Network Analysis – Service Area Tutorial

Getting Started

Network analyst is a set of tools that can be used to determine paths between different points in a network dataset. It utilizes detailed information about network connectivity, impedances, and restrictions to determine the most efficient routes. Impedances are factors that affect travel, like distance or time, and restrictions are factors like one-way streets and speed limits.

Most commonly a network consists of roads, but it can also be composed of railways, electrical systems, or waterways. Network analyst can be used across a variety of different disciplines including planning, engineering, and marketing, to provide solutions to network-related problems.

Some examples of questions that can be answered using network analysis include:

What is the fastest route to the grocery store?
How far can emergency services reach within 10 minutes?
How can I optimize my delivery fleet?
What is the optimal location for my shop?

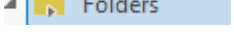
There are six types of network analysis:

1. Service Area – Identifies all areas that can be reached within a certain distance or time of a specific point.
2. Route – Identifies the ideal route (shortest, quickest) to a destination.
3. Closest Facility – Identifies the closest facility to a destination.
4. Location-Allocation – Identifies the ideal facilities to respond to demands.
5. Origin-Destination Cost Matrix – Displays travel costs (distance or time) between origins and destinations in a table format.
6. Vehicle Routing Problem – Identifies the most efficient way to dispatch a fleet of vehicles, typically for delivery.

In this tutorial, you will learn how to perform a service area network analysis to determine the service areas for childcare centers in the Waterloo Region by distance. You will create your service area using a pre-made network dataset of roads in the Waterloo Region, and then add time costs. You will perform your analysis using a variety of both time and distance impedances.

Importing Your Data

To import your data into the map, you will first need to connect to the Network Analysis folder.

Open the catalog pane and right click on 

. Select “Add Folder Connection” and browse to the Network Analysis folder. Click OK.

Now that you have added the connection to the Network Analysis - Service Area Tutorial folder add the Child_Care_Centres layer to your map. We will wait until later to add in the RMOW network, as we need to make some modifications to it first.

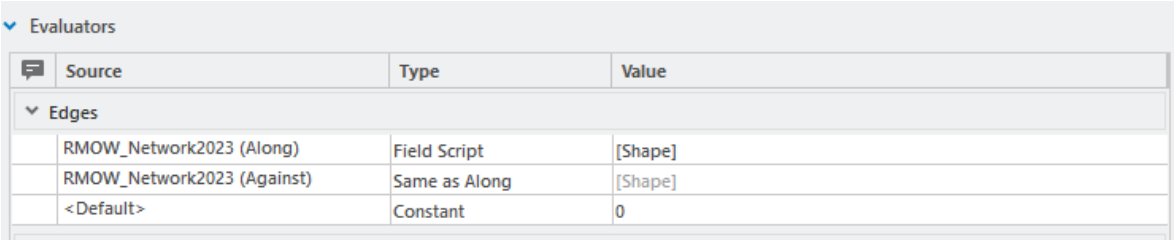
Setting Up Costs

Open the catalog pane. If this is not already on the right side of your screen, click on the view banner at the top, and then select the catalog pane icon.
Locate the network analysis folder, open the RMOWrdNet2023_1.gdb, double click on the RMOWrdNet2023 File Geodatabase Feature Dataset and right click on the RMOW_Network2023 layer, the one with an icon that looks like this:

Click on properties.

Select the travel attributes tab, and then select costs. We are now going to set up our distance and time costs. The tool should have already created a default cost attribute, Length. You can change the name to make it more descriptive by clicking the three lines in the top right and selecting Rename. An appropriate name would be “meters”.

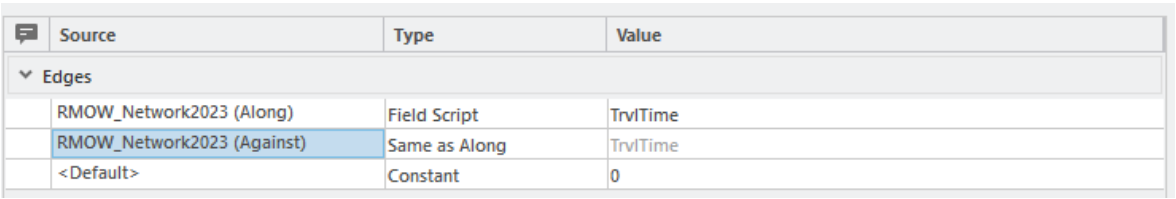
Change the Units value to Meters. In the edges section, set the RMOW_Network2023 (Along) Type to Field Script, and the the RMOW_Network2023 (Against) to Same as Along. The value for both should be [Shape].



Next, we are going to add our time cost.

Still under the costs tab, select the three lines and then select New. Change the name of the new cost to “Minutes”.

Under edges, set the RMOW_Network2023 (Along) type to Field Script, and ensure that RMOW_Network2023 (Against) is set to Same as Along. In the Value box for RMOW_Network2023 (Along), find the icon that looks like this:  Select it, and then write in the Result box “!TRVLTIM!”.

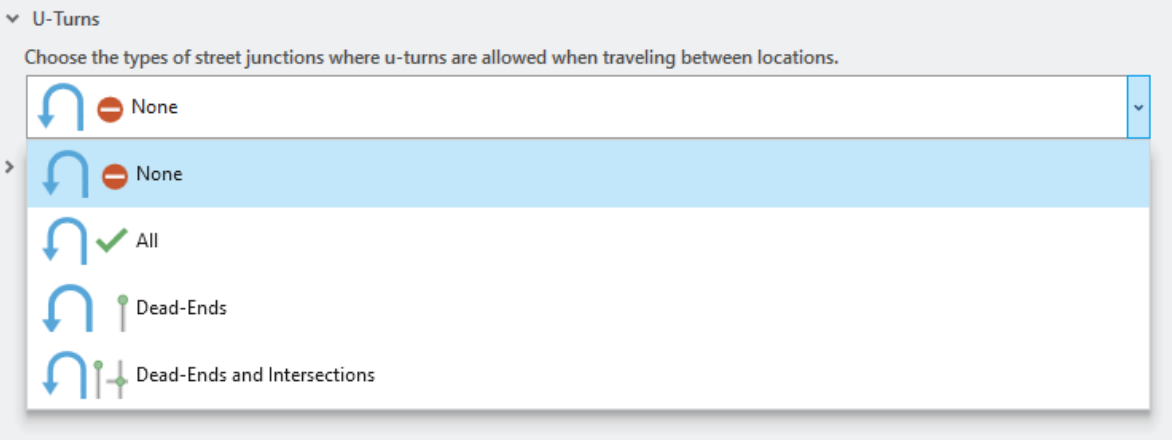


Adding Travel Modes

Still in the properties pane, select Travel Modes under Travel Attributes. Click the three lines in the top right corner and select New. Name your new travel mode “Driving Time”. Leave the type as Driving. Set the Impedance to the Minutes cost, and the Distance Cost to Meters.

Click the three lines and select Copy. Name this new travel mode “Driving Distance”. Again, leave the type as Driving. Set the Impedance to Meters and the time cost to Minutes.

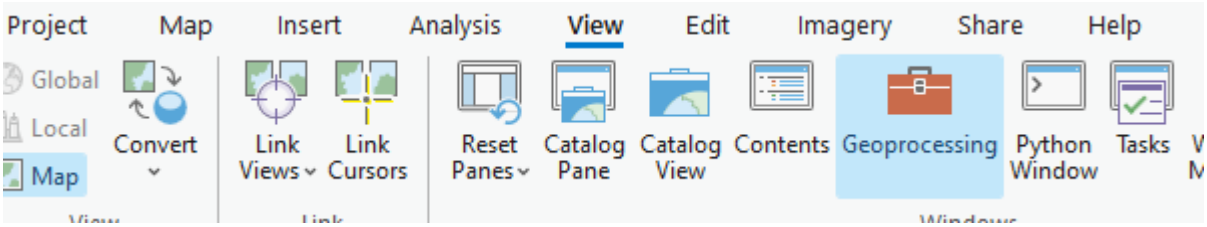
On the dropdown under U-Turns, make sure that it is set to None for both travel modes.



Click okay to finalize the changes made, and then close the properties window.

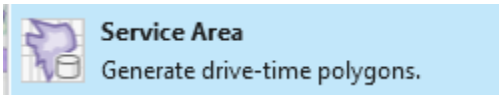
Insert all of the RMOW_Network data into your map.

Open the Geoprocessing menu. You can find this by clicking the View tab in the top right of your screen. Search for “Build Network” and select it. Click and drag the RMOW_Network2023 layer into the “Input Network Dataset” Box. Check “Force Full Build”, and then hit run.

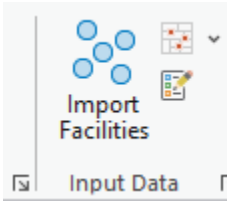


Creating a Service Area

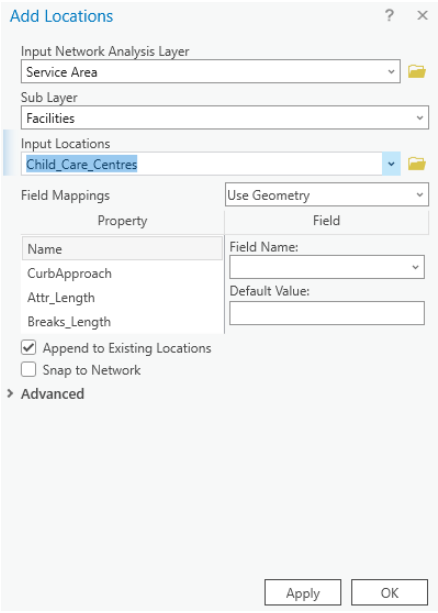
Select the analysis tab at the top of your screen. In the workflows section, select Network Analysis, and then pick Service Area in the dropdown menu. This will create the service area layer in which you will import your points into.



Select the Service Area Layer tab at the top of your screen. Click on the import facilities button in the top left corner. This is where you will add in your Childcare Centre points.



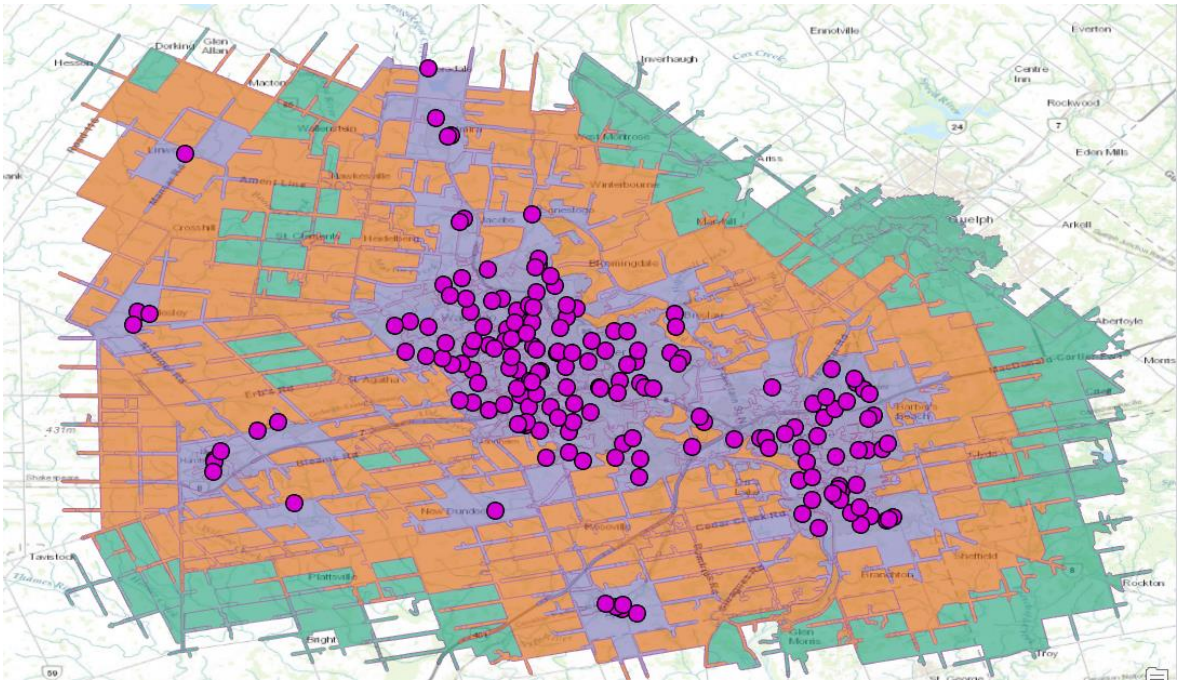
In the Input Locations field, select the Child_Care_Centres layer in the dropdown menu. The other fields do not need to be adjusted. Click OK. Your Child_Care_Centres points should now show as the facilities in the Service Area layer.



Performing Analysis

Click on the service area layer in the contents pane, and then click the service area layer tab at the top. Under travel settings, ensure the direction is set to “away from facilities”. In the dropdown under “mode” select “Driving Distance”. In the cutoffs box, type in “5000”. Hit run. You have now created the 5km service areas for each Childcare Facility.

You can also add in additional service areas to see the travel distance at different levels. For example, if you wanted to see the 5km, 10km, and 15km service areas, you can input “5000, 10000, 15000” in the cutoffs box. Click run. Your map should look like this, with three different service areas.



Next, we are going to do the same thing for Driving Time. In the dropdown under “mode” select “Driving Time”. You can leave the cutoffs as the default: 5, 10, and 15 minutes, or change them if you would like. Select run, and the 5, 10, and 15 minute service areas should be created.

You can also change the appearance of the service areas. In the output geometry section, click the dropdown menu to change from standard precision to high precision. Click run.

Lastly, click the dropdown that says “overlap”. Change to “split” to create polygons that do not overlap.

Wrapping Up

As stated in the opening Network Analyst is a set of tools that model distance and time along a line network. This is a quick overview to get an understanding of the different tools available to more accurately model space and time constrained to a plausible network. With this knowledge you will better understand GIS modeling and the requirements other logistics and business intelligence tools.

Created 2024 by: Markus Wieland
Elizabeth Beach
Bonnie Kirkwood
UNIVERSITY OF WATERLOO
GEOSPATIAL CENTER
https://uwaterloo.ca/library/geospatial/