

## TUTORIAL 7.3 | ISOCHROMATIC MAPS

### Goals

- Learn how to create travel time maps using a QGIS plugin.
- Generate the centroids and vertices of polygons.
- See how walking distance to parks correlates with demographics.

### Introduction

In this tutorial you'll learn how to draw a walking distance polygon using a QGIS plugin: ORS (open route service). ORS can calculate driving, biking, and walking distances between any two points or series of points. It can also generate isochrones, which are polygons of the travel radius around a point. In other words, instead of generating simple circles (as the crow flies), OSR calculates distances based on roads and sidewalks.

For this tutorial you'll download all the parks in your city using the OSM plugin. Then, you'll generate the central points of the parks to calculate the travel distances from. Finally, you'll bring in the block group level racial census data from an earlier tutorial and compare it with the 5- and 20-minute walking distances to parks in your city.

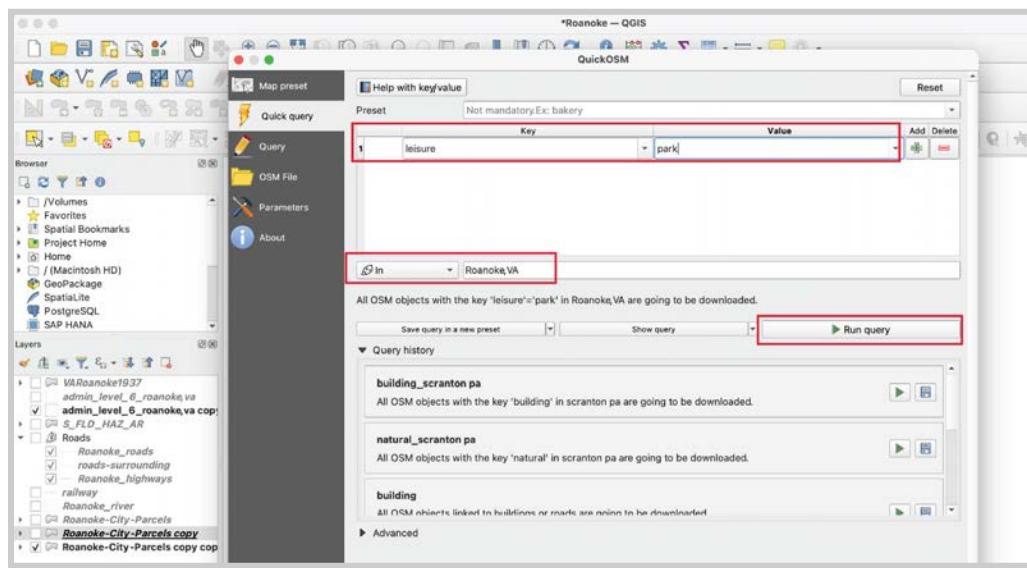
For some parks, which are large or irregular shapes, calculating distance to its center doesn't give an accurate perspective of its accessibility. A large park might require 5 or more minutes walking from its edge to reach its center. Instead, you'll individually select these and simplify their geometry. Then, you'll extract the vertices of these simplified geometries and use them instead.

**Step 1: Open a new QGIS file and add the physical geography.**

1a Set the CRS to 17N.

1b Import your administrative boundary and river layers for reference.

1c Download parks using the OSM plugin. Set the “key” to “leisure” and the “value” to “park”. Set the location to In your city, and then “Run”. Delete any layers of point or line data, keeping only the polygon layer.

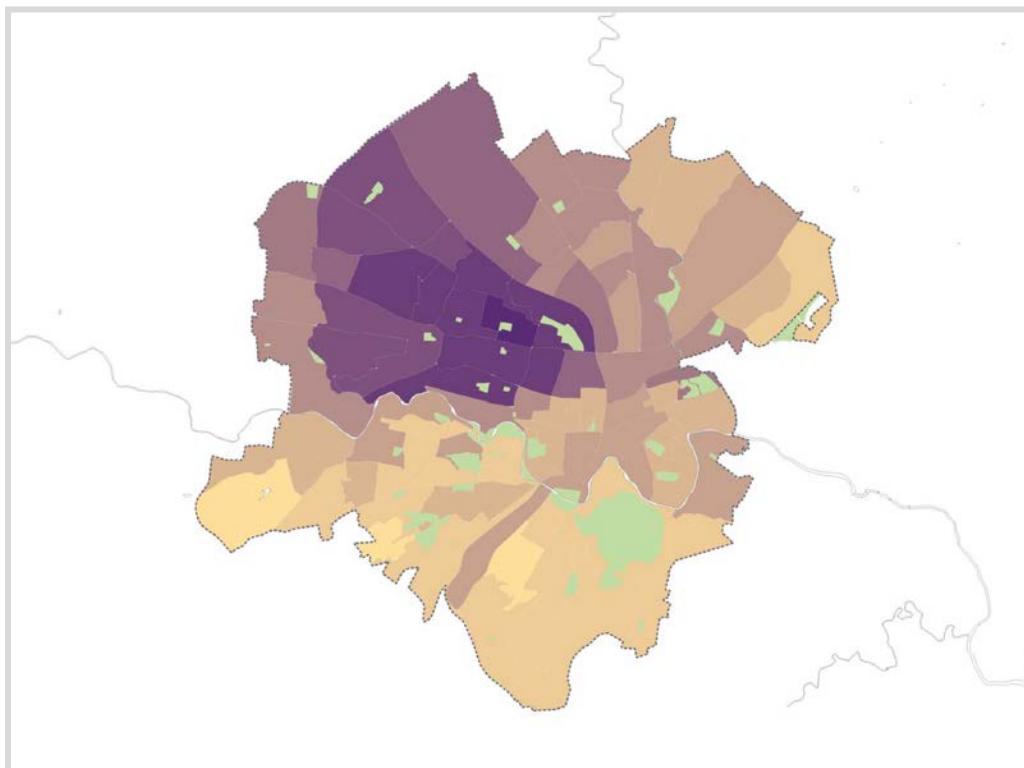


1d Style your parks.

**Step 2: Import the 2021 census race data layer.**

2a Load your “census-race” style, if you have it, from the previous tutorial to quickly style your layer.

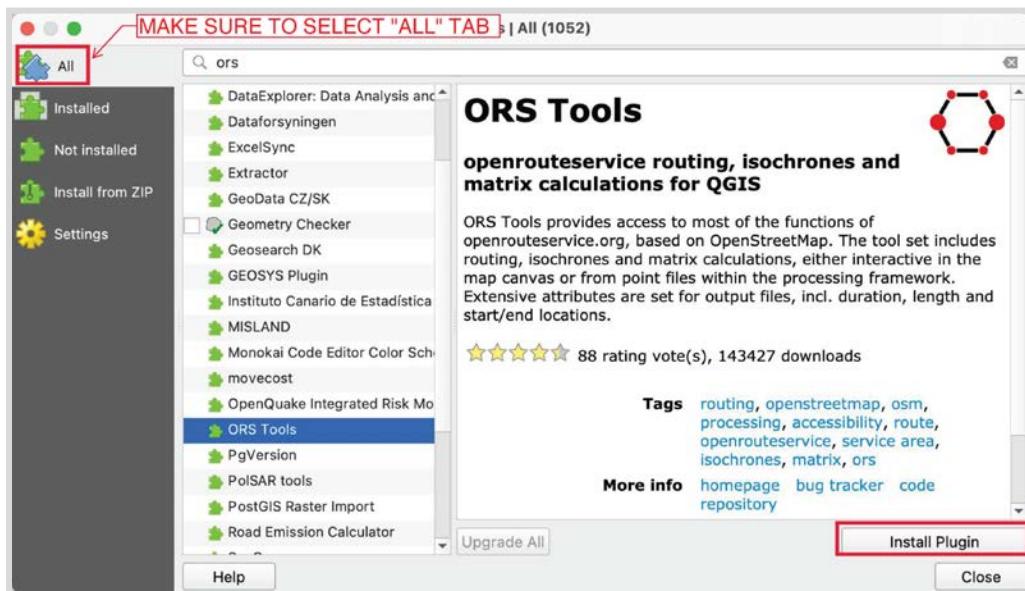
2b Notice the correlation between park location and demographic location.



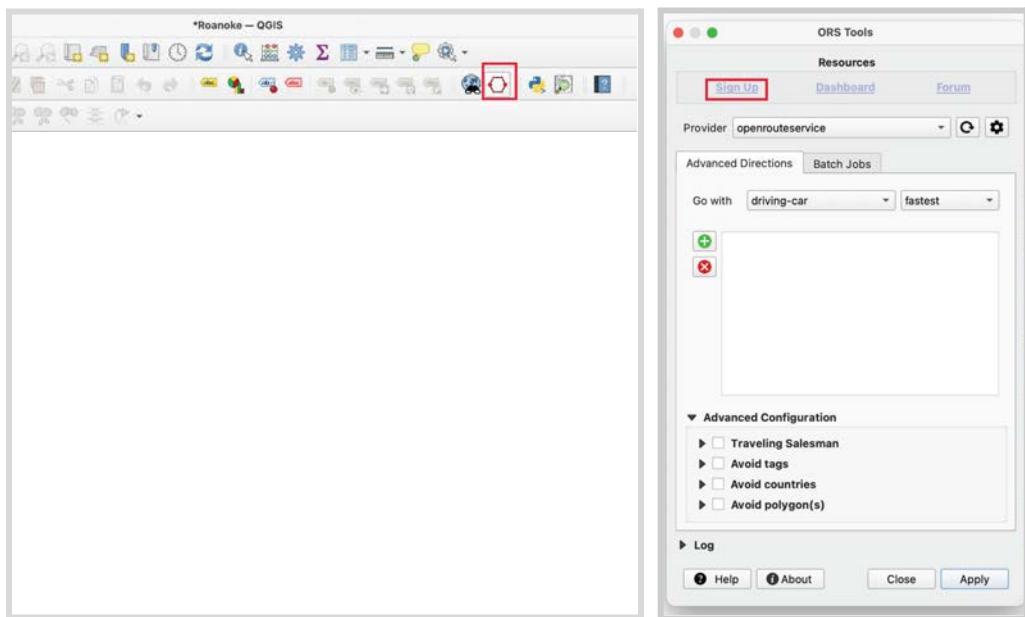
### Step 3: Download and sign up for the ORS plugin.

The ORS plugin limits the number of calculations you can perform each month. To track this, it requires you to obtain a user token, or key, and to add it to the plugin. You'll need to create a free account to get your user token.

3a In the Plugin library, search “ORS”. Install the “ORS Tools” plugin.



3b Open the “ORS Tools” plugin from the plugin menu or using the new icon on your toolbar. In the upper left corner, click “Sign Up” to visit the ORS website. Create a free account. Once you've done this, you can access your API Key.



**openroute service**

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### CREATE AN ACCOUNT

**SIGN UP WITH GITHUB**

or

Username \_\_\_\_\_ 0 / 20

Email\* \_\_\_\_\_

First name\* \_\_\_\_\_ Last name\* \_\_\_\_\_

Sector \_\_\_\_\_

Website \_\_\_\_\_

Define your password

New password\* \_\_\_\_\_ 0 / 25

Confirm new password\* \_\_\_\_\_ 0 / 25

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I accept [the terms of service](#) and was informed about [the privacy policy](#).

Please note:

- \* 1 account and free API key per person

**Dev dashboard**

**TOKENS** **PROFILE**

Username mshugars@vt.edu \_\_\_\_\_ ✓ 15 / 20

Email\* mshugars@vt.edu \_\_\_\_\_ ✓

First name\* Miranda \_\_\_\_\_ Last name\* Shugars \_\_\_\_\_

Sector **Education**

Website \_\_\_\_\_

Change password (optional)

New password\*  12 / 25

Confirm new password\*  12 / 25

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The screenshot shows the Dev dashboard interface. In the top left, there's a navigation bar with 'TOKENS' and 'PROFILE'. Below it is a table titled 'TOKENS' with columns: Name, Key, Is valid, Remaining Quota, and Actions. One row is highlighted with a red border, showing the key: 5b3ce3597851110001cf6248962dadd07f084fc48907b89d9c80f72. The 'Actions' column for this row contains a small gear icon. Below this table is a section titled 'Token quota' with a table showing quotas for various endpoints. The table has two main sections: 'Main Endpoints' and 'Microservice Endpoints'. The 'Main Endpoints' section includes 'Directions V2', 'Isochrones V2', and 'Matrix V2'. The 'Microservice Endpoints' section includes 'ElevationLine', 'ElevationPoint', 'Fuel', 'GeocodeAutoComplete', and 'GeocodeReverse'. Each entry shows 'Quota left (renews in)' and 'Per Min' values.

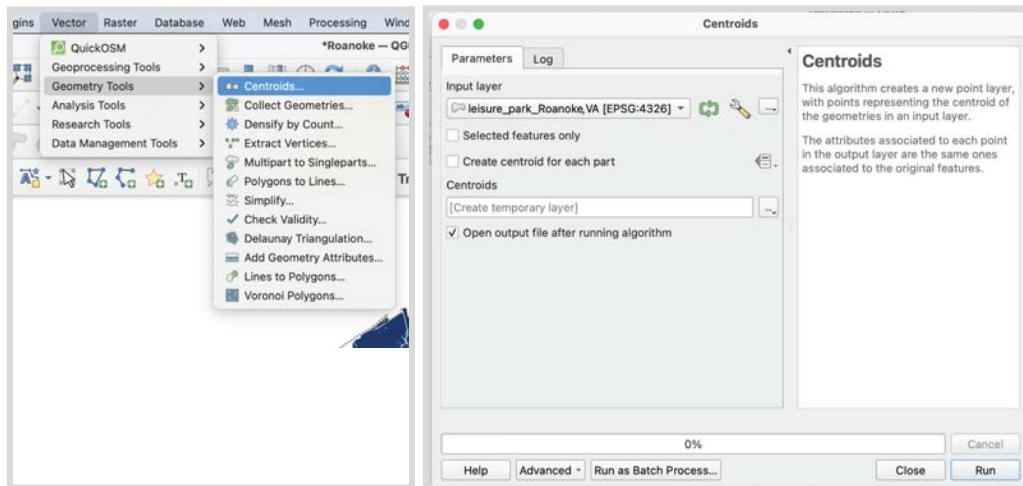
3c Click on your API key to copy it. Then, click the small gear in the upper right of the ORS plugin. Expand “openrouteservice”, and in “API key” paste your key. Then, click “ok”.

This screenshot shows the 'ORS Tools' application window. On the left, there's a sidebar with 'Sign Up', 'Dashboard', and 'Forum'. The main area shows a table of resources with columns: 'Quota left (renews in)' and 'Per Min'. A specific row for 'openrouteservice' is highlighted with a red border, showing the key: 5b3ce3597851110001cf6248962dadd07f084fc48907b89d9c80f72. To the right of this table is a 'Provider Settings' dialog box. It has tabs for 'Advanced Directions' and 'Batch Jobs', with 'Advanced Directions' selected. Inside the dialog, under the 'openrouteservice' provider, the 'API Key' field is populated with the same value: 5b3ce3597851110001cf6248962dadd07f084fc48907b89d9c80f72. There are also fields for 'Base URL' (https://api.openrouteservice.org) and 'Request timeout in seconds (1 - 3600)' (set to 60). At the bottom of the dialog are 'Add', 'Remove', 'Cancel', and 'OK' buttons, with 'OK' being highlighted with a red border. Below the dialog, there are sections for 'Advanced Config' (with checkboxes for Traveling Salesman, Avoid tags, Avoid countries, and Avoid polygon(s)) and 'Log' (with 'Help' and 'About' buttons).

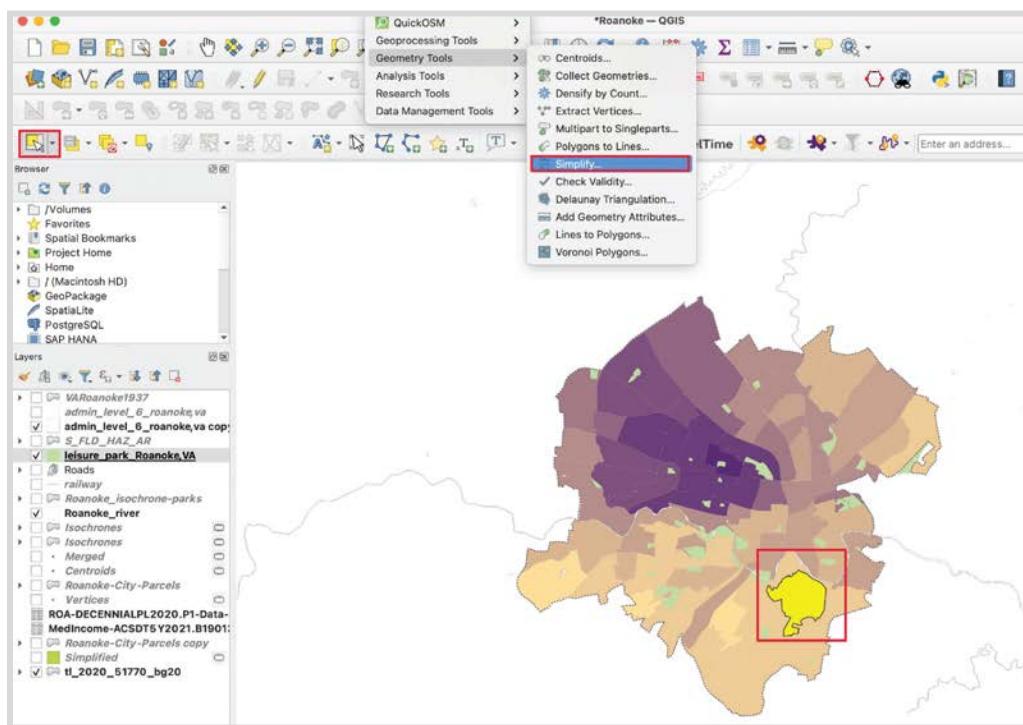
NOTE: the ORS window will not close automatically. It might disappear, but it's probably hidden behind your other windows. You can't open it again like you can with the OSM plugin, so if you click the icon in your toolbar and it doesn't popup, it's probably because it's still open and hidden behind your other windows.

#### Step 4: Calculate the points of your parks.

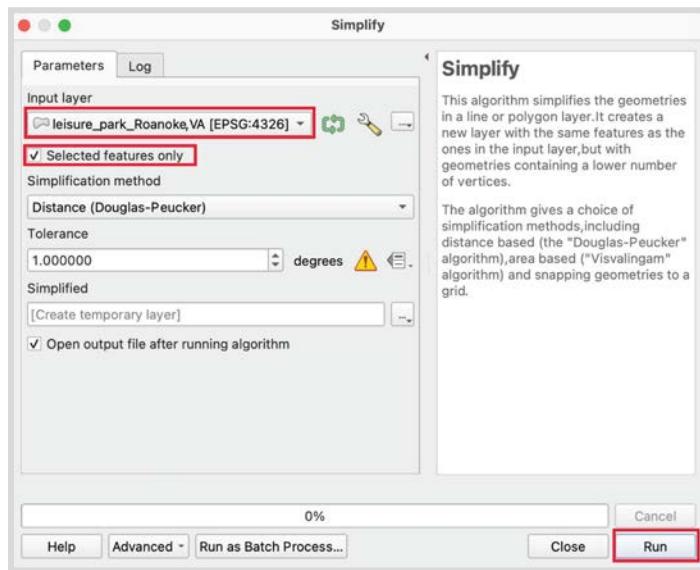
4a In the top toolbar, go to Vector > Geometry Tools > Centroids... Select the parks layer, and click "Run". You'll see a new layer appear with several points on your map.



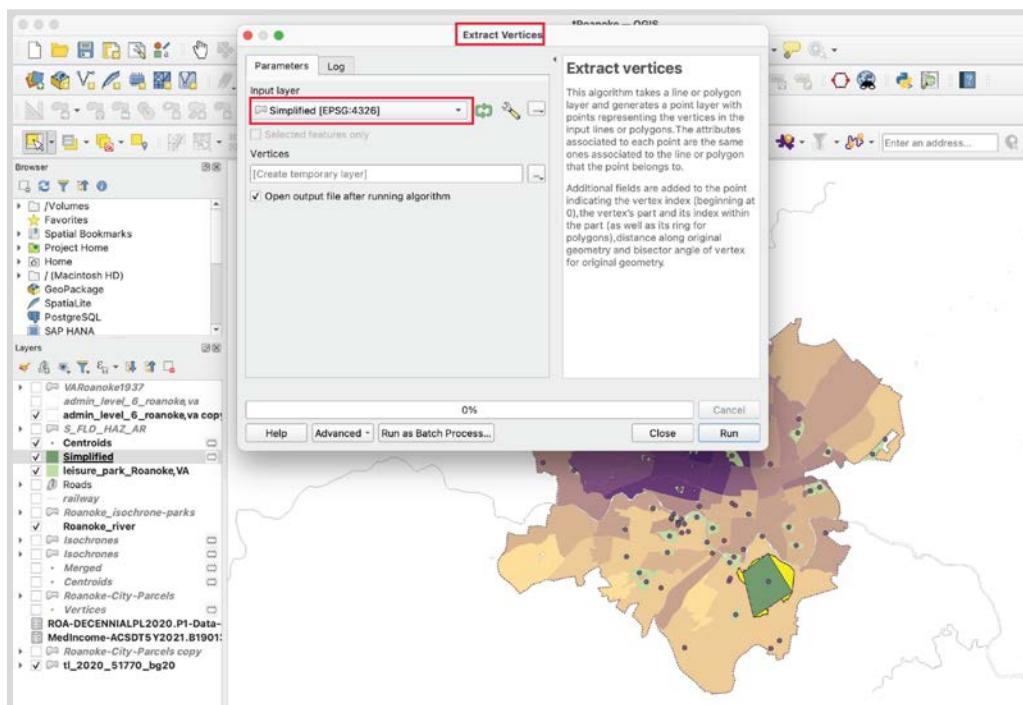
4b For any larger or irregularly shaped parks, like long riverside parks, the centroid will not be the best point to measure travel distance from. Instead, select these manually on the map with the "Select" tool (yellow square with arrow). Make sure you have the parks layer selected to select geometry from it. The parks will turn yellow when selected.



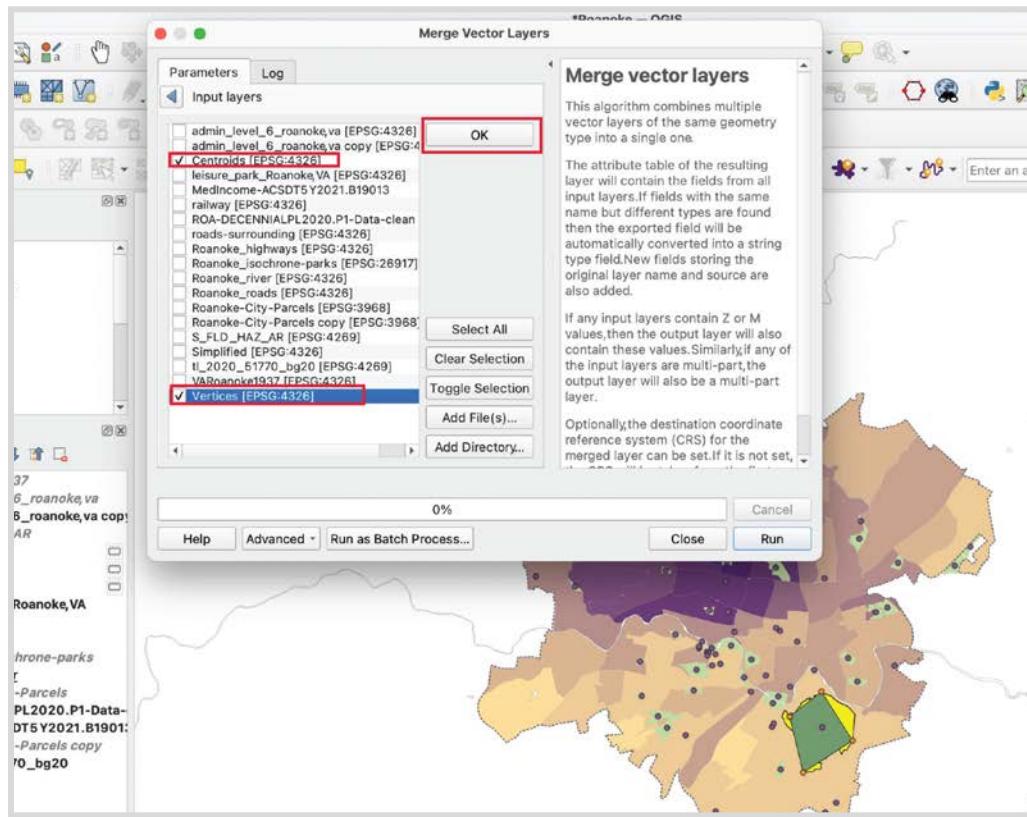
4c With these parks selected, go to Vector > Geometry Tools > Simplify... Set your “input layer” to parks, and check “Selected features only”. Then, click “Run”. You’ll see several crude polygons added to your map.



4d Next, you'll extract the vertices of these simplified polygons. If you extract the vertices of the unsimplified parks you'll end up with hundreds, which will be too many for the ORS tool to quickly calculate. Instead, the simplified geometries should each generate around 4 vertices. Go to Vector > Geometry Tools > Extract Vertices... Select your simplified geometry layer and “Run”.



4e Now, you'll combine the two point layers: the vertices and the centroids. Go to Vector > Data Management Tools > Merge Vector Layers... For "input layers", select the three dots to the right and then check the "vertices" and "centroids" layers. Click "ok" and then "run".

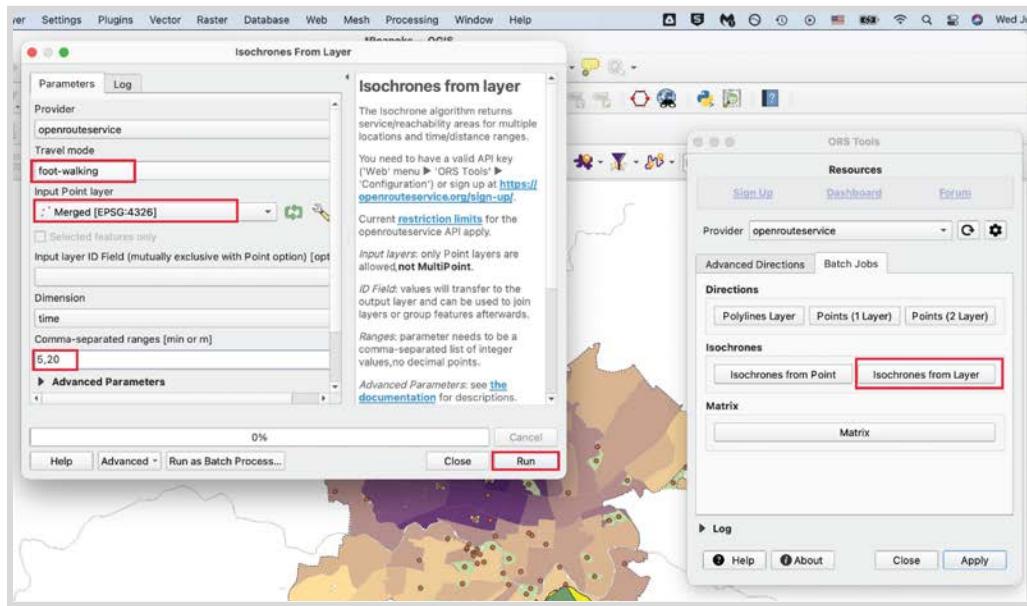


Note: it's alright if these are all temporary layers for now, as long as QGIS doesn't crash on you. If you're worried about that, save the points layer as a permanent layer in your data folder.

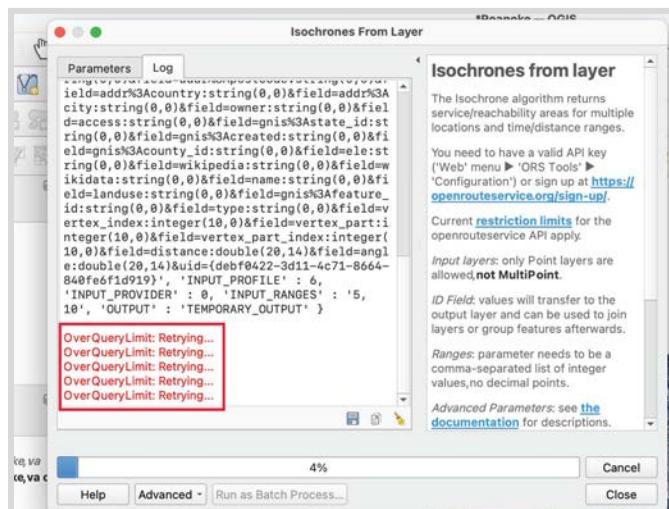
### Step 5: Run the ORS Tool.

Note that this step may take some time.

5a Open the ORS tool and select the “Batch Jobs” tab. Under “Isochrones”, select “Isochrones from Layer”. For “Travel-mode” select “foot-walking”, and for “input point layer”, select your merged point layer. You’ll see that the time range is automatically set to 5 minutes and 10 minutes. Change this to 5 and 20 (roughly ¼ mile and 1 mile walking). Instead of leaving it as “Create temporary layer”, save the new layer to your data folder. Finally, click “Run”.

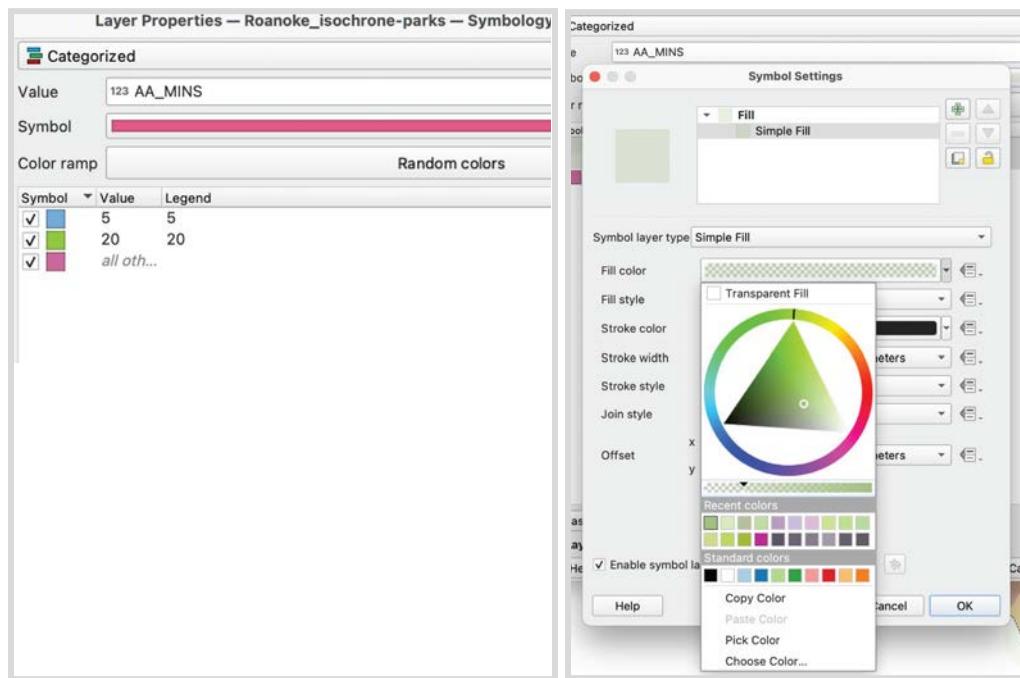


The run will stop with the error message “Over Query Limit” in red. Just let it keep running and eventually you’ll be under the query limit again and it will continue. This may take some time. I calculated my 5 minute and 20 minute intervals separately and joined them after, and each took about 5 minutes to calculate with Roanoke’s modest park number (about 60 points). Be prepared to wait maybe 15 or 20 minutes for your layer to finish loading.



### Step 6: Style the isochrones.

6a Set your new layer symbology to “Categorized”, select the AA\_Mins layer, and then style your 5 minute and 20 minute polygons. It's a little tricky to show the census data and the isochrones. I recommend setting the opacity of the isochrone polygons to 10 or 20%, and keeping its outline at 100% opacity. Consider a dashed or dotted outline.



**Step 7: Create a print layout.**

7a Your print layout should include two maps: one with the census map and parks, and one additionally with the isochrones. As always, include a title, legend, scale, north arrow, map labels, your name, and sources.

