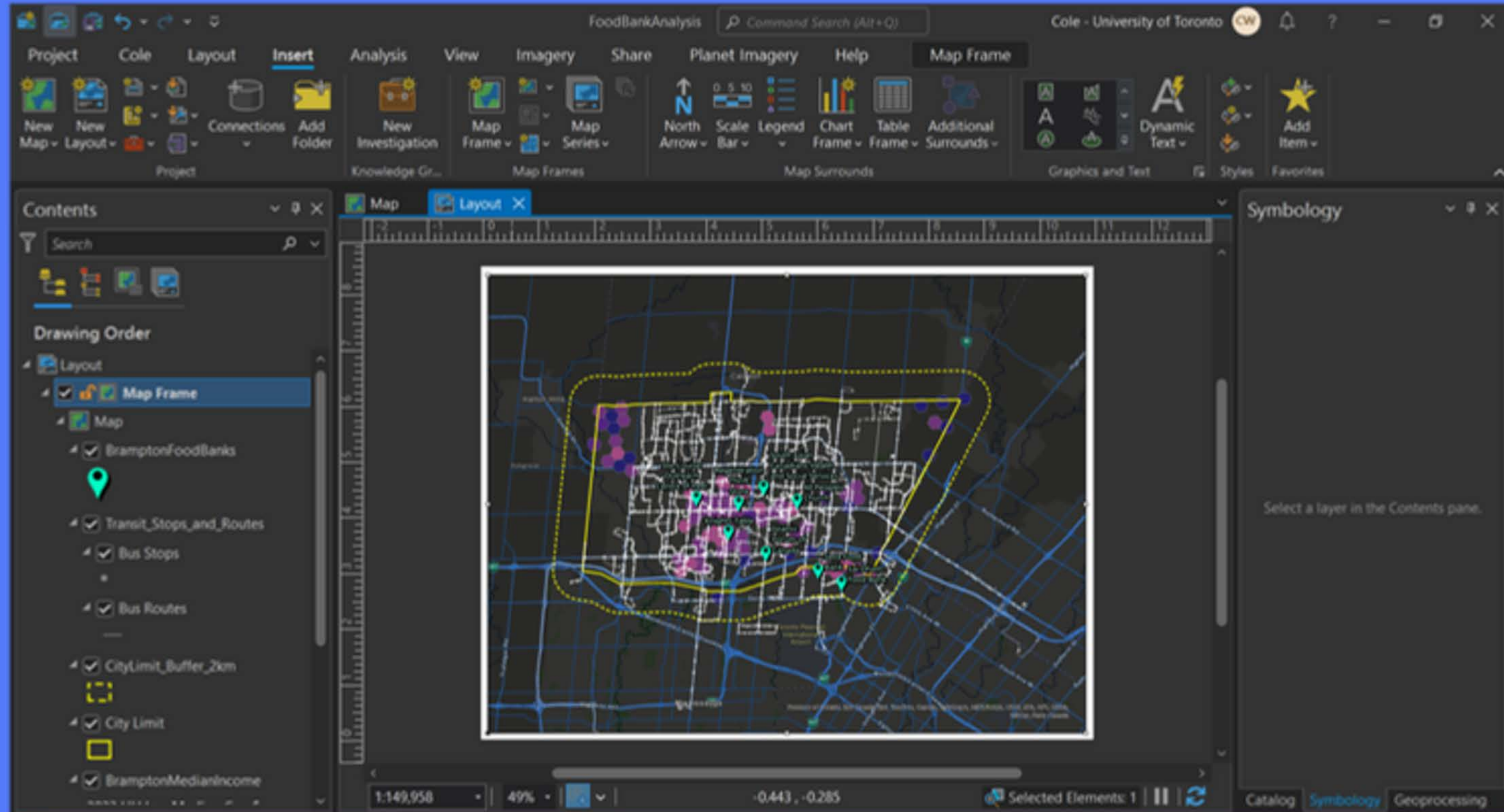
2. ArcGIS Pro - Next Steps - Layouts

- Click the **Map Frame** button and click the **Map** button



2. ArcGIS Pro - Next Steps - Layouts

- Hold down the left mouse button and drag to place the Map Frame within the Layout.
- **Title text, north arrows, scale bars, and legends** can be added at this point.



Resources: Further Reading

Learn ArcGIS Pro

- Map and Data Library Tutorials
<https://mdl.library.utoronto.ca/taxonomy/term/70>
- Esri Training: Getting Started With Spatial Analysis
<https://www.esri.com/training/catalog/5bca58f8f77b99238f845e1c/getting-started-with-spatial-analysis/>
- Esri Training: Exploring Spatial Relationships
<https://www.esri.com/training/catalog/60d1fa75b588b75ae084c42c/exploring-spatial-relationships/>
- Layouts in ArcGIS Pro
<https://pro.arcgis.com/en/pro-app/latest/help/layouts/layouts-in-arcgis-pro.htm>

Other Resources

- Esri Education Blog: How to find, evaluate, and use geospatial data in a GIS
<https://community.esri.com/t5/education-blog/how-to-find-evaluate-and-use-geospatial-data-in-a/ba-p/1366056>
- GIS for Urban Planning (Official Esri website)
<https://www.esri.com/en-us/industries/urban-community-planning/overview>



Resources: Finding Data

Spatial Data

MDL Geospatial Data Collection

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

Scholars GeoPortal

<https://geol.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>

Other Data and Media

MDL Numeric Data Collection

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

Wikimedia Commons

https://commons.wikimedia.org/wiki/Main_Page

Creative Commons Search Portal

<https://search.creativecommons.org/>

Freesound

<https://freesound.org/>

Open Culture

(see the Free Art & Images and Free Music sections)

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

Burst by Shopify

<https://www.shopify.com/stock-photos>

GitHub: Awesome Public Datasets

<https://github.com/awesomedata/awesome-public-datasets>

Internet Archive (Archive.Org)

<https://archive.org/>

Resources: Troubleshooting

Esri community discussion boards

<https://community.esri.com/>

GIS StackExchange

<https://gis.stackexchange.com/>

Contact the Map and Data Library

<https://mdl.library.utoronto.ca/about/contact-form>



Thank you!