

# OpenStreetMap: A World of Data

**Ethan Nelson**

# Workshop Agenda and Learning Goals

## OpenStreetMap 102

- Recognize background and current status
- Distinguish data structure and types available
- Obtain, wrangle, and analyze data
- Identify the OSM map tile rendering chain

## Mapathon

- Generate data to help eliminate Malaria from afar

# Think about a trip you've taken...



## Think about a trip you've taken...

- From your life experiences based on that trip and others, you have:
  - Knowledge of the environment
  - Knowledge of the components
  - Knowledge of the intricacies
  - Knowledge that is *current*
- Imagine taking this knowledge from people all around the world and compiling it into a database.
- You have now walked through the model of OpenStreetMap contribution!

# OpenStreetMap Features

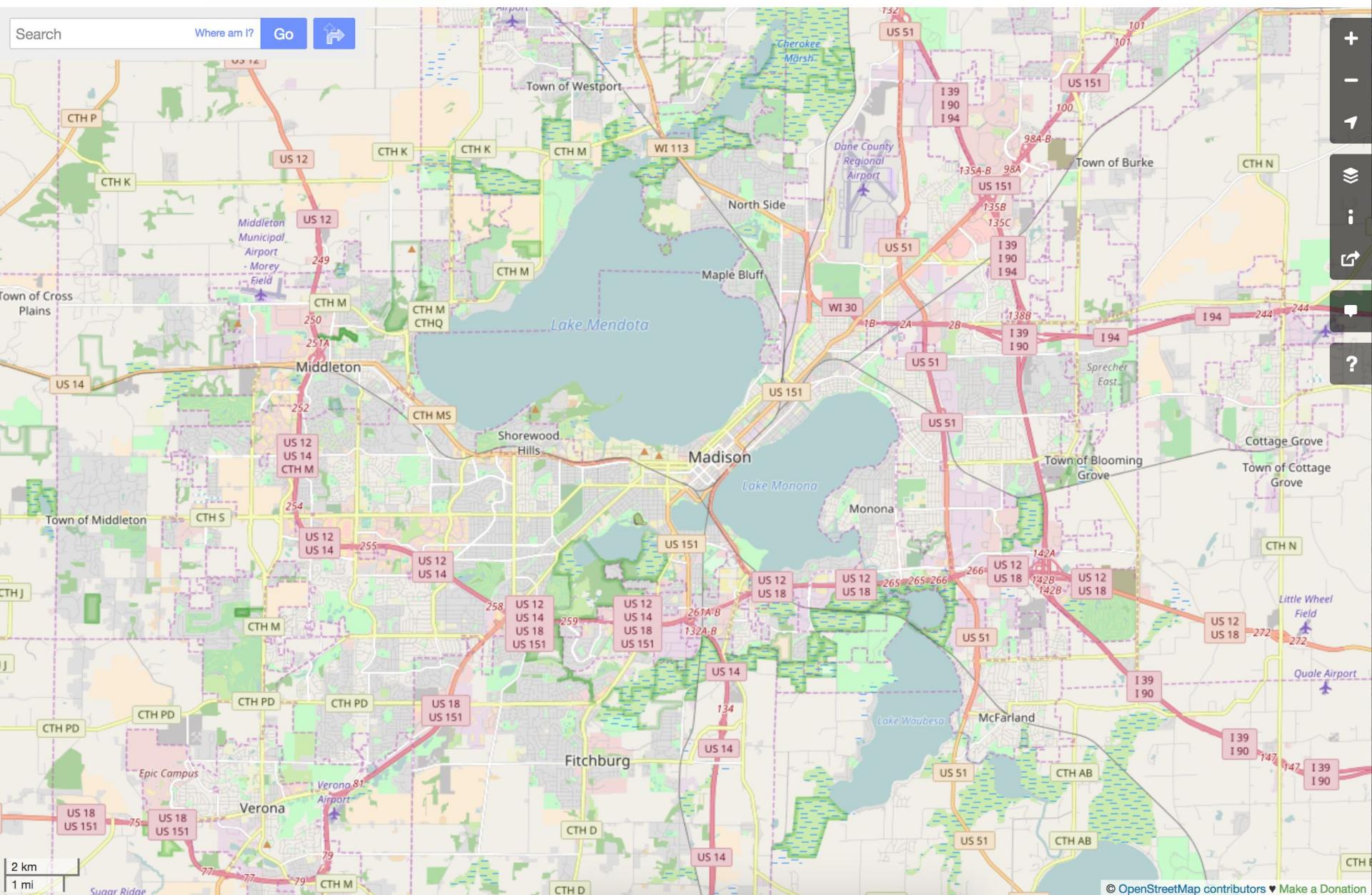
OSM is open source and volunteer-contributed data.

Not limited by...

Proprietary software

Jurisdictional boundaries

Rigid data representation



# History of OSM

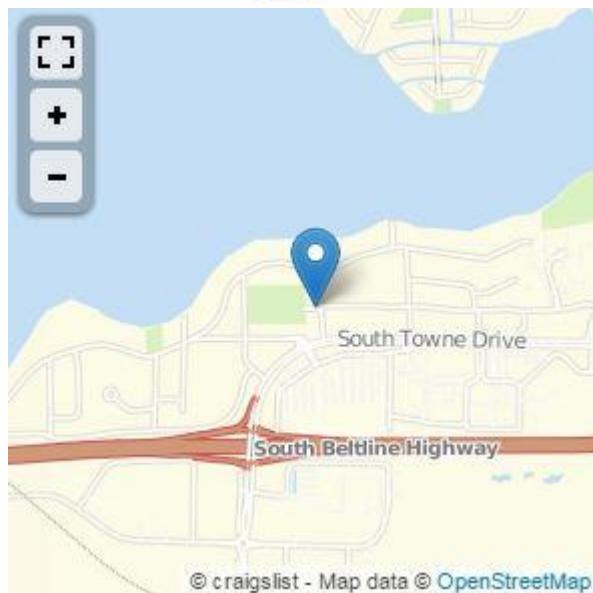
- Began in the early 2000s in the United Kingdom.
- Government agencies were collecting and generating datasets but not distributing them freely.
- Steve Coast, founder, would ride his bike around town to collect GPS traces and compile the resulting data.
- The OpenStreetMap Foundation was founded in 2006.
- With donations of aerial imagery and proprietary data, as well as imports of public domain datasets, the database greatly expanded.

# Present State of OSM

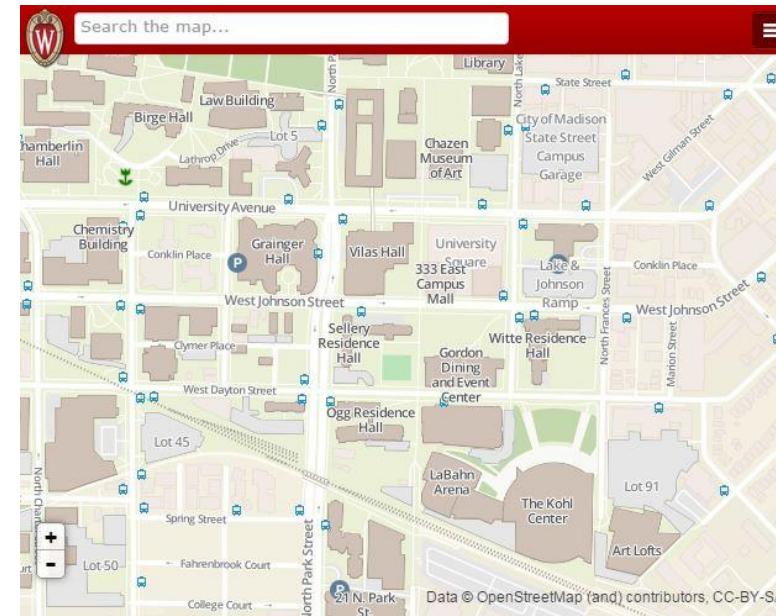
- OSM allows contributions from anywhere in the world.
- Almost 4,000,000 registered users.
  - Contributor and active contributor counts are indeed lower.
- Nearly 4 billion nodes, 400 thousand ways, and 5 million relations.
- Being adopted by many companies and organizations.
- Also used in research (e.g. pedestrian and bike access, routing).
- Still free!

# Who Uses OSM?

# craigslist



# FOURSQUARE



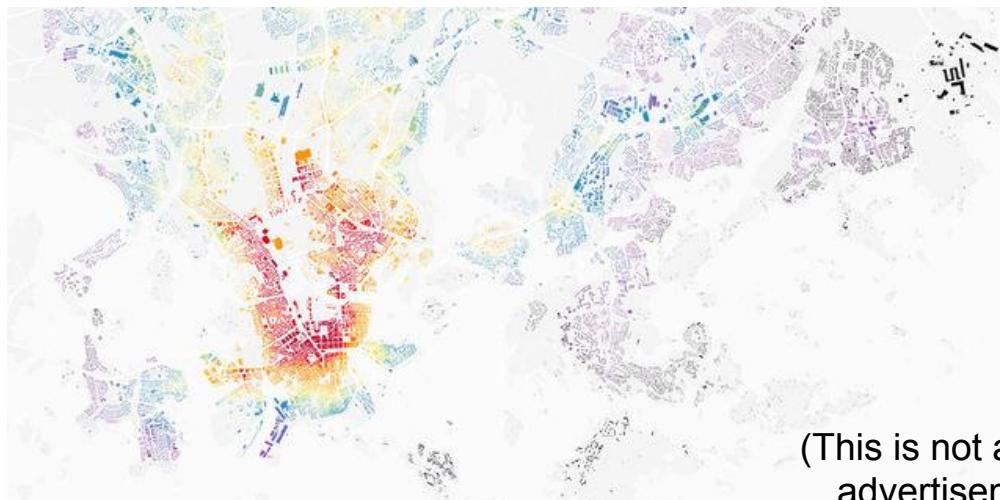
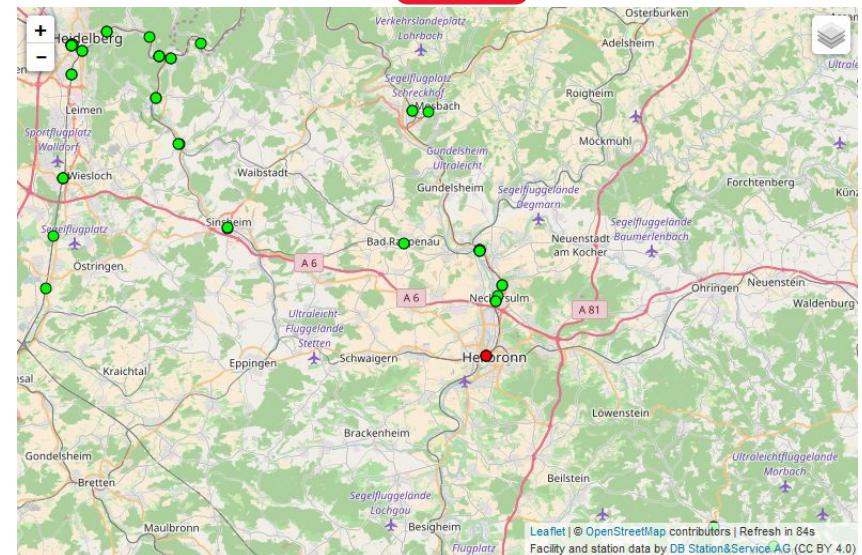
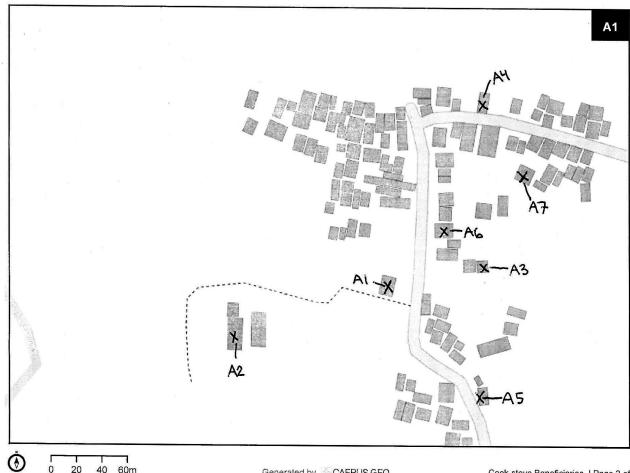
(This is not a paid advertisement.)



# Who Uses OSM?



American  
Red Cross



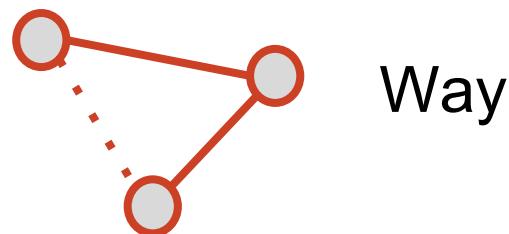
(This is not a paid  
advertisement.)

# Organizational Structure of OSM

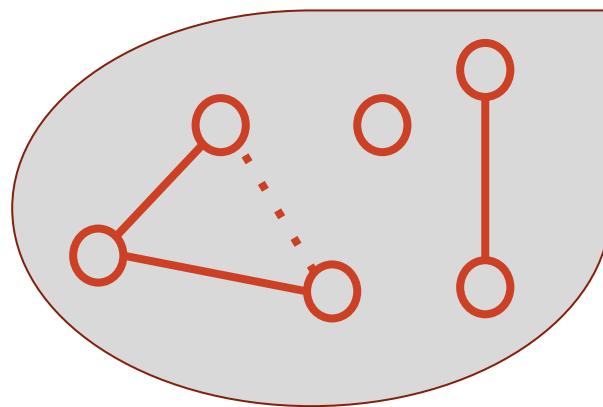
- The OpenStreetMap Foundation (OSMF) is the main non-profit organization that supports the project.
  - The Foundation elects Board Members to guide policy.
  - Working Groups are charged with various tasks that support OSM.
- OSMF organizes the annual international OSM conference, *The State of the Map*.
- Local Chapters support OSM activities on a more localized scale, usually at the country level.
- Organizations of a similar end goal as OSM (e.g. open source, GIS, etc.) often are associated with OSM as well.
- Volunteer-driven means that many of OSM's tools and data are supported and provided by the community.

# OSM Data Structure

○ Node



Way



Relation

# Data Types in OSM

- Tagging in OpenStreetMap is free-form. All attributes follow the form

key[:namespace...] = value[;value...]

- An OSM guiding principle is “on-the-ground” status, meaning map things that exist physically in reality.
- Examples include

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"><li>• Streets</li><li>• Sidewalks</li><li>• Bike paths</li><li>• Bridleways</li><li>• Alleys</li><li>• Amenities</li><li>• Tourist attractions</li><li>• Benches</li></ul> | <ul style="list-style-type: none"><li>• Fire hydrants</li><li>• Bus stops</li><li>• Trees</li><li>• Benches</li><li>• Parking lots</li><li>• Buildings</li><li>• Entrances and exits</li><li>• Trash cans</li></ul> | <ul style="list-style-type: none"><li>• Public bookcases</li><li>• Golf courses</li><li>• Railroads</li><li>• Railroad crossings</li><li>• Dog parks</li><li>• Land use</li><li>• Administrative boundaries</li></ul> |
|--|---|---|

# Data Types in OSM

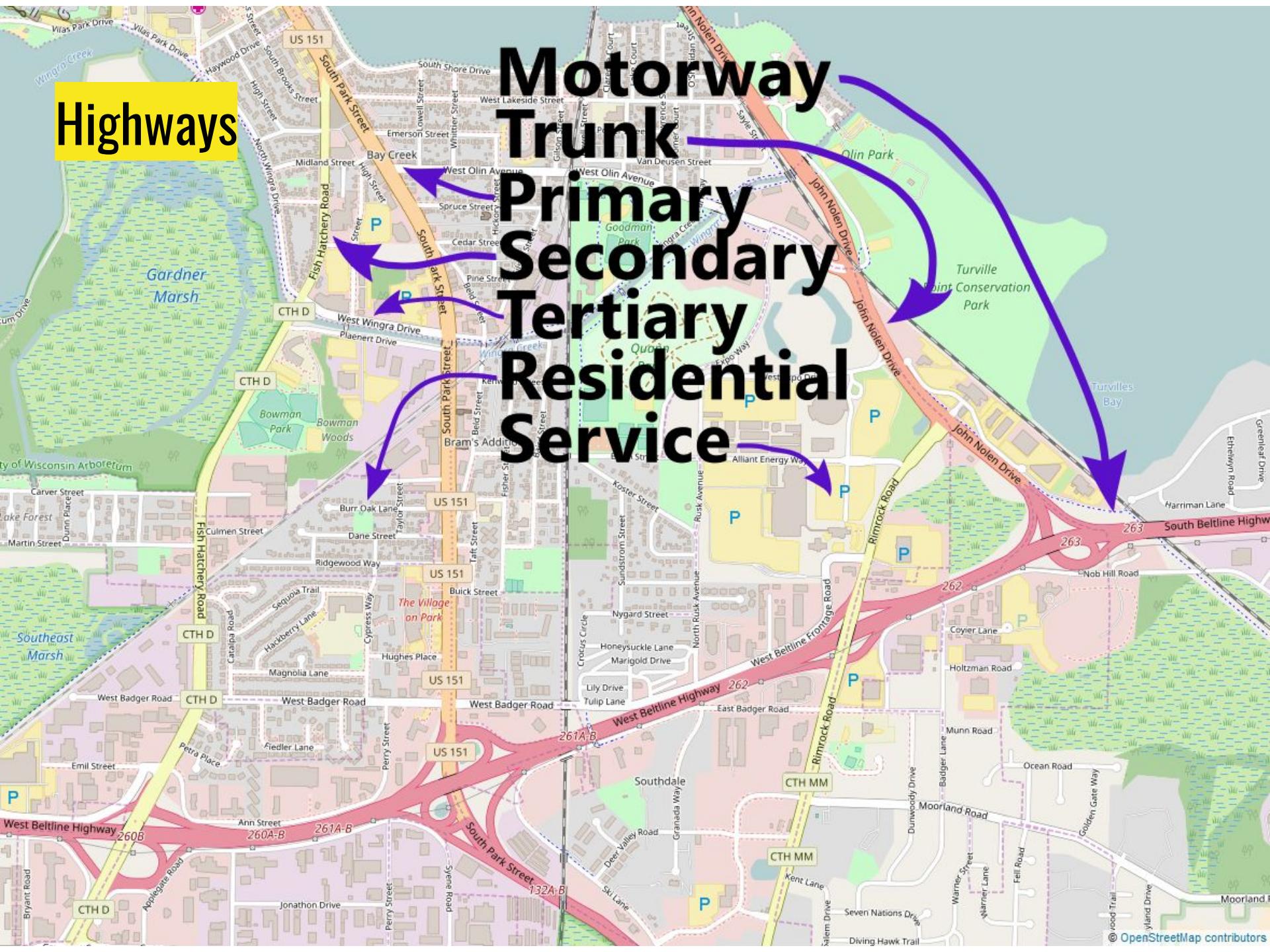
- The OSM wiki contains information about community-supported tagging schemes.

[http://wiki.osm.org/wiki/Map\\_Features](http://wiki.osm.org/wiki/Map_Features)

- Mappers are free to tag how they wish.
- Since OSM started in England, many of the names are based on British English usage and spelling...

# Highways

# Motorway Trunk Primary Secondary Tertiary Residential Service



# Changesets in OSM

- Edits are added to the database in changesets.
- Changesets can have anywhere from 0 to 10,000 edits.
- Changes can be additions, modifications, or deletions.
- Best practices suggest mappers create changesets for edits in a given area.
- Some users save/upload after every change, while others upload changes after a mapping session.

# Browser View of Changeset



Edit History Export

GPS Traces User Diaries Copyright Help About

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Search

Where am I?

Go



**Changeset: 1020304**

fixed wrong oneway

Closed about 8 years ago by Peter Lerner

Tags

created\_by

JOSM/1.5 (1561 de)

Discussion

[Log in to join the discussion](#)

Ways (2)

Birkenstraße (33826866, v1)

Birkenstraße (4751760, v10)

Relations (1)

70664, v2

Nodes (1)

336428690, v2

<< 1007939 · Peter Lerner · 1020339 >>

[Changeset XML](#) · [osmChange XML](#)



30 m  
100 ft

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# XML View of Changeset

```
- <osmChange version="0.6" generator="CGImap 0.6.0 (18217 thorn-01.openstreetmap.org)" copyright="OpenStreetMap and contributors" attribution="http://www.openstreetmap.org/copyright" license="http://opendatacommons.org/licenses/odbl/1-0/">
- <create>
- <way id="33826866" visible="true" version="1" changeset="1020304" timestamp="2009-04-29T20:45:03Z" user="Peter Lerner" uid="46964">
  <nd ref="336428705"/>
  <nd ref="336428634"/>
  <nd ref="336428654"/>
  <nd ref="336428671"/>
  <nd ref="336428664"/>
  <nd ref="336430647"/>
  <nd ref="308654190"/>
  <nd ref="21730916"/>
  <tag k="created_by" v="JOSM"/>
  <tag k="highway" v="secondary"/>
  <tag k="name" v="Birkenstraße"/>
  <tag k="oneway" v="yes"/>
  <tag k="source" v="yahoo"/>
</way>
</create>
- <delete>
  <node id="336428690" visible="false" version="2" changeset="1020304" timestamp="2009-04-29T20:45:03Z" user="Peter Lerner" uid="46964"/>
</delete>
- <modify>
- <relation id="70664" visible="true" version="2" changeset="1020304" timestamp="2009-04-29T20:45:03Z" user="Peter Lerner" uid="46964">
  <member type="way" ref="4751760" role="" />
  <member type="way" ref="30487650" role="" />
  <member type="way" ref="30487651" role="" />
  <member type="way" ref="30487654" role="" />
  <member type="way" ref="33826866" role="" />
  <tag k="type" v="dual_carriageway"/>
</relation>
</modify>
- <modify>
- <way id="4751760" visible="true" version="10" changeset="1020304" timestamp="2009-04-29T20:45:03Z" user="Peter Lerner" uid="46964">
  <nd ref="21730917"/>
  <nd ref="298479612"/>
  <nd ref="336428705"/>
  <tag k="created_by" v="JOSM"/>
  <tag k="highway" v="secondary"/>
  <tag k="name" v="Birkenstraße"/>
</way>
</modify>
</osmChange>
```

# How Data is Contributed to OSM

- Going somewhere:
  - Logging a route with GPS.
  - Using printed OSM maps to manually annotate features.
- Tracing satellite imagery.
- Viewing submitted photos or videos.
- Adding notes on the OSM website.
- Imported from some other source after consulting with the OSM community.
- OSM treasures quality through value-added human touch.
- In any case, the data contributed must be compatible with the OSM data license.

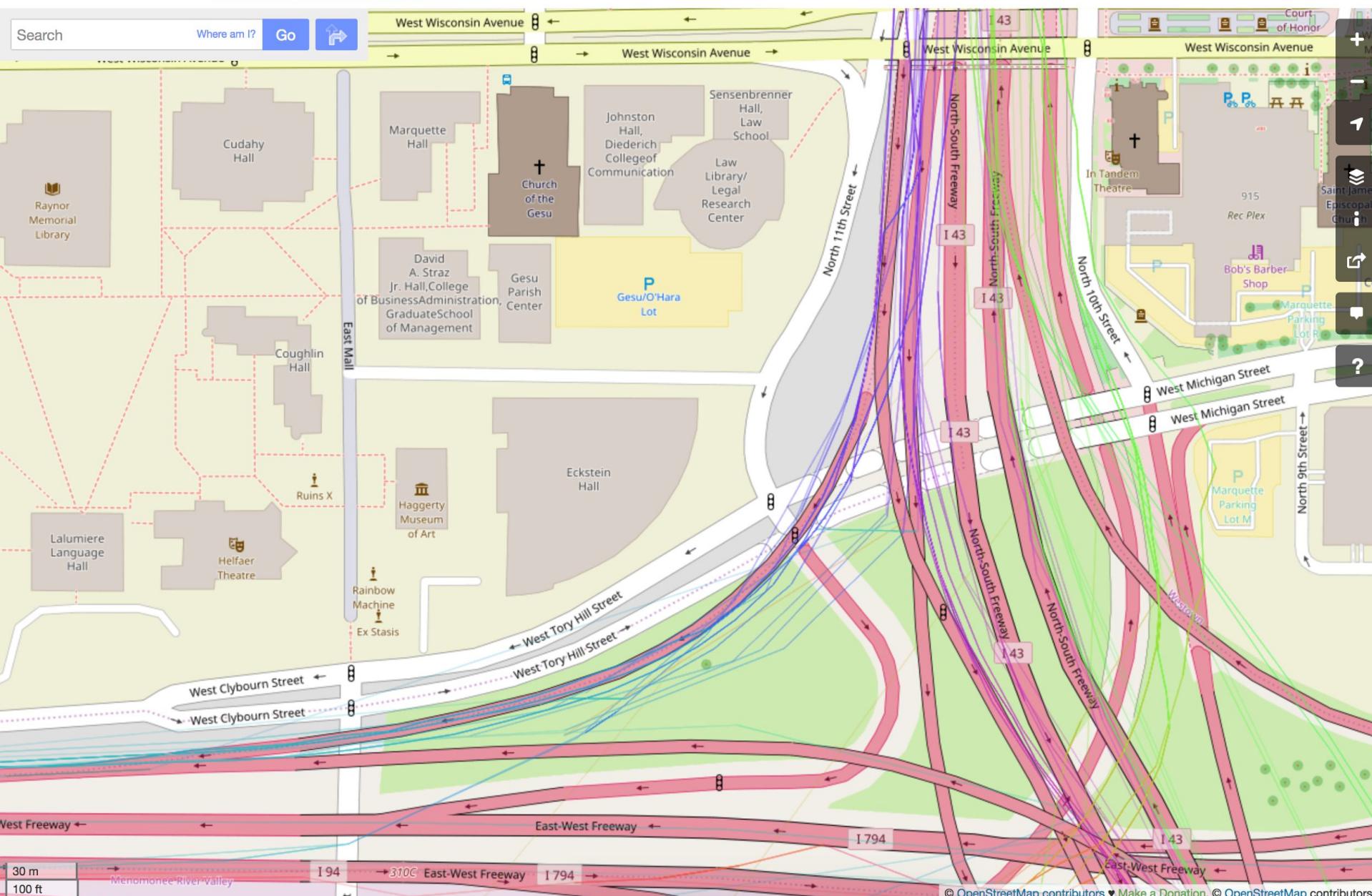
# GPS Traces

OpenStreetMap

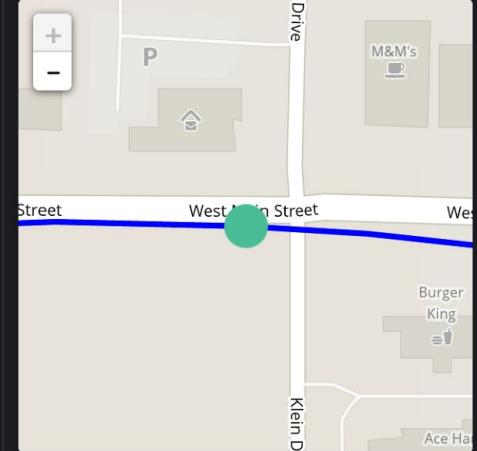
Edit History Export

GPS Traces User Diaries Copyright Help About

Log In Sign Up



# Street-level Imagery



## Info

Track uploader: fta  
Date of recording: Mar 24, 2017  
Track no.: 64850  
Platform: Unknown  
Total no. of images: 133  
OBD: No

1 220 Points

Coverage	Photos	Distance	Points
1	49	1.53 km	245
2	7	0.31 km	35
3	52	1.58 km	156
5	7	0.31 km	14
-	77	0 km	770

Load full resolution photos



# A Note on Data Contributions to OSM

- OSM community emphasizes a human touch to mapping.
- As a result, any sort of mechanical or bulk edit needs to be discussed openly with the community first.
- Some imports of public datasets has occurred in the past, including the original highway network in the US and buildings in a few cities around the US.
- The OSM Wiki has more information about the guidelines for importing and mechanical edits.
  - Generally, the community is interested in ensuring data imported is useful and will not grow stale.

# OpenStreetMap Editing Software

- The main in-browser editing software for OSM is iD, available directly on the OSM website.
  - An older project, Potlatch, is also provided--though not recommended.
- The main desktop application editing software for OSM is Java OSM (JOSM).

<http://josm.openstreetmap.de>

- There are an array of mobile phone editors, including Maps.me and Vespucci.

# iD Editor (in-browser)

< Edit feature ✓



Hotel Building



Point

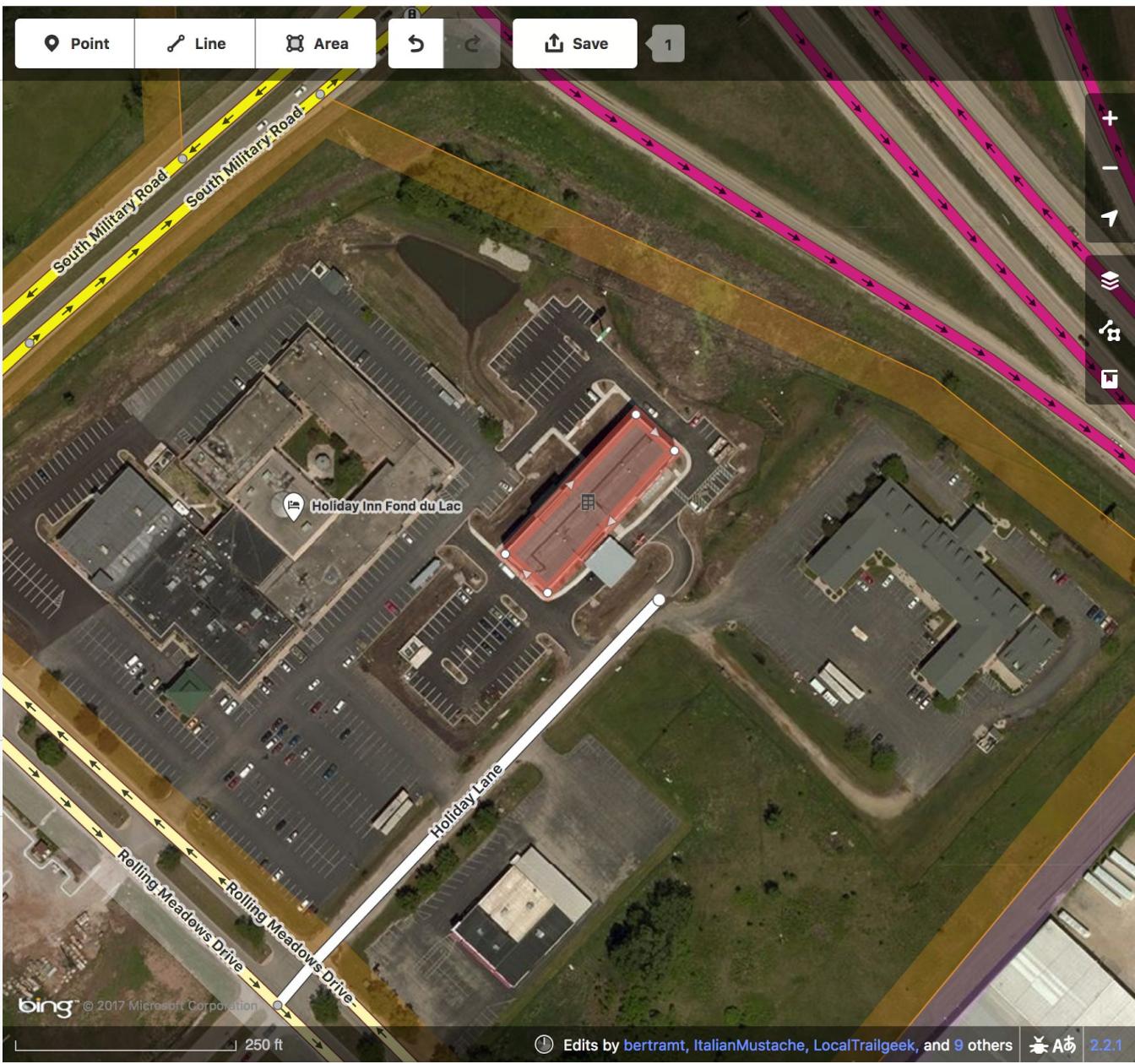
Line

Area



Save

1



▼ All fields

Name



Holiday Inn Express



Address



123

Street

City

State

Postcode

Levels



2, 4, 6...



Smoking



No, Separated, Yes...

Add field:

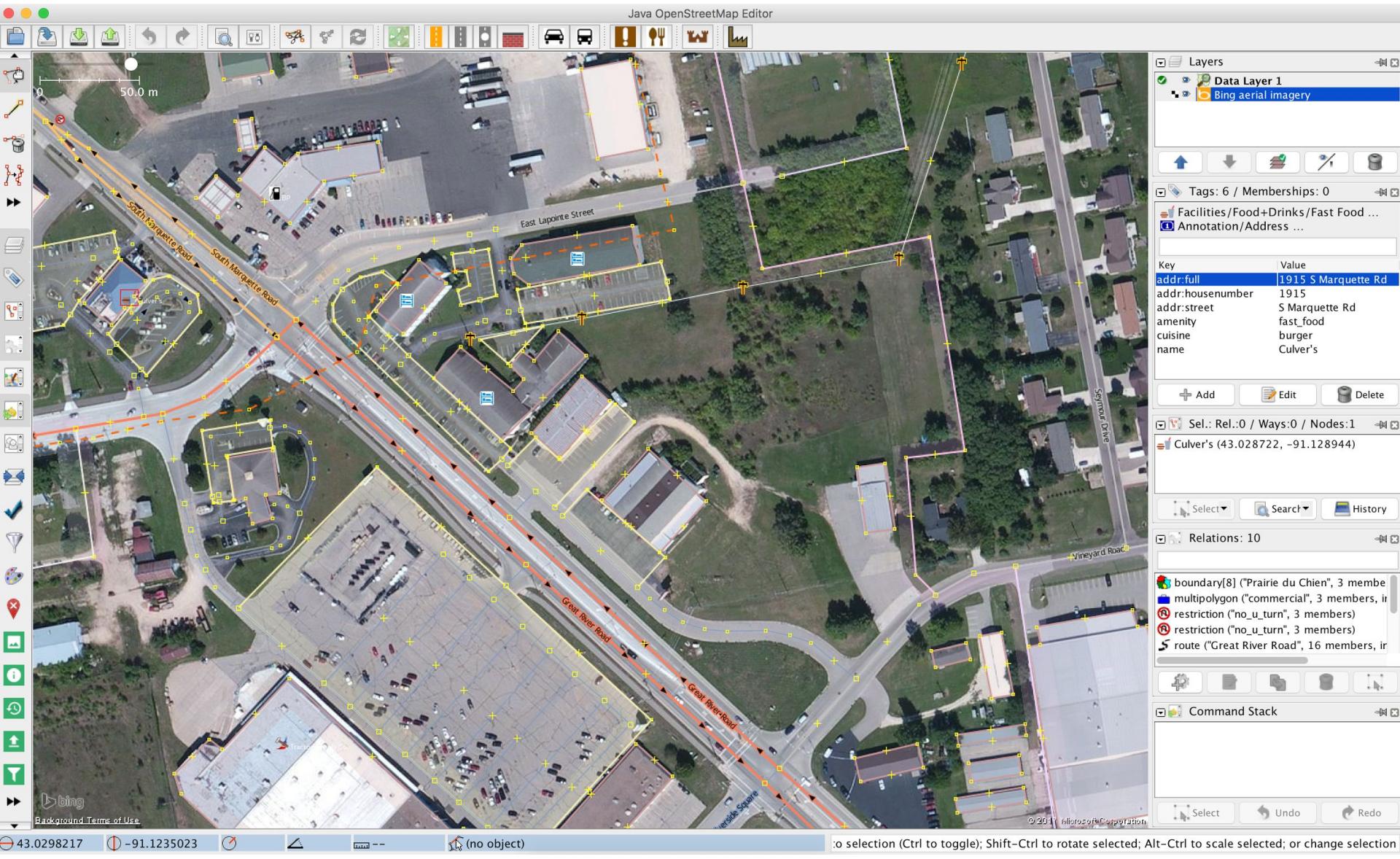
Description, Elevation, Email...

► All tags (2)

▼ All relations (0)



# JOSM (Desktop Application)



# OSM Data License

- OSM data is presently published with the Open Data Commons Open Database License (ODbL).

<http://www.osm.org/copyright>

You are free:

- To Share
- To Create
- To Adapt

As long as you:

- Attribute
- Share-Alike
- Keep open

*(I am not a lawyer)*

- Using copyrighted sources is prohibited, as is using sources that cannot be distributed without restriction.

# OSM Raw Data Access

- OSM officially publishes raw file dumps and diffs:  
<http://planet.osm.org>
- File dumps, called planet files, can be downloaded in compressed XML or a binary (PBF) form.
  - These dumps contain the *whole* world of data of present features.
- Diffs (replication files) contain changes on a minute, hour, or day granular basis.
- Full history files are also offered that contain all data, whether currently or previously present (read: deleted data is included).

# OSM Raw Data Access

- Planet files are enormous and difficult to wrangle on a regular desktop machine.
- Businesses and community members provide extracts from the planet file for smaller areas.
  - <http://download.geofabrik.de> continent to state scale extracts (+ .shp)
  - <http://mapzen.com/data/metro-extracts> metropolitan areas
  - <http://download.bbbike.org/osm/> metropolitan or custom regions
  - <http://www.osm.org/export> custom regions
- Command line tools like osmosis allow you to trim planet files according to any shape as well.

# OSM Raw Data Usage

- Planet and region files in xml or pbf form are usually intended to be imported into Postgres database.
  - osm2pgsql provides a feasible interface.
- Smaller files of xml and shp form can be utilized by typical desktop GIS applications (QGIS, ArcGIS, etc.).
- Some applications also have plugins to directly download data for a given region.

# OSM Filtered Data Access

- Community tools exist that allow you to obtain only a subset of data.
  - <http://overpass-turbo.eu>
- Geocoders also exist to query address information.
  - Nominatim
- OSM has a public-facing API that allows you to download a specific feature or group of features.

# Ancillary OSM Data Sources

- There are some projects providing data that can be used with OpenStreetMap mapping.
  - <http://openstreetcam.org> provides user-contributed street-level imagery
  - <http://mapillary.org> provides user-contributed street-level imagery
  - <http://www.osm.org> provides user-contributed GPS traces (GPX)
  - Bing and DigitalGlobe allow tracing from satellite imagery.

## Exercise: Obtaining Data

With the Overpass Turbo interface, navigate to Wisconsin.

Use wizard to query highway=bridleway.

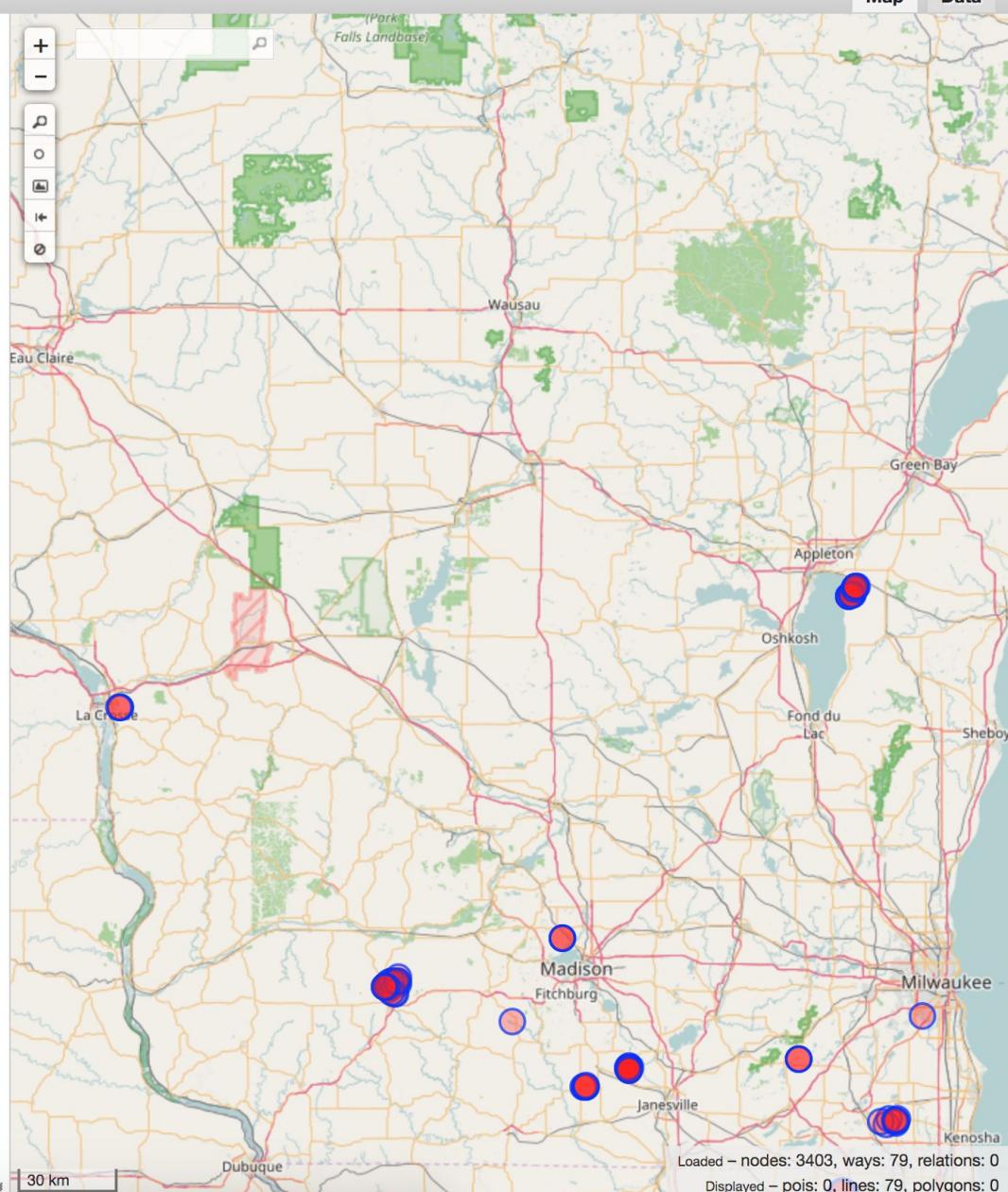
Export to GeoJSON.

Open up in a geospatial editor if you have one installed.

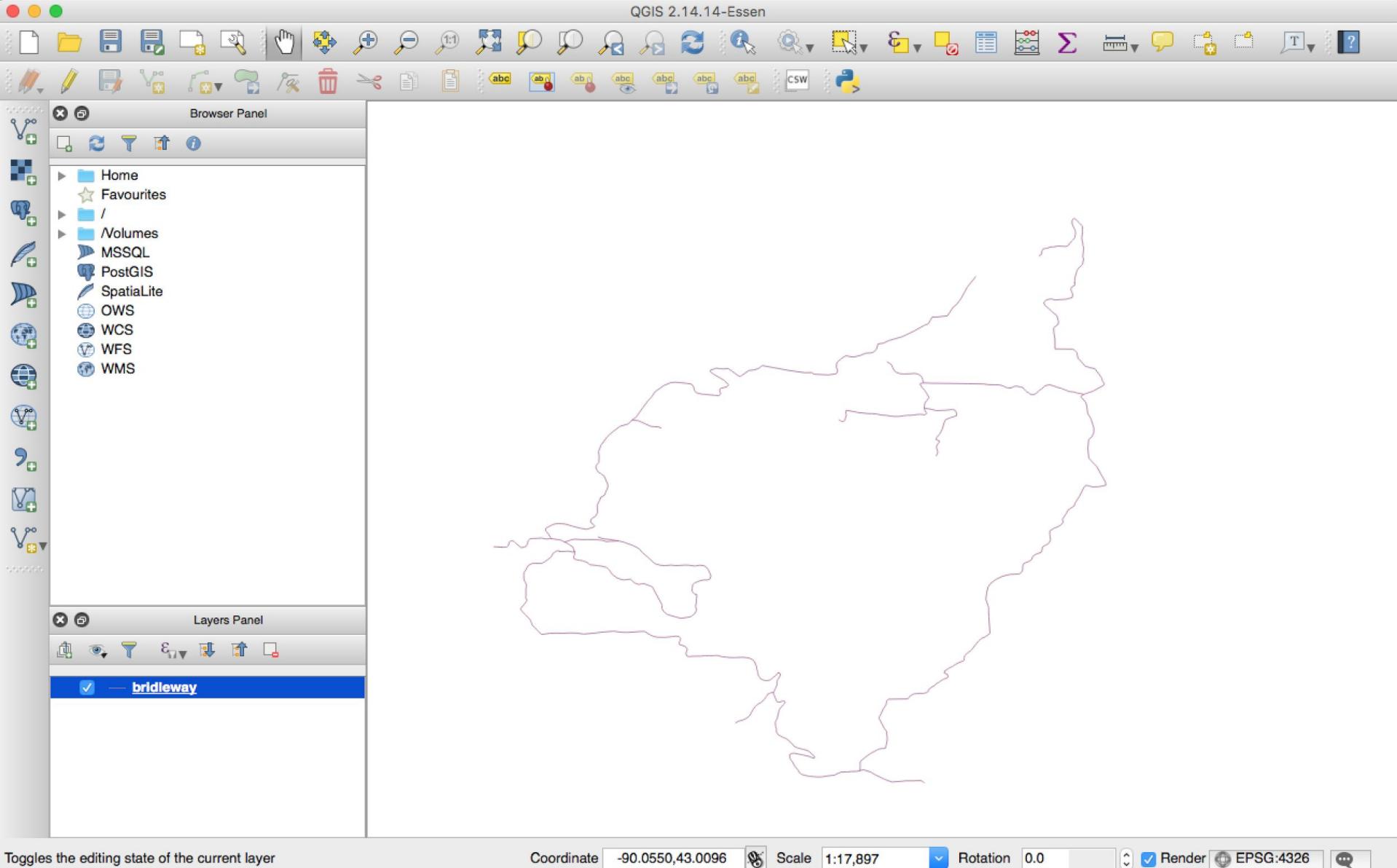
<http://overpass-turbo.eu>

[Run](#)[Share](#)[Export](#)[Wizard](#)[Save](#)[Load](#)[Settings](#)[Help](#)overpass turbo  Flattr this![Map](#)[Data](#)

```
1 /*  
2 This has been generated by the overpass-turbo wizard.  
3 The original search was:  
4 "bridleway"  
5 */  
6 [out:json][timeout:25];  
7 // gather results  
8 (  
9     // query part for: "bridleway"  
10    way["highway"="bridleway"]({{bbox}});  
11 );  
12 // print results  
13 out body;  
14 >;  
15 out skel qt;
```



QGIS 2.14.14-Essen



## Another Exercise

Let's use the map features wiki page to find tags for bike paths and bike lanes.

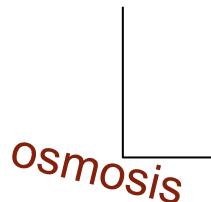
[http://wiki.osm.org/wiki/Map\\_Features](http://wiki.osm.org/wiki/Map_Features)

Zoom in to East Madison and run an Overpass query to find bike paths or lanes.

<http://overpass-turbo.eu>

# Raster Map Tiles with OpenStreetMap

Planet Data



[Optional Extract]

*osmosis*

A vertical line segment starting from the bottom of the '[Optional Extract]' text and extending upwards to the right, ending in a small square bracket.

PostgreSQL/PostGIS

A vertical line segment starting from the bottom of the 'PostgreSQL/PostGIS' text and extending upwards to the right, ending in a small square bracket.

Tiles

*Mapnik*

A vertical line segment starting from the bottom of the 'Tiles' text and extending upwards to the right, ending in a small square bracket.

Web page

*Leaflet, OL*

# Osmosis

- Command line tool that is a Swiss army knife of utility:
  - Extract data from a planet file
  - Merge or diff planet files
  - Generate planet files
  - Generate replication files
  - And so on...
- Osmosis can convert data types that are common to OSM, e.g. PBF to XML.

<http://wiki.osm.org/wiki/Osmosis>

## osm2pgsql

- Command line tool that can dump OSM data into a PostgreSQL database.
- Some transformations and filtering of the data occurs to generate tables that are useful for rendering and geocoding.
- This program works out of the box, but for special applications be sure to read the documentation.

<http://wiki.osm.org/wiki/osm2pgsql>

## Mapnik (and Mapnik-Python)

- Mapnik is the rendering engine that generates raster tiles from data within PostgreSQL.
- A Python wrapper exists that allows for easy scripting of tile generation.
- Mapnik requires a stylesheet that defines what is drawn and how it is drawn.

<http://mapnik.org>

## Browser Map Libraries (Leaflet, OpenLayers)

- Javascript map libraries load and display raster (or vector) map tiles in a browser.
- Lightweight and fairly plug-in-play to web pages.

<http://leafletjs.com>

<http://openlayers.org>

# Wrap-up of OpenStreetMap 102

- OSM is part of the free and open source ecosystem, providing geographic data with global coverage.
- OSM data can be used for numerous purposes, from map tile rendering to research to geocoding.
- It is an active community of map-oriented folks.



# “Mapathon”: Experiential Learning with OSM

- A good way to become familiar with data in OSM prior to using it is to contribute to the database.
- Often events are held where people focus on a common goal in mapping called a “mapathon”.
- We are going to be working on a project today that remotely assists with malaria eradication efforts.
- These data are coordinated by the Humanitarian OpenStreetMap Team.

## Humanitarian OSM Team (HOT)

- HOT is a non-profit focused on using OSM for capacity building and disaster response.
- HOT started after the earthquake in Haiti in 2010 and the subsequent mapping to help in relief efforts.
- Organizations such as Missing Maps work in tandem with HOT and partner with Doctors Without Borders, Red Cross, and other agencies.
- HOT provides not only remote mapping assistance but also training on the ground for mappers.

HOT



# OSM Tasking Manager

- The OSM Tasking Manager is a web tool commissioned and maintained by HOT.
- OSM TM contains mapping projects and helps in coordinating the mapping effort.
  - Each project area is subdivided into small tasks.
  - Tasks are checked out by mappers so that people are not stepping on each other in mapping features.
  - Once a task is checked out, that area can be opened in editing software.

<http://tasks.hotosm.org>

Search for 3112 or 3114.



## Wrap-up

- OSM provides a great deal of data that is available to use for any purpose.
- The data tagging schema is fairly flexible, providing a diversity of information.
- The OSM community has developed software tools to manipulate and convert OSM data into easier forms.
- OSM relies on contributors to stay current; I encourage you not only to contribute but also to recruit others!

# Thank You!

<http://ethan-nelson.me/osm>

<http://osmus.slack.com>

[ethan.nelson.osm@outlook.com](mailto:ethan.nelson.osm@outlook.com)