

OpenStreetMap: A World of Data

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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

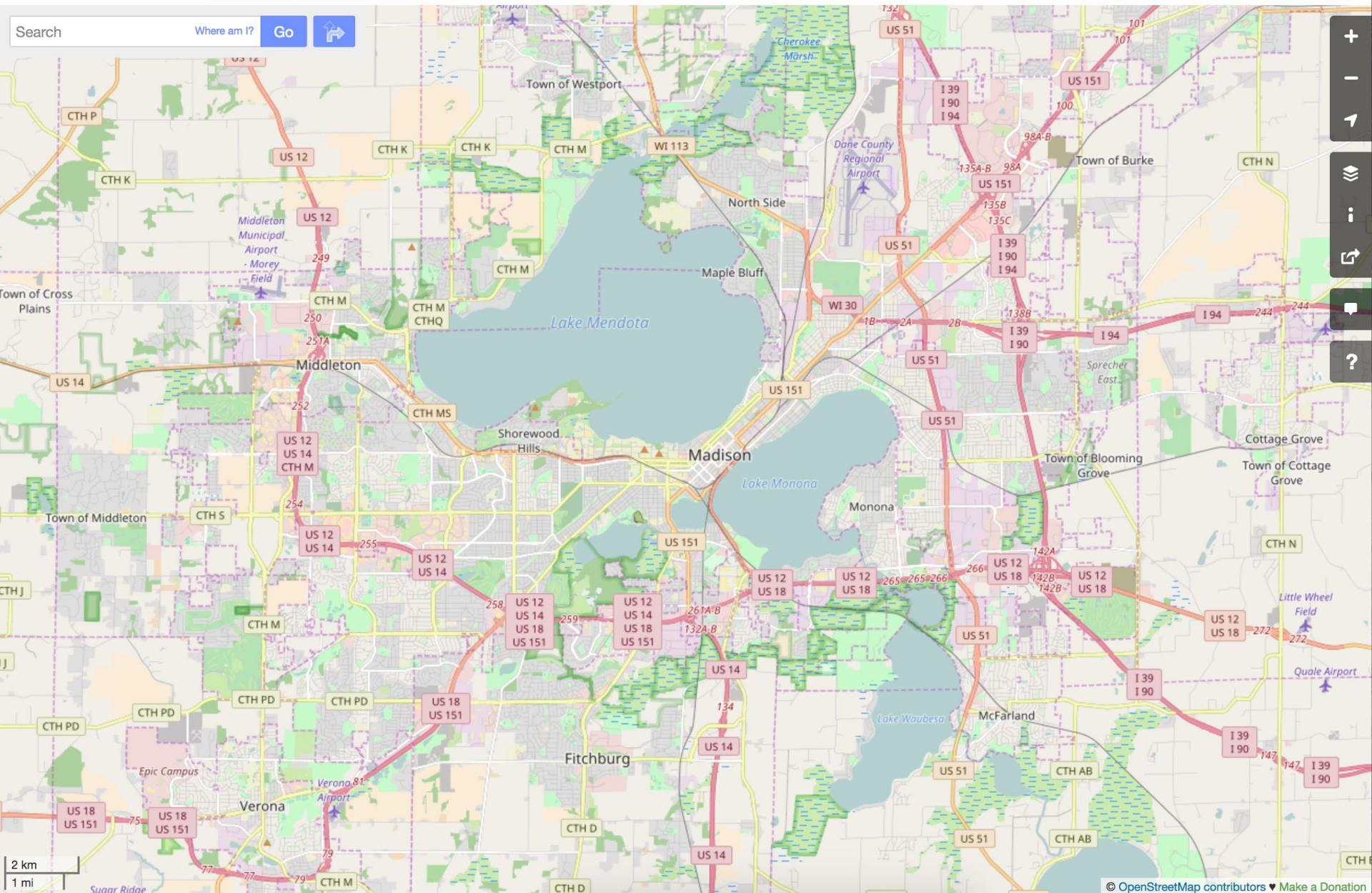
Jurisdictional boundaries

Rigid data representation

Search

Where am I?

Go



History of OSM

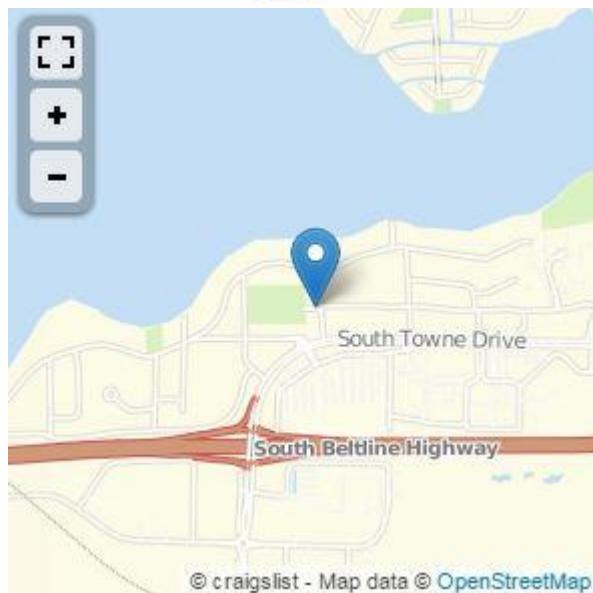
- Began in the early 2000s in the United Kingdom.
- Government agencies were collecting and generating datasets but not distributing them freely.
- Steve Coast, founder, would ride his bike around town to collect GPS traces and compile the resulting data.
- The OpenStreetMap Foundation was founded in 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

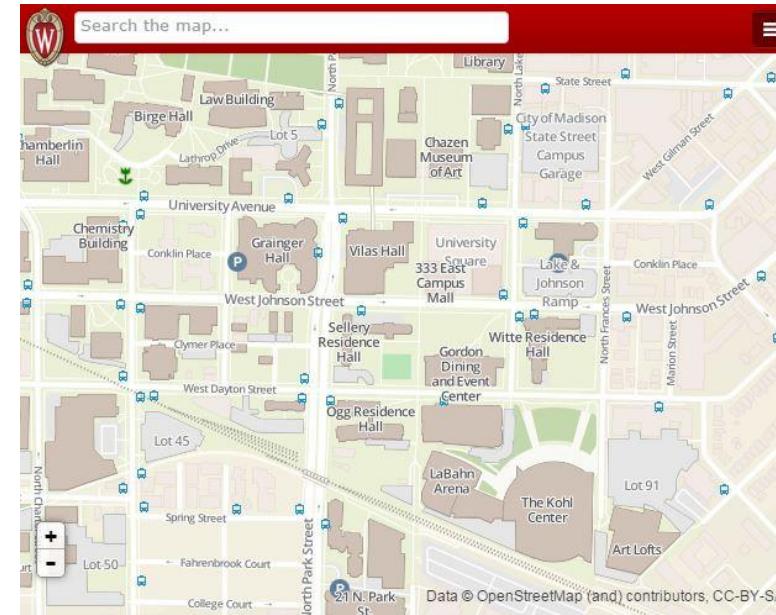
- OSM allows contributions from anywhere in the world.
- Almost 4,000,000 registered users.
 - Contributor and active contributor counts are indeed lower.
- Nearly 4 billion nodes, 400 thousand ways, and 5 million relations.
- Being adopted by many companies and organizations.
- Also used in research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

Who Uses OSM?

craigslist



FOURSQUARE



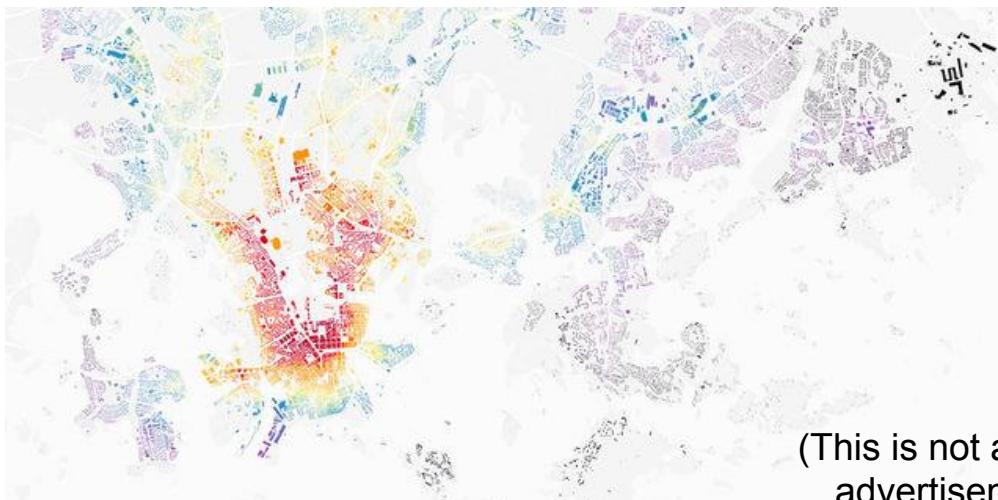
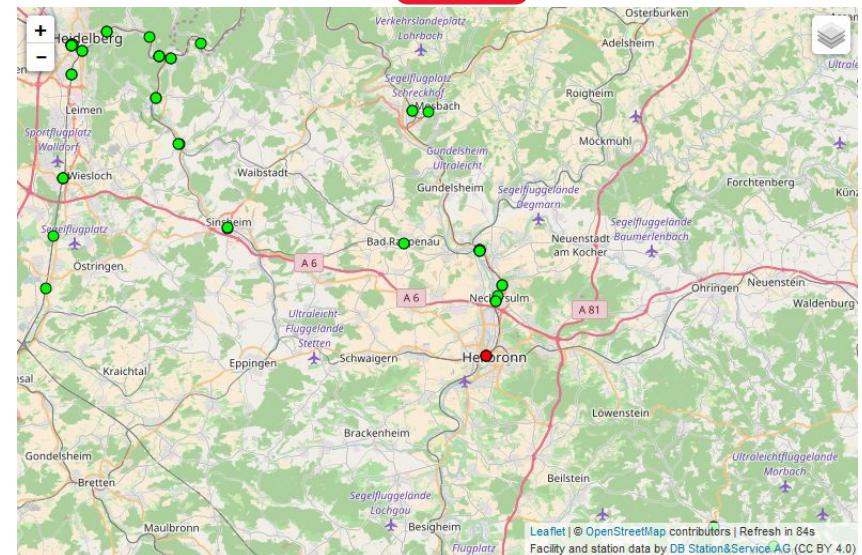
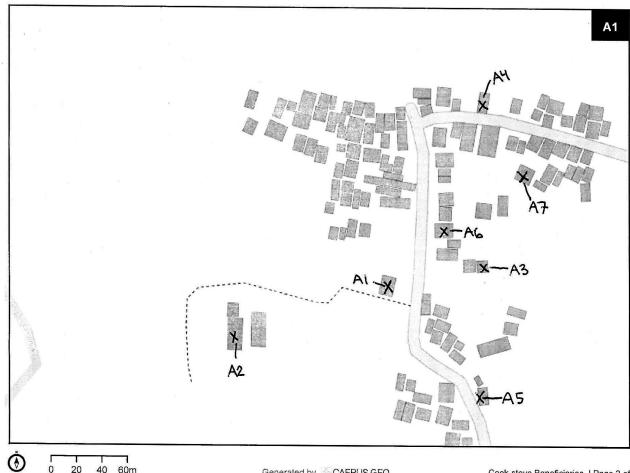
(This is not a paid advertisement.)



Who Uses OSM?



American
Red Cross



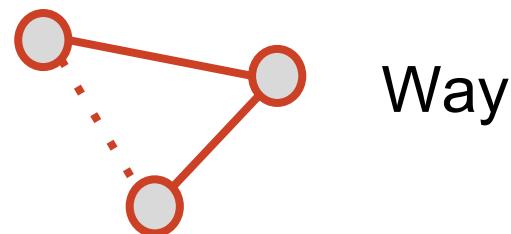
(This is not a paid
advertisement.)

Organizational Structure of OSM

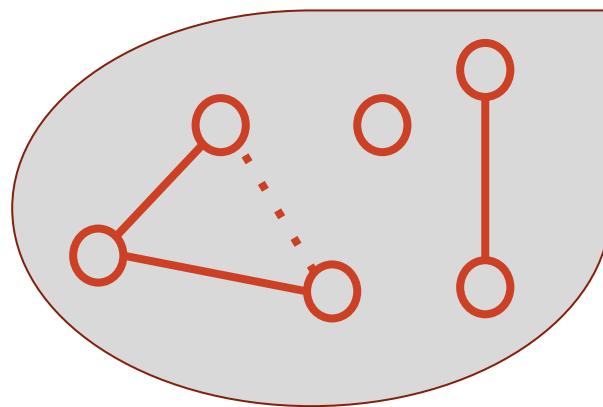
- The OpenStreetMap Foundation (OSMF) is the main non-profit organization that supports the project.
 - The Foundation elects Board Members to guide policy.
 - Working Groups are charged with various tasks that support OSM.
- OSMF organizes the annual international OSM conference, *The State of the Map*.
- 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">• Streets• Sidewalks• Bike paths• Bridleways• Alleys• Amenities• Tourist attractions• Benches | <ul style="list-style-type: none">• Fire hydrants• Bus stops• Trees• Benches• Parking lots• Buildings• Entrances and exits• Trash cans | <ul style="list-style-type: none">• Public bookcases• Golf courses• Railroads• Railroad crossings• Dog parks• Land use• Administrative boundaries |
|--|---|---|

Data Types in OSM

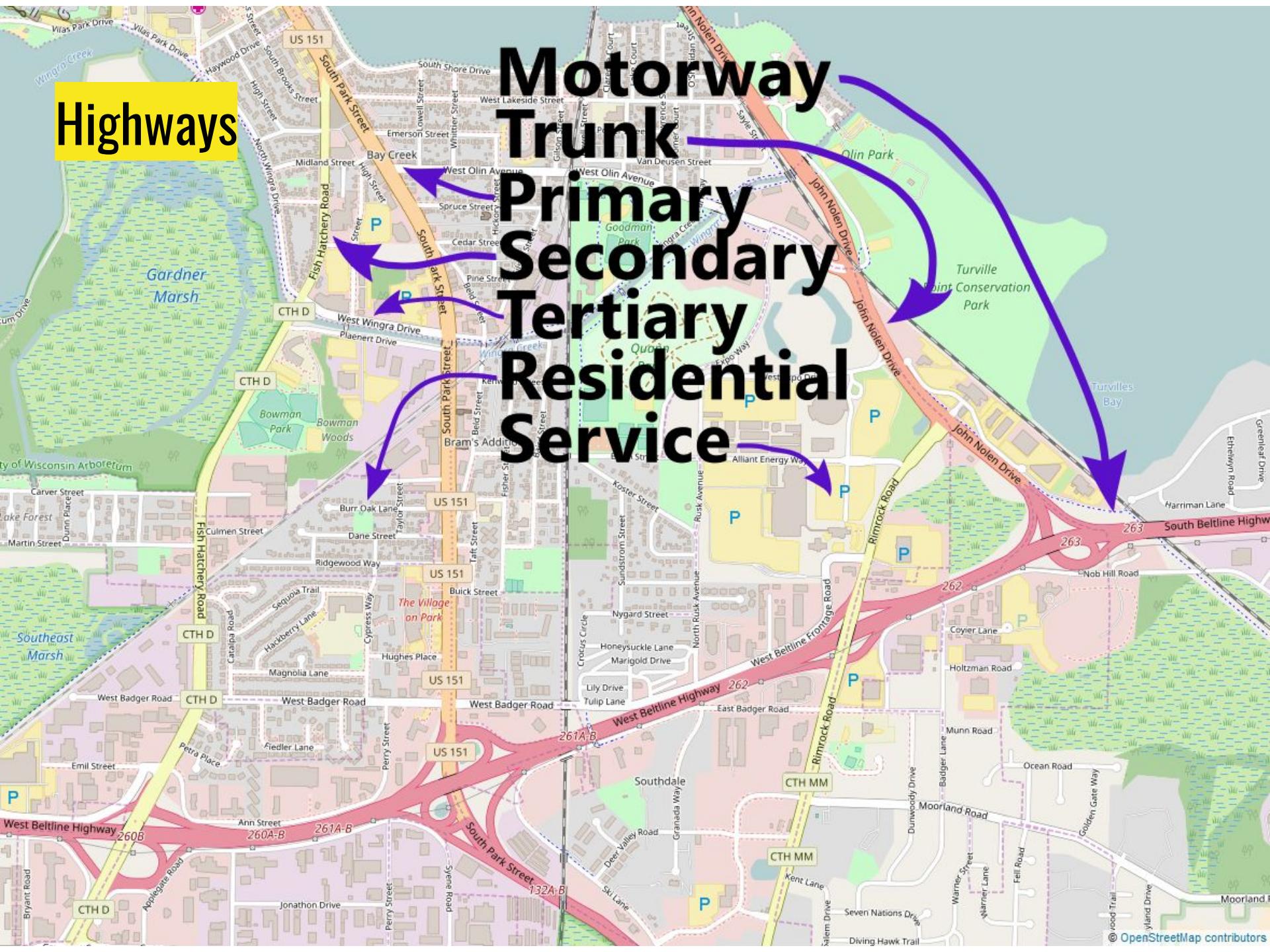
- The OSM wiki contains information about community-supported tagging schemes.

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

Log In Sign Up

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](#)



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.

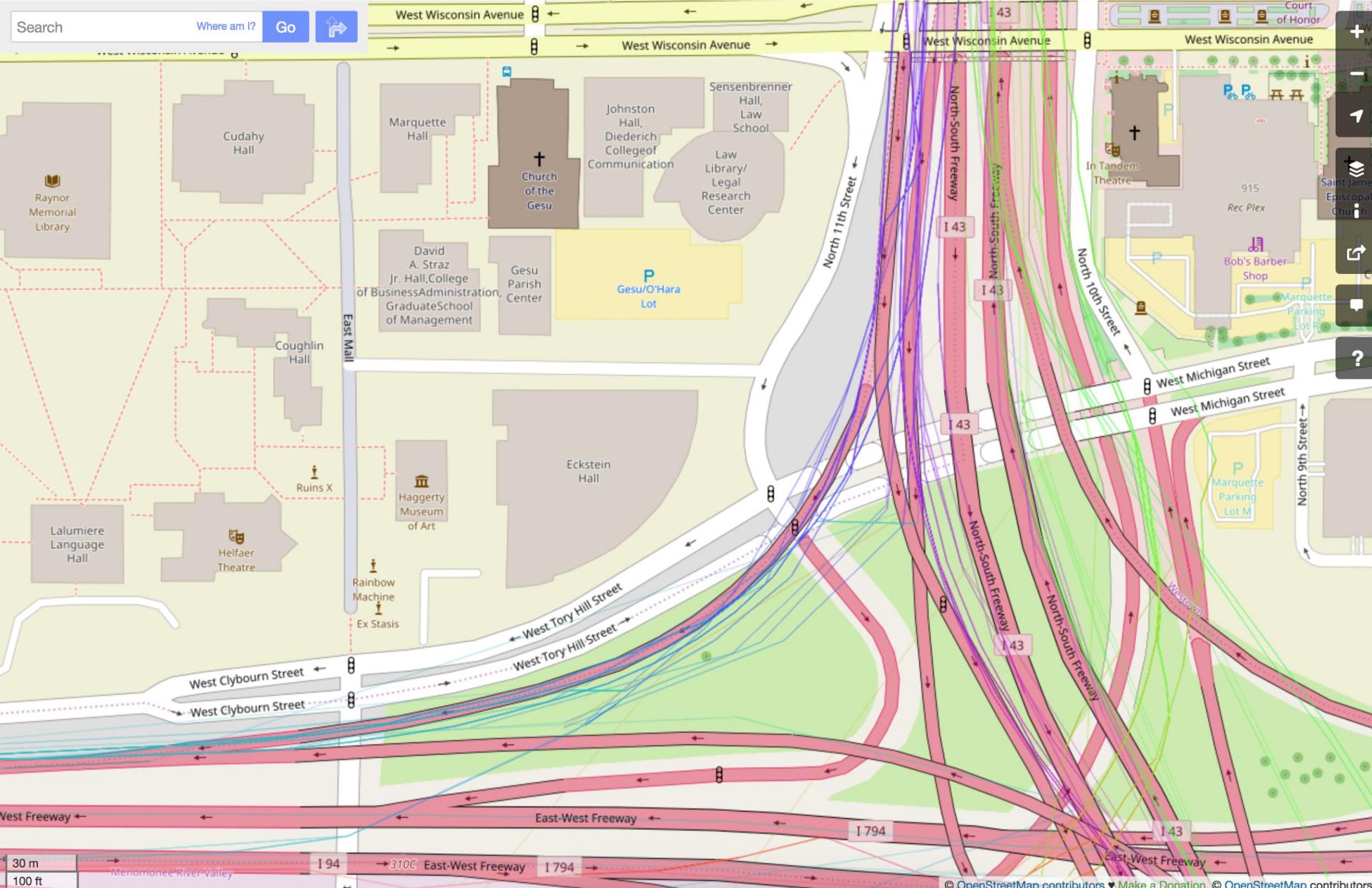
GPS Traces

OpenStreetMap

Edit History Export

GPS Traces User Diaries Copyright Help About

Log In Sign Up



30 m
100 ft

194 → 310C → 1794 → East-West Freeway

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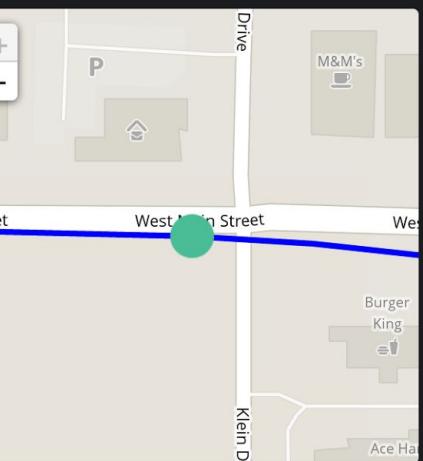
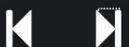
Street-level Imagery



8 / 133

+

-



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

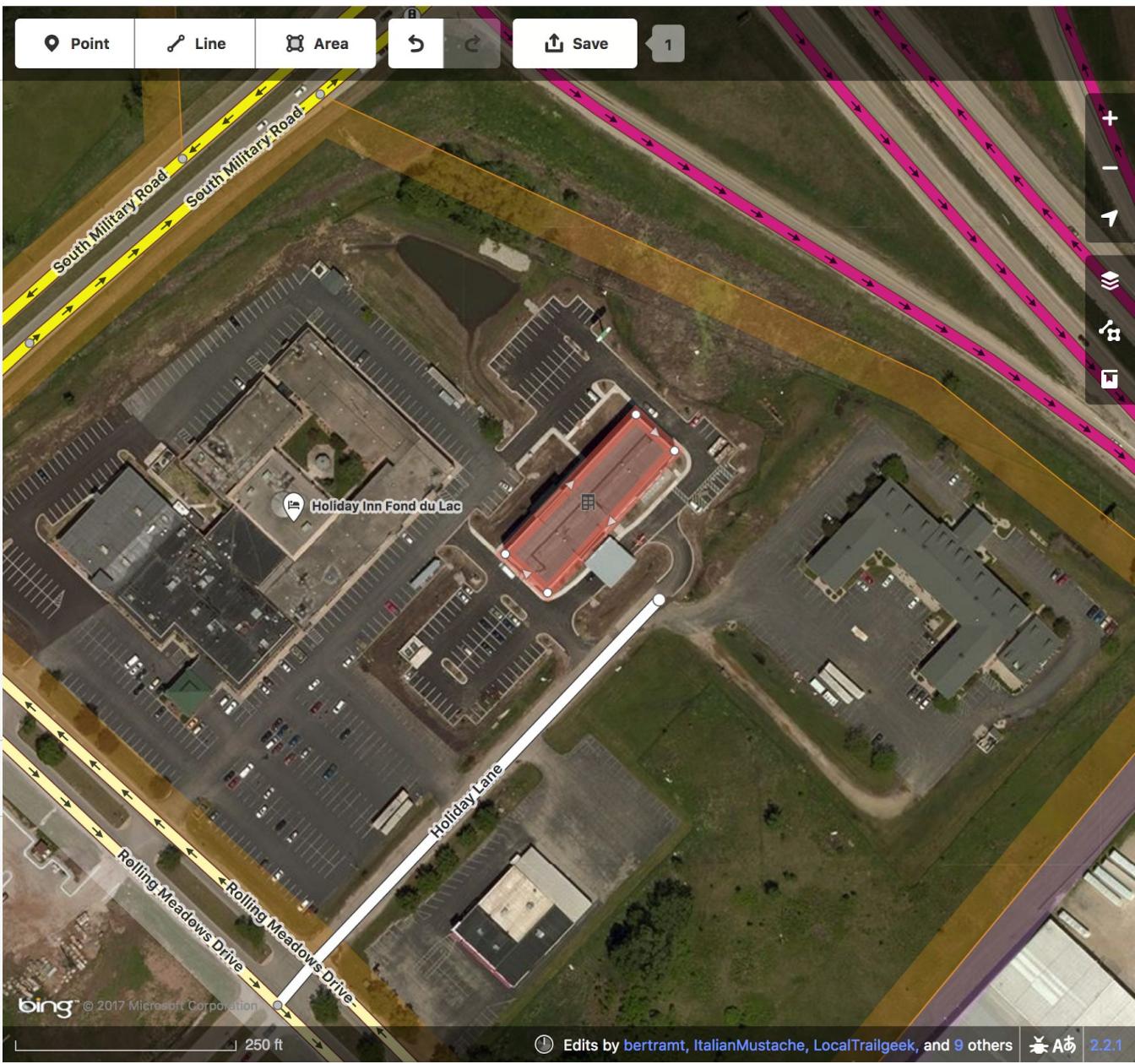
Line

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)



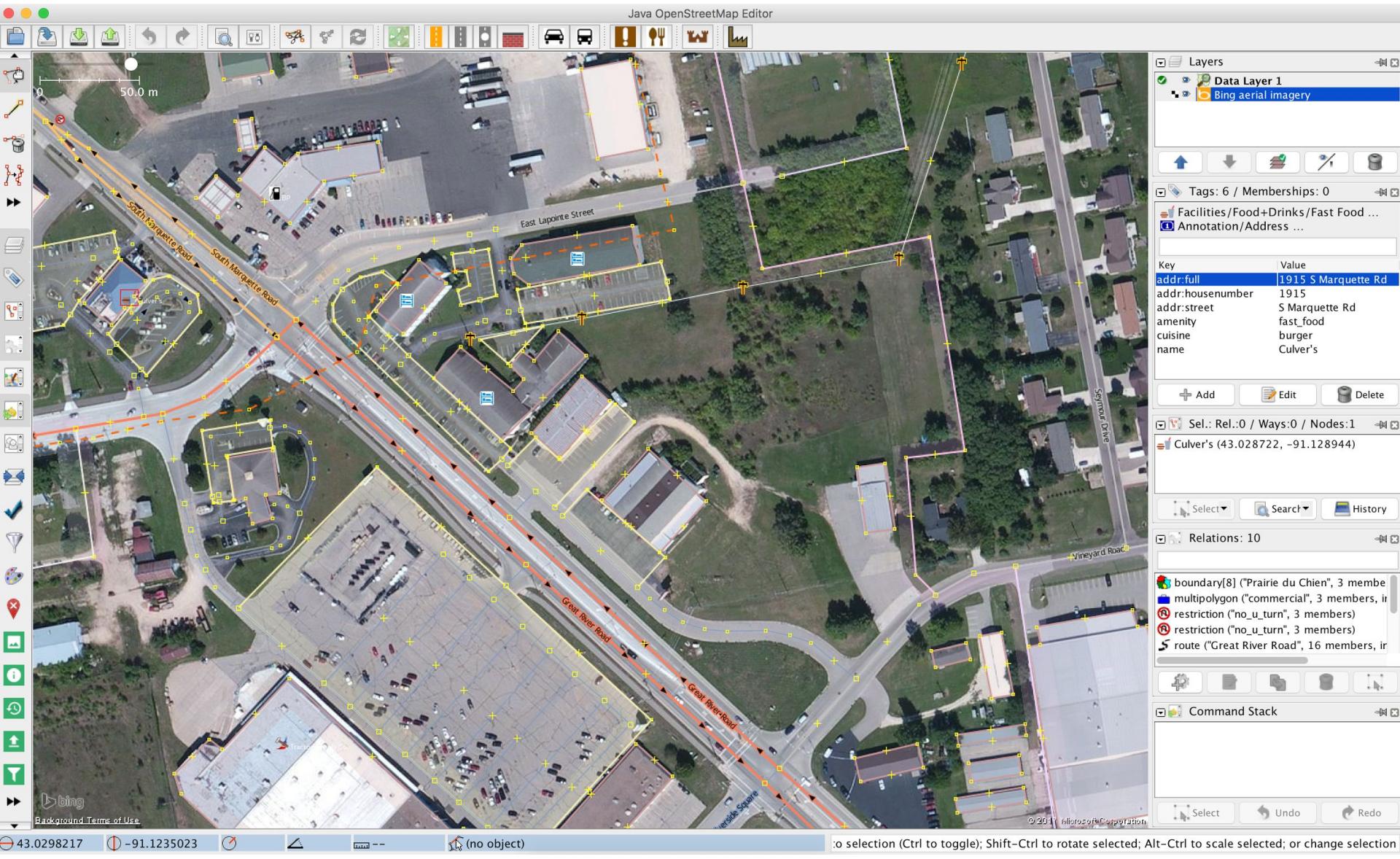
bing © 2017 Microsoft Corporation

250 ft

Edits by bertram, ItalianMustache, LocalTrailgeek, and 9 others

A 2.2.1

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.

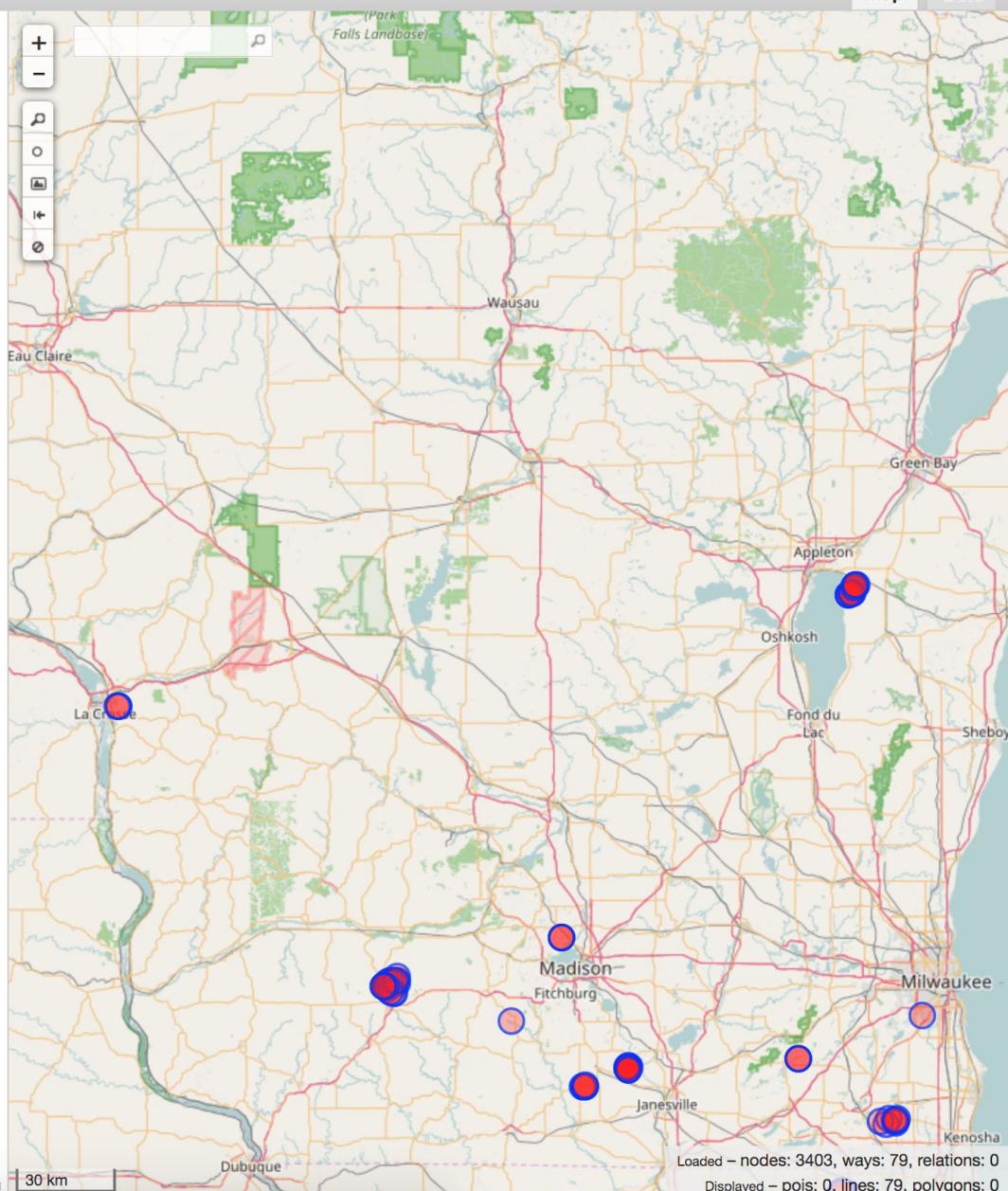
Export to GeoJSON.

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

The screenshot shows the QGIS interface with a map of a coastline. A purple line layer named "bridleway" is selected and visible on the map. The Layers Panel on the left shows the "bridleway" layer is checked. The Browser Panel shows various connection options like Home, Favourites, MSSQL, PostGIS, SpatiaLite, OWS, WCS, WFS, and WMS. The bottom status bar displays coordinates (-90.0550, 43.0096), scale (1:17,897), rotation (0.0), and rendering settings (EPSG:4326).

Browser Panel

- Home
- Favourites
- /
- Volumes
- MSSQL
- PostGIS
- SpatiaLite
- OWS
- WCS
- WFS
- WMS

Layers Panel

bridleway

Toggles the editing state of the current layer

Coordinate -90.0550,43.0096 Scale 1:17,897 Rotation 0.0 Render EPSG:4326

Another Exercise

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

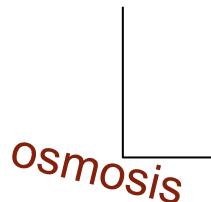
http://wiki.osm.org/wiki/Map_Features

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



PostgreSQL/PostGIS

osm2pgsql



Tiles

Mapnik



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 Response



http://wiki.openstreetmap.org/wiki/File:2015_04_26_Nepal_Earthquake_Kathmandu_living_lab.png

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